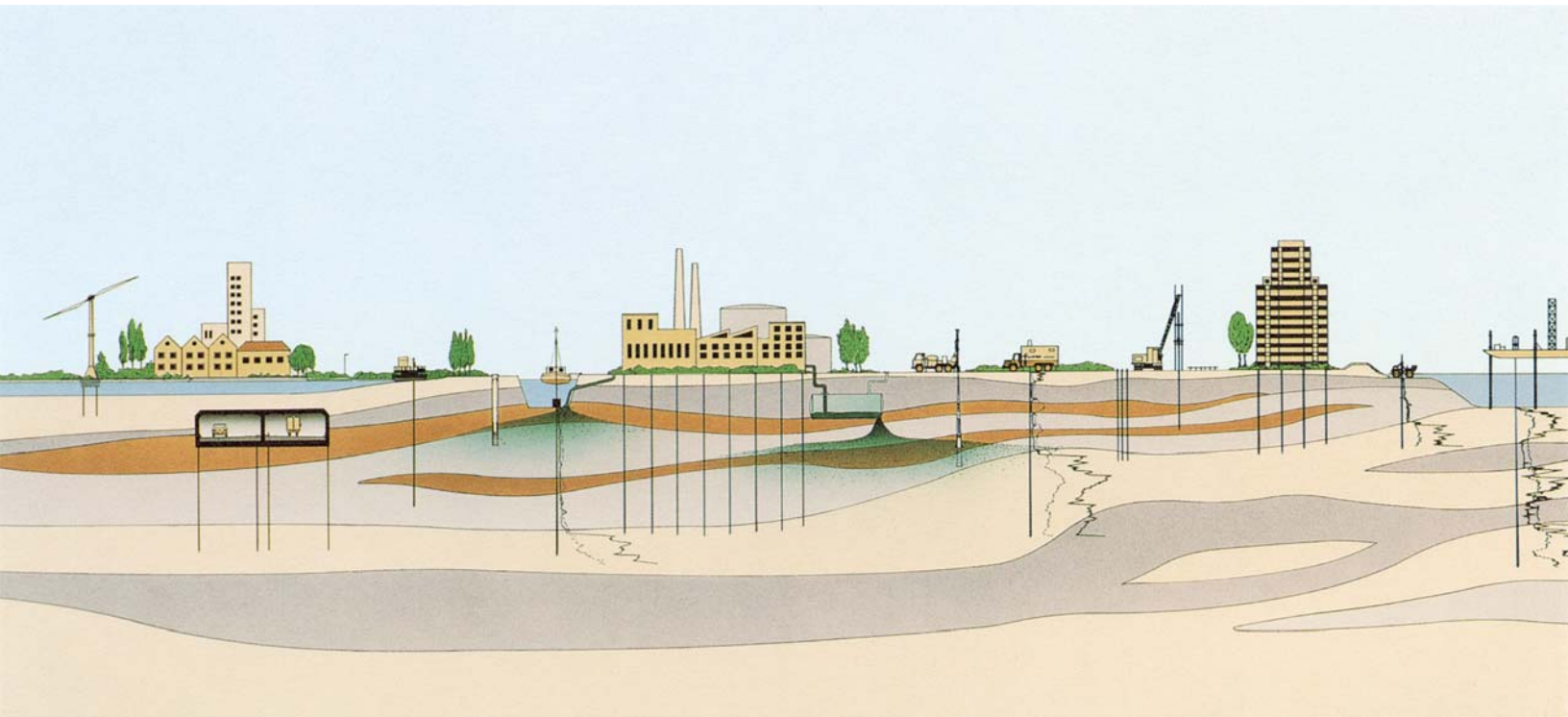
Appendix I.2
Pre-feed Level Geotechnical Study
Pacific NorthWest LNG Project
Lelu Island

FUGRO CONSULTANTS, INC.

PRE FEED-LEVEL GEOTECHNICAL STUDY
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

REPORT NO. 04.10130058
KELLOGG BROWN AND ROOT, LLC
HOUSTON, TEXAS



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December 24, 2013

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Attention: Mr. Nathan Chesley (nate.chesley@kbr.com)
Project Manager

Pre FEED-Level Geotechnical Study
Pacific Northwest LNG Project
Lelu Island, British Columbia, Canada

Fugro Consultants, Inc. (Fugro) is pleased to present this report of our pre FEED-Level geotechnical recommendations for the Pacific NorthWest LNG project (PNWLNG) located on Lelu Island, British Columbia, Canada. Fugro Consultants, Inc. has been contracted by Kellogg Brown and Root, LLC (KBR) under a Master Services Contract No. 4600002309 to perform geotechnical study for the proposed Pacific Northwest LNG Project. The current study was authorized under Work Release No.: 4250020839. Our services were performed in general accordance with our proposal No. 05.2012G031, dated January 16, 2013 and Change order Nos. 4, 5, 6, and 7. PNWLNG project consists of construction of onshore facilities and nearshore marine facilities. The onshore facilities are anticipated to include LNG storage tanks, LNG trains, flare stacks, processing facilities, workshops, administration buildings, pipe racks and pipelines, a construction camp, future fractionation/common facilities, and a bridged site access across the northern channel to the mainland. The nearshore marine facilities are anticipated to include an LNG export terminal with multiple berths and a connecting trestle, and a Materials Offloading Facility (MOF) area with turning basin. This report presents our recommendations for both onshore and nearshore facilities. Interim draft reports for turning basin and MOF, onshore facilities, bridge, and nearshore facilities were submitted during the course of the study. Comments and requests for additional information received from KBR were addressed and are incorporated into this draft report.

Additionally, a draft copy of this report was presented to KBR on November 11, 2013. KBR provided comments on our draft report on November 19, 2013. Preliminary answers to the comments were discussed during a phone conversation with KBR and also provided via an e-mail on November 25, 2013. In addition to the comments, Fugro was also requested to provide additional recommendations. This report addresses the comments and also includes additional recommendations requested by KBR and supersedes all previously provided geotechnical information.

We appreciate the opportunity to be of service to KBR and Pacific Northwest LNG. Please call us at (713) 369-5400 if you have any questions or comments concerning this report, or when we may be of further assistance.

Sincerely,

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Executive Summary

This report presents our pre FEED level geotechnical recommendations for the proposed Pacific Northwest LNG Project on Lelu island, British Columbia, Canada. The project consists of construction of both onshore and near shore facilities. The onshore facilities are anticipated to include LNG storage tanks, LNG trains, flare stacks, processing facilities, related structures, a construction camp, and a bridged site access across the northern channel to the mainland. The nearshore facilities are anticipated to include an LNG export terminal with multiple berths and a connecting trestle, and a Materials Offloading Facility (MOF) area with turning basin. The scope of work included onshore lineament assessment, nearshore geophysical survey, onshore and nearshore geotechnical study, and onshore and nearshore Seismic Hazard Analyses.

Previous Studies. Prior to this Pre Feed-Level study, several studies were conducted by Fugro to assist KBR and PNWLNG in identifying geologic hazards and key considerations relative to development of this site for a LNG facility. Findings and recommendations from previous studies are briefly summarized in this report. The coastal region of British Columbia is an area of active geologic and seismic hazards (geohazards). Fugro carried out a phased approach to provide an initial assessment of potential geohazards of engineering and regulatory concern including; ground conditions, tsunami, and fault rupture. The phased approach is based on increasing levels of detailed studies and data collection as additional information is developed. Desktop and metocean modeling of potential tsunami sources and their impacts to the site indicated earthquake related tsunami hazard is relatively low (i.e. historic maximum wave heights of 1.7m). Tsunamis resulting from local submarine and subaerial landslides and sources have not yet been assessed. Detailed tsunami assessment and modeling of local sources is recommended, once dredging plans are finalized during the FEED or final design stages.

Lineament Assessment. Analysis of Lidar derived elevation data acquired for this project identified strongly expressed linear topographic features, chiefly associated with bedding, jointing, and fracturing of metamorphic rock substrate. In order to assess if these features present a potential for fault rupture and surface deformation, initial field based reconnaissance geologic assessment of lineaments and shallow test pit exploration of these features was completed. The initial assessment suggests that the strong linear features are derived from fracturing, shearing, and metamorphism of the bedrock during emplacement (Cretaceous Period). Existing academic literature depicting the presence of faults near the project vicinity, have not demonstrated Quaternary activity. Initial Lidar-based wave-cut platforms of several thousand years old show no credible evidence of faulting where traversed by lineaments. Borings drilled for the pre-FEED geotechnical study and acoustic televiewer logs indicate several bedrock shear zones at the logged locations. Further assessment of the shear zones encountered in the onshore borings is recommended during FEED level study, to define specific characteristics of these bedrock shears,

their relation (if any) to surface lineaments, cross-cutting relationships, and the age and potential for Quaternary faulting.

Nearshore Geophysical Survey. Bathymetry, side scan sonar, magnetometer, two dimensional high resolution multi channel seismic, and sub-bottom profiler and seabed features data were acquired along trestle and berthing area and turning basin area. The top of the bed rock was not detected in the trestle and berthing area. Fatal flaws in regards to active faults, landslides, slump features, and slope stability were not discovered from the interpreted geophysical data. Plans are to perform additional geophysical survey using higher energy sources during FEED level study. The slopes are generally less than 2.5 degrees along the trestle. The slopes in berthing area are as steep as 12.5 degrees.

Seismic Hazard Analyses. Seismic hazard analyses were conducted to develop earthquake ground motion estimates at select location for the onshore and near shore facilities at ground surface. Horizontal design acceleration response spectra and peak ground accelerations were estimated for the Operating Base Earthquake (OBE) and Safe Shutdown Earthquake (SSE). The SSE and OBE design levels are based on the mean ground motion return periods of 2475 and 475 years, respectively. The final proposed site grade is El.+25 for onshore facilities and major portion of the plant site will encounter rock at El.+25. Possible cyclic softening of soft clays and liquefaction in silts at shallower depths of less than 3m below final grade of El. +25 are expected where soils were encountered. However, recommendations for supporting plant structures in this report recommend removal of all soft clays and silts and replacement with crushed phyllite or imported aggregate (See Onshore Facilities Section). Liquefaction potential of placed and compacted aggregate fill is low to none.

In trestle and berthing area, shallow coarse-grained soils (within 6 meters below mudline) were found to be generally liquefiable for both SSE and OBE events. The nearshore borings also indicate the presence of fine-grained soils that may be moderately susceptible to susceptible to liquefaction to depths up to about 16 meters. The thickness and extent of liquefiable soils will be refined based on information from CPT soundings to be performed during FEED level geotechnical study.

Onshore Facilities. This study has identified areas of significant variability in subsurface conditions within the footprint of onshore facilities. The site preparation and foundation design recommendations for onshore facilities is categorized into 3 different areas; LNG Tanks area (Area 1), ISBL/OSBL Rock Area (Area 2) and ISBL/OSBL Fill Area (Area 3). These areas are delineated on Plate 32. Areas consisting of soft cohesive soils were encountered below El+25 m in few borings in the LNG Tank area. Site preparation, with soft soils in tank footprints, should consist of removing soft soils and replacing with flowable fill to support tanks at a grade. Area1 and Area 2 will consist of shallow foundations supported on rock. The soft soils in Area 3 should be removed

and replaced with aggregate fill. The structures may be supported on rock socketed drilled shafts and are at grade in Area 3 based on depth of fill and structures sensitivity to settlement. Relocating structures to avoid unfavorable subsurface conditions may provide significant savings in design and construction of foundations. The bridge site access foundation may consist of shallow foundations at abutments and rock socketed driven pipe piles for the bents.

Slope Stability – Nearshore Facilities. Slope stability evaluation was conducted using limit equilibrium method. Pseudo static analyses method was used for OBE and SSE seismic events. A factor of safety of 1.7 was computed against slope failure for static case. The slope is expected to deform and spread laterally during both OBE and SSE event. The deformation could impose lateral loads on the pile foundations. We recommend that consideration be given to relocating the berthing area by shortening the trestle to avoid impact of slope deformations on the project. The magnitude of movement and its impact on piles and mitigation will be presented as part of the FEED level study.
A slope stability analysis of existing slopes in turning basing is presented in this report for both static and seismic events. In most places, the observed rock mass discontinuities do not daylight and sliding is unlikely to occur.

Materials Offloading Facility. Driven sheetpile is not considered to be a viable option for MOF construction because rock was encountered at shallower depths. Gravity concrete structure or rock socketed/doweled pipe piles with sheetpile and rock bolts/anchors may be feasible alternatives**.**

Trestle and LNG Jetty. There is significant variation in subsurface stratigraphy (e.g. depth to rock and shear strength of cohesive soils) in the borings drilled for Trestle and Berthing area. Nearsurface granular soils in the trestle and berthing areas may have a potential for liquefaction. Additionally, lateral displacement of existing slopes in some localized areas near the berthing areas should also be expected. Driven pipe pile recommendations are presented to support the trestle and berthing structures. We recommend consideration be given to avoiding the steeper soil slope near berthing area by changing the orientation or shortening the trestle, if feasible. Additional investigation during FEED level geotechnical study will assist in refining recommendations presented here**.**

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1.0 INTRODUCTION

1.1 Project Description

Kellogg Brown and Root, LLC (KBR) is assisting Pacific Northwest LNG (PNWLNG) in the design and construction of LNG Project on Lelu Island, British Columbia (BC), Canada. PNWLNG is a proposed liquefied natural gas (LNG) liquefaction and export facility on Lelu Island within the District of Port Edward on land administered by the Port of Prince Rupert, in British Columbia, Canada. The proposed LNG facility will be located on Lelu Island, with most of the facilities on the northwest side of the island. A vicinity map identifying the project site is presented on Plate 1. Pacific Northwest LNG project consists of construction of both onshore and nearshore facilities. The onshore facilities are anticipated to include LNG storage tanks, LNG trains, flare stacks, processing facilities, workshops, administration buildings, pipe racks and pipelines, a construction camp, future fractionation/common facilities, and a bridged site access across the northern channel from/to the mainland. The nearshore facilities are anticipated to include an LNG export terminal with multiple berths and a connecting trestle, and a Materials Offloading Facility (MOF) area with turning basin. The scope of work included onshore lineament assessment, nearshore geophysical survey, onshore and nearshore geotechnical study, and onshore and nearshore seismic hazard analyses.

Based on our discussions with KBR, the onshore and the nearshore areas of this project are further subdivided based on the location of the above-mentioned equipment/structures. The onshore area is subdivided into LNG Tanks area, Inside Battery Limits (ISBL) and Outside Battery Limits (OSBL) area. The nearshore area is subdivided into turning basin, Material Offloading Facility (MOF), Berthing Facility, and Trestle. The overall site plan including the locations of the proposed onshore and nearshore equipment/structures are shown on Plates 2a and 2b of this report.

Access around the facility will require construction of typical roads constructed in accordance with standard engineering specifications. The proposed construction will require the use of cranes, excavators, trucks and other heavy machinery, which would require construction of heavy haul roads around the site. Details about traffic loadings were not available at this time. Therefore, in this report we have included typical pavement recommendations that are suitable for the pre FEED stage of the project.

1.2 Purposes and Scope

The purpose of this study was to provide pre FEED-Level geotechnical study to assist in the planning stages of the proposed PNWLNG project. We accomplished this purpose by:

- Performing a desk top and field based evaluation of onshore lineaments for fault or surface deformation hazard;
- Performing nearshore geophysical survey consisting of side scan sonar, magnetometer, 2D high-resolution multi-channel seismic along the LNG jetty, trestle alignment, and turning basin area;
- Drilling a total of 33 onshore borings and 6 nearshore borings with depths ranging from 20 m to 110 m;
- Performing PS suspension logging within 7 borings and acoustic televiewer logging within 6 borings;
- Performing field and laboratory tests on the select samples to evaluate geotechnical engineering properties of subsurface soils and rocks;
- Developing a site model integrating the LiDAR derived elevation data, nearshore geophysical survey, geologic mapping, geophysical testing/field probing, with geotechnical field exploration and laboratory testing results;
- Generalizing subsurface soil and rock stratigraphy and development of interpreted engineering design parameters based on the results of field and laboratory tests;
- Performing seismic hazard analyses and evaluating liquefaction potential of encountered soils;
- Developing geotechnical recommendations for shallow and deep foundations and site preparation including cut and fill slopes for onshore facilities, deep foundations for trestle, jetty, and bridge;
- Performing slope stability analyses of slopes in turning basin area and LNG jetty area for both static and seismic events;
- Developing pavement recommendations and presenting corrosion potential considerations;
- Providing construction considerations including: site preparation, temporary excavations, rock excavations, foundation installation, fill specifications and compaction requirements, use of excavated rock material for fill material, and construction monitoring; and
- Preparing this engineering report summarizing our findings and recommendations.

We were neither asked nor authorized to evaluate environmental conditions at the site. Therefore, environmental assessments, compliance with regulatory requirements, assessment of potential contamination migration, and environmental analyses were beyond the scope of this study.

1.3 Applicability of Report

We have prepared this report for KBR and PNWLNG for use as geotechnical input for pre FEED design of the proposed Pacific Northwest LNG project. The scope of our analyses for this study, as well as the conclusions and recommendations in this report, were selected or developed based on our understanding of the project, as described above and in later sections of this report. If pertinent details of the project have changed or otherwise differ from our descriptions, we request that we be notified and authorized to review the changes, and if necessary, modify our conclusions and recommendations. The information presented in this report shall be used for preliminary design of foundations and cost estimation for the project. Final design for construction should be based on final geotechnical study based on comprehensive geotechnical exploration and laboratory testing program.

1.4 Limitations

Fugro makes no claim or representation concerning any activity or condition falling outside the specified purpose to which this report is directed. We have conducted our work using the standard level of care and diligence normally practiced by recognized engineering firms now performing similar services under similar circumstances. We intend for this report, including all illustrations, to be used in its entirety. The information presented in this report may not apply to locations not explored by borings or areas outside the project boundaries. This information should be made available to prospective users for information only, and not as a warranty of subsurface conditions.

1.5 Unit Conversions and Datums

The recommendations presented herein are based on the SI Unit System. Table 1.1 provides a quick reference for conversion from SI to Imperial Units.

Table 1.1: Conversion Units

From SI System	To Imperial System	Multiply by
Kilo Newtons – kN	Kips – k	0.224809
Mega Newtons – MN	Kips – k	224.809
Kilo Newtons/meter^2 – kN/m^2 (kPa)	Pounds/feet^2 - psf	20.885
Kilo Newtons/meter^3 – kN/m^3	Pounds/feet^3 - pcf	6.3659
Meters – m	Feet – ft	3.2808
Millimeters – mm	Inches – in.	0.03937

2.0 PREVIOUS STUDIES

2.1 Previous Reports

Fugro has performed various desktop studies including a site selection study to assist KBR in selection of site for the PNWLNG project. The following documents have been issued by Fugro to date as part of the PNWLNG project and considered in development of design recommendations and construction considerations presented herein.

- Assessment of Existing Geologic and Geotechnical Conditions, Geohazards, and Seismic Hazards of Potential LNG Sites, British Columbia, Canada – Fugro Project No. 04.79221400, January 10, 2012;
- Metocean Desk Study for a LNG Site Selection, British Columbia, Canada – Fugro GEOS Report No. C56392/6977/R2, 15 March 2012;
- Addendum to Metocean Desk Study for a LNG Site Selection, British Columbia, Canada – Fugro GEOS Report No. C56392/7170/R0, 15 March 2012;
- Phase 1A Geologic Reconnaissance Survey and Geophysical Site Visit, LNG Project, Lelu Island, British Columbia, Canada – Fugro Project No. 04.10120100, September 21, 2012.
- Phase 1B Assessment of Bog and Peat Deposits – GIS Analysis and Field Verification Survey, LNG Project, Lelu Island, British Columbia, Canada – Fugro Project No. 04.10120100, January 28, 2013.
- Tsunami Wave Height Run-Up Estimate, Lelu Island, British Columbia, Canada, Fugro Project No. 04.10120100 Phase 3, February 2013.
- Lineament Analysis & Report, Progress PNW LNG Project, Lelu Island, British Columbia, Canada Fugro Project No.: 04.10130058, September, 2013.
- Marine Geophysical Survey Report, Survey Period: May 4 – 16, 2013, Report Number: 23.00007028 R2.

2.2 Geologic Hazards AND Metocean Desk Studies

The desktop studies submitted in January 2012 included assessments of existing geologic and geotechnical conditions, potential geologic and seismic hazards (geohazards), and available metocean data. A subsequent study was conducted to assess the Tsunami Height Run Up and was presented to KBR in February 2013. The study indicated that based on historical precedent and available published materials, the remaining distal sources, may pose a low tsunami hazard to Lelu Island, with historic impacts of up to 1.7 meters near this site. Tsunamis resulting from local submarine and subaerial landslides and sources have not yet been assessed. Detailed tsunami assessment and modeling of local sources is recommended, once dredging plans are finalized during the FEED or final design stages.

2.3 Reconaissance Survey and Geoprobing

The geologic reconnaissance survey and geophysical site visit report submitted in September 2012 summarizes the anticipated subsurface conditions and anticipated design and construction considerations based on the findings from the desktop studies and observations during the site reconnaissance. The evaluations of bog deposits and GIS analysis report submitted on January 28, 2013 builds on the reconnaissance survey report submitted in September 2012. The report provides an evaluation of the anticipated thickness and preliminary lateral extent of the bog deposits based on the site reconnaissance. The observations and conclusions presented in this report supersede the Phase 1B Assessment of Bog and Peat Deposits report.

2.4 Lineament Assessment Study

Analysis of Lidar derived elevation data acquired for this project identified strongly expressed linear topographic features, chiefly associated with bedding, jointing, and fracturing of metamorphic rock substrate. In order to assess if these features present a potential for fault rupture and surface deformation, initial field based reconnaissance geologic assessment of lineaments and shallow test pit exploration of these features was completed. The results of the study were submitted on September 6, 2013 (Appendix I). The initial assessment suggests that the strong linear features are derived from fracturing, shearing, and metamorphism of the bedrock during emplacement (Cretaceous Period). Existing academic literature depicting the presence of faults near the project vicinity, have not demonstrated Quaternary activity. Initial Lidar-based wave-cut platforms of several thousand years old show no credible evidence of faulting where traversed by lineaments. Borings drilled for this study (pre-FEED geotechnical study) and acoustic televiewer logs indicate several bedrock shear zones at the logged locations. Detailed assessment of the boring encountered bedrock shear zones is recommended during FEED level study, to define specific characteristics of these bedrock shears, their relation (if any) to surface lineaments, cross-cutting relationships, and the age and potential for Quaternary faulting.

2.5 Nearshore Geophysical Survey

Bathymetry, side scan sonar, magnetometer, 2D high resolution multi channel seismic, and sub-bottom profiler and seabed features data were acquired along trestle and berthing area and turning basin area. The top of the bedrock was not detected in borings in the trestle and berthing areas. Fatal flaws in regards to active faults, landslides, slump features, and slope stability were not discovered from the interpreted geophysical data. Plans are to perform additional geophysical survey using higher energy sources during FEED level study. The slopes are generally less than 2.5 degrees along the trestle. The slopes in berthing area are as steep as 12.5 degrees**.** Detailed bathymetry results for this area are presented in Fugro Report No. 23.00007028 R2 dated July 13, 2013 (Appendix J).

3.0 ONSHORE FIELD EXPLORATION

3.1 General

Onshore field services for the PNWLNG project mainly included including; drilling soil/rock borings, onshore geophysical surveys consisting of PS and acoustic televiewer logging, installing piezometers, and excavating test pits for the onshore lineament evaluation. Lelu Island is located along the western coast of British Columbia (BC) and is separated from the mainland by a tidally-influenced northwest trending channel. The island is undeveloped and there is no direct land connection between the site and the mainland. Therefore, all equipment and work related facilities were mobilized to/from the island either by air or floating craft. Helicopter transportation and logistical support for the project was provided by Lakelse Air of Terrace, BC. Lakelse provided crew transfer boat and employed helicopters outfitted and capable of lifting the required drilling rigs and assisted in providing pad building supplies. Geotech Drilling Services Ltd of Prince George, BC provided onshore drilling equipment and drilling staff that included 2 to 3 skid-mounted heli-portable drilling rigs capable of advancing the borings in soil and rock. All permits, notifications, and rights-of-entry for all land-based activities were provided to Fugro by Progress.

The onshore field investigation plan for the entire project included drilling and sampling three borings (BH-1 thru BH-3) for the north crossing bridge, three borings (BH-6 thru BH-8) for the Material Offloading Facility (MOF), 24 borings (BH-4, BH-5, and BH-9 to BH-30) for the LNG tank, ISBL, and OSBL areas, and one boring (BH-31) for the onshore portion of the trestle alignment. Both onshore and nearshore field services were performed concurrently. The location of soil/rock borings, PS logging and acoustic televiewer logging borings, piezometers, and test pits, for the entire project including the onshore and nearshore investigations are presented on Plates 2a and 2b of this report.

Field exploration activities related to onshore drilling and sampling soil/rock borings was performed from June 17 through July 27, 2013 for all borings except BH-2. BH-2 required additional permitting and was drilled from August 17 through 19, 2013. Test pit excavations were performed from July 16 through July 18, 2013. Field activities carried out included:

- Surveying and staking of onshore boring and test pit locations based on coordinates provided by KBR;
- Clearing each test location to create a minimum working area of about 10 m by 10 m in size for the drilling equipment;
- Building temporary pads for supporting drilling equipment;
- Drilling and sampling a total of 31 borings (BH-1 to BH-3) to depths varying between 20 and 59 m below the existing ground surface;

- Collecting seismic velocity data using PS-logging techniques at six drilled boring locations;
- Performing acoustic televiewer logging at six drilled boring locations;
- Installing a total of eight temporary piezometers at completed boring locations;
- Excavating 8 test pits to a maximum depth of about 1 m for geologic lineament evaluation; and
- Grouting all boreholes not completed as piezometers following drilling, sampling, and logging at each respective location.

This section presents information related to onshore geotechnical field exploration program, including surveying, site clearing, pad building, geotechnical borings, PS and acoustic televiewer logging, piezometer installation, and test pits.

3.2 Surveying

The land surveying was provided by a McElhanney Land Surveyors Ltd. (McElhanney) of Terrace, British Columbia. Datum was per KBR original drawings as provided to us, UTM zone 9. McElhanney located and staked the proposed onshore boring locations and elevations in general accordance with the site plans provided by KBR. Borings were drilled at the locations staked by McElhanney, except for BH-5. Drilled BH-5 location is shown on Plate 2a. Coordinates and elevations for the onshore borings are summarized in Table 2.1 and are also included on the respective boring logs in Appendix A.

3.3 Utility Clearance and Permits – Access Bridge.

Fugro contacted BC-1 Call to coordinate utility clearance prior to advancing borings BH-1 and BH-2 located on the mainland side of the bridge. Progress (subsidiary of Petronas) applied for an encroachment permit from BC Ministry of Transportation for BH-1, which was advanced on the shoulder of existing Skeena Drive.

Permitting and permission was required prior to performing archeological exploration (by Stantec), clear vegetation, and mobilize equipment to the BH-2 location. Progress coordinated with the Provincial Government to acquire the permission to initiate the field exploration at BH-2. Additionally, BH-2 is located in close proximity of Canadian National (CN) railway right-of-way and an active rail line. Fugro assisted Progress (Subsidiary of Petronas) in acquiring a CN permit prior to site clearing, pad building, and mobilization to BH-2. Additionally, due to the proximity to the active rail line, a CN rail flagman was required during the fieldwork at the BH-2 site. Fugro worked closely with the flagman to ensure a successful completion of the works without interruption to the rail service. BH-1 was advanced on the eastern shoulder of Skeena Drive and did not require site clearing.

3.4 Site Clearing and Restoration

The island is heavily vegetated with vegetation ranging from thick brush to dense mature tree cover. As described earlier, there are no access roads, inter-island travel is by foot, and clearings are few on the island. Therefore, site clearance was required for each of the proposed onshore boring locations. Site clearing activities were performed by Blue Heron of Prince Rupert, BC, a Canadian licensed and authorized tree felling subcontractor. Prior to site clearance, Fugro worked closely with Progress and their archeological subcontractor, Stantec, to avoid encroaching upon or damaging culturally modified trees (CMTs).

Site clearance consisted of cutting/removing vegetative cover (brush to mature tree size material) to create a minimum working area of about 10 m by 10 m in size for the drilling equipment and exploration works at each of the drilling locations and the three helicopter/equipment staging areas. Additionally, footpaths were brushed/cleared so that site personnel could access the island from the marine vessel landing locations along the beachfront as well as to provide inter-island access to the boring locations and helicopter staging areas.

Following completion of the field activities, Blue Heron assisted with the site reclaimation of the drill pads and walking paths. Site reclamation consisted of dispersing onsite cut wood and brush used to create walkways and removal of all pad-building wood brought to the island for the field work.

3.5 Pad Building

Drill rig staging pads were required as part of the field exploration works to support the drilling equipment once transported by the helicopter. The pads were built by Minconsult Exploration Services with locally sourced timber in British Columbia (BC) and transported to the island by helicopter. Each pad was custom-built for it's respective location and intended use. Following completion of the drilling and sampling at each location, the pad was deconstructed by Minconsult and the pad building materials was moved via helicopter to a subsequent location. Upon completion of the pre FEED site works, all of the pad building material was demobilized from the island and transported back to the mainland.

3.6 Geotechnical Borings

A total of 31 onshore borings, BH-1 through BH-31 were drilled to depths ranging from about 20 m to about 59 m. Detailed descriptions of the soils/rock encountered in the borings are presented on the boring logs on Plates A-1 through A-31 in Appendix A of this report. A key to the terms and symbols used on the boring logs is presented on Plate A-40. Field activities related to geotechnical borings, drilling and sampling methods and borehole completion are discussed in this section. The following table presents borings with coordinates and elevations, completed depths, and the proposed onshore structure for which the boring was performed.

Table 2.1 Onshore Borings – Onshore Facilities

Borehole	Northing (m)	Easting (m)	Elevation (m)	Drilled Depth (m)	Structure	Area
BH-1	6007611	416382	17.98	54.86	Road	Bridge Crossing
BH-2	6007508	416259	3.81	50.60	Bridge	
BH-3	6007346	416066	5.00	55.08	Bridge	
BH-4	6007251	416053	16.92	20.42	Road	OSBL
BH-5	6006993	415818	33.21	21.00	OSBL	
BH-6	6007112	415437	1.08	20.88	MOF	MOF
BH-7	6006971	415453	2.22	20.57	MOF	
BH-8	6006969	415295	0.77	20.94	MOF	
BH-9	6006918	415620	25.01	30.48	Fuel Tanks	OSBL
BH-10	6006835	415657	27.80	54.86	LNG Tank 3 Center	LNG Tank
BH-11	6006797	415643	27.49	33.53	LNG Tank 3 Perimeter	
BH-12	6006841	415696	29.84	34.75	LNG Tank 3 Perimeter	
BH-13	6006865	415632	27.92	31.09	LNG Tank 3 Perimeter	
BH-14	6006733	415534	29.63	59.44	LNG Tank 2 Center	
BH-15	6006696	415520	30.97	35.97	LNG Tank 2 Perimeter	
BH-16	6006739	415573	27.01	32.61	LNG Tank 2 Perimeter	
BH-17	6006764	415508	25.45	31.09	LNG Tank 2 Perimeter	
BH-18	6006636	415449	32.28	37.80	LNG Tank 1 Perimeter	
BH-19	6006660	415385	29.99	36.00	LNG Tank 1 Perimeter	
BH-20	6006629	415410	30.63	59.44	LNG Tank 1 Center	
BH-21	6006592	415396	30.39	35.05	LNG 1 Tank Perimeter	
BH-22	6006717	415748	30.57	30.18	LNG Train 3	ISBL
BH-23	6006600	415612	40.36	27.43	LNG Train 2	
BH-24	6006484	415474	24.29	55.40	LNG Train 1	
BH-25	6006513	415803	25.73	21.34	Future Fractionation	
BH-26	6006339	415596	34.78	21.34	Future Fractionation	
BH-27	6006414	415945	30.45	19.81	Utilities	OSBL
BH-28	6006327	415842	38.63	30.48	Utilities	
BH-29	6006240	415738	27.62	20.73	Utilities	
BH-30	6006150	415921	35.28	21.49	Warehouse/ Workshop	
BH-31	6006690	415177	5.00	20.33	Trestle	Trestle

Note: All coordinates are based on reference datum, UTM zone 9.

2.5.1 Drilling Rig Movement. The onshore drilling and sampling services were performed by Geotech Drilling using two skid-mounted heli- portable drilling rigs concurrently. The drill rigs and

equipment were mobilized to the island and to each subsequent drill site via helicopter due to lack of vehicular travel/access on the island.

2.5.2 Drilling and Sampling Methods. Borings were performed using rotary wash drilling and HQ3 wireline coring techniques. Soil materials were typically sampled at about 0.5 m intervals in the upper 3.6 m, and at about 1 m intervals until bedrock materials suitable for coring was encountered. Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques. Bedrock materials were continuously cored using triple-tube HQ3 wireline core assemblies equipped with diamond drilling bits to the minimum depths below the proposed final site grade specified by KBR.

Undisturbed samples of cohesive soils were obtained by hydraulically pushing a 68 mm diameter, thin-walled tube (Shelby) to a distance of about 0.6 m or to refusal, whichever occurred first. The field procedure for cohesive soil sampling was conducted in general accordance with the Standard Practice for Thin-Walled Tube Sampling of Soils (ASTM D1587).

Disturbed soil samples were obtained by driving a 50 mm OD split-barrel standard penetration test (SPT) sampler in general accordance with the Standard Penetration Test (SPT) procedure described in ASTM D1586. The SPT N-values, defined as the number of blows required for a 64 kg hammer falling 0.76 m to drive the split-barrel sampler the final 0.30 m of the 0.45 m sampling interval, are recorded during sampling and are presented on the logs in Appendix A.

Rock coring was accomplished by rotary drilling procedures using triple-tube HQ3 (nominal 60mm diameter) wireline coring assemblies in general accordance with the *Standard Practice for Diamond Core Drilling for Site Investigation* (ASTM D2113). The wireline core assembly allows quick retrieval of the inner core barrel from the downhole core/drill string using a hydraulically operated wireline winch and an overshot retrieval tool. The bedrock was generally continuously cored at 1.5 m intervals to total depth. However, depending upon the bedrock characteristics (fracturing, weathering, etc.) that resulted in lower core recovery and/or blocking, some core runs were shortened in an effort to increase recovery in difficult materials. Full core runs (1.5m) were re-established as conditions permitted.

The samples obtained using Shelby tubes, are termed as “tube” samples, and were not extruded in the field. A portion of the sample from the ends of the tubes was collected for performing moisture content tests at the laboratory. Ends of Shelby tubes were sealed, and the tubes were labelled and placed in an appropriate container for storage and transport.

Rock cores recovered from the borings were removed from the inner tube, visually observed in the field, and classified by engineering geologists in general accordance with procedures outlined in the US Bureau of Reclamation (2001) and the International Society of Rock Mechanics (1981), as drilling proceeded. The bedrock materials were logged relative to material type, weathering,

hardness, degree and type of fracturing, coring rate, total core recovery (TCR), solid core recovery (SCR), and rock quality designation (RQD). The TCR is defined as the percent of the length of core recovered to the length of the core run; SCR is defined as the percent of solid, cylindrical lengths of recovered core relative to the length of the core run; and RQD is defined as the percent of the cumulative length of core samples at least 10 cm long to the length of the core run. Based on ASTM D 6032 pieces of core that are moderately or intensely weathered should not be included in the calculation of RQD. The procedures used in determining TCR, SCR, and RQD are presented on Plate A-40 in Appendix A. Recorded TCR, SCR, RQD, and drilling rate information are presented on the boring logs on Plate A-41 in Appendix A. Rock core recovery dropped to zero at certain depths. These depths may be associated with shear zones that were identified in acoustic televiewer logs. Rock core pictures for each boring are presented on Plates A-42 through A-169.

3.7 Borehole Acoustic Televiewer Logging

Acoustic borehole logging was performed within 6 soil/rock borings BH-01, BH-03, BH-10, BH-14, BH-20, and BH-24 using a high-resolution acoustic televiewer. The primary objective of acoustic logging is to measure the orientation of geologic discontinuities (strike and dip of bedding planes, fractures, shears, etc.) within the bedrock materials. Borehole acoustic televiewer tools generate 360 degree images of the borehole wall by transmitting ultrasound pulses from a rotating sensor and recording the amplitude and travel time of the reflected signals from the interface between drilling mud or fluid and the surrounding formation. Field activities associated with televiewer logging, interpretation method, and interpreted results are presented in Appendix B of this report.

3.8 Piezometer Installation

A standpipe temporary piezometer was installed within 8 soil/rock borings, BH-2, BH-3, BH-7, BH-11, BH-16, BH-26, BH-28, and BH-30, after drilling and sampling efforts at each respective location was completed. The purpose of the piezometers was to provide a means of measure groundwater levels with time. The lower portion of the piezometers were completed with screened PVC casing; the annulus (between the casing and the drilled hole) was backfilled with sand to above the elevation of the screened interval. The upper 1.5 to 3 m of each installation was completed with blank casing (unslotted) that extended above the ground surface and the annulus backfilled with bentonite chips to near the ground surface. A schematic of each completed piezometer is presented on Plate A-170 through A-177. The groundwater readings indicated the water at the existing ground surface at installed locations.

3.9 PS Suspension Logging

PS suspension logging was performed within 6 onshore soil/rock borings, BH-1, BH-3, BH10, BH-14, BH-20, and BH-24. The objective of the PS suspension logging is to determine the compression and shear wave velocity profiles of the subsurface materials in order to obtain an

understanding of the in-situ dynamic properties. The PS suspension logging tool is a single probe that contains a seismic source and two bi-axial receivers. The probe is lowered into the boring to the test elevation, the seismic source is actuated, and the results are recorded on a laptop computer. The probe is then raised to the next test elevation and the process repeated. The elapsed time between arrivals of the waves at the receivers is used to determine the average velocity. Source to receiver analysis is also performed for quality assurance. PS suspension logging method, data interpretation, and computed shear wave velocity, profiles are presented in Appendix C of this report.

3.10 Borehole Completion

Each boring not completed as a piezometer was backfilled with cement grout following completion of drilling and sampling at each respective location. Cuttings generated during drilling were spread on the ground at the completion of each borehole and removal of the drill pads.

3.11 Test Pit Excavation and Logging

A total of 8 test pits were excavated in mid-July 2013 as part of Lineament Assessment study in an attempt to better characterize subsurface materials along the lineaments identified during analysis of the LiDAR data; 6 in the area of LNG tanks and 2 in the northeastern portion of the island. The findings have been interpreted to suggest that the fault rupture and the surface deformation hazard for the Lelu Island is low. Stratigraphy of the units exposed in the test pits generally consisted of root mat over organic silt over silty sand over rock bed:

This composite profile demonstrates that organic material forms a very large component of the total volume of unconsolidated material located in the low relief areas of Lelu Island. Test Pit logs are presented in Appendix D of this report. Detailed results on the lineament assessment are provided in separate Fugro report dated September 6, 2013 (Appendix I).

3.12 Onshore Sample Storage and Shipping

Fugro's field geologists visually classified and logged the recovered soil and rock core materials in the field during the drilling process. The recovered samples and cores were labeled and readied for transport to shore. Once onshore, the core samples were digitally photographed and the soil and rock cores packaged for shipment to our testing laboratories in either Calgary, Alberta or Houston, Texas under chain-of-custody documentation. The following outlines our detailed procedure for sample storage and shipping:

- Labels and identification information were placed in a plastic bag within each of the sample tubes and taped on the outside of the sample tube.
- Rock core samples were placed in wooden storage boxes. When placing rock core samples in the core boxes, the depth intervals were identified and spacers were inserted to identify areas where core recovery was not obtained. The core box was

marked on the outside lid and on one end with project name, borehole number, box number, and depth of core within the box.

- The boxed cores and identifying label were photographed in color under regulated lighting conditions with a Kodak color chart in our field site facility in Port Edward.
- The core boxes, tube samples, and bulk samples were transported under chain-of-custody documentation to our testing laboratories in either Calgary, AB and Houston, Texas periodically during the field program.

4.0 NEARSHORE FIELD EXPLORATION

4.1 General

Field exploration consisted of performing nearshore geophysical surveys including bathymetric surveys, side scan sonar, and magnetometer surveys, drilling and sampling six borings (BH-32 through BH-37), and performing PS logging at BH-35 as shown on Plate 2b. Following are the subsections that provide brief details on various field services performed in the trestle and berthing area of the project.

4.2 Nearshore Geophysical Surveys.

The bathymetric surveys, side scan sonar, and magnetometer surveys, were conducted by Fugro between May 4 and May 10, 2013. Results of the geophysical surveys were presented in Fugro Report No. 23.00007028 R2 dated July 13, 2013 and is included in the report in Appendix J. In the trestle and berthing area, seabed elevations range from El. -1.8 m to El. -46.8 m, and slopes are generally less than 2.5° except for the berthing area where slopes are as steep as 12.5°. Plates 3, 4a, and 4b present the results of the bathymetry and seafloor slopes varying within the trestle and berthing area. The results of the geophysical survey in the turning basin indicate that the seabed elevations within the turning basin area range from EL. –3 m to –31 m LAT and slopes sometimes approach 60° where bedrock protrudes up through the sediment. Plates 5a and 5b present the results of the bathymetry and seafloor slopes varying within turning basin area. Dredging will be required within the turning basin and MOF area to match the proposed dredge elevation of El. -12.5 m and El. -10 m LAT, respectively. The top of bedrock was not seen in the geophysical data for the trestle and berthing areas, because the top of bedrock likely lies well below the limit that the boomer and sub-bottom profiler systems that were used during the pre-FEED survey.

4.3 Geotechnical Borings

The nearshore boring program to support the pre-FEED geotechnical design for the marine trestle, berthing facility, and turning basin consisted of performing 8 nearshore borings (BH-32 through BH-39) near the locations indicated in Plate 2a and summarized in the following table. Detailed descriptions of the soils/rock encountered in the borings are presented on the boring logs on Plates A-32 through A-39 in Appendix A of this report. A key to the terms and symbols used on the boring logs is presented on Plate A-40. The borings were advanced to depths of about 50 m to 110 m below the mudline from our Skate 3a jack-up drilling platform between June 27 and August 2, 2013. Borings BH-32 ,BH-33, BH-38 and BH-39 were drilled in jacked mode. BH-34 through BH-37 were drilled in spudded mode.

Table 4.1 Summary of Trestle and Berthing Facility Borings

Boring	Northing (m)	Easting (m)	Approx. Water Depth (m)	Boring Depth (m)	Depth to Bedrock (m)	Remarks
BH-32	6006253	414629	-4.83	61.39	51.6	Trestle Alignment
BH-33	6005800	414121	-5.79	71.51	70.3	Trestle Alignment
BH-34	6005361	413597	-6.88	50.00	43.6	Trestle Alignment
BH-35	6004966	413115	-10.06	109.90	Not Encountered	Trestle Alignment/ Berthing Facility
BH-36	6004612	413413	-10.13	109.90	Not Encountered	Berthing Facility
BH-37	6005292	412787	-10.01	77.45	72.6	Berthing Facility
BH-38	6007090	415333	-2.50	30.51	2	Turning Basin
BH-39	6007311	415200	-6.60	29.99	0.5	Turning Basin

4.3.1 Drilling and Sampling Methods. The nearshore borings were advanced using rotary wash drilling and a 102mm-inside-diameter Geobor S triple-tube wireline coring assemblies. Soil materials in borings BH-33 to BH-35 and BH-37 were typically sampled at about 0.5m intervals in the upper 3m to 6m; at about 3m intervals to depths of about 60m; and at about 4m intervals below about 60m. In borings BH-32 and BH-36, the soil materials were sampled at about 1m intervals to depths of about 7m, at about 3m intervals to depths of about 60m; and at about 4m below about 60m. Soil samples were recovered using a combination of pushed thin-wall tubes and/or driven Standard Penetration Test (SPT) samplers to depths of about 60m to 70m; below those depths, pushed thin-wall tubes were used exclusively in the soil materials as the extent of the SPT sampling rods had been exceeded. Bedrock materials (where encountered) were continuously cored using triple-tube Geobor S wireline core assemblies equipped with diamond drilling bits to drilling termination. Borings BH-35 or BH-36 were terminated at depths of about 110 m at the practical limit of the available drill string; bedrock was not encountered to the depths explored at those locations.

Undisturbed samples of cohesive soils were obtained by pushing a 68 mm diameter, thin-wall tube (Shelby) about 1m or to refusal, whichever occurred first. The field procedure for cohesive soil sampling was conducted in general accordance with the Standard Practice for Thin-Walled Tube Sampling of Soils (ASTM D1587). Pocket penetrometer and/or hand torvane readings were generally conducted in the recovered soil materials exposed in the bottom ends of the tube samples where appropriate. The readings are reported on the respective boring logs.

Disturbed soil samples were obtained by driving a 50 mm OD split-barrel standard penetration test (SPT) sampler in general accordance with the *Standard Penetration Test (SPT)* procedure described in ASTM D1586. The SPT N-values, defined as the number of blows required for a 64

kg hammer falling 0.76 m to drive the split-barrel sampler the final 0.30 m of the 0.45 m sampling interval, are recorded during sampling and are presented on the logs in Appendix A.

Rock coring was accomplished by rotary drilling procedures using triple-tube Geobor S (nominal 102mm diameter) wireline coring assemblies in general accordance with the *Standard Practice for Diamond Core Drilling for Site Investigation* (ASTM D2113). The wireline core assembly allows quick retrieval of the inner core barrel from the downhole core/drill string using a hydraulically operated wireline winch and an overshot retrieval tool. The bedrock was generally continuously cored at 1.5m intervals to total depth. However, depending upon the bedrock characteristics (fracturing, induration, weathering, etc.) that resulted in lower core recovery and/or blocking, some core runs were shortened in an effort to increase recovery in difficult materials. Full core runs (1.5m) were re-established as conditions permitted.

Rock cores recovered from the borings were removed from the inner tube, visually observed in the field, and classified by engineering geologists in general accordance with procedures outlined in the US Bureau of Reclamation (2001) and the International Society of Rock Mechanics (1981), as drilling proceeded. The bedrock materials were logged relative to material type, weathering, hardness, degree and type of fracturing, coring rate, total core recovery (TCR), solid core recovery (SCR), and rock quality designation (RQD). The TCR is defined as the percent of the length of core recovered to the length of the core run; SCR is defined as the percent of solid, cylindrical lengths of recovered core relative to the length of the core run; and RQD is defined as the percent of the cumulative length of core samples at least 10 cm long to the length of the core run. Based on ASTM D 6032 pieces of core that are moderately or intensely weathered should not be included in the calculation of RQD. The procedures used in determining TCR, SCR, and RQD are presented on Plate A-40 in Appendix A. Recorded TCR, SCR, RQD, and drilling rate information are presented on the boring logs in Appendix A.

4.3.2 Cuttings Containment. Drill cutting containment was attempted for all of the nearshore borings, however, containment was not always successful in very soft sediments and is not generally possible when drilling in spudded mode. However, drill cuttings were circulated to the jack-up from borings BH-32, BH-33, BH-35 through BH-37 and placed in 55-gallon drums for containment, transfer to shore, and storage for later disposal in an approved area of Ridley Island.

4.3.4 Borehole Completion. The nearshore borings were backfilled with neat cement grout following completion of drilling and sampling at each respective location.

4.4 PS Suspension Logging

PS suspension logging was performed in boring BH-35. PS suspension logging method, data interpretation, and computed shear wave velocity, profiles are presented in Appendix C of this report.

4.5 Nearshore Sample Storage and Shipping

Fugro's field geologists visually classified and logged the recovered soil and rock core materials in the field during the drilling process. The samples were stored and shipped according to the procedure presented in Section 3.12 Onshore Sample Storage and Shipping.

5.0 LABORATORY TESTING

5.1 General

The laboratory-testing program was designed to evaluate pertinent engineering properties of the foundation soils and rocks. Soil and rock samples were transported and all laboratory testing was performed at Fugro laboratories located in Houston and Calgary. Classification tests, corrosion potential tests (soils only), unconfined compression (UC) tests, and point load strength index (PL) (rock only) tests were performed on selected soil and rock core samples. The following sections present brief description of the soil and rock test performed on the samples. Additionally, laboratory tests that were performed in general accordance with applicable standards on selected soil samples are summarized in Table 5.3.

5.2 Soil Testing

5.2.1 Classification Tests. The classification tests included tests for natural water content, specific gravity, liquid and plastic limits (collectively termed Atterberg Limits), sieve analysis, material finer than the No. 200 sieve (percent fines), and hydrometer tests. These tests aid in classifying the soils and are used to correlate the results of other tests performed on samples taken from different borings and/or different depths. The results of these tests are presented on the boring logs in Appendix A. Sieve and Hydrometer test results are presented in Appendix E of this report.

5.2.2 Undrained Shear Strength Tests. We measured the undrained shear strengths of selected undisturbed cohesive samples by performing miniature vane shear, unconfined compression, or unconsolidated-undrained triaxial compression tests. Natural moisture contents and dry unit weights were determined as routine parts of the shear strength tests. We also performed strength tests on selected remolded samples to assess the sensitivity of clay soils. The results of the laboratory shear strength tests, along with the field estimates of shear strength, are presented on the boring logs in Appendix A.

5.2.3 Compressibility Characteristics. The compressibility characteristics of the foundation soils were measured by performing Constant Rate of Strain (CRS) one-dimensional consolidation tests and incremental consolidation tests. A total of 5 CRS and 20 incremental consolidation tests were performed on undisturbed, cohesive samples. We performed each test with a rebound-reload cycle. Natural moisture contents and dry unit weights were determined as routine portions of the consolidation tests. The consolidation test results are presented on Appendix E of this report.

5.2.4 Organic Content Testing. Organic content of peat and soil samples was determined by performing Loss on Ignition (LOI) tests. Samples for the tests were selected based on the field

reporting of presence of organics in the soils. The LOI test provides the organic content of a given soil sample as a percentage of the dry unit weight of the soil sample.

Table 5.1 Organic Content Test Results

Boring No.	Depth, m	Moisture Content, %	Organic Content, %
BH-3	1	540	81
BH-4	1	180	29
BH-5	1	327	45
BH-9	1	110	15
BH-10	1	299	96
BH-10	5	1064	91
BH-12	2	870	97
BH-15	3	876	66
BH-16	3	762	94
BH-17	1	808	81
BH-17	5	794	93
BH-18	1	687	77
BH-19	1	84	20
BH-22	3	743	69
BH-22	9	1280	84
BH-23	1	318	74
BH-24	1	395	75
BH-24	7	18	2
BH-25	2	717	60
BH-26	3	140	19
BH-27	2	634	61
BH-27	5	20	2
BH-28	3	762	92
BH-29	3	287	44
BH-30	1	505	96
BH-30	2	NA	1
BH-33	14	NA	3
BH-36	47.5	NA	4
BH-38	50.5	NA	4

5.2.5 Corrosion Potential Tests. The corrosion potential of the surficial soils was evaluated using a series of laboratory tests including pH, sulfate ion concentration, chloride ion concentration, and electrical resistivity. Samples from various depths and locations were selected for testing. The results of the completed corrosion potential tests are presented in Section 18.0 *Soil Corrosion*

Potential of this report. The corrosion potential test results are presented on Appendix F of this report.

5.3 Rock Testing

5.3.1 Unconfined Compression (UC) Tests. Unconfined compression (UC) tests were performed on selected rock core samples collected from borings to estimate the uniaxial compressive strength (UCS). Prior to performing the UC test, the rock core samples were prepared in accordance with ASTM D 4543. The load and strain measurements were recorded directly by a computer generating the corresponding stress-strain data at a predetermined load and deformation. The UCS determined from the peak axial stresses at which the samples failed are presented on the boring logs in Appendix A.

5.3.1 Point Load (PL) Strength Index Tests. The PL test is an index test for strength classification of rock samples. Rock samples in the form of either a core or irregular shapes are tested by the application of concentrated loads through a pair of truncated, conical platens with little or no sample preparation required. The load is steadily increased until failure occurs within 10 to 60 seconds, and the failure load is recorded. The size-corrected point load strength index, *Is*(D), of a rock specimen is defined as the value of *Is* that would have been measured by a diametric test with *D* = 50 mm and given the symbol *Is(50)*. Size correction is accomplished using the formula:

$$I_{s(50)} = (F)(I_s)$$

where: F = size correction factor, and

Is = uncorrected point load strength

The "Size Correction Factor *F*" was obtained from the expression:

$$F = (0.02\ D_e)^{0.45}$$

where: F = size correction factor, and

D_e = equivalent core diameter (a diameter of an equivalent core with a cross-sectional area equivalent to that of the failure surface)

The results of the laboratory point load tests are presented on the boring logs in Appendix A.

5.3.3 Brazilian Tensile Test. We performed Brazilian tensile test, splitting indirect tensile test, on a total of 4 rock samples. The tests were performed in accordance with ASTM D 3967 – 08. Rock samples in the shape of circular disk with a thickness-to-diameter ratio (*t/D*) between 0.2 and 0.75 are tested using this procedure. The load is applied to the rock sample using a pair of curved or flat bearing blocks. The compressive load is continuously increased to produce an approximately constant rate of loading or deformation such that failure will occur within 1 to 10 min of loading. The splitting tensile strength of the specimen shall be calculated as follows:

$$\sigma_t = 2P / \pi LD$$

where: σ_t = splitting tensile strength, MPa,

P = maximum applied load indicated by the testing machine, N,
L = thickness of the specimen, mm, and
D = diameter of the specimen, mm.

Table 5.2 Brazilian Tensile Test Results

Boring No.	Depth, m	Splitting Tensile Strength, MPa
BH-7	5.1	8.1
BH-14	6.4	6.5
BH-20	11.3	4.5
BH-24	13.7	4.7

5.4 Summary of Laboratory Testing

The laboratory tests were performed in general accordance with applicable standards and are presented in Table 5.3 along with the quantity of each test type performed.

Table 5.3: Laboratory Test Description and Summary

Laboratory Test	Testing Standard	Quantity
Water Content	ASTM D2216	902
Atterberg Limits	ASTM D4318	97
Natural Density	ASTM D2937	682
Sieve Analysis	ASTM D 422	6
Hydrometer	ASTM D 422	16
Percent Finer than No. 200 Sieve Tests	ASTM D1140	59
Unconfined Compression Tests on Soils	ASTM D2166	10
Unconsolidated-Undrained Triaxial Compression	ASTM D 2850	79
Minivane Tests	ASTM D4648	31
Organic Content Test	ASTM D2974	29
Consolidation Tests (CRS and INC)	ASTM D4186	25
pH of Soil	AASHTOT291	8
Sulfate Ion Concentration	AASHTOT290	8
Chloride Ion Concentration	AASHTO T291	8
Electrical Resistivity	ASTM G57-78	8
Unconfined Compression Tests on Rock	ASTM D 7012	113
Point Load Strength Index Tests on Rock	ASTM D 5731	611
Brazilian Tensile Tests on Rock	ASTM D3967	4

6.0 GENERAL SUBSURFACE CONDITIONS

6.1 General Site Conditions

Lelu Island is located along the western coast of BC and is separated from the BC mainland by a tidally-influenced northwest trending channel. Lelu Island is undeveloped and there is no direct land connection between the site and the mainland. The shoreline is primarily rocky, steep, and difficult to access. Above the high tide line, the island is heavily forested with old growth forest underlain by a dense organic mat of fallen wood, undergrowth, and dense moss. Near the shoreline, slopes are generally steep, rising 15 to 20 meters through dense woods. Inland, the topography is undulating due to glacial erosion that scoured out weaker bedrock material leaving a rolling terrain with localized bogs and subsequent deposits of peat (Refer to Fugro Report No.: 04.10120100 dated January 28, 2013). Drainage features are strongly developed generally parallel to subparallel to the structural trend of the island (generally northwest to southeast) and along fracture traces, particularly on the northern part of the island. The following sections present information on geomorphology and surface geology, regional geology, regional seismicity, and subsurface and groundwater conditions.

6.2 Geomorphology and Surface Geology

The surficial geology of the site is the result of glacial scour of the foliated bedrock, followed by stream erosion, and inundation by rising sea level at the beginning of the Holocene. Pleistocene glaciation reached its peak on the British Columbia coast 16,000 to 17,000 years ago followed by a rapid retreat due to climate change and calving leaving the Prince Rupert Area ice free after about 13,000 years ago (Clague and Ward, 2011). Scouring by glacial ice, left extensive bedrock exposures, Lelu Island being one of them, of relatively fresh bedrock exposed at the surface. The Lelu Island site may have been located near the bottom of a glaciated valley where ice flows generally flattened the terrain. Differential weathering by glacial scour acting on interlayered weak and hard rock resulted in undulating bedrock surface and linear ridges and valleys. The major structural features in the region are the right lateral Queen Charlotte fault and associated coast-parallel faults bounding tectonic assemblages. The assemblage containing Lelu Island, the Alexander Terrane, consists of accreted and metamorphosed rock of Ordovician to Triassic age.

Bedrock underlying Lelu Island consists of Paleozoic-Mesozoic sheared and moderately to highly metamorphosed sedimentary and volcanic rocks (phyllitic to schistosic gneiss) with dominant foliation oriented roughly N30°W (214°/12°) (coast-parallel). Bogs and deposits of peat have formed over much of the upper island where organic materials have accumulated in depressions in the glaciated bedrock surface. In some cases, the mass of accumulated organic matter may slow the drainage on some slopes resulting in terrace-like bogs. A layer of interlocking roots and mass forms a continuous cover in over fallen logs, soil and outcrops of rock. A geologic map identifying

the various geologic units, joints/foliations, bog, and deposits of peat is presented on Plate 6 of this report.

6.3 Regional Geology and Faulting

Geologic mapping of the region has been completed by various authors, including the Geologic Survey of Canada (GSC) and Natural Resources of Canada (NRCAN), which illustrate north-striking, transform or strike-slip faults that follow the physiographic provinces and terrain boundaries of the Canadian Cordillera. Published geologic mapping by and Nelson et al[1] and Crawford and Crawford[2]suggests that the northwest-trending Prince Rupert Shear Zone (PRSZ) is located east of the island in Lelu Slough. Gehrels[3] maps the PRFZ west of the island crossing the trestle alignment.

None of the faults within and immediately proximity to Lelu Island (identified from existing mapping and available seismicity data) have been assessed for Quaternary activity, and are presumed to be inactive. Borings drilled for the pre-FEED geotechnical study and acoustic televiewer logs indicate several bedrock shear zones at the logged locations. Detailed assessment of the boring encountered bedrock shear zones is recommended during FEED level study, to define specific characteristics of these bedrock shears, their relation (if any) to surface lineaments, cross-cutting relationships, and the age and potential for Quaternary faulting

6.4 Regional Seismicity and Seismic Hazard Analyses

Available publications and reports describing the seismotectonic setting of northwestern coastal British Columbia consider the nearest active fault zone to be 200 km to the west of Lelu Island. Available seismicity catalog data are consistent with this conclusion with no seismicity within 50 km of Lelu Island (Plate 7). The seismic hazard analyses reports presented in Appendix G and Appendix H have detailed descriptions of seismotectonic setting, seismotectonic model, historic seismic catalog, and seismic hazard analyses.

Additional geotechnical investigations and geologic studies will be conducted as part of the FEED phase of the project to refine the characterization of subsurface conditions and investigate the potential for the presence of local onshore faults in the project area. If these studies conclude that local active faults are present in the project area, the seismic hazard assessment will be updated to consider the additional ground motion associated with these local faults.

[1] Nelson, J.L., et al, (2012), *North Coast Project: Tectonics and Metallogeny of the Alexander Terrane, and Cretaceous Sinistral Shearing of the Western Coast Belt,* in Geological Fieldwork 2011, Paper 2012-1.
[2] Crawford, M.L. and Crawford W.A., (1999), *Terrane Assembly and Structural Relationships in the Eastern Prince Rupert Quadrangle, British Columbia,* in GSA SP 343
[3] Gehrels, G.E., (2001), *Geology of the Chatam Sound Region, Southeast Alaska and Coastal British Columbia,* in Canadian Journal of Earth Science.

6.5 Subsurface Conditions

6.6.1 Onshore Facilities. The subsurface conditions presented in this section are based on soil and rock conditions encountered in 24 borings, BH-4, BH-5, BH-9 through BH-30. The existing site grades vary from about El. +50 m to about El. +15 m within the footprint of the LNG tank, ISBL, and OSBL areas. Plate 8 presents color coded site topography indicating the low and the high areas around the site. Plate 8 shows the locations of the exploratory borings with respect to each of the planned LNG tank, ISBL, and OSBL areas.

Based on the information obtained from the borings drilled for this site investigation, generalized cross sections were prepared and are presented on Plates 10 through 17. The orientation of all the profile lines are shown on Plate 9 of this report. The profiles illustrate the complexity of the site geology across the entire site. Cross sections 1-1' through 3-3' are drawn northwest-southeast and cross sections A-A' through E-E' are drawn southwest-northeast through various borings as shown on Plate 9. Stratigraphy, material descriptions, and a graphical presentation of compressive strengths are presented on each of the boring logs presented in Appendix A. The site grade varied from about El. +50 m to about El. +15 m within the footprint of onshore facilities. Generally, the subsurface conditions varied significantly with elevation from surface to a depth of about about El.+ 20 m. In general, varying amount of overburden soils were encountered consisting of cohesive soils overlying the Paleozoic-Mesozoic sheared and moderately to highly metamorphosed sedimentary and volcanic rocks to the completion depth of the borings. Additionally, some borings encountered bedrock extending below the existing ground surface down to the completion depth.

Based upon the available results of field and laboratory tests, and our interpretation of the eight cross sections, we have identified three main stratums in these areas. A brief summary of the location of these three strata encountered in each boring is presented in Tables 4.2

Table 6.1 Subsurface Conditions

Stratum	Subsurface Conditions	Layer Thickness, m
I	Peat and organic soils	0 to 3.6
II	Cohesive Soils*	0 to 9
III	Bedrock	17+
* granular layers of about 0.2 to 0.7 m thick were encountered between Layers I and II or within Layer II in some borings ** bedrock was encountered below cohesive soils		

Peat and Organic Soils: Differential weathering by glacial scour acting on interlayered weak and hard rock resulted in undulating bedrock surface and linear ridges and valleys. Bogs and deposits of peat and soils have formed where organic materials have accumulated in depressions in the glaciated bedrock surface. Field estimates and laboratory tests indicate that the undrained shear strength of the peat and organic soils range from very soft (less than 5 kPa) to soft (20 kPa). Organic content test results are presented in Table 5.1.

Cohesive Soils: Subsurface conditions encountered in the borings indicate overburden soils below the peat and organic soils in most of the borings overlying the bedrock, to thickness varying between 0 m and 9 m. Field estimates and laboratory tests indicate that the undrained shear strength of the cohesive soils generally range from soft (10 kPa) to stiff(50 kPa). However, in some of the borings such as BH-10, BH-11, and BH-12 we encountered very soft to firm cohesive soils. In some borings we encountered hard cohesive soils. Shear strength for the cohesive soils varying with elevation is plotted and presented on Plate 18 of this report.

Bedrock: The Paleozoic-Mesozoic sheared and moderately to highly metamorphosed rocks are encountered to the completion depth of the borings. Bedrock materials at the project site consist of foliated metamorphic rock materials that increase in metamorphic grade from northeast to southwest across the island. The bedrock materials range from lower-grade metamorphosed phyllite in the northeast, to moderately metamorphosed schistose materials toward the interior of the island, to higher-grade metamorphosed gneissic rock materials in the southwest. Bedrock materials encountered in our borings are composed predominately of lower-grade metamorphosed phyllite interbedded with lesser amounts of moderate to higher-grade metamorphic schistose and gneissic layers. The phyillite is intensly jointed and foliated, with dominant foliation oriented roughly N30°W (214°/12°) (coast-parallel).

Unconfined compression tests were performed on rock core samples collected from borings at the site to estimate the uniaxial compressive strengths (UCS) of the existing rocks. Point load tests were also performed adjacent to most of the UC tests, permitting a site-specific correlation between the UCS and point load index. As mentioned earlier, the intense fracturing of the existing rock limited the number of testable UCS samples. Therefore, the correlation developed was based on the limited available data. The dataset presented on Plate 19a and 19b indicates a correlation value of UCS of rock being equal to 5 times point load test strengths ($I_{s(50)}$) for samples tested with load application normal to the foliations and 10 times point load test strengths ($I_{s(50)}$) for samples tested with load application parallel to the foliations. In addition to the point load tests performed adjacent to the UC tests, additional point load tests were performed on recovered core samples. These point load values were also converted to UCS using the developed correlation. The uniaxial compressive strengths of the phyllites generally ranged from less than 10 MPa to 120 MPa indicating that the phyllite is strong to extremely strong. The measured UCS results and the converted point load test results for the phyillites are plotted with elevation on Plate 20.

6.6.2 Access Bridge. The subsurface conditions presented in this section are based on soil and rock conditions encountered in 3 borings, BH-1 through BH-3. Bathymetry within the channel area was not acquired during this investigation, however, based on the bridge cross section provided by KBR, the existing grades within the channel vary between El. +15 m (near the banks) to about El. -10 m (near the center of the channel). Plates 21 and 22 present cross sections showing the soil/rock encountered at the boring locations. In general, near surface soils were encountered consisting of fill and peat overlying phyllite rock to the completion depth of the borings.

It should be noted that the subsurface conditions provided herein are based on the borings done outside the channel areas and mainly at the abutment locations. No borings were performed at the proposed bent locations during the current pre-FEED study. Subsurface information available from the provided Golder Report No. 902-1143, dated August 1990 was used for the channel area. Following subsections provide a brief summary of the subsurface conditions based on the borings drilled for this study

Near surface soils. Fill materials consisting of clayey sand with gravel road base is encountered in BH-1 at the ground surface extending down to a depth of about 0.8 m. BH-1 was located on the shoulder of Skeena Drive. Varying deposits of peat are encountered in BH-2 and BH-3 extending below the existing ground surface to depths of about 1.7 m and 0.9 m, respectively. The peat consist of very soft, wet, organic material with clay and sand.

Bedrock**.** The bedrock materials encountered in the borings for the bridge alignment generally consist of metamorphic phyllite interbedded with lesser amounts of gneiss and schist. The phyllite bedrock is generally strongly foliated and contains prominent joint sets coincident with the foliations based on the core and geophysical acoustic televiewer data. Review of the geophysical data from BH-1 suggests that the dips of the prominent foliation and joint set range from about 20 to 60 degrees to the northeast, while those of BH-3 are slightly steeper, ranging from about 40 to 70 degrees to the northeast. Additionally, the acoustic televiewer data suggest that there are two secondary foliation and joint sets that dip toward the southeast at about 45 to 75 degrees and to the west-southwest at about 15 to 75 degrees. The measured UCS results and the converted point load test results for the rock within in the area of Bridge area presented on Plate 23.

6.6.3 Nearshore Facility – Trestle and Jetty. The nearshore structures will consist of a trestle extending from the shoreline to the LNG jetty. The LNG Jetty will include a loading platform with breasting dolphins (berthing areas). Mooring dolphins will be installed on either side of each of the berthing area and will be connected to the loading platform by walkways (catwalks). The trestle alignment extends about 2.7 km southwesterly from the northwestern portion of the island, roughly subparallel to the northwestern limit of Flora Bank. Flora Bank is a tidally influenced shallow shelf area of non- to loosely-consolidated deltaic-like marine sedimentary deposits that ranged from about 46 to greater than 110 m in thickness at the locations explored. The marine sediments were underlain by material interpreted as glacial till at locations BH-32 through BH-34. Gneiss and phyllite bedrock materials were encountered beneath the till in borings BH-32 through BH-34 and below the marine sediments in boring BH-37. Evidence of shearing was observed in the phyllite bedrock in boring BH-34. Bedrock was not encountered to the depths explored in borings BH-35 and BH-36 advanced near the mooring facility.

The subsurface conditions presented in this section are based on soil and rock conditions encountered in 7 borings, BH-31 through BH-37. The cross-sections are shown on generalized subsurface profiles on Plates 25 and 26. Soil Shear strength profiles for trestle and jetty are

presented on Plate 27 and 28. The subsurface conditions encountered along the trestle and LNG jetty are divided into five areas based on feasible foundation types and capacities. These five areas are,

1. Abutment (onshore portion of the trestle): B-31,
2. Trestle: BH-32 and 33,
3. Trestle: BH-34,
4. LNG jetty: BH-35 and 37, and
5. LNG-Jetty: BH-36.

Based upon the available results of field and laboratory tests, and our interpretation of the cross sections, we have identified the following subsurface conditions at each of these areas.

Abutment – BH-31.The subsurface conditions at this location consisted of about 0.8 m of peat and organic silt over 1.2 m of silty sand over phyllite rock. The rock correlated uniaxial compressive strength ranged from about 20 MPa to 60 MPa

Trestle - BH-32 and BH-33. Generalized subsurface conditions at these locations consisted of about 6 m of loose silty sands and silts over 39 to 52 m thick under to normally consolidated lean and fat clay soils. Below clay soils, we encountered about 5 m of glacial till soils over phyllite rock. The shear strengths in clay soils ranged from about 10 to 30 kPa. The glacial till soils are very stiff to hard.

Trestle - BH-34. Generalized subsurface conditions at this locations consisted of about 6 m of loose silty sands and silts over 39 to 52 m thick under-to-normally consolidated lean and clay soils. Below clay soils, we encountered about 5 m of glacial till soils over phyllite rock at El.-55m. The shear strengths in clay soils increased linearly from about 10 to 45 kPa. The glacial till soils are very stiff to hard.

LNG jetty – BH-35 and 37. Generalized subsurface conditions at these locations consisted of under-consolidated to normally-consolidated cohesive soils. Bedrock was encountered at about El.-82 in Boring BH-37. Bed rock was not encountered at BH-35 within the drilled depth of 110 m. Shear strength of cohesive soils generally increased linearly from seafloor to about 40 kPa at a depth of about 45 m. At about 45 m below seafloor shear strength dropped to about 15 kPa and increased linearly with about the same slope to completion depth of the borings.

LNG Jetty – BH-36. Subsurface conditions at this location consisted generally of normally consolidated cohesive soils from seafloor to completion depth of the boring BH-36. The shear strength increased linearly from about 5 kPa at about 5 m below seafloor to 140 kPa at a depth of about 100 m below seafloor. Bedrock was not encountered within the drilled depth of BH-36.

6.6.4 Turning Basin and Materials Offloading Facility

Bathymetry, side scan sonar, magnetometer, 2D high-resolution multi-channel seismic, sub-bottom profiler, and seabed features data were acquired over 1000 x 500 meter area of the turning basin area. These surveys were not possible within the proposed MOF footprint because of the shallow water depths. The tops of bedrock including outcrops were mapped as a part of the proposed geophysical survey. Additionally, the results of the surveys indicated that within the turning basin area, the sediments (overburden) include sands, silt, clay or outcropping bedrock. Bedrock and overburden thickness mapping, and bathymetric contours within the turning basin area are presented on Plate 5a and 5b. The thickness of the overburden varies between 0 m to 16 m below existing seabed, however, greater than 1 m thickness was generally seen within the deep water areas of the turning basin. Additionally, sediment sampling was performed by Stantec at various locations (Plate 44) within the turning basin area. Preliminary field logs indicate overburden thickness varying between 2 m to 12 m.

Two soil/rock borings BH-38 and BH-39 that were performed within the footprint of the proposed turning basin also indicate very little overburden. Based on the information available from the geophysical survey and our borings drilled within this area, subsurface conditions in this area include overburden soils consisting of very soft to soft sandy clays with shell fragments overlying bedrock. Bedrock extending below the existing seabed is encountered in Boring B-39, which is located in the northwest area of the turning basin. In both the borings performed for this study, bedrock included highly weathered to moderately weathered, weak to hard, heavily foliated Phyllite. The bedding angles varied between 20 degrees to 70 degrees with some bedding planes infilled with quartz and infrequent clays. Generalized subsurface cross-sections for turning basin and MOF area are presented on Plates 29 and 30, respectively.

6.6 Groundwater Conditions

Groundwater conditions within borings were not directly determined during the geotechnical exploration. Upon completion of drilling and sampling, a standpipe piezometer was installed within 8 borings. The water in the piezometers was at or about ground surface elevations.

6.7 Variations

Our interpretations of soil, rock, and groundwater conditions, as described in this report, are based on data obtained from sample borings (limited field exploration) and laboratory tests (available to date), and our experience with similar projects. Although we have allowed for minor variations in the subsurface conditions, our recommendations may not be appropriate for subsurface conditions other than those reported herein. It is possible that undisclosed variations in soil and rock conditions may occur outside of the boring locations. The performed field exploration is for pre-FEED level study. We recommend a comprehensive field exploration and testing program be performed for final geotechnical study.

7.0 SITE PREPARATION - ONSHORE

7.1 General

Based on the information provided by KBR, the proposed final site grade in the LNG tank, ISBL, and OSBL areas is planned to be about El. +25 m. The existing site grades vary from about El. +50 m to about El. +25 m within the footprint of the main onshore facilities, with localized areas at elevations as low as El. +15 m. Therefore, significant amount of cutting will be required for the proposed LNG tank, ISBL, and OSBL areas to match the proposed final grade of El. +25 m. However, there are some localized low lying areas within the LNG tank area and ISBL area that may require fill.

The following sections present our site preparation recommendations for cut and fill areas, excavation considerations, reuse of onsite materials (filling considerations), cut and fill slopes, drainage considerations, and impact on foundation design.

7.2 Cut and Fill Areas

As mentioned earlier, bedrock outcrops, valleys, and defined drainage features characterize the site. Scouring by glacial ice, left extensive bedrock exposures. Differential weathering by glacial scour acting on interlayered weak and hard rock resulted in undulating bedrock surface and linear ridges and valleys. Therefore, significant amount of cutting will be required for the proposed LNG tank, ISBL, and OSBL areas to match the proposed final grade of El.+25 m as shown on Plate 31 of this report. Bogs and deposits of peat and soils have formed where organic materials have accumulated in depressions in the glaciated bedrock surface. Based on the existing site grades, proposed final grade of El. +25 m, and subsurface conditions encountered in our borings, the proposed cut is expected to expose mostly bedrock, with few areas still exposing cohesive overburden soils. Additionally, there are some low lying areas that may be covered with bog and peat deposits of varying thickness. Therefore, for providing site preparation and foundation design recommendations, the the LNG tank, ISBL, and OSBL areas can be categorized into 3 different areas; LNG Tanks area (Area 1), ISBL/OSBL Rock Area (Area 2) and ISBL/OSBL Fill Area (Area 3). These areas are delineated on Plate 32. The delineation of the areas is very approximate and may increase or decrease in extent once the FEED level study is completed. Brief description for each of these areas is provided in the following subsections.

7.2.1 LNG Tanks Area – Area 1. The proposed final grade of El. +25 m is expected to expose bedrock within the footprint of Tank TK-1, however, for Tanks TK-2 and TK-3, some borings indicated cohesive soils consisting of soft clays and some indicated bedrock. Therefore, within the footprints of Tanks TK-2 and TK-3 variable subsurface conditions consisting partially of soft cohesive soils and partially of bedrock were encountered (Plate 32). These soft cohesive soils

may extend down to about El. +15 m within the footprint of Tanks TK-2 and TK-3, and should be removed and replaced with flowable fill for the satisfactory performance of the foundations. To provide site preparation and foundation design recommendations, Area 1 is further divided into Area 1A and Area 1B. Flowable fill is recommended in lieu of crushed stone fill or cement stabilized sand as these fills would require rigorous compaction and quality control which may be very difficult to achieve. Additionally, the modulus of crushed rock fill and cement stabilized fill is much less than that of rock on which portion of the tank will be supported. Flowable fill recommendations are presented in the Section 19.1 Fill Materials and Placement of this report. Settlement criteria and estimated settlements are presented in *Section 9.0 LNG Tank Foundation*.

7.2.2 ISBL/OSBL Rock Area – Area 2. The proposed final grade of El. +25 m in Area 2 will expose mainly bedrock within the footprint of the proposed structures. Site preparation in this area, after final grading, will be limited to leveling to provide uniform support for the foundations. Leveling material should consist of flowable fill. Flowable Fill recommendations area presented in Section 19.1 of this report. Structures may be supported on shallow foundations in this area. Shallow foundation recommendations are presented in Section 10.0 Shallow Foundation Recommendations.

7.2.3 ISBL/OSBL Fill Area – Area 3. Generally, the depth to rock within Area 3 is expected to be lower than design final grade elevation of about El.+25 m. We anticipate subsurface soils in this area to consist of cohesive soils in localized areas to about EL.+15 based on available information. Additionally, portion of this area consist of valleys with elevations as low as El +10 m in localized areas (Plate 8). Site preparation in this area should consist of removing all cohesive soils to expose natural metamorphic rock. The area can then be backfilled with recommendations presented in Section 8.0 Foundation Types and Feasibility.

7.3 Excavation Considerations

Site preparation to achieve the proposed final grade will require excavation within exising rock and soils and filling in some areas. The following subsections provide general recommendations for excavation within rocks and soils encountered in this area.

7.3.1 Rock Excavation. A brief evaluation of rippability based on two empirical methods, compression wave velocity and point load index, were used to obtain indication on possibility of ripping the rock versus blasting. The rippability of an earth (rock) material is a measure of its ability to be excavated with conventional excavation equipment (e.g. a D11R Cat). To assess general rippability values, we employed the rippability reference charts from Caterpillar's Performance Handbook and the Pettifer and Fookes (1994) rippability and excavatability assessment technique. Both techniques are empirical methods of deriving a site rippability classification based on established rock parameter correlations, versus directly testing the rippability in the field.

Therefore, the charts must be considered at best as indicators of rippability. Tooth penetration is often the key to ripping success, regardless of seismic velocity.

The seismic p-wave velocities in the rock are greater than 4,000 m/s (Appendix C). General rippability values were found by referencing the "D11R" chart from Caterpillar's Performance Handbook (2000) and are provided on Plate 33 of this report. The D11R chart classifies the metamorphic rocks with a maximum velocity of up to 2,500 m/s as rippable. The Caterpillar reference chart classifies rock encountered at the site as non-rippable based on empirical field-testing. Blasting is expected to be required for excavation of the rock encountered at this site.

The Pettifer and Fookes (1994) rippability and excavatability assessment technique was also used to correlate the site rippability classification and is presented on Plate 34. This technique uses Point Load Index (I_s50) test values plotted against discontinuity spacing to derive rippability. The average point load index for the rocks at the site generally ranged from about 3 MPa to more than 30 MPa, which classifies the rock as strong to extra strong rock. The discontinuity spacing index for the rock encountered at the site is considered medium to large. The Pettifer and Fookes plot (Plate 34) indicates that blasting will be required. The Pettifer and Fookes method corroborates the rippability assessment derived from seismic velocity.

Controlled blasting techniques (e.g., variously termed smooth blasting, contour blasting, or cautious blasting) should be used for rock excavation to reduce damage to excavation perimeters (rock slope faces) and to rock below foundation grade. Such techniques will reduce development of uncontrolled cracking and maintain rock competence.

7.3.2 Soil Excavation. Cohesive soils encountered at boring location indicate that soils will not be able to support excavation equipment during excavation in most areas. Additional measures requiring matting or building of temporary gravel access roads will likely be required in most areas for soil excavation. Onsite rock material may be crushed and used as a general fill to build temporary roads/pads to support the excavation equipment for soil excavations, where required.

7.4 Reuse of Onsite Material

In general, the cohesive soils excavated do not meet requirements for general or structural fill. Reuse of excavated soils will require identifying material that could meet general fill requirements and will require drying of soils prior to reuse. Lack of space availability, effort required, and time constraints may preclude its use as fill material.

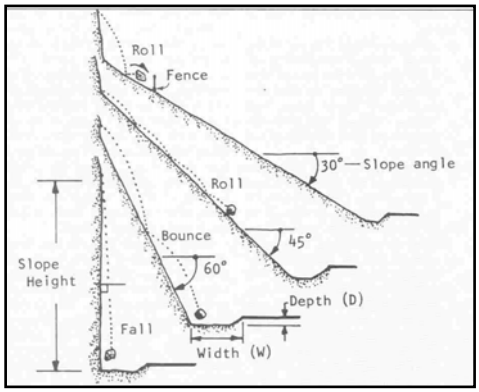
There is not adequate literature available on the use of crushed phyllite as select aggregate fill. Phyllite is a foliated and platy rock and may not meet the requirements for select aggregate fill (base course) that could be used as select aggregate fill. Laboratory testing will be required to qualify crushed phyllite rock fill for use as select aggregate fill. However tests should be performed on representative samples of rock after it is blasted, excavated and processed, as the test results

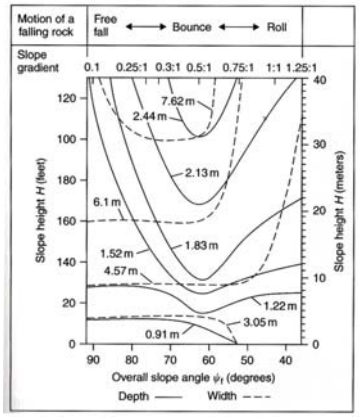
will not be valid because the process of blasting, excavating and gradation will change the properties (such as abrasion, freeze-thaw, percent fines and other testing required to qualify it as "concrete aggregate, structural fill etc.) of the rock material. *Section 19.1.1 Crushed Rock Fill* (onsite) presents tests to evaluate possible use of the material as select aggregate fill. If the onsite crushed rock does not meet the criteria presented in *Section 19.1.2*, it may be used as general fill in areas outside the footprint of shallow foundations or in areas where structures are supported on deep foundations. Phyllite (crushed) should not be used as aggregate for concrete.

7.5 Cut and Fill Slopes

The area within the footprint of onshore facilities is planned to be cut and graded to about El. +25 m. Plate 31 shows the expected locations of cut and fill slopes. The cut slopes will primarily consist of rock slopes and the fill slopes will consist of possibly general fill (crushed phyllite) slopes.

7.5.1 Rock Slopes. Rock slope design assumes smooth wall controlled blasting techniques of construction. The findings of the slope stability analyses performed for turning basin area in Section 15.0 may be used for the cut rock slopes beyond the footprint of the facilities for this pre-FEED study. The findings indicate the slope angle of about 43 degrees or steeper may experience sliding failure per kinematic analyses for static conditions, provided the slope and dipping angle are parallel. Pseudo-Static analyses indicated a sliding failure may be induced in slopes with slope angle (with horizontal) about 38 degrees for 2475 return period earthquake provided the slope and the dipping angle are parallel. The above analyses presents slope angles for scenario where slope and dip angles are parallel. Steeper slopes of about 1-horizontal to 3-vertical or steeper may be considered, especially in the southern portion of excavation sloping towards north, with appropriate measures, like including rockfall catchment/ditch area to prevent rockfall, if any, originating from the slope reaching the facilities. Slopes should be designed to meet structural geology to optimize excavation. Preliminary design of slopes and catchment/ditch area can be designed using design charts[4] presented below.





Ditch design chart Ritchie (1963)

[4] Ritchie, A. M., 1963. "Evaluation of Rockfall and Its Control." Highway Research Record, No. 17, pp. 13-28.

7.5.2 Fill Slopes. The fill slopes will consist of primarily crushed phyllite fill. Due to the structure of the material, high level of compaction may not be achieved. Additionally, the plate like structure may preclude the material from interlocking to form a durable fill material. If crushed phyllite meets the requirements presented in Section 19.1.2, we recommend that the fill slopes be no steeper than 1-vertical to 3-horizontal for this pre-FEED level study. The recommended slope provides a factor of safety greater than 2 for dry conditions and a factor of safety of at least 1.1 for saturated condition with water level at surface.

7.6 Drainage Considerations

The change in topography of the island for the construction of onshore facilities will change the drainage pattern. A comprehensive drainage plan should be developed to divert runoff from flooding the site. All runoff should be collected and diverted away from the structures. The finished surface level of the site should be graded with falls away from the structures and their foundations. Grading around the proposed structures should be such that future ponding or standing water around the foundations does not occur. All surface drainage measures should be designed to positively direct water away from the foundations.

7.7 Fill Settlement - Site Grade Raise

The valleys and areas where soft soils are excavated will be raised to match the final grade. The anticipated area of such fill is shown as Area 3 on Plate 31. The fill is expected to consist of crushed rock phyllite fill or select aggregate fill material. These areas could incur settlements within the fill depending on the thickness of the fill and level of compaction that could be achieved in the material. However, long-term settlements in the underlying rock will be minimal. We recommend that laboratory tests be performed to evaluate the compressibility characteristics of compacted crushed phyllite. A total settlement of about 0.5% of total fill thickness may be used as a preliminary estimate for crushed phyllite not meeting requirement of Section 19.1.2 and about 0.25% to 0.5% for fill meeting requirements of Section 19.1.2.

8.0 FOUNDATION TYPES AND FEASIBILITY -ONSHORE

8.1 General

All foundations should satisfy two basic, independent criteria. First, the largest bearing pressure transmitted to the foundation soils by the maximum structure loads should not exceed the allowable bearing pressure. Second, foundation movements resulting from settlement during the life of the structures should be within tolerable limits. The selection of suitable foundation types for the proposed structures will depend largely on design issues such as installation feasibility, the magnitude of applied loads, and the tolerable settlements for structures.

The proposed site is feasible for construction of facility based on this pre-FEED level geotechnical study provided that the recommendations presented in this report are properly incorporated in the planning phases of the project. We recommend that during FEED level geotechnical study, a comprehensive geotechnical study be conducted to delineate areas with weak soils below design grade elevation of El.+25 m.

As mentioned earlier, from site preparation and feasible foundation perspective the LNG tank, ISBL, and OSBL areas of the project site are divided into three areas Area 1 (LNG Tank Area), Area 2 (ISBL/OSBL Rock Area), and Area 3 (ISBL/OSBL Fill Area). These areas are shown on Plate 32 of this report. Areas consisting of soft cohesive soils are encountered below El+25 m in few borings drilled in the LNG Tank area. Therefore, Area 1 is further subdivided into Area 1A and Area 1B. Rock subgrade is expected at El. +25 m in Area 1A and soft cohesive soils below El. +25 m in Area 1B. The depth of cohesive soils below El. +25 m can be expected to be about 10 m in localized areas. Based on this information and LiDAR interpreted elevations and features, Area 1B was approximated as shown on Plate 32. Area 1B and Area 3 footprint is **approximate** and may increase or decrease in extent once the FEED level field exploration is completed.

Foundation types and feasibility for each of the above-mentioned area are discussed in the following subsections. Additionally, seismicity considerations and relocation alternatives to avoid extensive site preparations are also provided in this section.

8.2 LNG Tank Area – Area 1

The structures in the Area 1 primarily consist of LNG tanks and some minor support structures. The LNG tanks can be supported at grade on mat foundation after removal and replacement of cohesive soils with flowable fill from Area 1B after replacement. Mat foundation recommendations for tanks are presented in Section 9.0 LNG Tank Foundation Recommendations. Minor support structures, if any, within Area 1A and Area 1B with flowable fill may be supported on shallow foundations. Shallow foundation recommendations are presented in Section 10.0 Shallow Foundation Recommendations - Onshore. Minor support structures (settlement sensitive) in areas

where cohesive fill may not be removed can be supported on rock socketed drilled shafts. Deep foundation recommendations are presenting in Section 11.0 Rock Socketed Drilled Shafts - Onshore.

8.3 ISBL/OSBL Rock Area – Area 2

The structures in this area consist of LNG trains and OSBL structures. The anticipated foundation loading on shallow spread footings and mat foundations is expected to be less than 250 kPa. The surface conditions in Area 2 are expected to consist of phyllite rock at surface. The proposed structures in this area may be supported on shallow foundations bearing on rock. Shallow foundation recommendations are presented in Section 10.0.

8.4 ISBL/OSBL Fill Area – Area 3

Approximate delineation of Area 3 is shown on Plate 32. The area was identified based on limited field exploration data and features interpreted from LiDAR data. Area 3 consists of areas with surface elevations less than El. +25 m and/or cohesive soils below El. +25 m. Fill thickness of up to 10 m may be required in localized areas. This area needs to be explored further during the FEED phase of field exploration to delineate the extent of the area more precisely. Several foundation options were considered during the evaluation phase that consisted of shallow foundations on improved soils in the soft areas, shallow foundation on compacted select aggregate fill, and rock socketed drilled shafts. We recommend removing and replacing cohesive soils with crushed rock fill and supporting structures in this area on rock socketed drilled shafts for the following reasons:

- The cohesive soils are highly variable across the site.
- Once the site is developed and the site drainage is established, the under-consolidated cohesive soils in the area are expected to settle resulting in uneven surface depressions.
- These soils provide low lateral resistance for drilled shafts and are susceptible to cyclic softening during seismic events.
- Delineating areas where shallow foundations could be placed and designing for differential movements between structures will be difficult and unpredictable without extensive exploration and may require field adjustments.

Differential settlements between shallow foundations supported on fill and foundations supported on rock could be intolerable. As mentioned earlier, this area will need to be further defined based on next phase of field exploration. Shallow foundations may be feasible in areas with limited fill thickness. Based on the current borings drilled in this area the rock is very deep and therefore, we recommend for this pre-FEED level study all foundations in this area should be assumed to be supported on rock socketed drilled shafts. However, if the rock is shallow within some areas then

alternate recommendations such as flowable may be considered. However, these recommendations will have to be revisited after completion of the FEED-Level study.

8.5 Seismicity Considerations

The structures will be supported on shallow foundations bearing on rock or rock socketed drilled shafts. With the recommended site preparation and foundation recommendations, site class A may be used for design of structures in areas Area 1 and Area 2. Site class C may be used for design of structures supported at grade in Area 3, where soils will be replaced with imported aggregate fill or crushed phyllite fill. Onshore Seismic Hazard Analyses preliminary report submitted on October 16, 2013 presents the response spectra for the site classes mentioned above. Friction coefficients are provided for shallow foundations and lateral capacities are provided for rock socketed drilled shafts to assist structural engineer in designing structures for lateral loading during seismic events.

8.6 Relocation Considerations

This study has identified areas of significant variability in subsurface conditions within the footprint of the LNG tank, ISBL, and OSBL areas. Relocating structures to avoid unfavorable subsurface conditions may provide significant savings in design and construction of foundations. However, relocation may add to process design and engineering cost depending on relocated configuration. We suggest consideration be given to relocating Tanks TK-2 south southwest of its current location and TK-3 northeast of its current location to avoid Area 3, if feasible, to lower extensive site preparation, foundation design, and construction costs.

9.0 LNG TANK FOUNDATION RECOMMENDATIONS

Based on information provided by KBR, we understand that LNG storage tanks will be constructed in the LNG Tanks area as shown on Plate 20. As mentioned earlier, cohesive soils below El.+25 m were encountered in few borings drilled within the footprint of LNG Tank TK-2 and TK-3. Approximate area of these soils based on the boring data and LiDAR interpreted features is shown as Area 1B within Area 1A. As the proposed LNG tanks are highly sensitive to differential settlements, supporting the tank mats partially on fill soils and partially on rock may experience high differential settlements.Therefore, LNG tanks should be supported at grade on mat foundations consisting of reinforced concrete slabs with thickened edges only after removal and replacement of cohesive soils from Area 1B and replaced with flowable fill

Recommendations provided in this section assume that the proposed tank areas are prepared following the recommendations provided in Section 7.0 Site Preparation - Onshore of this report. This section presents our recommendations on shallow mat foundations for the proposed storage tanks based on our bearing capacity and settlement analyses. Recommendations for hydrotesting are also presented in this section.

9.1 Tank Loading and Settlement Criteria

The information on tank dimensions and loading presented here was provided by KBR. We understand that the proposed three LNG storage tanks will be 88.2 m in diameter and 42 m tall. The tank weights are expected to be 52,000 tonnes and 144,000 tonnes for empty and operating loading conditions, respectively. Average bearing pressures, during operating conditions, are about 415 kPa and 185 kPa around outer annulus and interior portion of the base slab, respectively. Average bearing pressures, during hydrotest conditions, are about 425 kPa and 225 kPa around outer annulus and interior portion of the base slab, respectively. The thickened edge for the outer annulus supporting the concrete outer tank is expected to be about 7 m wide. The settlement criteria for LNG tanks per FERC guideline are as follows.

Table 7.1 Settlement Criteria

Settlement Type	Settlement Criteria	Differential Settlement, mm.
Center to Edge	1:300	147
Along periphery – 7.6 m arc	1:500	15
Planar Tilt	0.02 radians	176

9.2 Subgrade Preparation

Tank TK-1 will be placed at grade on rock bearing surface. We recommend that prior to construction; any irregularities in the rock surface should be filled with flowable fill, to provide a

more uniform support for the foundations. Recommendations for fill materials and placement requirements are presented in Section 19.1 Fill Materials and Placement of this report. The subsurface conditions within the footprints of tanks TK-2 and TK-3 are variable from rock at surface to about 10 m of cohesive soils below El. +25 m. Cohesive soils should be removed from within and 5 m beyond the footprint (at excavation level) of the area and replaced with flowable fill. Recommendations for Flowable Fill are presented in Section 19.1. A minimum thickness of about 0.3 m of flowable fill should be placed in the area of tank mat foundation.

The rock quality at the bearing surface should be verified to be competent after blasting and excavation operation. Rock damaged due to blasting should be removed and replaced with flowable fill. Visual inspection of the rock mass at grade immediately prior to construction by a qualified geotechnical engineer/ geologist is also recommended to identify any anomalies or unforeseen conditions and assess the condition.

9.3 Material Parameters

Recommendations for the LNG tank foundation are developed based on one boring drilled at the center, 3 borings drilled on the tank periphery of each proposed tank, field and laboratory testing, test probes, interpreted elevations from LiDAR data, PS/acoustic televiewer logs, and integration of geomorphology information. Tank TK-1 should be supported at grade on competent rock. Portions of the Tanks TK-2 and TK-3 will require removal of soft soils and replacement with flowable fill. Please refer to Section 9.2 Subgrade Preparation. We selected design compressive strength of the rock to be 30 MPa. Design compressive strength of rock mass was taken as 4.5 MPa to account for jointing. Flowable fill recommendations are presented in construction considerations section of this report. We recommend the compressive strength of flowable fill to be used under foundations have an unconfined compressive strength of at least 1 MPa at 48 hours.

9.4 Mat Foundation Recommendations

A properly designed and constructed reinforced concrete mat foundation along with a thickened edge will support and distribute the tank load. The concrete mat will provide a level and solid surface to facilitate construction of the tank. The following sub-sections provide our recommendations for the foundation depth, tank stability, resistance to uplift loads, and resistance to lateral loads for the proposed mat foundation.

9.4.1 Foundation Depth. The foundation system, identical to a mat foundation in principle, would incorporate a reinforced slab with a thickness of about 0.5 m in the middle and approximately 0.8 m thick edges based on information provided by KBR. We recommend that the base of thickened edge of the mat foundation should be placed at a depth of at least 0.5 m below the final grade. We understand that the finished grade elevation will be about El. +25 m. We consider this depth to be appropriate for the tank foundations that are placed on competent rock. Field observations will be key to the performance of the tank foundations. We recommend that the

exposed foundation bearing rock should be observed by a qualified geotechnical engineer prior to the placement of the concrete for the mat foundation.

9.4.2 Allowable Net Bearing Pressure. The foundation system should provide an adequate factor of safety against shear failure of the subgrade and the settlement should be within the tolerance criteria. We understand the maximum applied pressure on the subgrade from tank loading is about 425 kPA around the annulus (7 m wide) and 225 kPa for the inner portion of the tank. Mat foundation designed based on recommendation presented in this report will have a factor of safety of about 3 for the above-mentioned loading. It should be noted that the factor of safety presented above are for foundations supported on rock surface or flowable fill as presented in 7.2 Subgrade Perpetration section of this report.

9.4.3 Resistance to Lateral Loads. Resistance of mat foundations to lateral loads can be provided by friction or adhesion at the base of the foundation. For concrete foundations poured in good contact with existing competent rock / flowable fill, an ultimate coefficient of friction of 0.7 can be used for calculation of lateral resistance. We recommend that the calculated lateral resistance of mat foundation be reduced by a factor of 2 to compute the allowable lateral resistance of the foundation. For the planned embedment depth of the foundation, passive resistance should be ignored.

9.5 Settlement Estimate

The LNG storage tanks will either be supported on rock and/or flowable fill. The elastic modulus of the rock was taken as 8,500 MPa and for flowable fill as 1,000 MPa. The computed elastic settlement was less than 25 mm at the center of the tank. The total, differential, and planar tilt of the tank will be lower than the settlement criteria presented in *Section 7.1 Tank Loading and Settlement Criteria*.

9.6 Hydrotesting Recommendations

The proposed tanks should be tested before being placed in service according to current API Specifications[5]. This testing generally consists of filling the tanks with water after construction, under controlled conditions to:

- Check the competency of the construction,
- Verify the ability of the foundation materials to carry the loads imposed by the tank and contents, and

[5]API Standard 653. (2009). *Tank Inspection, Repair, Alteration, and Reconstruction*. American Petroleum Institute, 4th edition, pp. 10-2 and 10-3.

- Reduce the amount of immediate settlement that each tank will experience after it is placed in service.

We recommend implementation of a controlled, stage-loaded hydrotest program for the proposed tanks, accompanied by a movement-monitoring program. The following paragraphs discuss our recommendations for hydrotesting.

9.6.1 Survey Control. We recommend that a series of reference points be established around each tank shell in order to monitor the movements of the tank during hydrotesting. API recommends at least 8 reference points be established around the perimeter of a tank but with spacing no more than about 9 m apart. Elevations of these points should be obtained prior to, during, and after hydrotesting. Elevation readings should be taken to the nearest millimeter. Readings should be referenced to a benchmark well away from the zone of influence of each tank (*i.e.* at least one tank diameter). In addition, reference points should be established on the tank bottoms within the tanks to measure movement before and after hydrotesting.

9.6.2 Loading. We suggest that, initially, water for the hydrotest be added to the tanks to reach one-fourth of the full tank height. This water level should be maintained until settlement observations indicate the rate of settlement has decreased significantly (at least 24 hours). Additional stage-loading increments should include the one-half, three-fourths mark, and the maximum allowed fluid level. Each level should be maintained until settlement readings are smaller than a predetermined range. If excessive settlement rates are observed, smaller loading increments may be required.

9.6.3 Data Evaluation. Settlement observations should be reviewed as the hydrotesting proceeds to assess total settlement, differential settlement, local slope, tank tilt, and out-of-plane distortion for the tanks. The project engineer and/or the tank manufacturer should establish criteria for acceptable settlement prior to hydrotesting. If settlements start approaching unacceptable limits, tank filling should be halted and not resumed until the situation is reviewed and evaluated by the structural engineer and/or tank manufacturer. Settlement observations should be obtained frequently to develop the data necessary to assess tank performance, preferably once daily. The Geotechnical Engineer-of-Record should be given the opportunity to review and evaluate the settlement data during hydrotesting of the completed tanks for foundation performance assessment.

10.0 SHALLOW FOUNDATION RECOMMENDATIONS

10.1 General

We anticipate shallow foundations and deep foundations to support structures in ISBL/OSBL Area 2, as delineated on Plate 32. The proposed equipment/structures will be supported on the existing rock after final grading. Additionally, Area 3 is expected to receive fill in areas with grade elevation below El.+25 m and/or areas with cohesive soils below El.+25 m. The depth of fill placement may vary from negligible to up to 10 m in localized areas. Structures in this area (Area 3) may be supported on shallow spread footings provided certain conditions are met (See Section 8.4).

This section presents recommendations for shallow foundations for various equipment/structures located in Area 2 (Plate 32) only, where rock is expected at design grade based on available information at the time of report preparation.

10.2 Foundation Loading and Settlement Criteria

LNG trains, OSBL structures and various equipment will be located in Area 2. The anticipated foundation loading on shallow spread footings and mat foundations is expected to be less than 250 kPa. We assumed settlement of up to 25 mm is acceptable for shallow foundations constructed in this area.

10.3 Area 2 Subgrade Preparation

The surface conditions in Area 2 are expected to consist of phyllite rock at surface. The rock should be excavated to bearing depth of the foundation. The rock quality of the bearing surface should verified to be competent after blasting and excavation operation. The rock damaged due to blasting should be removed and may be replaced with flowable fill. We recommend that prior to construction, any irregularities in the rock surface should be filled with flowable fill, to provide a more uniform support for the foundations. Recommendations for fill materials and placement requirements are presented in Section 19.1 Fill Materials and Placement of this report.

10.4 Material Parameters

Recommendations for the shallow foundations were developed based on limited number of borings drilled in Area 2, field and laboratory testing, test probes, interpreted elevations from LIDAR data, and integration of geomorphology information. Shallow foundations in this area will be supported at grade on rock. We selected design compressive strength of the rock to be 30 MPa. Design compressive strength of rock mass was taken as 4.5 MPa to account for jointing. Flowable fill recommendations are presented in construction considerations section of this report. We recommend the compressive strength of flowable fill to be used under foundations be at least 1 MPa at 48 hours.

10.5 Spread Foundation Recommendations

The following sub-sections provide our recommendations for the foundation depth, allowable net bearing pressure, resistance to uplift loads, and resistance to lateral loads for the proposed spread foundation.

10.5.1 Foundation Depth. We recommend that shallow foundations such as spread footings and mat foundations be placed at a depth of at least 0.5 m below the finished grade on the natural competent rock. If weak, fractured, or damaged rock is present at bearing surface, these unsuitable materials should be over-excavated and replaced with flowable fill (lean concrete) before placing the shallow foundations. The Geotechnical Engineer-of-Record or their qualified representative should observe all foundation excavations.

10.5.2 Allowable Net Bearing Pressure. A foundation system should provide an adequate factor of safety against shear failure of the subgrade and reduce the potential for excessive settlements due to overstressing of the underlying rock. We understand the maximum applied pressure on the subgrade is less than 250 kPa. Spread footings and mat foundations designed based on recommendation presented in this report will have a factor of safety of at least 3 for the mentioned loading. It should be noted that the factor of safety presented above are for foundations supported rock surface or flowable fill as presented in Section 10.3 Subgrade Preparation section of this report.

10.5.3 Resistance to Lateral Loads. Resistance of spread footings and mat foundations to lateral loads can be provided by friction at the base of the foundation. For concrete foundations poured in good contact with existing competent rock or flowable fill, an ultimate coefficient of friction of 0.7 can be used for calculation of lateral resistance. We recommend that the calculated lateral resistance of mat foundation be reduced by a factor of 2 to compute the allowable lateral resistance of the foundation. For the planned embedment depth of the foundation, passive resistance should be ignored.

10.5.3 Resistance to Overturning Moment. The design of spread footings and mat foundations subjected to overturning moments should consider a trapezoidal distribution of contact pressure between the base of the foundation and the foundation soil such that full soil contact and positive pressure is maintained under the foundation. We recommend the resultant be located in the middle third of the foundation.

10.5.5 Resistance to Uplift Loads. The uplift resistance of spread footings is limited to the weight of the foundation. We recommend the use of total unit weights of foundations in the calculation of uplift resistance. We recommend reducing the calculated uplift resistance using a factor of 0.8.

10.5.6 Settlement Estimates The spread footings will be supported on rock. The elastic modulus of the rock was taken as 8,500 MPa and for flowable fill as 1,000 MPa. The computed elastic

settlement was less than 25 mm at the center of the foundation for foundations with a footprint of up to 225 m^2

11.0 ROCK SOCKETED DRILLED SHAFTS - ONSHORE

11.1 General

The structures in Area 3 shown on Plate 32 should be assumed to be supported on deep foundations at this pre-FEED stage of the study. As mentioned previously, Area 3 is expected to have deep fill areas. Shallow foundations may not be feasible in this area due to various reasons presented in Section 8.4. A comprehensive feasibility analyses for use of shallow foundations in Area 3 will be evaluated after FEED level field exploration is completed. We recommend considering deep foundations as the option for this area during this pre-FEED level study. This section presents our recommendations for deep foundations consisting of rock socketed drilled shafts for supporting process related structures located in Area 3.

11.2 Soil and Rock Parameters – Area 3

Parameters for soil, crushed rock fill, and rock parameter are developed based on available information. The peat soils in this area should be removed during site grading activities. Additionally, we recommend removing cohesive soils to bedrock in this area. The removed soils and additional fill required to bring grade to final grade may consist of crushed phyllite (onsite) rock or imported select aggregate fill (refer to Section 7.4 Reuse of Onsite Material). Depth of crushed rock fill is expected to be up to 10 m (below El.+25) in localized areas with median value of about 5 m. The axial capacity contribution of crushed rock fill is not significant to total capacity of rock socketed portion of the drilled shaft, and hence has been ignored in our analyses. We selected design compressive strength of the rock to be 30 MPa. However, the lateral capacity of drilled shafts will be dependent on characteristics of crushed rock fill. We selected a conservative friction angle of 30 to 35 degrees for the aggregate fill for lateral load analyses.

11.3 Static Axial Capacity

Design of drilled shafts socketed into rock is governed by displacement considerations. A literature review of full scale load tests and finite element evaluations indicate that only a small portion of the compressive load applied to shaft top is actually transmitted to the tip at working loads. The load transmitted to the tip typically is within the range of 10 to 20 percent even for a relatively stiff, stubby shaft. Furthermore, the displacement required to mobilize significant tip resistance requires slip (relative movement between concrete and rock) along the full socket length of the shaft. Typically, axial compression load is carried solely by the side resistance of a shaft socketed into rock until a total shaft displacement on the order of 10 mm occurs[6]. The total settlement includes elastic compression of the shaft. Current methodology for the design of shafts socketed into rock suggests that tip resistance be ignored when determining axial compression capacity. Since tip

[6] Caltrans Manual for Bridge Design Specifications, November 2003.

resistance acts to minimize or even eliminate slip along sidewalls, socket bottoms should be thoroughly cleaned before reinforcement steel and concrete are placed. If the sockets can be cleaned thoroughly, we recommend using a tip resistance of 2.4 MPa. The maximum unit side resistance for rock socket can be estimated using the following:

$$^{7}f_{max} = b^{*}\ p_a^{*}(q_u/p_a)^{0.5}$$

where:

f_{max} = expected, maximum unit side resistance, kPa

b = empirical factor

q_u = uniaxial compressive strength, kPa

p_a = atmospheric pressure = 101.6 kPa

Recommended parameters for rock socket design are as follows:

b = 0.63 for sockets excavated using conventional methods.

q_u = 30 MPa.

p_a = 101.6 kPa

For the parameters above, f_{max} = 1,100 kPa. We recommended a minimum rock socket length of 3 to 5 times shaft diameter (depending on valley slopes) or 1.5 m, whichever is greater. The f_{max} value presented above is ultimate value and a factor of safety of 2.0 should be applied to calculate allowable unit side resistance. For uplift loading the allowable uplift unit side resistance should be limited to 0.7 times the allowable unit side resistance used for compression loading.

The structural capacities of drilled sockets should be checked for allowable stresses in the concrete, total downward axial loads, tension forces, lateral forces, and moments produced by dead plus probable maximum live loads. The area of the socket reinforcement extending from top to bottom should not be less than 0.75% of the gross area of the socket. Drilled socket concrete should be a high slump concrete (18- to 20-cm slump), which still has the proper characteristics of normal concrete such as workability, durability, cohesiveness (will not segregate during placement), and strength. We recommend a minimum 28-day compressive strength of 28 MPa for concrete.

11.4 Lateral Capacity

We have evaluated the lateral resistance of individual, isolated shafts for the rock and soil conditions presented in Section 11.2. The crushed rock fill soils will be compacted to specification and hence are not liquefiable. Hence, liquefaction and reduction in strength of rock fill was not considered in the analyses. We ignored the strength in upper 0.6 m to account for disturbance. The parameters used for analyses are as follows:

[7] "Canadian Foundation Engineering Manual", 4th Edition, Canadian Geotechnical Society, p.297, (2006)

Table 11.1 Soil Properties for Lateral Load Analyses

Depth, m	Soil Type	Friction Angle, degrees
0 to 3	Crushed Rock	32
3 to 11	Crushed Rock	35
10 to11	Strong Rock	-

The following parameters and loading conditions were used in our analyses:

- Young's Modulus of drilled shafts equal to 2.32×10^4 MPa;
- Top of the piles/shafts assumed at final rough grade of El.+25 m;
- Limiting deflections of 6.35, 12.7, and 25.4 mm were assumed in the analyses;
- Lateral loads were applied at the top of the shaft;
- Both free and fixed head conditions were considered in our single pile/shaft analyses.

We performed our analyses for a single shaft using the computer program Ensoft's LPILE Plus 5.0/5.0 M (2007). The program uses finite difference numerical techniques to compute lateral deflections and bending moments induced in a shaft due to lateral and axial loads applied at the top of the shaft. The shaft-soil system is modeled as a series of finite segments that represent the pile/shaft and the soil/rock. We analyzed both free-head and fixed-head conditions with lateral loads applied at the existing ground surface for the proposed deep foundations. We performed our analyses using limiting shaft top deflections of 6.35 mm, 12.7 mm, and 25.4 mm. These results are applicable for the proposed deep foundations installed lengths of at least 6 m with rock socket length of at least 1.5 m.

Table 11.2: Results of Lateral Load Analyses – Area 3

Shaft Section	Top Fixity	Lateral Load (kN)	Maximum Bending Moment, (kN-m)	Pile/Shaft Top Deflection (mm)
610-mm Diameter Rock Socketed Drilled Shaft	Free Head	30 56 96	50 95 170	6.35 12.70 25.40
	Fixed Head	90 161 256	145 270 475	6.35 12.70 25.40
760-mm Diameter Rock Socketed Drilled Shaft	Free Head	48 91 159	85 170 320	6.35 12.70 25.40
	Fixed Head	143 261 421	265 500 880	6.35 12.70 25.40

Individual, isolated shafts are representative of a free-head condition. A group of shafts structurally tied together with a rigid concrete cap is more closely representative of a fixed-head condition. On

the basis of the final foundation design, the Structural Engineer should determine the most representative condition.

11.5 Group Effects

The overall allowable **axial** load carrying capacity of a large group of shafts can, in many cases, be less than the sum of the individual allowable capacities. A reduction in the individual shaft capacity, to allow for group effects, is usually not necessary for shafts having a sufficient center-to-center spacing. The reduction in individual capacity depends on many factors including the configuration of the group, number of shafts in the group, shaft size, the depth of installation, and the shaft spacing. We recommend that driven steel pipe or concrete shafts be spaced at least 3 shaft diameters (center-to-center) to reduce substantial axial group effects. We recommend being notified if shafts will have center-to-center spacing less than 3 shaft diameters to evaluate each scenario on a case-by-case.

The overall **lateral** load carrying capacity of a large group of shafts can, in many cases, be less than the sum of the individual allowable capacities.The shaft group arrangement and more importantly, the center-to-center spacing between adjacent shafts have a significant impact on lateral group effects. Shafts spaced greater than about 5 to 6 shaft diameters, center-to-center, generally have limited group effects. If group effects are expected to be critical in design, we will be pleased to provide a detailed group effects

11.6 Load Tests

Axial load tests should be performed in general accordance with ASTM procedures for sensitive structures. The shaft load test program should include full-scale static load testing. Load testing should be conducted in the presence of an experienced Geotechnical Engineer. Load tests will be used to check the computed ultimate axial capacities. Each test shaft should be loaded to produce enough movement at the top of the shaft to determine the ultimate capacity. We recommend that we be retained to review the results of load tests to: 1) evaluate the load/unload-displacement response of the shafts, 2) evaluate the ultimate capacity of test shafts, 3) compare measured capacities and deflections with design criteria, and 4) develop installation guidelines.

11.7 Drilled Shaft Installation

Drilled shafts installed according to the recommendations presented in this report will penetrate through several meters aggregate fill and possibly natural cohesive soils (if left in place as part of final evaluation) before encountering rock. Area 3 crushed rock fill is surrounded by rock at El.+ 25 m and is expected to get saturated from runoff. Wet construction methods or temporary casing may be needed to shaft construction. A temporary casing is defined as casing installed to facilitate shaft construction only, which is not designed as part of the shaft structure, and which shall be completely removed after shaft construction is complete. All temporary casing shall be of ample strength to resist damage and deformation from transportation and handling, installation and

extraction stresses, and all pressures and forces acting on the casing. The casing shall be capable of being removed without deforming and causing damage to the completed shaft, and without disturbing the surrounding soil. The use of temporary casing requires that the Contractor be careful when pulling the auger/core barrel to remove cuttings/rock core from the excavation. The casing should be watertight and clean prior to placement in the excavation. A slightly oversized casing is sometimes used to reduce chances for snagging and lifting the casing during cleanout operations.

Rock coring techniques will be needed to excavate rock sockets. Even though socket design ignores tip resistance, socket bottoms, as well as sidewalls, should be cleaned. We recommend that specifications for the installation and construction of drilled shafts for this project be in accordance with the guidelines presented in *Drilled Shafts: Construction Procedures and Design Methods*. We should also be given an opportunity to review the proposed specifications prior to construction. The following installation techniques will aid in the successful construction of drilled shafts.

- Concrete should be placed using a slotted-pipe or pump conduit to prevent the concrete from being segregated by striking the steel cage.
- The clear spacing between rebars or behind the rebar cage should be at least three times the maximum size of the coarse aggregate.
- Centralizers on the rebar cage should be installed to keep the cage properly positioned.
- Cross bracing of a reinforcing cage may be used when fabricating, transporting, and lifting. However, experience has shown that cross bracing can contribute to the development of voids in a concrete shaft. Therefore, we recommend removing the cross bracing prior to lowering the reinforcing cage into the open shaft.
- Drilled socket concrete should be a high slump concrete (7- to 8-inch slump), which still has the proper characteristics of normal concrete such as workability, durability, cohesiveness (will not segregate during placement), and strength. We recommend a minimum 28-day compressive strength of 28 MPa for concrete.
- In addition to construction recommendations contained herein, the sockets should be constructed in general accordance with ACI 336.3R, Chapters 4 and 5.
- The contractor should review exploration methods documented in Fugro reports for the project, including coring methods utilized for phyllite rock at the site.
- The contractor’s construction work plan should describe how drilled shafts will be excavated and constructed.

- Consideration should be given for performing one or more test shafts to assess whether proposed excavation methods are appropriate for phyllite rock at the site.

The successful completion of drilled shaft excavations will depend largely on the suitability of the drilling equipment and skill of the operator. The contractor should schedule the sequence of operations so each excavation can be completed, reinforcing steel placed, and the concrete poured in a continuous, rapid, and orderly manner. The contractor should not place shafts adjacent to each other until the first shafts sets. Drilled shafts spaced closer than about 1.8 m (clear spacing) should be placed at least 6 hours apart and preferably on alternate days. Drilled shaft excavations should not be left open overnight.

12.0 ACCESS BRIDGE – MAINLAND TO LELU ISLAND

The bridge is planned to cross the tidally influenced channel to connect Lelu Island to the mainland. KBR provided us with the proposed bridge alignment and is shown on Plate 21 of this report. The bridge is expected to be about 250 m long with abutments onshore and 5 bents within the channel. The bridge alignment direction is southwest (Lelu Island) and northeast (mainland) and will cross an existing railroad near the northeast abutment (See Plate 35). Local tides are typically 6 m, but may range up to 9 m, and at low tide the channel is completely dry except for freshwater stream flow near the center of the channel. The top of the bridge deck is proposed at about El.+17 m at the northeast abutment and at about El.+15 m at the southwest abutment. Cross-section of the bridge alignment including the location of the bents and abutments is shown on Plate 35.

12.1 Previous Study – Bridge Crossing

We understand that Golder Associates Limited (Golder) performed a geotechnical study for bridge access to Lelu Island from mainland in 1990. KBR provided a copy of the geotechnical report, Report No. 902-1143, dated August 1990. The area of Golder's field exploration program was southeast of the location of the proposed bridge. The results of the Golder's report indicates that the proposed access alignment from the mainland to Lelu Island is underlain by thick deposits of relatively weak and compressible, fine grained marine clayey silts. It is inferred that the thick silt sediments represent marine sediment infilling of a rock controlled depression following the overall structural trend parallel to the shoreline of both Lelu Island and the mainland shoreline. Soils encountered at the explored location consisted of clayey silts to silty clays to the explored depth of about 9 m below existing grade. Shear strengths ranged from about 15 kPa at surface to about 60 kPa at about 9 m below grade. The report suggested that depth to rock could be as deep as 15 m on the northeastern portion of the bridge.

12.2 Bridge Foundation Considerations

Based on the information provided by KBR, preliminary foundation plans for all locations (bents and abutments) consist of piles with a pile cap. Abutment foundations are expected to consist of 4 piles and bent foundations are expected to consist of 6 piles. A maximum load (dead + live) of about 2,530 kN and 1,400 kN are estimated for piles at bents and abutments, respectively. A maximum load (dead + live + seismic) of about 2,690 kN and 1,000 kN are estimated for piles at bents and abutments, respectively.

Based on the subsurface conditions encountered in the borings drilled for this study and the loading conditions mentioned above, we recommend the proposed bridge be supported on competent rock. The natural rock slopes at the abutments should be analyzed for stability as part of the FEED level study. The alignment orientation is southwest (Lelu Island) to northeast

(mainland). LiDAR interpreted elevations are available in the area of the southwest abutment. The current slopes at southwest abutment range from about 12 to 35 degrees with horizontal and are expected to be stable based on the analyses performed (Section 15.0 Turning Basin and Materials Offloading Facility). If the natural slopes at the northeast abutment are found to be stable for both static and seismic events, abutments could be supported on mat foundations provided competent soil/rock is encountered at surface or at shallower depths. Foundations at the bents will most likely consist of deep foundations. We recommend a comprehensive geotechnical study be conducted as part of FEED level geotechnical study to evaluate the subsurface conditions along the alignment. As borings were not performed during the pre FEED-Level study within the channel, the subsurface conditions within the channel were assumed to consist of soft to stiff, silty clays and clayey silts, extending to a depth of of up to 15 m below existing ground based on the results available from Golder Report No. 902-1143, dated August 1990.

We recommend deep foundations consisting of rock socketed drilled shafts for the proposed bents. Driven pipe piles socketed into rock may be considered as an alternative. Rock socketed drilled shaft recommendations including preliminary lateral load capacities are presented in this report for static conditions only. Alternate foundation types and/or battered piles may need to be considered if lateral loads govern and the presented capacities are not adequate. Abutments may be supported on mat foundations if rock was encountered very close to the surface or on short rock socketed drilled shafts. Therefore, shallow foundation recommendations consisting of mat foundations are also presented in the following subsections.

Abutment foundations may consist of shallow foundations. Friction coefficients are provided for shallow foundations in this report. The bent foundations will consist of rock socketed drilled shafts. Lateral capacities of rock socketed drilled shafts are primarily dependent on near surface soils. Preliminary lateral capacities for deep foundations at bent locations were developed based on soil properties presented in Golder's report and are presented for information purposes only. The presented capacities are for static conditions only. Lateral capacities during and post seismic activity were not developed due to lack of adequate soils information at this time.

12.3 Shallow Foundations - Abutments

The following sub-sections present our recommendations for subgrade preparation, material parameters, foundation depth, allowable net bearing pressure, resistance to uplift loads, and resistance to lateral loads.

12.3.1 Subgrade Preparation. The subsurface conditions at southwest abutment location consist of about 1.7 m of peat soils over phyllite rock. The subsurface conditions at northeast abutment location consist of about 0.8 m of fill soils over phyllite rock. Peat and fill soils should be removed from the location. The rock quality of the bearing surface should verified to be competent after excavation operation. The rock damaged due to blasting/excavating should be removed and may be replaced with flowable fill. We recommend that prior to construction, any irregularities in the

rock surface should be filled with flowable fill, to provide a more uniform support for the foundations.

12.3.2 Material Parameters. Recommendations for the abutments are based on the borings drilled at the abutment locations, field and laboratory testing, interpreted elevations from LIDAR data, and integration of geomorphology information. Shallow foundations in this area can be supported at grade on rock. We selected design compressive strength of the rock to be 30MPa (Plate 23). Design compressive strength of rock mass was taken as 4.5MPa to account for jointing/fracturing.

12.3.2 Foundation Depth. We recommend that shallow foundations such as mat foundations be constructed with an embedment depth of at least 0.5 m within the bedrock and bearing on natural competent rock. If weak, fractured, or damaged rock is present at bearing surface, these unsuitable materials should be over-excavated and replaced with flowable fill (lean concrete) before placing the shallow foundations. The Geotechnical Engineer-of-Record or their qualified representative should observe all foundation excavations.

12.3.3 Allowable Net Bearing Pressure. A foundation system should provide an adequate factor of safety against shear failure of the subgrade and reduce the potential for excessive settlements due to overstressing of the underlying rock. Mat foundations should be proportioned so that the maximum contact pressure under dead loads and sustained loads does not exceed allowable net bearing pressure. The allowable net bearing pressures for shallow foundations consisting of mat foundations may be taken as 800 kPa. A factor of safety of 3.0 was used in the calculation of allowable net bearing pressure. Bearing pressure, as used in this report, is defined on Plate 36. To calculate values of W_e, Ws, and W_f from Plate 36, use total unit weights of 15 kN/m^3 for soil, 26 kN/m^3 for rock, and 23 kN/m^3 for concrete.

12.3.3 Resistance to Lateral Loads. Resistance of shallow foundations to lateral loads can be provided by friction at the base of the foundation. For concrete foundations poured in good contact with existing competent rock or flowable fill, an ultimate coefficient of friction of 0.7 can be used for calculation of lateral resistance. We recommend that the calculated lateral resistance be reduced by a factor of 2 to compute the allowable lateral resistance of the foundation. For the planned embedment depth of the foundation, passive resistance should be ignored.

12.3.4 Resistance to Overturning Moment. The design of mat foundations subjected to overturning moments should consider a trapezoidal distribution of contact pressure between the base of the foundation and the foundation soil such that full soil contact and positive pressure is maintained under the foundation. We recommend the resultant be located in the middle third of the foundation.

12.3.5 Resistance to Uplift Loads. The uplift resistance of shallow foundations is limited to the weight of the foundation. We recommend the use of total unit weights of foundations in the

calculation of uplift resistance. We recommend reducing the calculated uplift resistance using a factor of 0.8.

12.3.6 Settlement Estimates. We estimate that the mat foundations supported on competent bedrock will have small settlements. The elastic modulus of the rock was assumed to 8,500 MPa and for flowable fill it was assumed to be 1,000 MPa for estimating settlements. The computed elastic settlement was less than 25 mm at the center of the mat foundation with a footprint of up to 100 m^2.

12.4 Rock Socketed Drilled Shafts – Bridge Crossing

Bent foundations,and possibly abutment foundations is expected to consist of rock socketed drilled shafts. Selection of deep foundation type and dimensions will depend on the subsurface conditions at the bent locations. Subsurface conditions at bent locations were not explored during pre-FEED field exploration program. The subsurface conditions at bent locations should be evaluated during FEED level field exploration program. We have assumed the soils to consist soft to stiff silty clays and clayey silts based on information presented in Golder's report. We are presenting rock socketed drilled shaft recommendations to support the proposed bridge structure. However, additional pile types may need to be evaluated at the FEED stage of the project. As bedrock is encountered near ground surface at the proposed abutment locations, short rock socketed drilled shafts may be considered at these locations. Rock socketed drilled shaft recommendations are presented in Section 11.0 Rock Socketed Drilled Shafts – Onshore. Lateral capacity recommendations for bent shafts are presented below.

12.4.1 Lateral Capacity – Static Conditions. We have evaluated the lateral resistance of individual, isolated shafts for soil conditions presented in Golder's report. Liquefaction and reduction in strength of soils was not evaluated as adequate information on soil conditions is not available at this time. The soil properties used for lateral capacity analysis is as follows:

Table 12.1 Assumed Soil Strength for Lateral Capacity Analyses

Depth, m	Soil Type	Undrained Shear Strength, kPa
0 to 2.5	Clay	15
2.5 to 5	Clay	24
5 to 7.5	Clay	39
7.5 to 10	Clay	60
10 to11	Strong Rock	--

The following parameters and loading conditions were used in our analyses:

- Young's Modulus of drilled shafts equal to $2.32x10^4$MPa;
- Top of the piles/shafts assumed at final rough grade of about El.+12 m;

- Limiting deflections of 6.35, 12.7, and 25.4 mm at the mud line were assumed in the analyses;
- Lateral loads were applied to the shaft at mudline level;
- Both free and fixed head conditions were considered in our single pile/shaft analyses.

We performed our analyses for a single shaft using the computer program Ensoft's LPILE Plus 5.0/5.0 M (2007). The program uses finite difference numerical techniques to compute lateral deflections and bending moments induced in a shaft due to lateral and axial loads applied at the top of the shaft. The shaft-soil system is modeled as a series of finite segments that represent the pile/shaft and the soil/rock. We analyzed both free-head and fixed-head conditions with lateral loads applied at the existing ground surface for the proposed deep foundations. We performed our analyses using limiting shaft deflections of a 6.35 mm, 12.7 mm, and 25.4 mm at mudline. The lateral load was applied at the mudline. These results are applicable for the proposed deep foundations installed lengths of at least 5 m.

Table 4: Results of Lateral Load Analyses

Shaft Section	Top Fixity	Lateral Load (kN)	Maximum Bending Moment, (kN-m)	Pile/Shaft Top Deflection (mm)
610-mm Diameter Rock Socketed Drilled Shaft	Free Head	20	45	6.35
		33	80	12.70
		56	140	25.40
	Fixed Head	58	115	6.35
		97	200	12.70
		154	345	25.40
760-mm Diameter Rock Socketed Drilled Shaft	Free Head	35	80	6.35
		57	145	12.70
		94	250	25.40
	Fixed Head	96	210	6.35
		160	370	12.70
		253	635	25.40

Individual, isolated shafts are representative of a free-head condition. A group of shafts structurally tied together with a rigid concrete cap is more closely representative of a fixed-head condition. On the basis of the final foundation design, the Structural Engineer should determine the most representative condition.

13.0 FOUNDATION TYPES AND FEASIBILITY - NEARSHORE

The LNG export terminal will consist of multiple berths and a connecting trestle. The berths for the LNG jetty are proposed to be located nearshore, past both Agnew Bank and Flora Bank with water depths of mostly greater than 15 m. The conceptual location is chosen to intentionally avoid extensive dredging to allow for safe vessel passage, berthing, and to avoid Flora Bank. A trestle that is approximately 2.7 km long will connect the northwestern shoreline of Lelu Island to the LNG Jetty. The conceptual layout showing the LNG jetty and the trestle are presented on Plate 24 of the memorandum.

Conceptual plot plans showing the jetty and trestle cross sections were provided to us on Drawings MA-ATA-G20B-008 through MA-ATA-G20B-0014, dated May 31, 2013. Based on the information provided on the drawing, the LNG jetty will include a pile supported loading platform and multiple mooring and breasting dolphins. The top of the loading platform and the dolphins along the jetty are planned at El. +12 m. The trestle will be a pile-supported structure with bents that will include a set of 2 or 3 piles. The trestle is currently planned with top elevation of EL. +12 m for its entire length, except near the shoreline. The 340 m section of the trestle near the shoreline will have 3.5% slope to match the proposed grade of El. +24.3 m onshore.

13.1 Bathymetry & Slopes

The seafloor elevations in the trestle and berthing areas range from El.-1.8 m near the shoreline to El.-30 m in the berthing area. The elevation at the southwest end of the trestle route is approximately El.-10 m. As mentioned earlier, detailed bathymetry results for this area are presented in Fugro Report No. 23.00007028 R2 dated July 13, 2013 (Appendix J). Additionally, Plates 3 depicts the bathymetry along the proposed trestle and berths.

The trestle route extends straight out from shore to a topographic break at the berthing area, where the seabed slope angle is about 12.5 degrees when compared to less than 2 degrees along the trestle alignment. From the shoreline (northeast) to a distance of 1000 meters, the slopes show small bathymetric changes of less than 0.5 meters and they appear to form intricate patterns on the seabed. At the northeastern end of the trestle right adjacent to the shoreline there are bedrock outcrops which have slopes as steep as 32°. For the remainder of the trestle route from 1100 meters from the shoreline to the slope break, the slopes are generally less than 2.5°, with most localized slopes less than 1°. The steepest slopes in the berthing area are 12.5° near the northwest end.

The subsurface soils are under-to-normally consolidated (as discussed in the later section) with significant variability in shear strengths across each boring. Preliminary slope stability analyses is presented in Appendix H Seismic Hazard Analyses – Nearshore. The slope at the berthing is anticipated to deform and spread laterally. We recommend performing additional geophysical

surveys using high energy source coupled with borings and CPTs to assist in performing detailed slope stability analyses to check stability of existing slopes and dredge slopes (if any). Additionally, lateral spreading during seismic event and impact on lateral load capacity of piles can be evaluated once additional information is collected during the FEED level study.

13.2 Seismicity and Liquefaction

Seismic Hazard Analyses has been performed and the final results are presented in Appendix H of this report. Horizontal design acceleration response spectra and peak accelerations were estimated for the Operating Base Earthquake (OBE) and Safe Shutdown Earthquake (SSE). The SSE and OBE design levels are based on the mean ground motion return periods of 2475 and 475 years, respectively.

The proposed trestle and LNG jetty structures will be supported on pile foundations. Liquefiable silty sands have been identified generally within the upper 6 meters below the mudline along the trestle alignment for both OBE and SSE condition (See Plates 37 and 38). At BH-34 liquefaction depth could be up to 16 m below mudline. The borings (BH-35, 36, and 37) for the berthing area were moved as shown on Plate 2b due to inaccessibility. Liquefiable soils were encountered to depth of 4 m and possibly from 8.5 to 11.5 m at boring BH-35. Liquefiable soils were not encountered at BH-36 and BH-37. Plates 37 and 38 present liquefaction analyses/depths at each location for borings 32, 33, and 34 for OBE and SSE cases. In cohesive soil layers, the effects of cyclic softening on lateral pile capacity is accounted for through the use of p-multipliers. Liquefaction of silty sands will induce post-earthquake reconsolidation drag-load and downdrag.

13.3 Relocation Considerations - Berthing

Slope stability evaluation was conducted using limit equilibrium method. Pseudo static analyses method was used for OBE and SSE seismic events. A factor of safety of 1.7 was computed against slope failure for static case. The slope is expected to deform and spread laterally during both OBE and SSE case. The deformation could impose lateral loads on the pile foundations. We recommend relocating the berthing area by shortening the trestle to avoid impact of slope deformations on the project, if feasible. The magnitude of movement and its impact on piles and mitigation will be presented as part of the FFED level study.

13.4 Foundation Types

In general, most of the structures in this area will be constructed over water. Foundation types will likely consist of driven piles. Foundations supporting the trestle and the loading platform will be subject to axial loading and some lateral loading. The mooring and breasting dolphins will typically carry relatively low axial loading when compared to lateral loads. We understand that trestle piles will be subjected to axial loading of about 450 to 900 kN. The LNG jetty piles may generally be subjected to an axial load of about 2,250 kN.

We have included deep foundation recommendations consisting of open ended steel pipe piles to support the proposed structures. We recommend deep foundations consisting of rock socketed drilled shafts or rock socketed driven pipe piles where rock is encountered at shallow depth or in dry areas near the shoreline. Rock socket capacities are presented in Section 11.0 Rock Socketed Drilled Shafts – Onshore Facilities. Abutment and near abutment portion of the trestle may be supported on mat foundations or on short rock socketed shafts/piles as rock was encountered very close to the surface. Shallow foundations may be designed per recommendations presented in Section 12.3 Shallow Foundations – Abutments. Based on the axial loading, we expect open-ended pipe piles for trestle and LNG jetty will be friction piles and may not be tipped into bedrock.

14.0 DRIVEN PIPE PILES - NEARSHORE

The trestle and LNG jetty will most likely be supported on driven open-ended pipe piles. The following sections present axial and lateral pile capacity recommendations and construction considerations.

14.1 Static Axial Capacity

We computed the geotechnical axial capacity, in both compression and tension, for 915 mm open-ended steel pipe piles based on our review of the soil boring logs, standard penetration test results, and laboratory test results. We computed the geotechnical axial pile capacity of individual, isolated driven open-ended pipe piles using API RP 2A (2000)[8] procedures. In this method, the ultimate compression capacity of a pile for a given penetration was computed as the sum of the skin friction acting on the pile wall and the end bearing.

Coring and plugging conditions were evaluated in the computations for open-ended driven pipe piles. The coring condition generally controls as an open-end pipe pile is initially driven into the ground. At shallower depths when the pile is coring, relative movement between pile and soil occurs both on the outside and inside of the pile wall. The end bearing area is only the cross-sectional area of steel. As the pile is driven deeper into the soil, the soil friction on the inside of the pile wall increases until a soil plug forms. When the pile plugs, the soil plug moves downward with the pile during driving. Pile resistance is mobilized only on the outer wall. The end bearing area during plugging is the gross area of the pile. We also neglected the soil strength in the upper 1.5 m below mudline to account for scour. The computed axial pile capacity curves for open-ended steel pipe piles are presented on Plates 39 through 42. Negative skin friction due to underconsolidated soils was not considered as the piles are all friction piles and are not tipped into a hard/dense layer of soils.

14.1.1 Liquefaction and Downdrag. In general, liquefiable silty sands have been identified up to depths of about 6 m below mudline along the trestle alignment. However, at BH-34 the liquefaction depth may be as deep as 16 m. In general, liquefaction in layers will reduce axial soil resistance during a seismic event and induce post-earthquake reconsolidation drag-load and downdrag settlement. Factor of safety for axial capacity is expected to be greater than 1 during earthquake event. The down drag loads are presented on Plates 39 through 42. The presented downdrag loads should be added to the applied axial loads for design of foundations for post liquefaction case.

[8] American Petroleum Institute (2000).

14.1.2 Axial Group Resistance. The overall allowable axial load carrying capacity of a large group of piles/shafts may, in some cases, be less than the sum of the individual allowable capacities. A reduction in the individual pile capacity, to allow for group effects, is usually not necessary for piles/shafts having a center-to-center spacing of 3 or more pile diameters[9]. The reduction in individual capacity depends on many factors including the configuration of the group, number of piles/shafts in the group, pile size, depth of installation, and pile spacing.

14.2 Lateral Pile Capacity

We performed our lateral capacity analyses using the computer program LPILE Plus 5.0.3 (2007), developed by Ensoft, Inc. This program uses finite difference numerical techniques to compute lateral deflections and bending moments induced in a pile due to lateral and axial loads applied at the top of the pile. The pile-soil system is modeled as a series of finite segments that represent the pile and the soil. Soil resistance is calculated using p-y curves developed from a distribution of input soil unit weights and strength parameters specific to the subsurface conditions in this area. The following parameters and loading conditions were used in our analyses:

- We applied lateral load as cyclic loading with 5,000 load cycles at the pile top.
- Young's Modulus of steel pipe piles equal to 200 GPa;
- Top of the piles assumed at final rough grade of about El.+12 m;
- Limiting deflections of 25, 50 and 75 mm at pile top (El.+12 m);
- Lateral loads were applied to the pile at El. +12 m;
- No external moments were applied at the top of the piles;
- We analyzed both free-head and fixed-head conditions with lateral loads applied at the pile top;
- In addition, we reduced the wall thicknesses of the steel pipe piles by 3 mm to account for corrosion in our lateral capacity analysis;
- For piles we neglected the soil strength in the upper 1.5 m below seafloor to account for scour

The computed lateral loads at the pile top versus pile top lateral deflection, and maximum bending moment for static loading are presented in Table 14.1.

[9] FHWA HI-96-033 Design and Construction of Driven Pile Foundations, Hannigan, P.J., Gobel, G.G, Thedean, G., Likins, G.E., and Rausche, F. for FHWA, December 1996, Volume 1 and 2.

Table 14.1: Results of Lateral Load Analyses without liquefaction and soil softening

Shaft Section	Top Fixity	Load applied at Pile Top (kN)	Maximum Moment, (kN-m)	Depth of Maximum Moment Below Pile Head (m)	Pile Deflection at Pile Top (mm)	Pile Deflection at Mudline (mm)
915-mm Diameter Steel Pipe Pile (Trestle)	Free Head	4	80	20.3	25	3
		7.5	155	20.3	50	6
		11	225	20.3	75	9.5
	Fixed Head	15	185	0	25	5
		28.5	350	0	50	12
		41	510	0	75	19
915-mm Diameter Steel Pipe Pile (Jetty)	Free Head	2.0	50	25.9	25	3
		3.5	95	26.6	50	6.5
		5	135	26.6	75	10
	Fixed Head	6.5	110	0	25	6
		12.5	205	0	50	12.5
		18	295	0	75	20

Additionally, as mentioned earlier, liquefaction in low plasticity silts and clays has been evaluated based on Atterberg limits and water content using the criteria of Bray and Sancio (2006) and Idriss and Boulanger (2008). Liquefaction in the low plasticity silts is not expected, although cyclic softening can be expected in these layers. In cohesive soil layers, the effects of cyclic softening on lateral pile capacity is accounted for through the use of p-multipliers. We used a p-multiplier of 0.5 for cohesive soils based on preliminary PSHA in computation of lateral loads during earthquake event. A p-multiplier of 0.1 was used for silty sands in the upper 7 m. The computed lateral capacities with liquefaction and cyclic softening are presented in Table 14.2.

Table 14.2: Results of Lateral Load Analyses with liquefaction and soil softening

Shaft Section	Top Fixity	Load applied at Pile Top (kN)	Maximum Moment, (kN-m)	Depth of Maximum Moment Below Pile Head (m)	Pile Deflection at Pile Top (mm)	Pile Deflection at Mudline (mm)
915-mm Diameter Steel Pipe Pile (Trestle)	Free Head	2.5	60	21.7	25	4.5
		5	115	22.4	50	10
		7.5	165	22.4	75	15.5
	Fixed Head	10	145	0	25	8.5
		18.5	265	0	50	18.5
		25.5	370	0	75	22.5
915-mm Diameter Steel Pipe Pile (Jetty)	Free Head	1.7	45	26.6	25	3.5
		3	85	27.3	50	7.5
		4	120	27.3	75	12

Shaft Section	Top Fixity	Load applied at Pile Top (kN)	Maximum Moment, (kN-m)	Depth of Maximum Moment Below Pile Head (m)	Pile Deflection at Pile Top (mm)	Pile Deflection at Mudline (mm)
	Fixed Head	6	100	0	25	7
		11	185	0	50	15
		15.5	270	0	75	23.5

Individual, isolated piles are representative of a free-head condition. A group of piles structurally tied together with a rigid concrete cap is more closely representative of a fixed-head condition. On the basis of the final foundation design, the Structural Engineer should determine the most representative condition.

14.2.1 Lateral Group Effects. The overall allowable **axial** load carrying capacity of a large group of piles can, in many cases, be less than the sum of the individual allowable capacities. A reduction in the individual pile capacity, to allow for group effects, is usually not necessary for shafts having a sufficient center-to-center spacing. The reduction in individual capacity depends on many factors including the configuration of the group, number of piles in the group, pile size, the depth of installation, and the pile spacing. Piles spaced at least 5 to 7 pile diameters (center-to-center) have minimal to no lateral group effects.

14.3 Lateral Capacity and Battered Piles

Lateral load capacities are low as expected due to the exposed pile lengths of greater than 17 m (top of piles at El.+12 m and seafloor elevation is about El. 5 to El. 10) above the seafloor and soft under consolidated soils below the seafloor. Fixity and cross bracing impact has not been incorporated into the computation of lateral deflections. Greater lateral resistance can be obtained by using battered pile, especially for the berthing and mooring foundations. Computation method for geotechnical capacity of battered piles is presented on Plate 43.

14.4 Driven Pile Installation Recommendations

Recommendations for driven piles are included in this section. We have included discussions of pile driving specifications, pile driving equipment, installation methods, and pile driving records.

14.4.1 Pile Driving Specification. Detailed pile driving specifications for the driven piles should be prepared by the design engineer in conjunction with the geotechnical consultant. The specifications should cover the project requirements for furnishing and installing the piles including the scope of work, necessary submittals, piling details, equipment requirements, installation requirements and tolerances, capacity evaluation, and construction records. The specification should require the contractor to submit a complete package detailing the proposed piling equipment and installation procedures for approval prior to mobilization to the site. The complete

package should also include the results of a wave equation analysis to evaluate the proposed pile driving hammer and cushion system prior to approval for mobilization to the site.

14.4.2 Pile Driving Equipment. Foundation piles should be driven using a hammer of adequate size in as nearly a continuous operation as feasible, without interruption, if possible. Pile driving hammers may be diesel, steam, or hydraulic operated. The use of a drop hammer, with a light ram and a large stroke, is discouraged since this type of hammer can produce exceedingly high and damaging stresses.

As previously stated, we recommend that the contractor perform a detailed wave equation analysis to evaluate the proposed pile driving hammer and cushion system prior to approval for mobilization to the site. The results of the wave equation analysis should be used to demonstrate that the proposed hammer has sufficient energy to install the piles/shafts to the required penetration and capacity, and that the hammer is properly cushioned to avoid structurally damaging the piles. To avoid damaging the pile and/or pile driving equipment, the maximum blow count to reach design grade penetrations should be determined and agreed upon by all parties involved prior to the start of actual pile driving.

The definition of pile refusal is primarily for contractual purposes to define the point where pile driving with a particular hammer should be stopped and other methods instituted (such as drilling, jetting, or using a larger hammer) and to prevent damage to the pile and hammer. The definition of refusal should also be adapted to the individual soil characteristics anticipated for the specific location. Refusal should be defined for all hammer sizes to be used and is contingent upon the hammer being operated at the pressure and rate recommended by the manufacturer. If a pile reached refusal short of design penetration, pile acceptance should be evaluated by a geotechnical engineer before remedial installation procedures or design modifications are undertaken.

An accurate and detailed log should be kept by an independent inspector during production driving. The log should provide a complete record of hammer blows per 0.3 m of penetration from the initial to the final blow for each pile installed. The record for each pile should also include the driving date, pile information, hammer information, cushion information, hammer and compressor operation information, hammer stroke, hammer stroke rate, ground and pile tip elevations.

14.4.3 PDA Testing. The dynamic pile monitoring instrumentation consists of two reusable strain transducers and two reusable accelerometers, connecting cables and a PDA Model PAX unit. Each dynamic PDA test pile will be prepared for attachment of the bolt-on PDA instrumentation upon arrival at the site. Pairs of strain transducers and accelerometers are bolted to opposite sides of the test piles to collect data during the initial driving and/or restrike driving tests per geotechnical engineer's testing plan. A single, multiple-wire cable is attached to the instrument gages and connected to the PAX data acquisition system on the ground adjacent to the pile-driving crane.

14.4.4 CAPWAP Analyses. The accuracy of the PDA computed axial load capacity (compression and tension) and other quantities are significantly improved by performing CAPWAP (**CA**se **P**ile **W**ave **A**nalysis **P**rogram) analyses in the office following completion of the fieldwork. In the CAPWAP computer analysis, the measured velocity at the pile top from the field data and an assumed set of soil parameters are input into a traveling wave algorithm. Soil parameters (soil quake and damping parameters and the distribution of static soil resistance) are adjusted in the computer program until a best-fit agreement is obtained between the calculated and measured force at the pile top. The CAPWAP signal matching analyses provide estimates of the side friction capacity, end bearing capacity and the distribution of capacity along the pile.

15.0 TURNING BASIN AND MATERAILS OFFLOADING FACITLITY (MOF)

The turning basin is currently proposed in the northwest area of the proposed LNG plant as shown on Plate 2a of this report. Materials Offloading Facility (MOF) is planned to be located on the southeast side of the proposed turning basin. The MOF area is planned to be used for material and equipment delivery during the construction of the project. Based on the information provided by KBR, the design elevation in the turning basin area is El. -12.5 m with proposed design El. -10 m within the MOF area. The elevation within the turning basin and MOF area varies from about El.+1 m (at MOF) to about El.-30 m (middle of Porpoise channel) Dredging will be required to enable barges to safely turn and reverse their direction of travel and provide access to the MOF. The proposed dredge areas are delineated on Plate 44 of this report. This section presents slope stability analyses of natural slopes in the area and options for MOF design.

15.1 Slope Stability Analysis

Dredging will mainly encounter bedrock based on our review of subsurface conditions within the dredge areas. The slopes within the existing rocks will need to be evaluated as they are heavily bedded and foliated. In regularly bedded or foliated rock, cut by joints, there are many possibilities for block movement along weak planes. A reconnaissance level kinematic rock slope stability assessment was performed using a generalized statistical implementation of the method generally attributed to Markland (1972). Calculations were performed using the computer software Mathematica 9, including an in-house enhancement of the stereonet package originally described by Haneberg (2009a).

Only the geometric relationships between the discontinuities and the cut slopes are used in the kinematic analyses. The kinematic analyses assume no rock reinforcement to the slope. External forces, such as seismic loads and hydrostatic pressures, are not considered in the kinematic analyses. As the proposed project area is under water hydrostatic pressures are expected not to vary and cause any instability. However, seismic loads may cause seismic instabilities. Therefore, a pseudo-static stability analysis is performed to assess the stability of the slopes during earthquakes. Following sections provides a brief discussion on the results of the kinematic and Psuedostatic analyses.

15.2 Kinematic Analysis

Generally, kinematic analysis involves stereographic projection of rock mass bedding and fractures measured in the field, and comparing the discontinuity geometry against outcrop and anchorage excavation direction and inclination. Stereographic projections of fracture data are tools commonly used to predict the types of discontinuity-controlled rock slope failures that are possible for given cut slope configurations and rock friction angles. The analysis of the discontinuity data allows for

the recognition of potential rock slope stability failures by examining the geometric relationships between discontinuity surfaces and the rock face. The technique is simple and easily performed, and the effects of various rock friction angles and different rock slope configurations are readily seen. The methods and data used in this assessment are appropriate for a general overview of the site-wide potential for shallow rock slope failure. However, they are not replacements for the site specific investigations necessary to support design and they should not be used as such.

15.2.1 Method of Analysis. As typically implemented, Markland's method compares the orientation of a single planar rock slope face with the orientations of rock mass discontinuities within the slope, supplemented with an estimate of the dry static angle of internal friction along the discontinuity surfaces, to assess the kinematic possibility of movement for a specific location. The analysis also implicitly assumes that all analyzed discontinuities are continuous and through-going, such that they may act as slope-scale slip surfaces. It is not a mechanical analysis and therefore does not explicitly consider forces acting in or on the slope.

Different authors implement Markland's method using different approaches and terms that are, in the end, geometrically equivalent. Planar orientations are represented by dip vectors (dip angle / dip direction) in this report rather than the poles-to-planes used in other implementations. Three kinds of rock slope failure are generally analyzed:

- Planar sliding is considered possible when the dip angle of a discontinuity is 1) greater than the friction angle , 2) less than the slope angle, and 3) the dip direction of the discontinuities is close to that of the slope (e.g., ±20° to ±30° from the rock slope direction).
- Wedge failure is considered possible when the plunge of the intersection between two planar discontinuities is 1) greater than the friction angle 2) less than the slope angle, and 3) the azimuth of the intersection vector is close to the dip direction of the slope (e.g., ±20° to ±30° from the rock slope direction or azimuth).
- Topping failure is considered possible when discontinuities dip into, rather than out of, the slope. The potential for toppling under static conditions depends on the width to height ratio of the rock slabs or prisms being analyzed (Haneberg, 2009b), but this cannot be explicitly included in a Markland-style kinematic analysis. Therefore, toppling is generally considered possible for rock slabs or prisms if the 1) the dip angle of the discontinuities is greater than 90° minus friction angle, 2) the dip direction of the discontinuities is opposite that of the slope, and 3) dip direction of the discontinuities is close to that of the slope (e.g., ±20° to ±30° from the rock slope direction).

Because of the large possibility of slope face orientations over the project area and the general nature of this investigation, this pre FEED-Level assessment considers all possible slope orientations with some specific cross sections analyzed as shown on Plate 47a and 47b.

15.2.2 Rock Discontinuity Orientations and Strength. Kinematic analyses incorporates the extensive discontinuity data collected from the turning basin area to help identify potential rock slope failure conditions in the proposed excavation cut slopes. It should be noted that the orientation of the rock structures with reference to the horizontal (strike, bearing,trace, trend) and the vertical (dip, plunge, inclination) was not available within Borings BH-38 and BH-39 because acoustic televiewer logging was not performed within the borings. However, similar rock types were encountered within the onshore borings. Therefore, rock mass discontinuity data from Borings BH-20 and BH-24 acoustic televiewer logs was used for this assessment (Plate 48 and 49).

A total of 518 discontinuity measurements were available from those two boreholes. These were supplemented by 116 measurements obtained from outcrops in the area and included in the lineament assessment report, Fugro Report No. 04.10130058, dated August 19, 2013. Additionally, 460 discontinuity measurements from Borings BH-10 and BH-14 acoustic televiewer logs, were plotted for comparison with BH-20 and BH-24. However, these were not used in the analysis because site conditions appeared uniform with respect to discontinuity orientations.

Geologic mapping along the margins of Lelu Island was performed by Fugro and confirmed that the underlying bedrock is strongly foliated metamorphic rock, gradually increasing in metamorphic grade from northeast to southwest from phyllite to phyllitic schist to gneissic schist to schistosic gneiss. Foliation orientations vary systematically by about 25° from about 315° (N45°W) at the western end of the island to 290° (N20°W) at the eastern end—foliation dips are relatively consistent from 45°NEto 60°NE. Detailed results of the geologic mapping were presented in a separate Fugro Report No. 04.10130058, dated August 19, 2013. In this report, a total of 116 joint set measurements were collected on bedrock exposures along the margins of Lelu Island. These joints are typically planar cracks, sometimes more than 10 meters long, forming sets with joints spaced 1 to 2 meters apart. These measurements were compiled and analyzed and resulting calculation shows that the population clusters around three dominant orientations: N14°W/47°E (J1), N48°E/89°SW (J2), and N53°E/63°NW (J3). The primary sets illustrated in the equal area plots (Plates 48 through 54) are pervasive throughout the turning basin areas are summarized below:

- The dominant concentration of discontinuities in both data sets evaluated for the turning basin area has an average dip vector of approximately 45°/315° (dip angle/ dip direction). This set, named as F1 in Lineament Assessment Report, represents metamorphic foliation comprising compositional layering and some open discontinuities along the foliation.

- Sets J1 and J3 identified in Lineament Assessment Report are also apparent in the B-20 and B-24 borehole data although their distribution is more dispersed.
- Set J2 identified in Lineament Assessment Report, which consists of a near vertical set of discontinuities striking NE-SW, is absent from the borehole data. This is likely because vertical boreholes have a small likelihood of interesting vertical discontinuities (e.g., Haneberg, 2009c) whereas horizontal to sub-horizontal outcrop surfaces would have a high likelihood of intersecting vertical discontinuities.
- With the exception of joint set J2, both data sets appear to agree well with each other and confirm the existence of 4 major discontinuity sets across the project area (Fugro Lineament Assessment Report No. 04.10130058).

Markland (1972) style assessments require a friction angle that is equivalent to the angle of internal friction for discontinuities along which sliding may occur. This analysis uses the discontinuity condition factor approach of Hack et al (2002) to estimate friction angles from failure planes observed in cores from the site, which has the advantage of producing an estimate of the friction angle from easily observable discontinuity surface characteristics and does not require assumption or measurement of factors such as the discontinuity wall compressive strength or the normal stress acting across discontinuities. A total of 12 estimates were made based on failure surfaces in cores from boreholes B-38 and B-39, yielding a value of friction angle ranging between 35° and 51°. The average value of 43° is used in the assessments described below with the caveat that the actual angle along some discontinuities may be smaller, which should be considered in any application of these results.

15.2.3 Results of Kinematic Analysis. After defining the discontinuity sets, analyses for each mode of potential failure was performed. Plate 49 shows the 518 measured discontinuities and a 43° friction circle (angle of internal friction along which sliding may occur). Plate 51 shows 9,777 wedge intersections for intersecting planes with dihedral angles > 30°. Orientations for the wedge intersections were calculated as the cross product of the normal vectors to each of the two intersecting discontinuities. As mentioned earlier, a general site-wide assessment was initially performed to arrive at a general understanding of potential instabilities for the variety of slope orientations shown on the accompanying site-wide slope angles (Plate 45) and slope directions (Plate 46) maps. Additionally, four critical slope profiles were selected for slope-specific kinematic analysis and are shown as 1-1' through 4-4' on Plates 45, 46, 47a, and 47b. General site-wide relationships are addressed first followed by four selected slopes across the turning basin area. Following is a summary of results for each mode of failure.

Planar Sliding. For the case of planar slides, the principal hazard appears to be posed by the NE dipping foliation planes (F1), most of which dip 10° to 30° more than the friction circle, that daylight along steep (> 43°) NE dipping rock faces. These conditions exist in few places within the project area as shown on Plate 49. However, as shown on Plates 45 and 46, there are very few places

where slopes are oriented towards the NE (orange on Plate 46) and steep enough (red on Plate 45) for the planar discontinuities to daylight. Additionally, a scattering of discontinuities oriented SE and NW also fall above the friction circle; however, they are not nearly as numerous or closely spaced as the F1 foliation planes. They may pose the potential for small planar rockslides in places where the topographic or bathymetric slope is steep (>43°) and facing either ESE or WNW.

Plate 50 shows planar sliding results for the four selected slopes, 1-1' through 4-4'. As indicated, small and sparsely populated critical zones exist for slopes 1-1' and 3-3', because the critical zones are so small and contain very few dip vectors, the kinematic potential for plane sliding in those locations appears to minor (shaded portion on Plate 50). Slopes 2-2' and 4-4', in contrast, have no critical zones because the existing slopes are flatter than the friction angle and no kinematic potential for plane sliding exists in those locations.

Wedge Failure. For the case of wedge slides, the principal hazard is associated with the two clusters of intersections shown on the lower part of Plate 51. One is oriented nearly N and the other ENE. Similar to the planar slides, these orientations do not appear to pose a site-wide hazard because there are very few places where slopes are oriented towards the NE (orange on Plate 46) and steep enough (red on Plate 45) for the wedge intersections to daylight.

Plate 52 shows wedge sliding results for the four selected slopes, 1-1' through 4-4'. Similar to the planar sliding assessments, small critical zones exist for slopes 1-1' and 3-3'. However, they fall below the density contour threshold of 0.5% within each 1% area and are effectively empty (although, if individual wedge intersections are plotted then a very small number do fall within the critical zone). Also as above, there are no critical zones for Slopes 2-2' and 4-4', because the existing slope angle is less than the friction angle. Therefore, the kinematic potential for wedge failure at the four example slopes appears to be inconsequential to non-existent.

Toppling Failure. Toppling does not appear to be a significant site-wide hazard because of the small number of near vertical discontinuities.

15.3 Pseudo-Static Limit Equilibrium Analysis

Simplified pseudo-static stability analysis is performed, using a simple equation that assumes an infinite slope with a failure plane parallel to the slope surface, to assess the stability of the slopes during earthquakes. The analysis included evaluation of potential for planar rock-sliding along rock mass discontinuities in the event of an earthquake.

Based on the Probabilistic Seismic Hazard Analyses (PSHA) study conducted by Fugro (2013) the following peak ground accelerations (PGA) were selected for this analysis:

- OBE Event (475-yr): PGA = 0.08g
- SSE Event (2475-yr): PGA = 0.146g

The PGA values were reduced by a factor of one-half to obtain the pseudostatic coefficient k used in the analyses (e.g. Hynes-Griffin and Franklin, 1984).

15.3.1 Results of Analysis. Site-wide seismic rock slope stability was evaluated using back calculation based upon the pseudostatic infinite slope factor of safety equation (Huang, 1977a & 1978b) presented below.

$$F = \frac{[(1 - r_u)\cos \propto - C_s \sin \propto] \tan \emptyset}{\sin \propto + C_s \cos \propto}$$

Cs, as above, is the pseudostatic coefficient, r_u is the pore pressure coefficient, ϕ is angle of internal friction, and α is dip angle (explained later in the following section). The critical dip angle above which seismically triggered rockslides should occur along favorably oriented discontinuities was estimated by setting the above-mentioned equation equal to 1, using a friction angle of 43° as described previously, assuming zero pore water pressure and a pseudostatic seismic coefficient Cs or k, and solving for the maximum allowable discontinuity dip angle.

Sliding as a consequence of the OBE (475-yr) and the SSE Events (2475-yr) are predicted along all discontinuities dipping greater than 40° and 38°, if they satisfy the necessary kinematic conditions discussed previously (i.e., if rock blocks are free to move in directions parallel or nearly parallel to the dip direction of F1, J1, or J3). If the kinematic conditions are not satisfied, for example if discontinuities dip more steeply than the estimated friction angle but into the slope rather than in the direction of the slope, then sliding should not occur.

Likewise, the kinematic conditions will not be satisfied, if

- discontinuities dip more steeply than estimated the friction angle but its apparent dip in the direction of the topographic or bathymetric slope (also known as slope aspect) is less than the friction angle; or
- discontinuities dip more steeply than the topographic or bathymetric slope, and do not daylight.

The range of bathymetric or topographic slope orientations, over which seismically triggered rock sliding is expected to occur on discontinuities with dip angles greater than the friction angle, was defined by calculating the angular deviation from the dip direction at which the apparent dip along the discontinuity falls to the friction angle. Apparent dip is the angle of inclination of a planar structure, such as a rock mass discontinuity, measured from horizontal along a line other than the direction of its true or maximum dip. The apparent dip angle is always less than the true dip angle and can be easily calculated using standard techniques (e.g., Ragan, 2009; Haneberg, 2009a). This was accomplished using the standard equation relating true and apparent dip angles, for example as given in Ragan (2009).

The portions of the study area over which this occurs for each of the three main discontinuity sets (F1, J1, and J3) are shown in Plate 53a and 53b. Plates 54a and 54b show pseudo-static results for the four selected slopes, 1-1' through 4-4'. As in the static cases, small and sparsely populated critical zones exist for slopes 1-1' and 3-3', because the critical zones are so small and contain very few dip vectors, the kinematic potential for plane sliding in those locations appears to be minor. Slopes 2-2' and 4-4', in contrast, have no critical zones because the existing slopes are flatter than the friction angle and no kinematic potential for plane sliding exists in those locations. Additionally, a map depicting the critical zones for the slope failures due to the OBE and SSE events are shown on Plate 55, where the orientations of F1, J1 and J3 do not appear to pose a site-wide hazard, because there are very few places where slopes have dip angles greater than and are oriented along either of these discontinuity sets.

15.4 Conclusions and Recommendations

The investigations and analyses in this report are intended to give a realistic, but generalized overview of site conditions. The existing slopes within the turning basin area vary between 10° to as steep as 60° (Plate 45). Under kinematic or pseudostatic constraints, the slope and discontinuity orientation necessary for sliding to occur must be present. In most places (Plates 46 and 55), the observed rock mass discontinuities do not daylight and sliding is unlikely to occur. By extension, the discontinuity dip angle above which seismically triggered rock sliding will occur can also be used to define a critical bathymetric or topographic slope. If seismically triggered sliding will not occur on discontinuities dipping less than the friction angle, and kinematic constraints require a slope angle greater than the discontinuity in order for it to daylight, then topographic or bathymetric slopes below that angle should be stable with respect to rock slides. Therefore, any planned slopes (such as in the transition zone between El. -12.5 m and El. -10 m) depending on the orientation discontinuity may vary between 40° (OBE) to 38° (SSE) and almost a near-vertical cut (Plate 55).

Although sufficient for preliminary planning or pre-FEED level studies, this report is not a substitute for design level investigations or analyses. In particular, the slope stability analyses use generalized parameters that may vary across the project area and a highly idealized infinite slope model. Subsequent assessments of slope stability should include detailed consideration of slope-specific geology obtained from oriented cores, televiewer logs, and any nearby outcrops; determination of effective joint roughness coefficients and other parameters necessary to adequately characterize field-scale discontinuity shear strength (potentially including Hoek-Brown parameters for pervasively fractured rocks); and stability analyses that take into account location specific bathymetry or topography. Newmark or fully dynamic slope stability analyses may also be justified for some critical locations, particularly where slope movements have the potential to affect structures or endanger lives; their appropriateness should be at the discretion of qualified design engineers.

15.5 Dredging Considerations and MOF

The proposed turning basin and MOF areas will require dredging as shown on Plate 44. As mentioned earlier, the design elevation in the turning basin area is El. - 12.5 m with proposed design El.–10 m within the MOF area. Our review of the subsurface conditions within the dredge channel and MOF area indicate that dredging operations will primarily encounter bedrock with very soft to very soft clay sediments near surface. The estimated unconfined compressive strengths in the phyllite (within the anticipated dredge zone) generally ranged from about 20 to 150MPa, however, greater than 250 MPa values were also observed at some intervals. We understand that original plans were to install sheetpile wall for the MOF wharf. Driven sheetpile wall is not considered feasible as rock was encountered at shallow depths. Gravity concrete structure or rock socketed/doweled pipe piles with sheetpile and rock bolts/anchors may be feasible alternatives.

Two factors are important in the dredging of rock, the strength of the actual rock and the rock mass structure. The ability to dredge homogeneous rock is controlled primarily by the rock strength. However, the strength of the rock becomes less important as the degree of fracturing and number of other discontinuities increases. In a highly fractured rock, or one with multiple discontinuities, the excavation process is more controlled by the loosening and dislodging of the material, rather than cutting through it. The orientation of the rock structure relative to the position of the dredger is also important. With the sub-vertical planar features in the rock at this site, the dredging contractor may learn that the dredging operation is more efficient when proceeding from one direction, rather than the opposing direction. The contractor shall be responsible for the determination of the dredging characteristics of the site materials and the means and methods necessary to accomplish the dredging. The information presented in this report is not intended as a warranty of subsurface conditions encountered.

16.0 DYNAMIC PROPERTIES

16.1 General

PS suspension logging was performed at 7 boring locations (BH-1, BH-3, BH10, BH-14, BH-20, BH-24, BH-35). The objective of the PS suspension logging is primarily to determine shear wave velocity profiles of the subsurface materials in order to obtain an understanding of the in-situ dynamic properties. We are also providing compression wave velocities where the compression wave velocity measurements were considered to be reasonable. Please refer to Appendix C for further information.

16.2 PS Logging Test Results

Vertical profiles of the subsurface stratigraphy for both the compression (P) (where applicable) and shear (S) wave interval velocities were obtained from the logs. The probe is lowered into the boring to the test elevation, the seismic source is actuated, and the results are recorded on a laptop computer. The elapsed time between arrivals of the waves at the receivers is used to determine the average velocity. Source to receiver analysis is also performed for quality assurance. The probe is then raised to the next test elevation and the process repeated. The calculated interval velocities for compression (where applicable) and shear waves have been plotted as velocity profiles and are presented in Appendix C.

The profiles at the tested locations within the onshore facilities consisted of rock profiles. The shear wave velocities are generally greater than 1,500 m/s and compression wave velocities are generally greater than 4,000 m/s. Profiles of the calculated shear modulus values and Poisson's ratio are also presented in Appendix C. Poisson's ratio generally ranged from 0.25 to 0.40 in rock. The following equations may be used to compute shear modulus, Young's modulus and bulk modulus for each test interval.

Poisson's ratio $$\nu = \frac{V_P^2 - 2V_S^2}{2(V_P^2 - V_S^2)}$$

Shear modulus $$G_{\max} = \rho V_S^2$$

Young's modulus $$E = 2G_{\max}(1+\nu)$$

Bulk modulus $$K = \frac{E}{3(1-2\nu)}$$

Where:

V_P is the compression wave velocity,

V_S the shear wave velocity and

ρ is the bulk density, 2.8 g/cm^3 (for rock)

16.3 Dynamic Spring Constants

Dynamic spring constants are highly dependent on the in-situ dynamic soil properties as well as the physical properties of the foundation element. Dynamic response of foundations is also dependent on the configuration of the foundation system, i.e. the dynamic response of an individual foundation element may vary greatly from that of a group of foundation elements. Typically, we evaluate dynamic spring constants using frequency independent methods after detailed information on foundation loads and design has been developed..

17.0 PAVEMENT RECOMMENDATIONS

We understand that temporary construction roads and permanent access roads will be constructed for the project. Vehicle frequency and loading conditions for the access roads have not been finalized for the pre-FEED study. However, the roads are expected to carry moderate to heavy traffic loads mostly in accordance with HS20 loading conditions. For paved roads, asphaltic concrete pavements are commonly used in British Columbia. The following subsections present our recommendations for the access roads including drainage, pavement sections, and site and subgrade preparation. Our recommendations are based on the assumption that the pavements will be placed on existing site grade after completion of site preparation activities.

17.1 Subgrade Preparation

Roads and their final alignments have not been finalized at this time. The subgrade in the area of LNG tank, ISBL, and OSBL areas will consist of either rock at the surface or granular fill depending on the location along the paved roads. There may be scenarios where the road alignment will cross areas of soft soils outside the footprint of the onshore facilities. Pavement sections for this scenario should be developed once the layout and elevation of roads has been finalized. This section presents typical recommendations for pavements in the area of LNG tank, ISBL, and OSBL areas only.

The rock quality of the bearing surface should be verified to be competent after blasting and excavation operation has been completed. The rock damaged due to blasting should be removed and may be replaced with sub-base course. In the areas of crushed stone fill (Area 3) along the road alignment, the subgrade should be proofrolled to identify soft or weak areas. We recommend that prior to construction, any irregularities in the rock surface and or weak areas identified should be filled with properly compacted subbase course.

17.2 Pavement Sections

A detailed pavement design was beyond the scope of this study since design traffic loads have not been developed at this time. Typical pavement sections are presented in the table below are in general accordance with practice in the local area.

Table 10.1. Typical Pavement Sections Pavement

Type and Recommended Use	Material	Thickness	Subgrade
Flexible Pavement (Medium Volume – 100,000 to 300,000 ESALs)	Hot-Mix Asphaltic Concrete over	75 mm	Rock (Area 1A and Area 2)
	Crushed Base Course over	250 mm	
	Sub-Base Course	150 mm	
Flexible Pavement (Medium Volume – 100,000 to 300,000 ESALs)	Hot-Mix Asphaltic Concrete over	75 mm	Select Aggregate Fill (Area 3)
	Crushed Base Course over	250 mm	
	Sub-Base Course	300 mm	
Flexible Pavement (Low Volume – less than 100,000 ESALs)	Hot-Mix Asphaltic Concrete over	50 mm	Rock (Area 1A and Area 2)
	Crushed Base Course over	200 mm	
	Sub-Base Course	150 mm	
Flexible Pavement (Low Volume – less than 100,000 ESALs)	Hot-Mix Asphaltic Concrete over	50 mm	Select Aggregate Fill (Area 3)
	Crushed Base Course over	200 mm	
	Sub-Base Course	300 mm	

Select Base Course and Sub-base course. The crushed base course and sub-base course should be in accordance with British Columbia Ministry of Transportation's Standard Specification for Highway Construction Section 202. The crushed base course shall be compacted to a minimum 100% of the laboratory density obtained by the current ASTM test method D 698 in lifts of 150 mm or less.

Asphalt. Hot mix asphaltic concrete (HMAC) should be placed in accordance with British Columbia Ministry of Transportation's Standard Specification for Highway Construction Sections 501 and 951. Asphaltic concrete shall be compacted such that degree of Compaction of the mean of any five consecutive tests shall be greater than 97%.

17.3 Drainage

The importance of drainage to the proper operation and function of any pavement cannot be overemphasized. The pavement and subgrade surface should be raised above adjacent grade and properly sloped into drainage inlets or lateral ditches. Water should not be allowed to pond on or adjacent to the pavement whereby the subgrade may become saturated. If the pavement sublayers do become saturated, the bearing capacity will be greatly reduced and the useful life of the pavement will be decreased. Periodic inspections and repair of cracks in pavement sections should be performed as part of future facility maintenance.

18.0 SOIL CORROSION POTENTIAL

Steel and concrete elements in contact with soil, whether part of a foundation or part of the supported structure, are subject to degradation due to corrosion or chemical attack. Therefore, buried steel and concrete elements should be designed to resist corrosion and degradation based on accepted practices.

Soil pH, resistivity, and chloride and sulfate ion concentration tests were performed on eight samples. These tests were performed on samples from varying depths to assess the corrosion potential on buried steel and concrete. Our laboratory test results are discussed in the following sections. The potential for corrosion of buried steel and degradation of buried concrete based on a comparison of the laboratory test results with published guidelines is also discussed. The guidelines used to evaluate corrosion and degradation potential is also presented.

18.1 Laboratory Test Results

The results of our laboratory corrosion potential testing are summarized as follows.

Table 18.1 Summary of Corrosion Potential Testing

Boring	Depth (m)	Material Description	pH	Resistivity (ohm-cm)	Ion Concentration, ppm	
					Chloride	Sulphate
BH-4	1	Peat	3.6	NP*	<100	<100
BH-10	4	Clay	7.9	2,315	<100	139
BH-11	3	Peat	3.8	NP	<100	148
BH-11	4	Clay	8.0	2,513	<100	117
BH-11	4.5	Clay	4.1	NP	<100	272
BH-16	4	Clay	7.9	2,640	<100	221
BH-20	1	Peat	4.5	NP	<100	<100
BH-27	4.5	Clay	8.2	2,806	<100	<100

*NP – not performed as sample size was not adequate to perform testing.

18.2 Corrosion of Buried Steel

The corrosion potential of steel is influenced by electrical resistivity, chloride ion concentration, and pH. Corrosion of steel is more likely in soil environments with low resistivity, high chloride ion concentrations, or low pH. For example, it is not necessary to have a resistivity between 0 and 1000 ohm-cm and a pH between 0 and 4.5 to indicate a Very High potential for corrosion potential. Table 18.2 presents general guidelines for estimating the corrosion potential of steel as a function of chloride ion concentration, pH, and electrical resistivity[10].

[10] Palmer, J.F. (1974), "Soil Resistivity Measurements and Analysis", Materials Performance, Vol.13

Table 18.2 Corrosion Potential based on Resistivity, pH and Chloride Content

Resistivity, ohm-cm	Chloride Content, ppm	pH	Corrosion Potential
0 – 1,000	>500	0 – 4.5	Very High
1,000 – 2,000		4.5 – 5.5	High
2,000 – 5,000	<500	5.5 – 6.5	Moderate
> 5,000		> 6.5	Mild

Each of the columns in the above table should be used independently of the others for estimating corrosion potential. The results indicate that the potential for corrosion due to chloride ion concentration is ***mild to moderate*** and the potential due to pH is ***mild*** in tested clay samples and **very high** in tested peat samples. Based on the electrical resistivity results, the corrosion potential for buried steel is ***moderate in clay soils***. We recommend that a Corrosion engineer be consulted to recommend appropriate protective measures.

18.3 Degradation of Concrete

The degradation of concrete is caused by chemical agents in the soil or groundwater that react with concrete to either dissolve the cement paste or precipitate compounds which cause cracking and flaking. The concentration of water-soluble sulfates in the soils is a good indicator of the potential for chemical attack of concrete. Sulfate concentrations in soil can be used to evaluate the need for protection of concrete based on the following table[11].

Table 18.3 Degradation of Concrete using Sulfate Ion Concentration

Sulfate Ion Concentration, ppm	Aggressiveness
>20,000	Very Severe
2,000 to 20,000	Severe
1,000 to 2,000	Moderate
<1,000	Mild

The results of sulfate tests on the selected soil samples from this study indicate the potential for deterioration of concrete, based on sulfate ion concentrations, is generally ***mild*** across the site. We recommend that a materials engineer be consulted to determine if protective measures are warranted.

[11] ACI Manual of Concrete Practice, Part 1, Section 201.2R-12, (1986).

19.0 CONSTRUCTION CONSIDERATIONS

Site preparation and foundation related construction considerations are presented in respective sections of the report. The following subsections provide our construction related considerations for fill materials and placement, groundwater, and construction monitoring.

19.1 Fill Materials and Placement

Fill materials will be required to raise the grade below the foundations or as backfill around the foundations. Unsuitable soils that are over-excavated, below the foundations may be replaced with crushed rock fill (onsite), select rock fill (imported) and/or flowable fill depending on the foundations. Other site grade rise areas will require general fill to match the proposed final grades.

19.1.1 Crushed Rock Fill (onsite). The onsite-excavated rock can be processed and used as fill to raise grade and as backfill under foundations supported on deep foundations. The aggregate fill, if manufactured, should be well graded and meet the requirements of select aggregate fill presented in Section 19.1.2. Laboratory testing should be performed to evaluate the engineering characteristics of crushed rock fill including compactability of the material. Crushed rock fill may be used as general fill if it does not meet requirements Section 19.1.2. The particle size of crushed rock fill should be less than 75 mm. Compaction specifications should be developed once comprehensive laboratory evaluation is completed.

19.1.2 Select Aggregate Fill (imported). Granular aggregate fill should consist of inert and durable particles to withstand deleterious effects of exposure to water, freeze-thaw, and compaction. The aggregate shall be uniform in quality and free of excess of flat or elongated pieces. Granular fill should have a maximum particle size of less than 50 mm and have no more than 5 percent material passing the 0.075 mm size sieve. The aggregate fill should be in accordance with British Columbia Ministry of Transportation's Standard Specification for Highway Construction Section 202. The aggregate fill should be placed in loose lifts not more than 250-mm and uniformly compacted to 98 percent of the maximum dry density (as determined by ASTM D1557) at a moisture content within 2 percent dry to 2 percent wet of the optimum moisture content. A Geotechnical Engineer should review the final selected material.

19.1.3 Flowable Fill. Flowable fill may be used as backfill against foundations or replacement for places were loose or unsuitable soils are exposed. In general, sandy soils containing less than about 30 percent fines are suitable for use as flowable fill. Flowable fill should meet the following recommendations.

- sandy soils used for flowable fill should contain no more than 30 percent fines,
- the sand and cement should be thoroughly mixed,

- proportioning of the sandy soil and cement should be sufficient to produce at the least an unconfined compressive strength of 1 MPa at 48 hours while remaining workable for placement,
- the flowable fill should not be placed when ambient air temperature is below 4 degrees Celsius,
- placement of the flowable fill should completely fill the space to be backfilled,
- the flowable fill should be placed using standard ASTM procedures for soil-cement materials; if a fluid consistency is used for the soil-cement slurry, an “elephant trunk” vibrator may be used to remove air voids from the mixture, and
- backfill over the flowable fill should not be placed until after initial set (4 to 6 hours) has been achieved for the flowable fill.

19.2 Groundwater Considerations

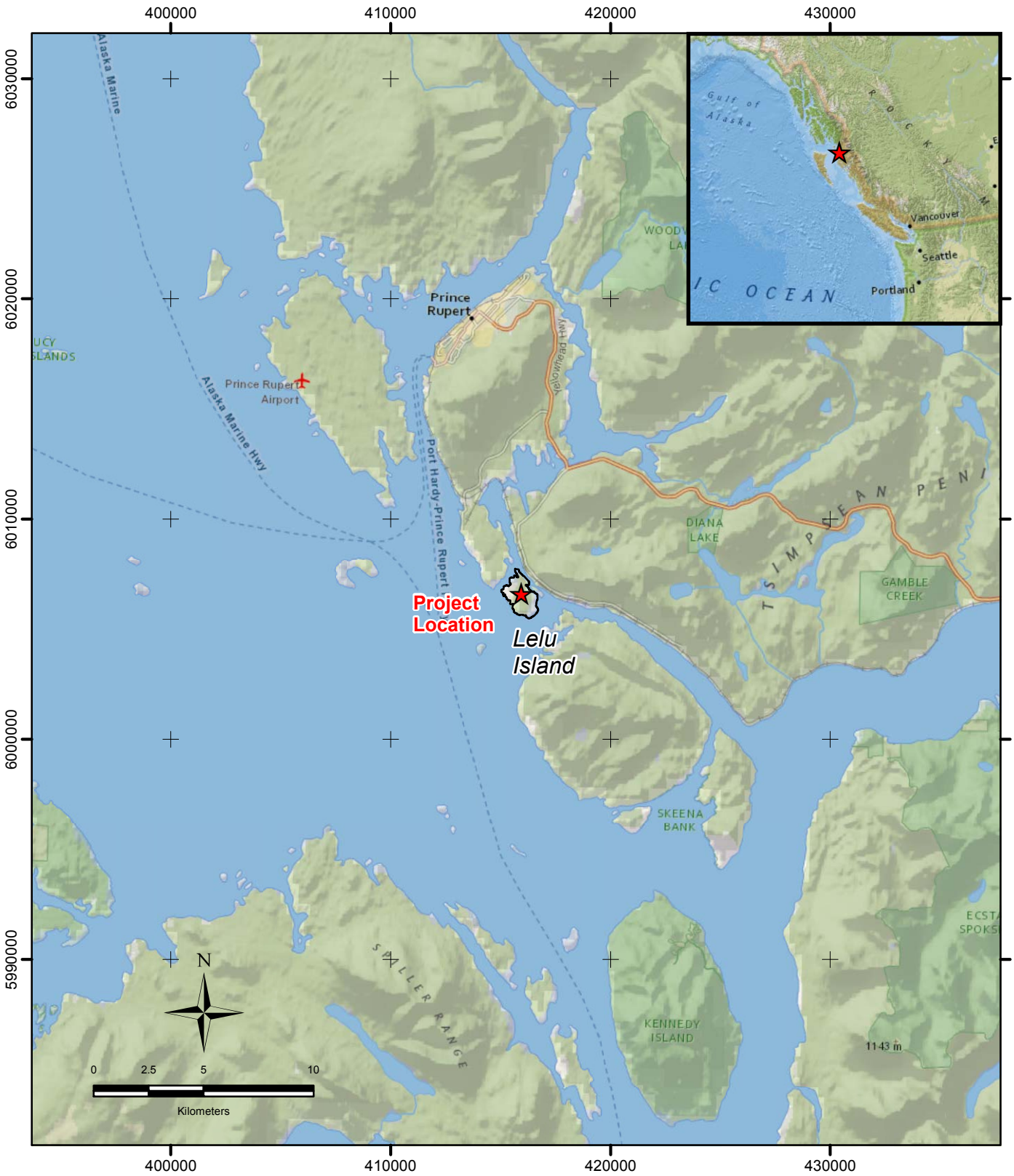
The ground water encountered in borings is primarily perched water from surface runoff that has been captured in depressions (Please refer to Section 6.2 Geomorphology and Surface Geology). Water perched in larger bogs will need to be drained prior to excavation and site grading activities. Excavation of shallow bogs with smaller footprints can be carried out from surrounding rock surface. Additionally, excavations in Area 3 below El. +25 m for removal of cohesive soils will encounter perched water. We understand there is constant seepage of water at ends of the bogs of Area 3. This observation and the soils encountered in the borings indicate the peat and cohesive soils are heavily saturated. Surface runoff should be diverted away from the footprint of the facilities. The Contractor should be prepared to provide proper groundwater control.

19.3 Construction Monitoring

Construction monitoring should be an integral part of construction of the facility. During construction phase, we strongly recommend that a Geotechnical Engineer, or qualified representative, be present on-site to evaluate the suitability of subgrade soil and/or rock for foundation support and to observe foundation installation and testing. On-site observations may also aid in recognizing and reconciling other unanticipated soil/rock or groundwater conditions and ensure that design recommendations are appropriate and properly implemented during construction.

* * *

ILLUSTRATIONS



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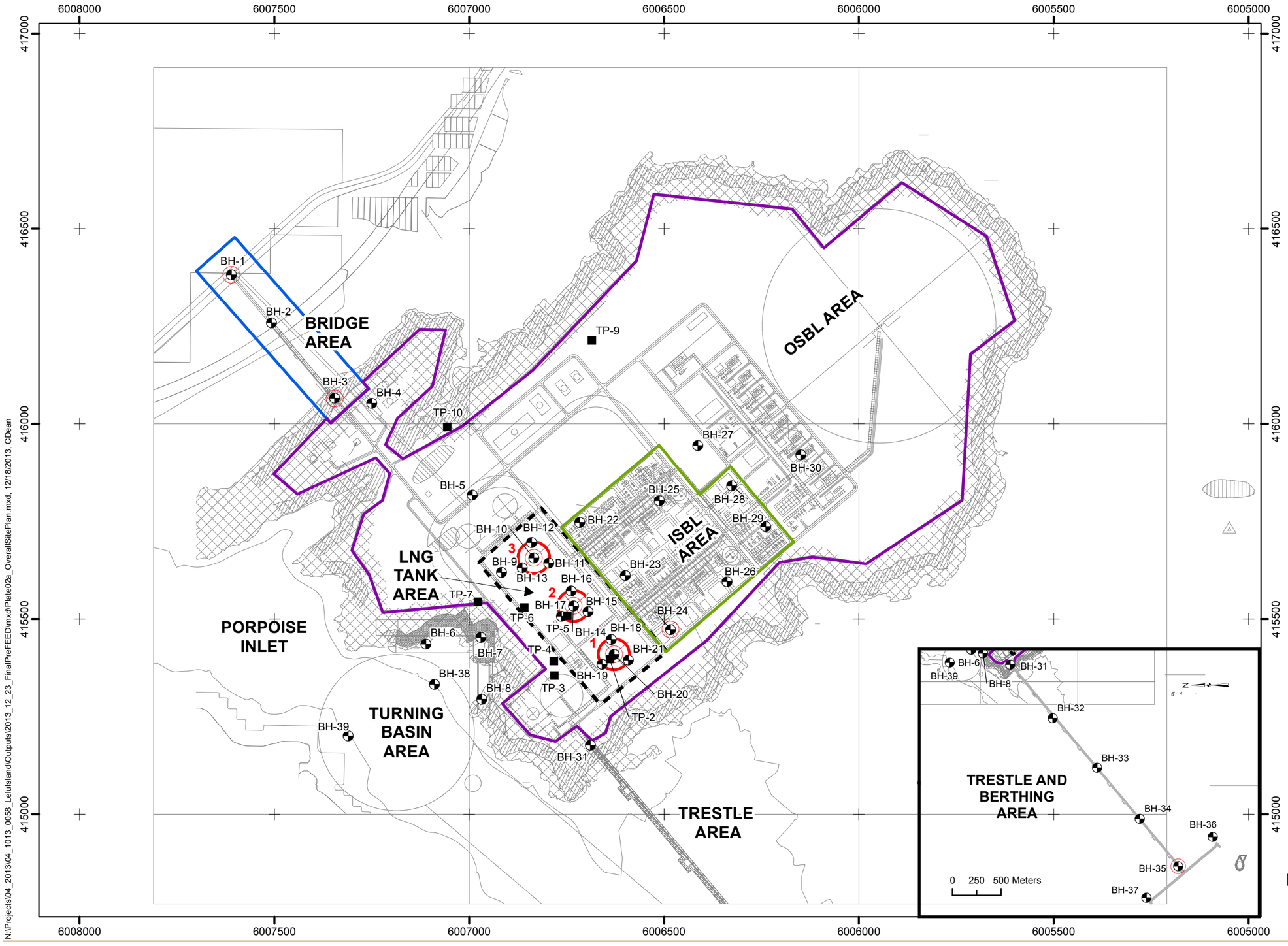
VICINITY MAP

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE 1



Legend

- Borings
- PS Logging/Acoustic Televiewer Borings
- Test Pits
- 2 — LNG Tank and Tank Number
- ISBL Area
- OSBL Area
- Bridge Area
- LNG Tank Area

Notes:

1) Base drawing provided by KBR

2) Boring locations are approximate

N

1:10,000

200 100 0 200
Meters

OVERALL SITE PLAN
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE 2a

N:\Projects\04_2013\04_1013_0058_LeluIsland\Outputs\2013_12_23_FinalPreFEED\mxd\Plate02a_OverallSitePlan.mxd, 12/18/2013, CDean

412000 413000 414000 415000 416000

6007000 6006000 6005000 6004000

BH-31
BH-32
BH-33
BH-34
BH-35
BH-36
BH-37

Legend

- Borings
- PS Logging Borings
- LNG Tanks
- Site Plan
- Nearshore Geophysical Survey Area

Topography Contours

- Major contour, interval = 20m
- Minor contour, interval = 5 m

Notes:

1) Base drawing provided by KBR

2) Boring locations are approximate

N

1:15,000

200 100 0 200
Meters

OVERALL SITE PLAN
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE 2b

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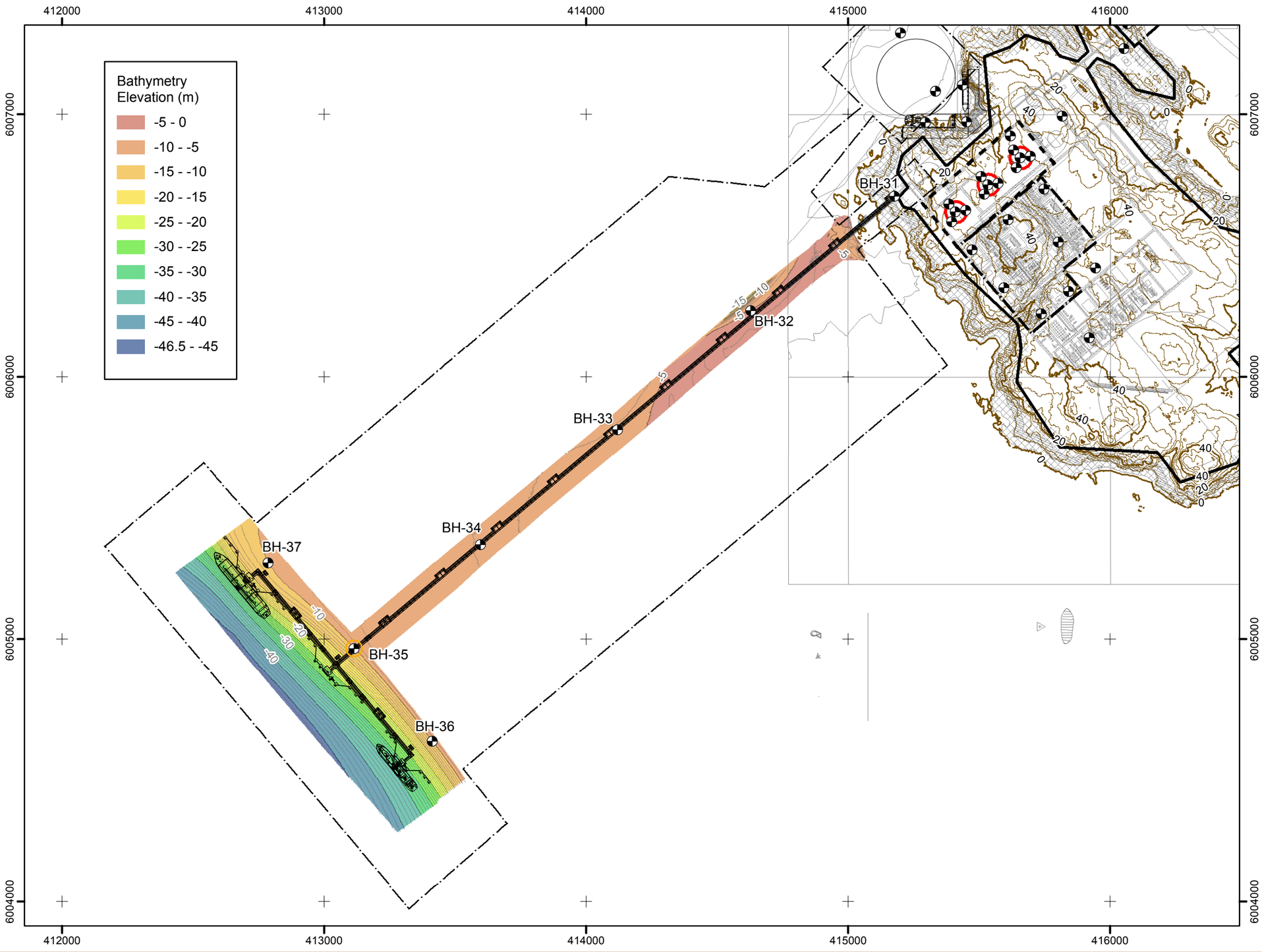

Legend

- Borings
- PS Logging Borings
- LNG Tanks
- Site Plan
- Nearshore Geophysical Survey Area

Topography Contours

- Major contour, interval = 20m
- Minor contour, interval = 5 m

Bathymetry Contours

- Minor Contour, interval = 0.5 m
- Major Contour, interval = 1 m

Notes:

1) Base drawing provided by KBR

2) Boring locations are approximate

N

1:15,000

200 100 0 200
Meters

TRESTLE AND JETTY BATHYMETRY
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE 3

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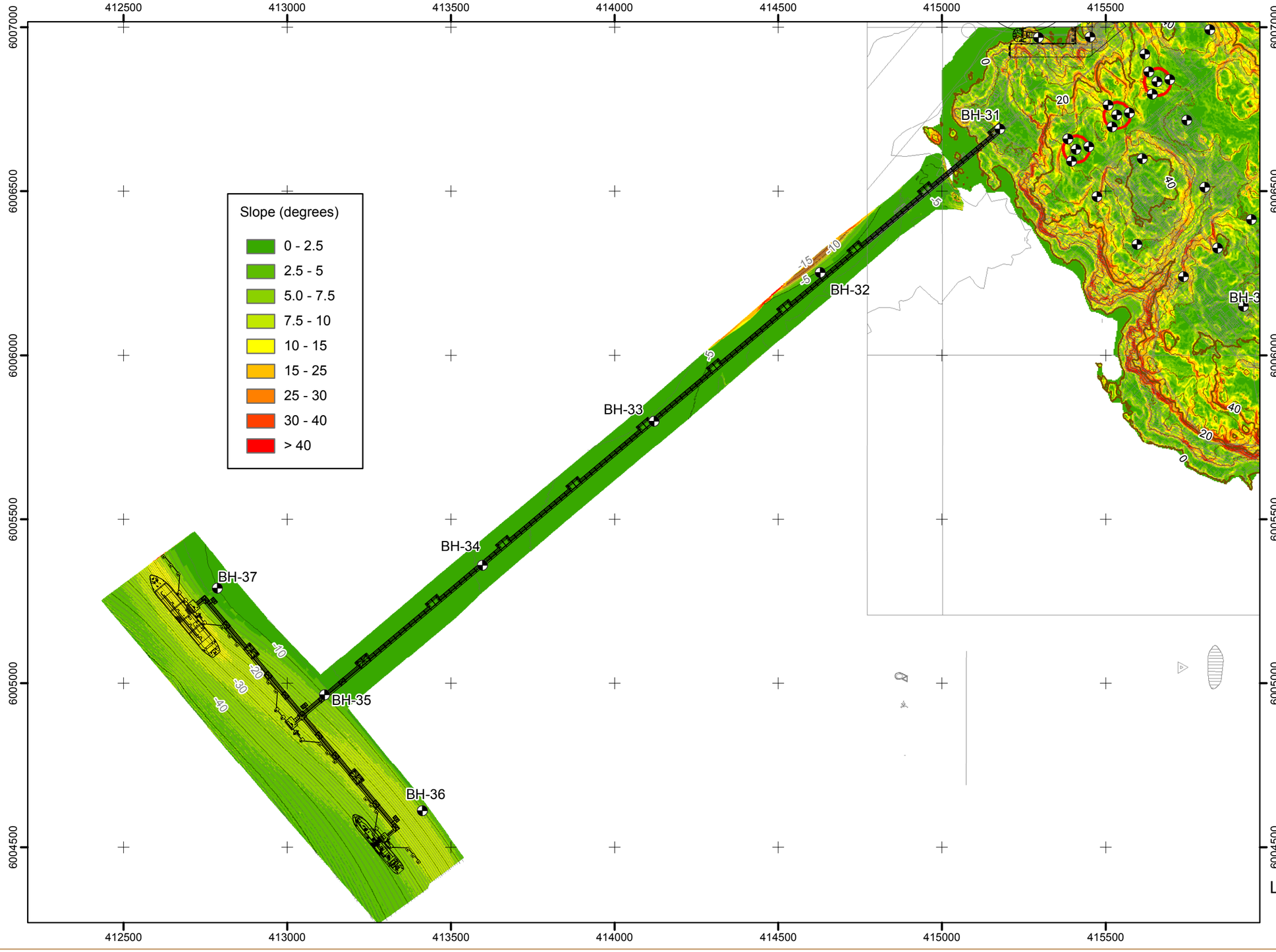

Legend

- Borings
- LNG Tanks
- Site Plan

Topography Contours

- Major contour, interval = 20m
- Minor contour, interval = 5 m

Bathymetry Contours

- Minor Contour, interval = 0.5 m
- Major Contour, interval = 1 m

Notes:

1) Base drawing provided by KBR

2) Boring locations are approximate

N

1:12,000

200 100 0 200 Meters

TRESTLE AND JETTY SLOPES

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE 4a

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412500 413000 413500

6005000

6004500

BH-37

BH-34

BH-35

BH-36

-10

-20

-30

-40

Slope (degrees)

- 0 - 2.5
- 2.5 - 5
- 5.0 - 7.5
- 7.5 - 10
- 10 - 15
- 15 - 25
- 25 - 30
- 30 - 40
- > 40

Legend

- Borings
- Site Plan

Bathymetry Contours

- Minor Contour, interval = 0.5 m
- Major Contour, interval = 1 m

Notes:

1) Base drawing provided by KBR

2) Boring locations are approximate

N

1:5,000

100 50 0 100 Meters

TRESTLE AND JETTY SLOPES

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE 4b

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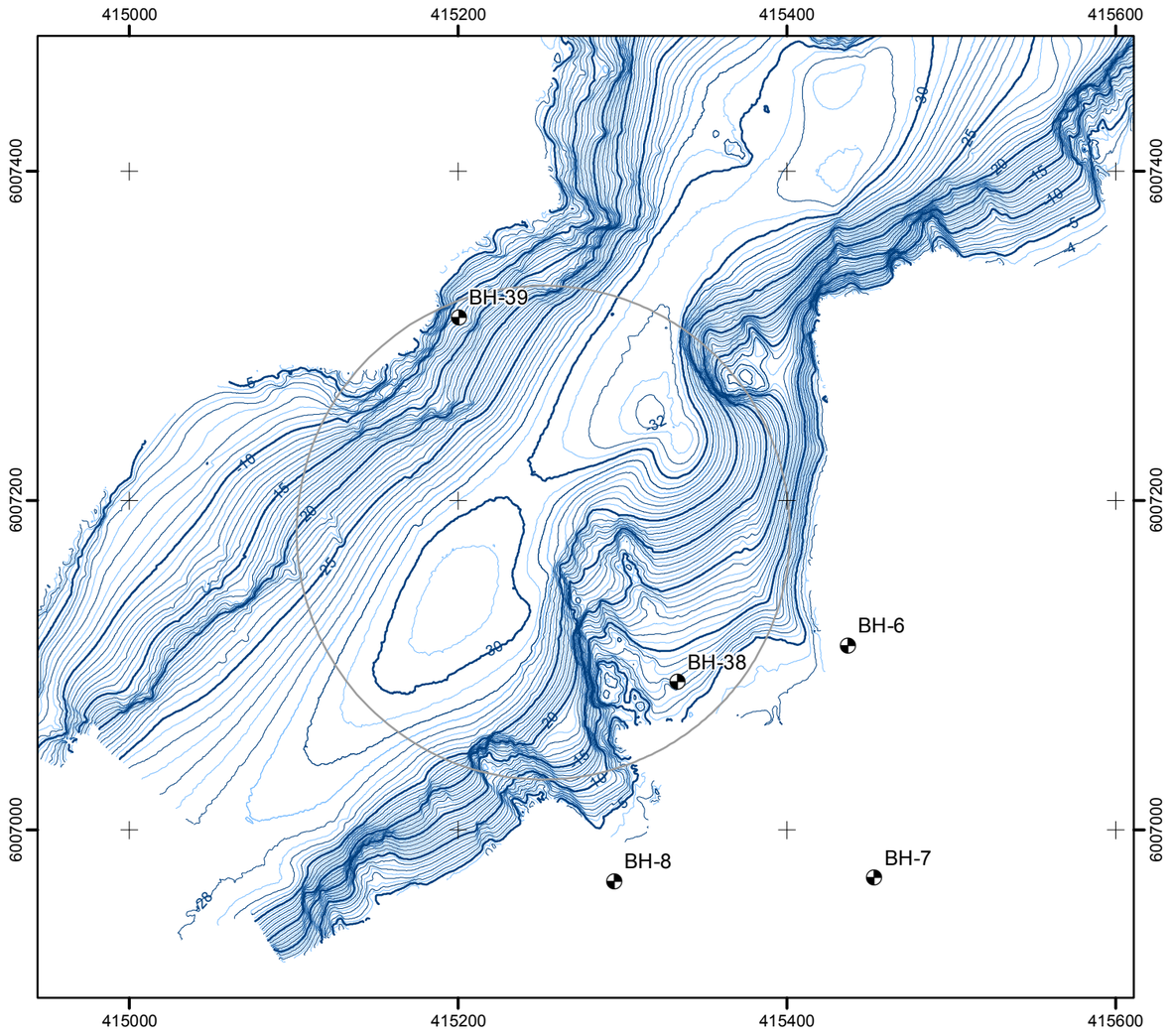
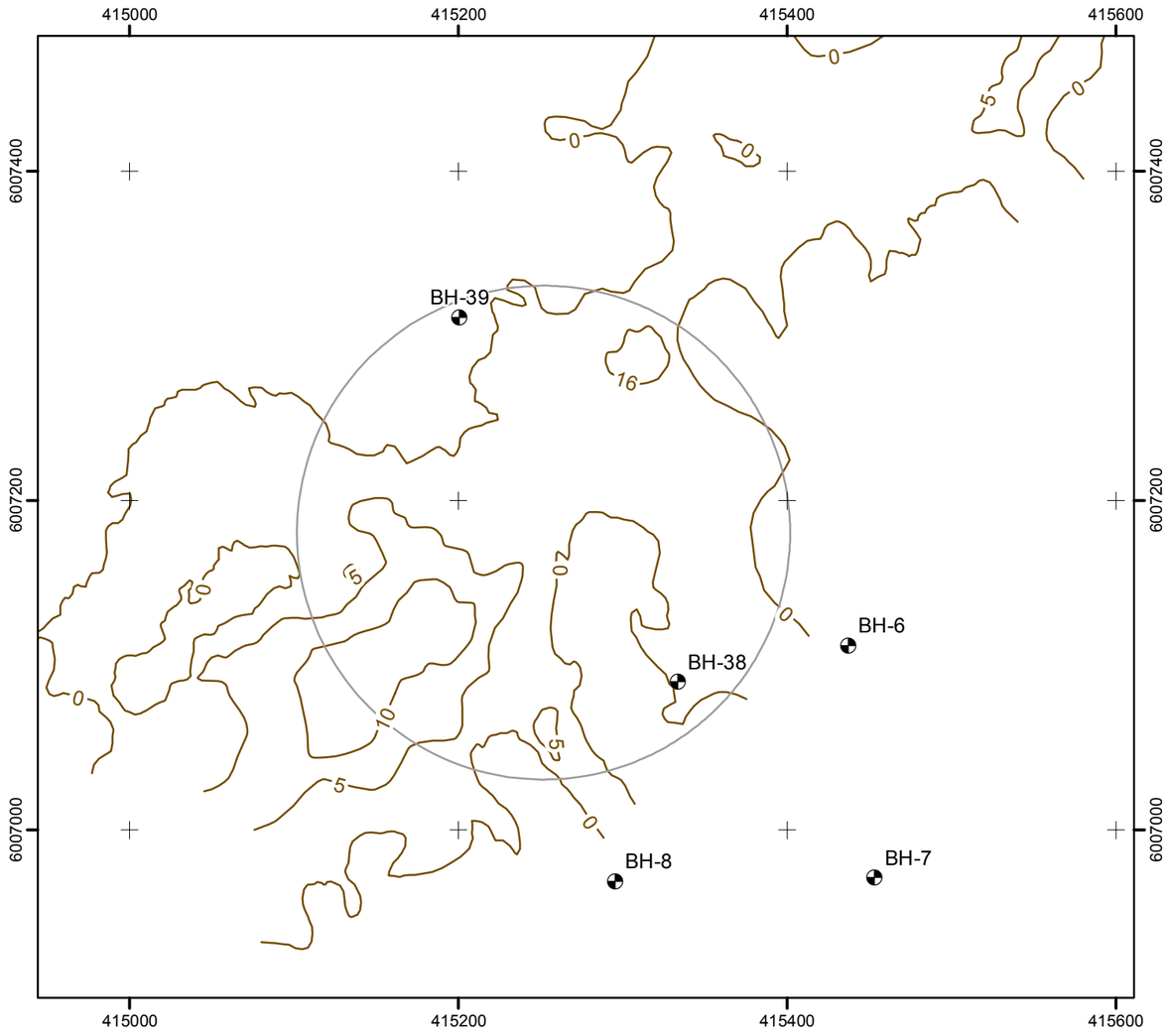


INTERPRETED BATHYMETRY



OVERBURDEN THICKNESS

Legend

- Boring Location
- Index Bathymetry Contours (1-m interval)
- Bathymetry Contours (5-m interval)
- Minor Bathymetry Contours (0.5-m interval)
- Isopach Contours (5-m interval) of overburden material which consists of sand, silt, and clay overlying bedrock

Notes:

1. Bathymetry and overburden thickness are based on the results obtained from our geophysical survey presented in Fugro report no. 23.00007028 R2 dated July 13, 2013.

2. Bathymetry contours are in meters and referenced to CVC28BC - Canadian Vertical Datum/Lowest Astronomical tide (LAT).

N

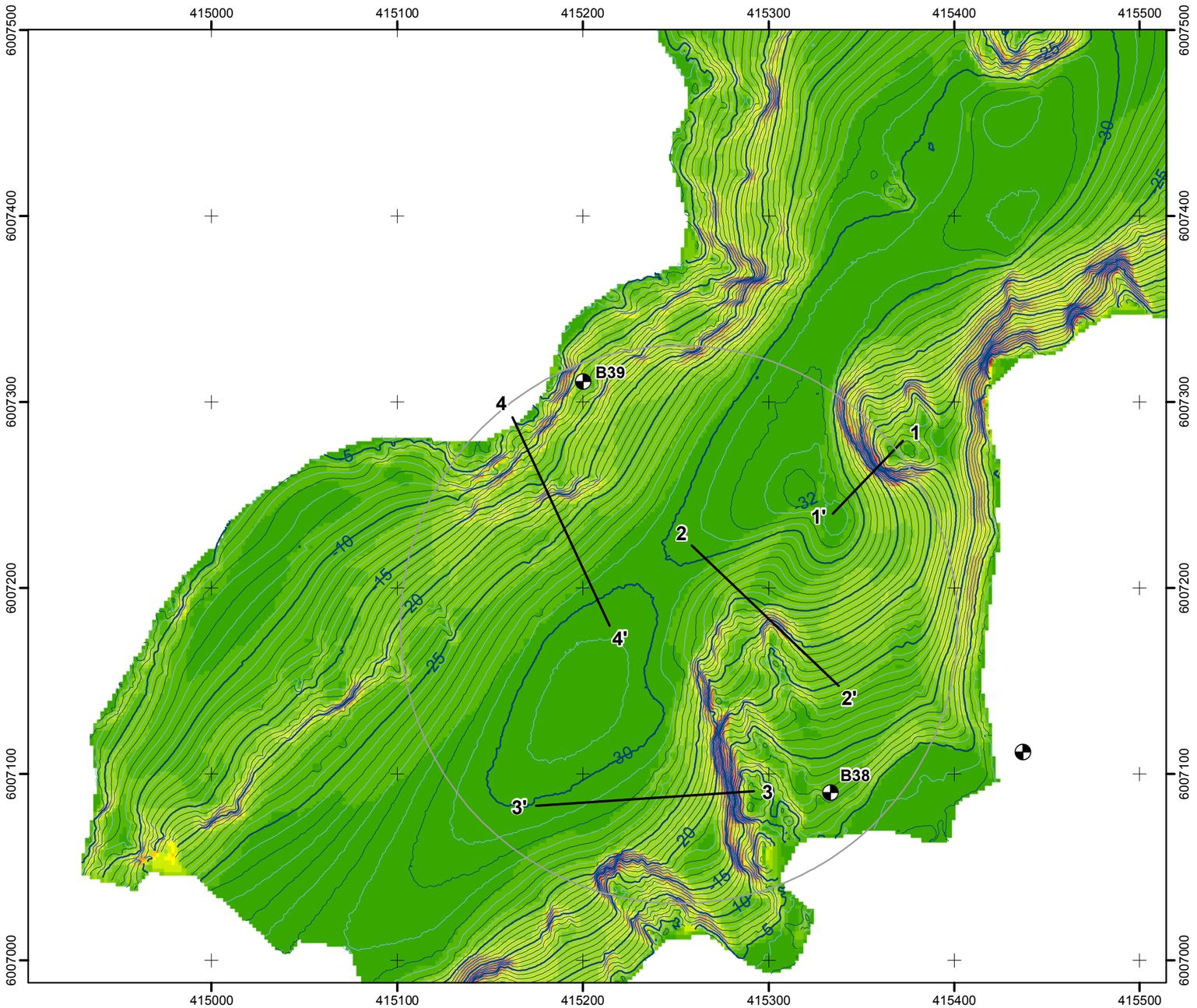
1:3,600

0 50 100 200 Meters

BATHYMETRY AND OVERBURDEN THICKNESS
TURNING BASIN
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE 5a

N:\Projects\04_2013\04_1013_0058_LeluIsland\Outputs\2013_12_23_FinalPreFEED\mxd\Plate05a_TurningBasinBathy.mxd, 12/19/2013, CDean



Legend

- Boring Location
- Index Bathymetry Contours (1-m interval)
- Bathymetry Contours (5-m interval)
- Minor Bathymetry Contours (0.5-m interval)
- Cross Section Line
- Turning Basin

Slope (Degrees)

- 0 - 5
- 5.000000001 - 10
- 10.00000001 - 15
- 15.00000001 - 20
- 20.00000001 - 25
- 25.00000001 - 30
- 30.00000001 - 35
- 35.00000001 - 40
- 40.00000001 - 45
- 45.00000001 - 50
- 50.00000001 - 60

Notes:

1. Bathymetry is based on the results obtained from our geophysical survey presented in Fugro report no. 23.00007028 R2 dated July 13, 2013.

2. Bathymetry contours are in meters and referenced to CVC28BC - Canadian Vertical Datum/Lowest Astronomical tide (LAT).

N

1:2,500

0 50 100 200 Meters

BATHYMETRY AND SLOPE INTERPRETATION
TURNING BASIN
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE 5b

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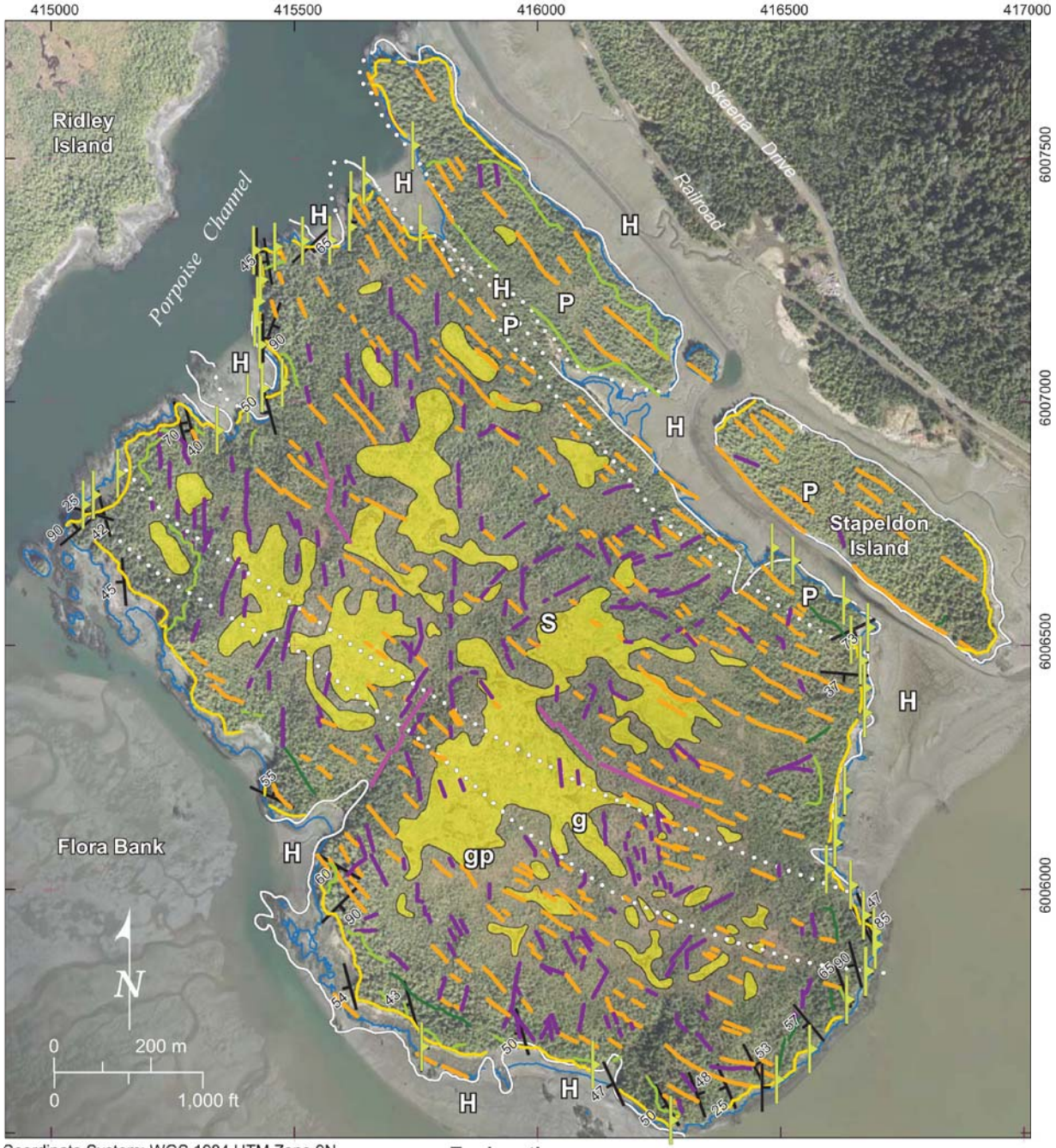

SURFACE GEOLOGY MAP
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE 6

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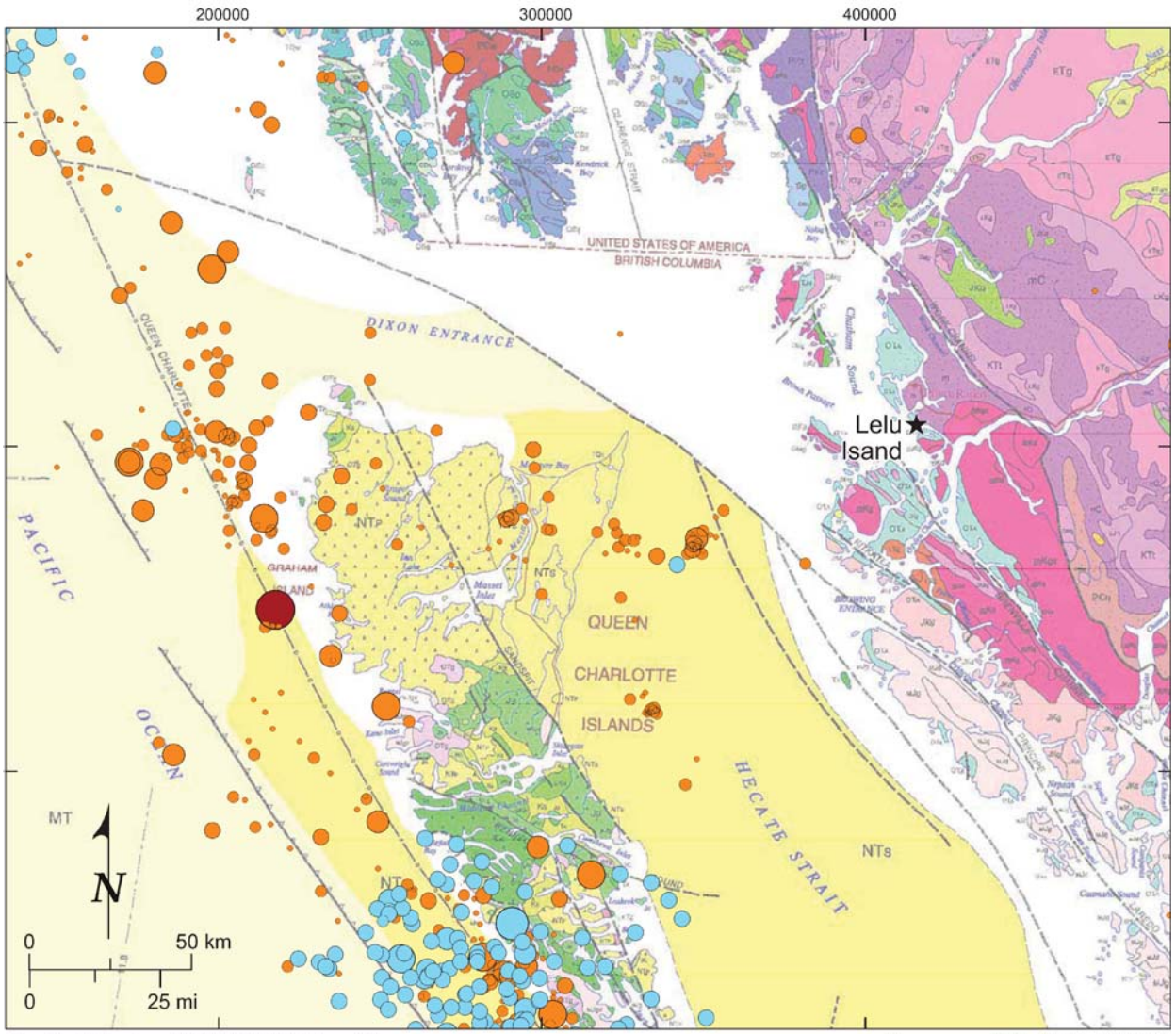

Coordinate System: WGS 1984 UTM Zone 9N

Map source: GCS, 2000 - OF2948d

Explanation

Seismicity Magnitude (dated 2009 to 2013)

- 2.5 - 2.9
- 3 - 3.9
- 4 - 4.9
- 5 - 5.9
- 6.0 - 6.9
- 7.0 - 7.9
- 8.0 - 8.9
- ≥ 9.0

Source: USGS

Seismicity Magnitude (dated 1700 to 2008)

- 2.5 - 2.9
- 3 - 3.9
- 4 - 4.9
- 5 - 5.9
- 6.0 - 6.9
- 7.0 - 7.9
- 8.0 - 8.9
- ≥ 9.0

Source: SHEEF

Geologic Units

m	Metamorphic rocks (undivided); includes Central Gneiss Complex (mC)
mK	Variably foliated hornblende quartz diorite, tonalite, and hornblende diorite intrusive into Gravina-Nutzotin rocks of South East Alaska and forming part of Western Coast Plutonic Complex (Mid-Cretaceous (87 - 130 Ma)
OTA	Undivided phyllite in Alexander Terrane, includes Devonian to Triassic rocks in Duncan Canal Shear Zone; undivided calcareous mudstone, siltstone, thin-bedded limestone, subordinate mafic to felsic volcanics, carbonate chert, minor ultramafics; locally metamorphosed to slate, phyllite, schist, gneiss, and marble; marine (Ordovician - Triassic)

TECTONIC SETTING AND LOCATION MAP
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE 7

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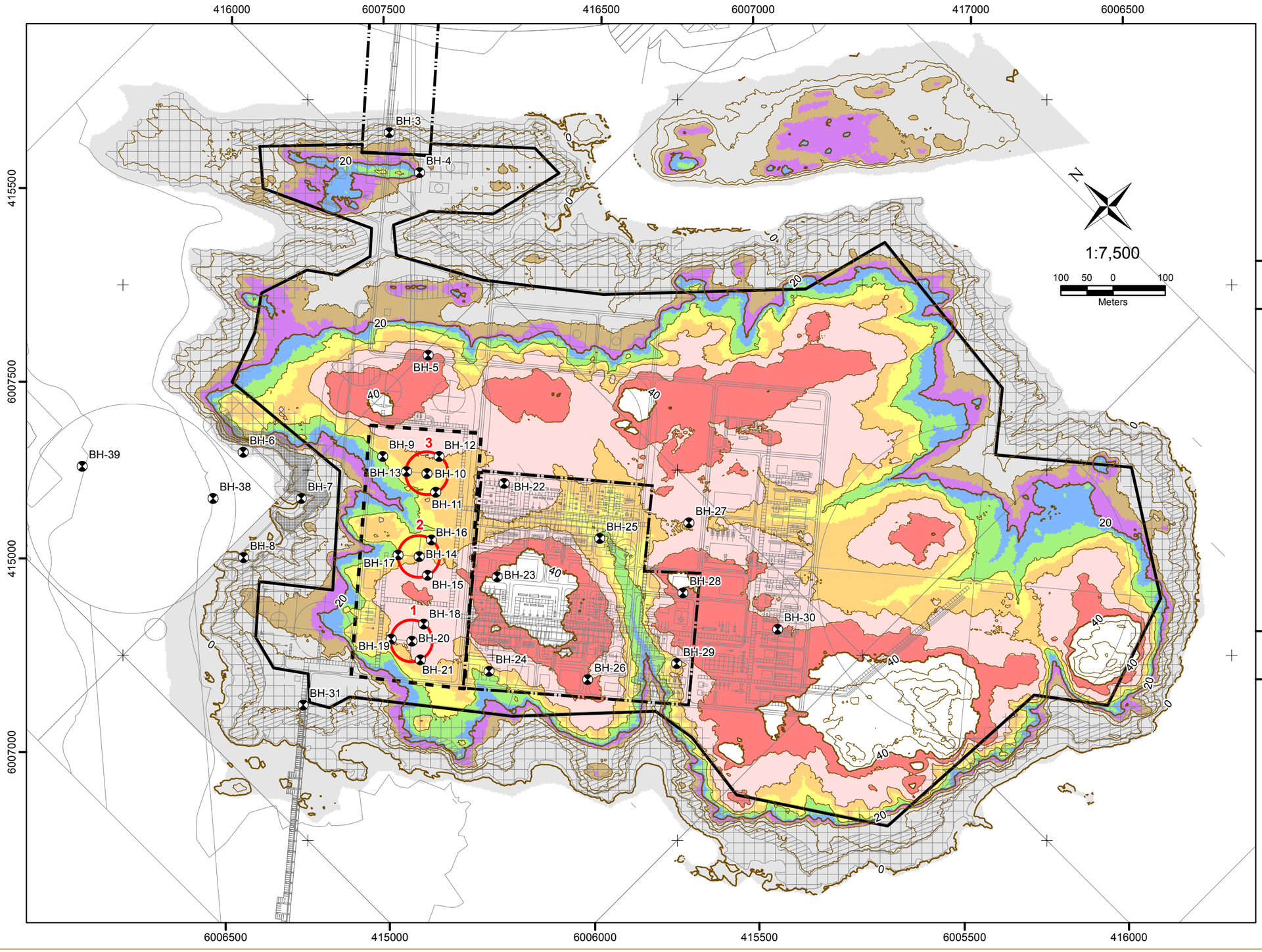

Legend

- Borings
- Major contour, interval = 20m
- Minor contour, interval = 5 m
- Site Plan
- 2 LNG Tank and Tank Number
- ISBL Area
- OSBL Area
- Bridge Area
- LNG Tank Area

Existing Topography (m)

< 15	25 - 27.5
15 - 17.5	27.5 - 30
17.5 - 20	30 - 35
20 - 22.5	35 - 40
22.5 - 25	> 40

Notes:

1) Base drawing provided by KBR

2) Boring locations are approximate

SITE TOPOGRAPHY – ONSHORE FACILITIES
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE 8

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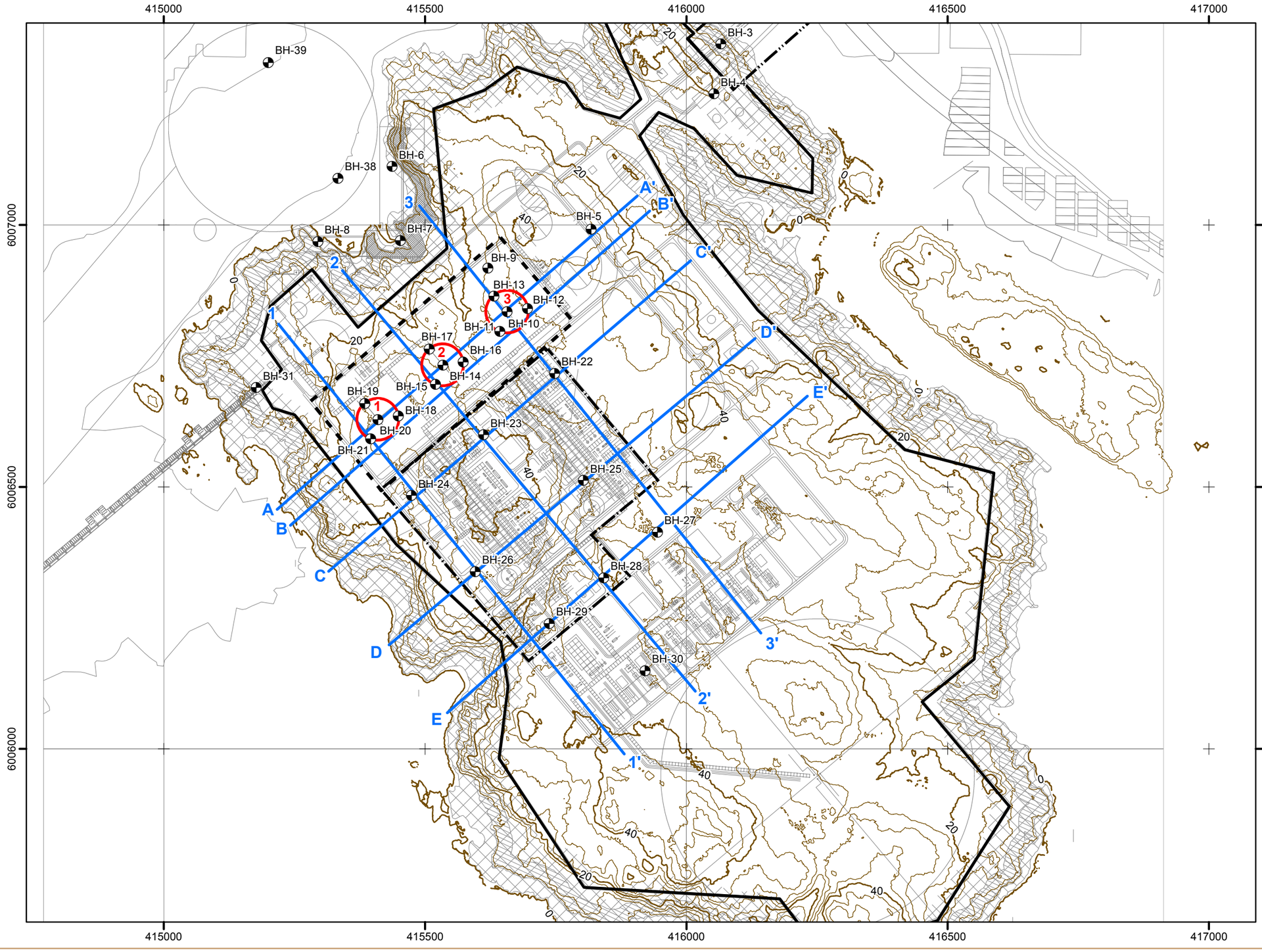


Legend

- Borings
- LNG Tank and Tank Number
- Cross Section Lines
- Major contour, interval = 20m
- Minor contour, interval = 5 m
- Site Plan
- ISBL Area
- OSBL Area
- Bridge Area
- LNG Tank Area

Notes:

1) Base drawing provided by KBR

2) Boring locations are approximate

N

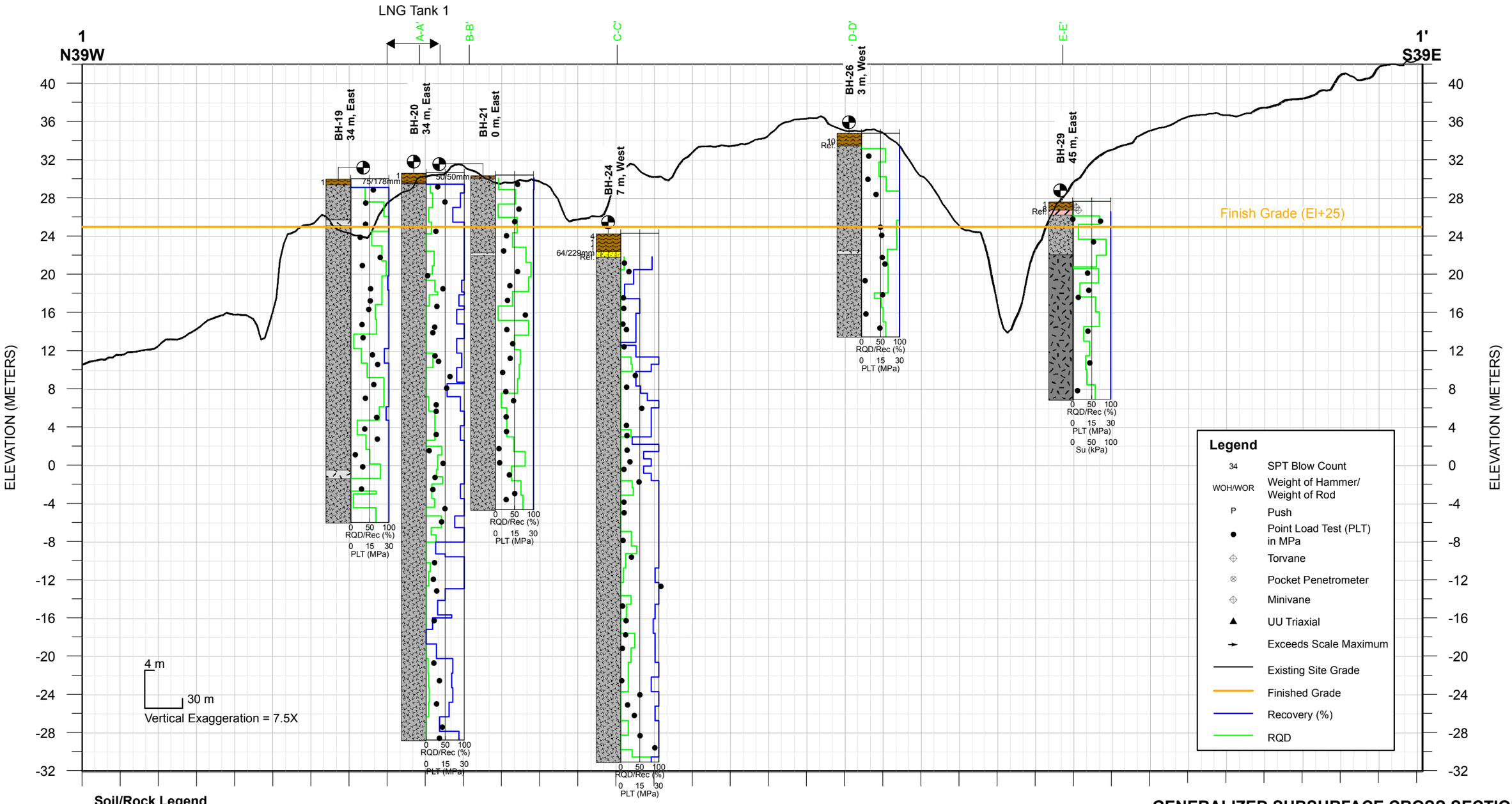
1:7,500

200 100 0 200 Meters

PLAN OF BORINGS
ONSHORE FACILITIES
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE 9

N:\Projects\04_2013\04_1013_0058_LeluIsland\Outputs\2013_12_23_FinalPreFEED\mxd\Plate09_Xsects_Onshore.mxd, 12/18/2013, CDean



Soil/Rock Legend

- Lean CLAY (CL)
- Silty CLAY (CL-ML)
- Lean CLAY with Sand (CL)
- Sandy Lean Clay (CL)
- Fat CLAY (CH)
- Silt (ML)
- Sandy SILT (ML)
- Gravelly SILT (ML)
- Clayey SAND (SC)
- Silty SAND (SM)
- PEAT
- SHALE
- Conglomerate
- Phyllite
- Gneiss
- Schist

GENERALIZED SUBSURFACE CROSS SECTION 1-1'
ONSHORE FACILITIES
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE 10

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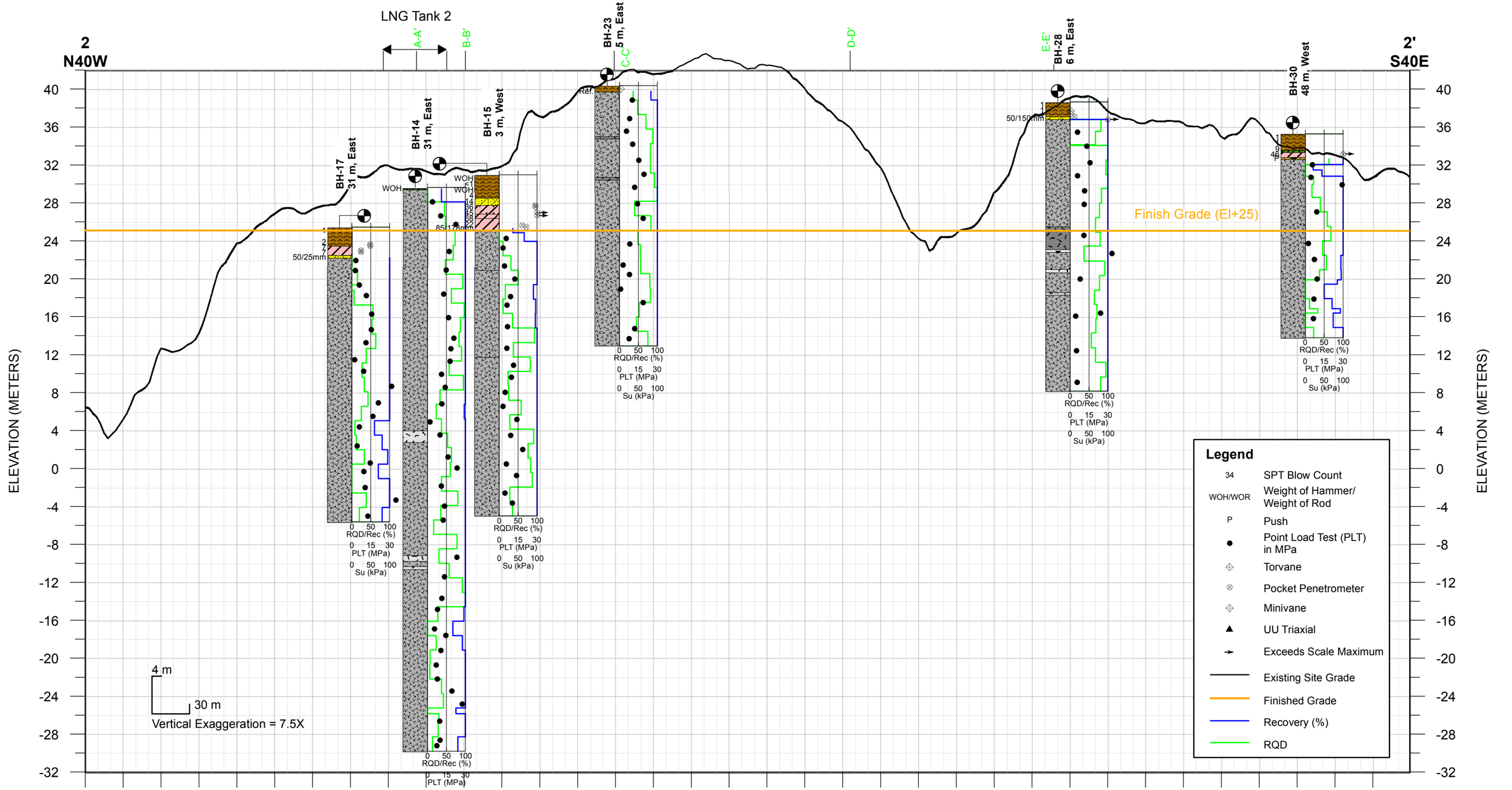

Soil/Rock Legend

- Lean CLAY (CL)
- Silty CLAY (CL-ML)
- Lean CLAY with Sand (CL)
- Sandy Lean Clay (CL)
- Fat CLAY (CH)
- Silt (ML)
- Sandy SILT (ML)
- Gravelly SILT (ML)
- Clayey SAND (SC)
- Silty SAND (SM)
- PEAT
- SHALE
- Conglomerate
- Phyllite
- Gneiss
- Schist

GENERALIZED SUBSURFACE CROSS SECTION 2-2'
ONSHORE FACILITIES
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE 11

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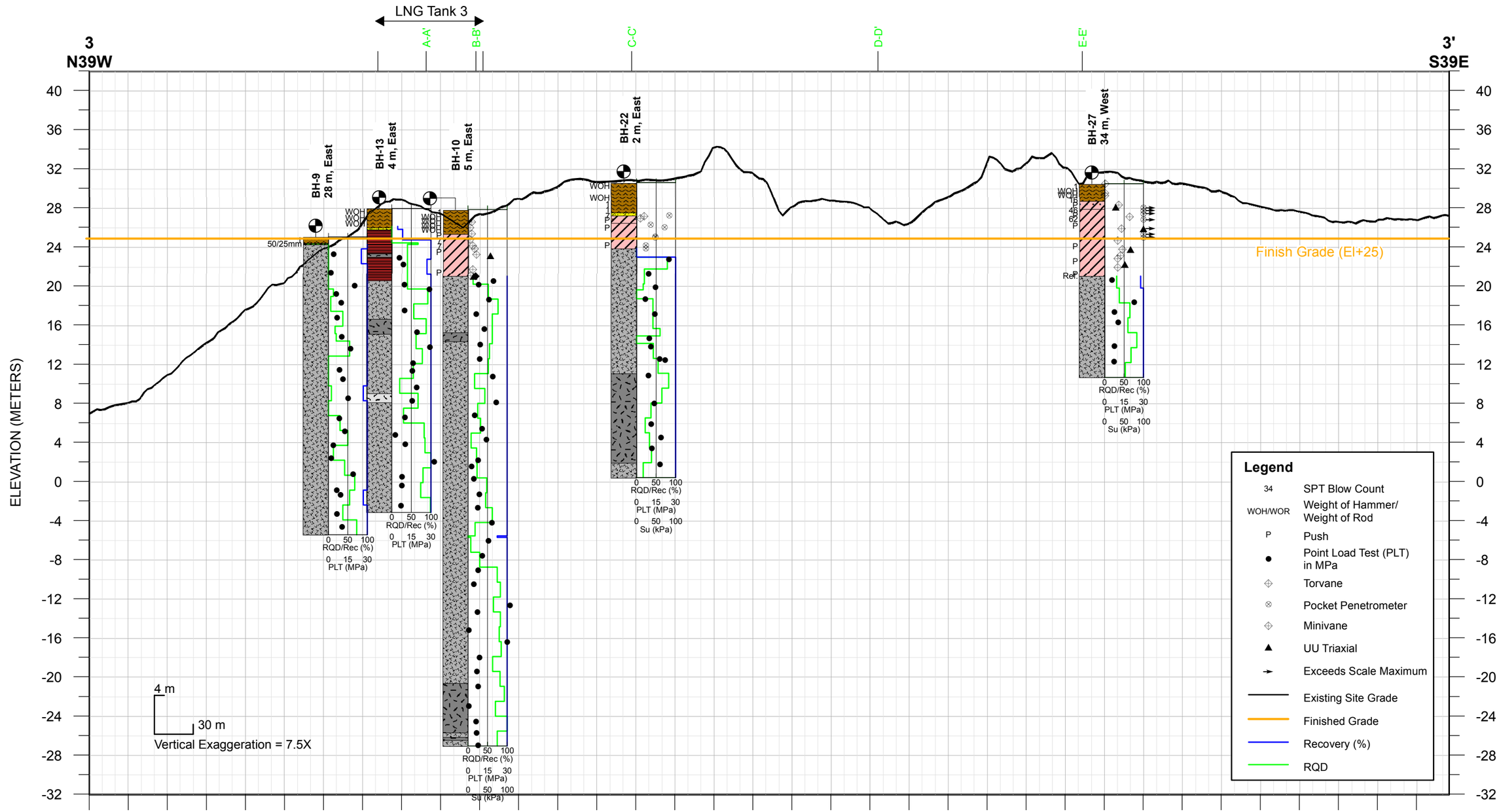


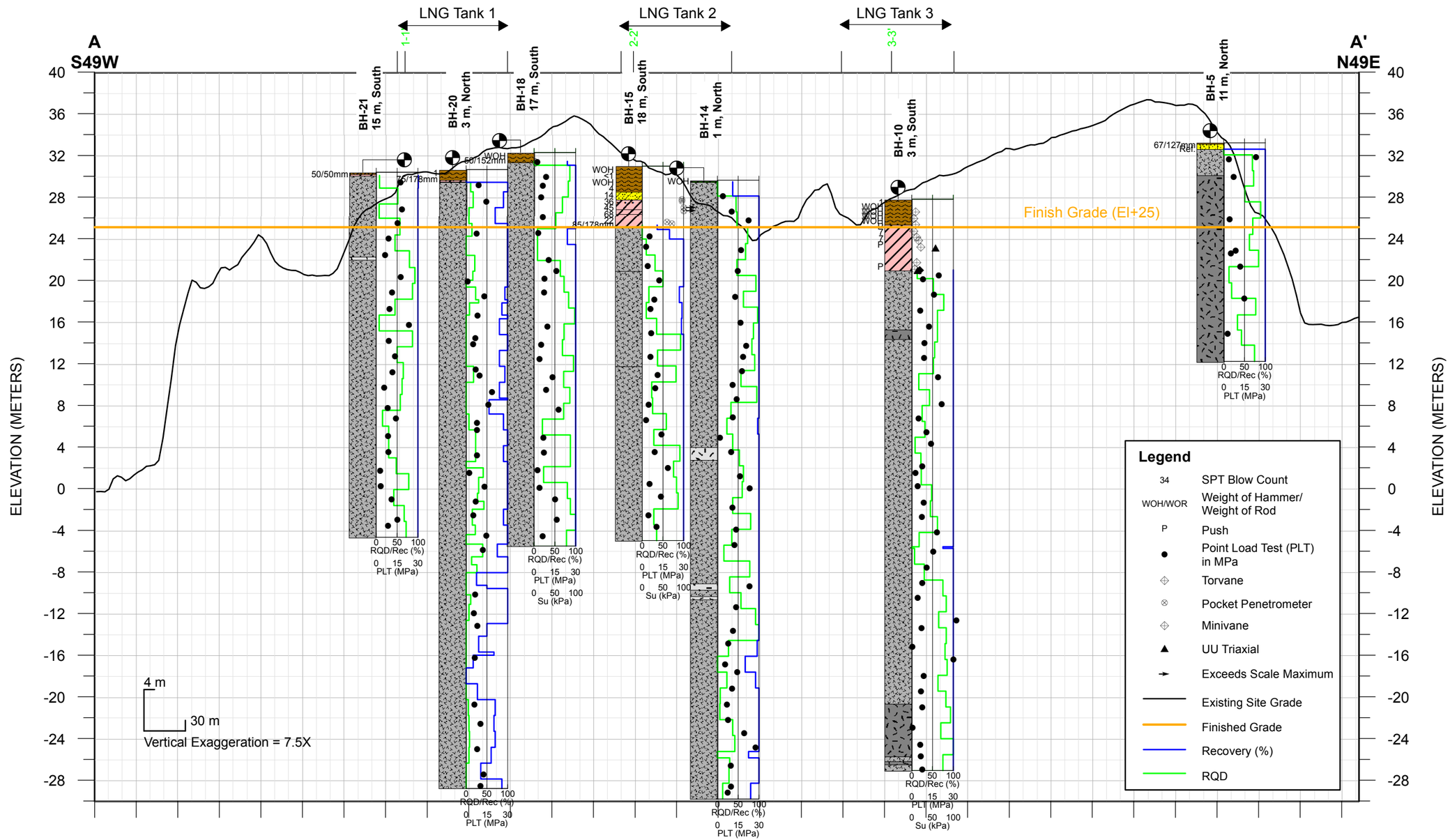
Soil/Rock Legend

Lean CLAY (CL)	Sandy Lean Clay (CL)	Sandy SILT (ML)	Silty SAND (SM)	Conglomerate	Schist
Silty CLAY (CL-ML)	Fat CLAY (CH)	Gravelly SILT (ML)	PEAT	Phyllite	
Lean CLAY with Sand (CL)	Silt (ML)	Clayey SAND (SC)	SHALE	Gneiss	

GENERALIZED SUBSURFACE CROSS SECTION 3-3'
ONSHORE FACILITIES
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE 12

N:\Projects\04_2013\04_1013_0058_LeluIsland\Outputs\2013_12_23_FinalPreFEED\mxd\Plate12_Prof3.mxd, 12/18/2013, CDean



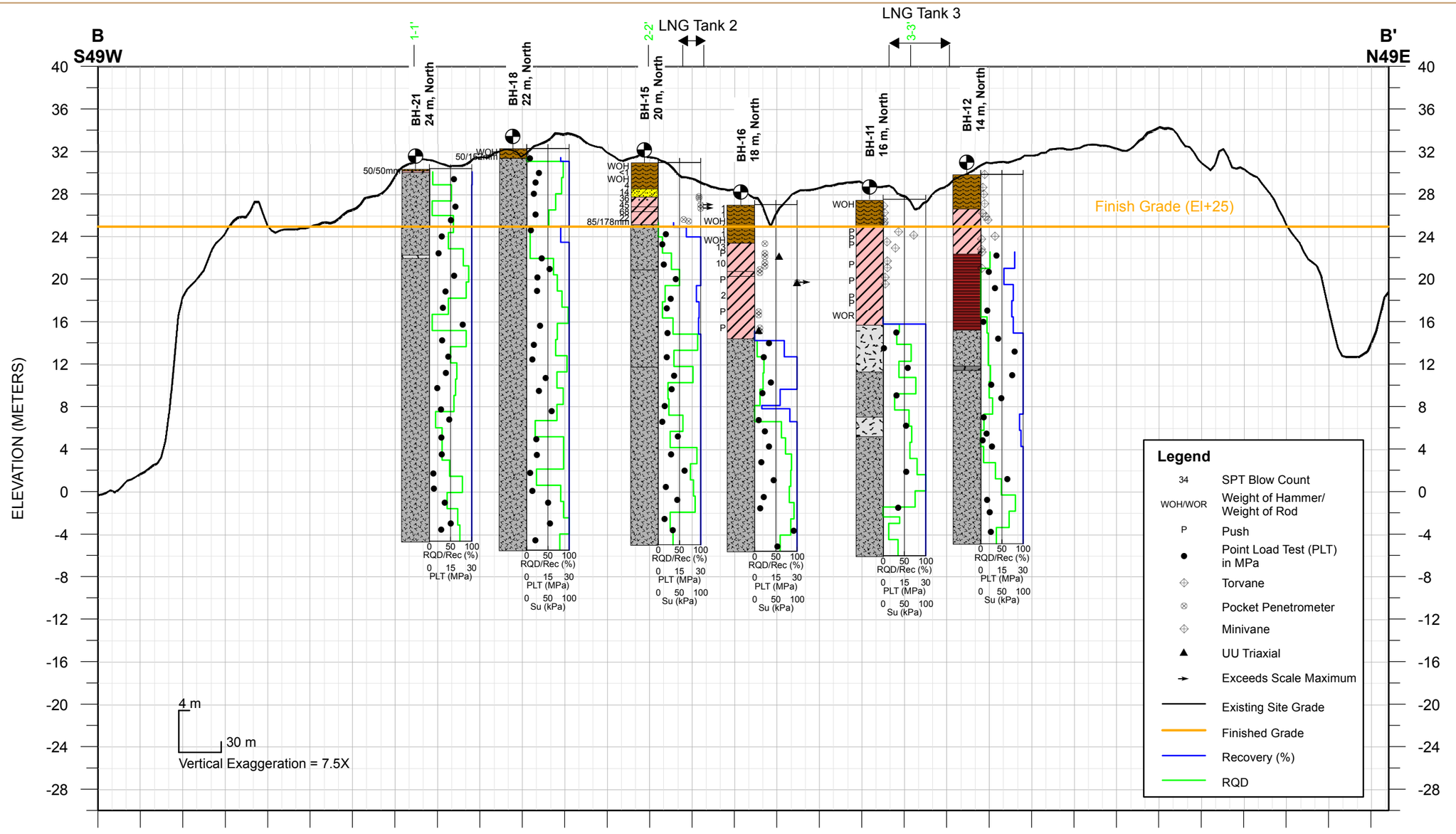
Soil/Rock Legend

Lean CLAY (CL)	Sandy Lean Clay (CL)	Sandy SILT (ML)	Silty SAND (SM)	Conglomerate	Schist
Silty CLAY (CL-ML)	Fat CLAY (CH)	Gravelly SILT (ML)	PEAT	Phyllite	
Lean CLAY with Sand (CL)	Silt (ML)	Clayey SAND (SC)	SHALE	Gneiss	

GENERALIZED SUBSURFACE CROSS SECTION A-A'
ONSHORE FACILITIES
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE 13

N:\Projects\04_2013\04_1013_0058_LeluIsland\Outputs\2013_11_11_DraftPreFEED\mxd\Plate13_ProfA.mxd, 11/8/2013, CDean



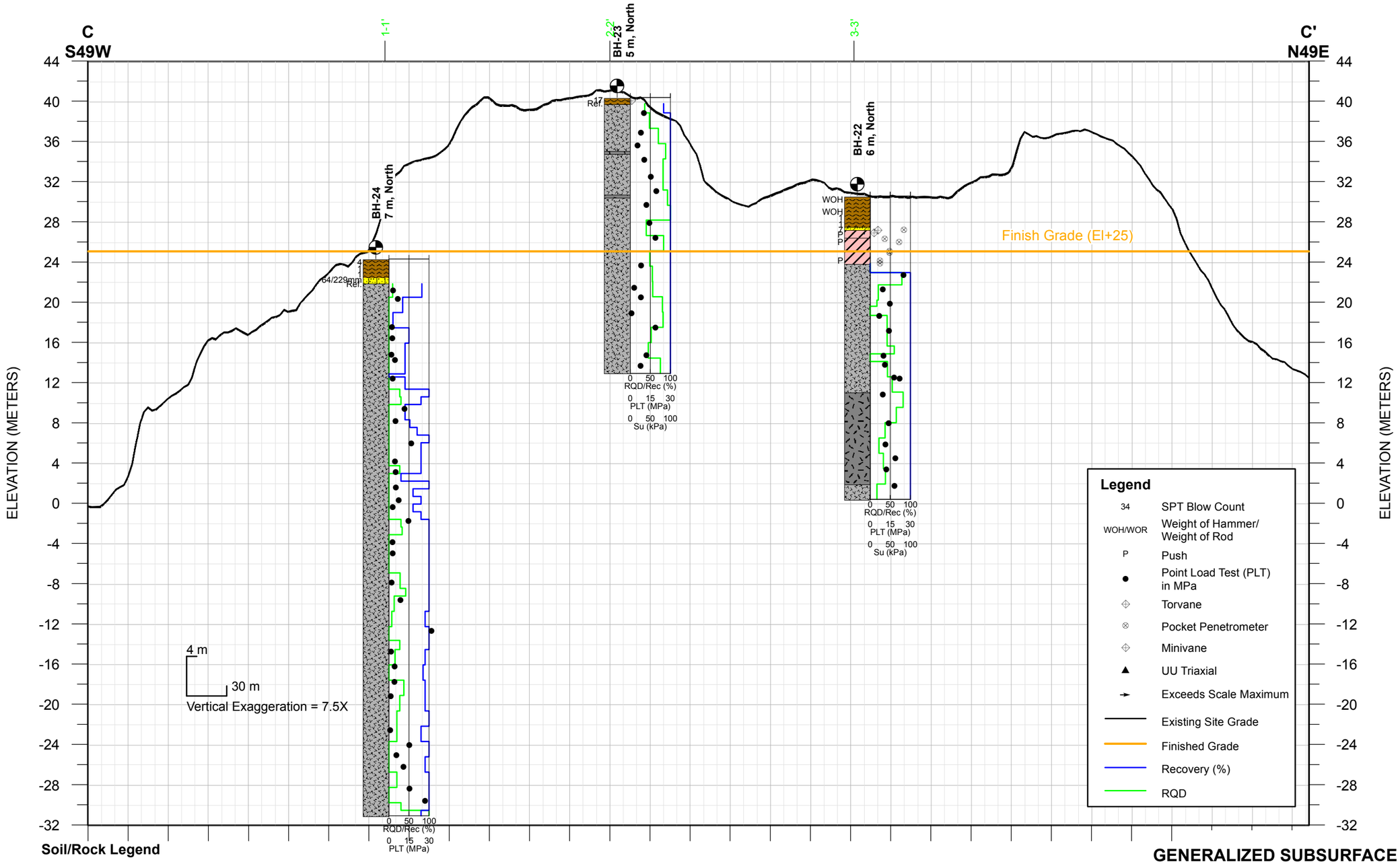
Soil/Rock Legend

- Lean CLAY (CL)
- Silty CLAY (CL-ML)
- Lean CLAY with Sand (CL)
- Sandy Lean Clay (CL)
- Fat CLAY (CH)
- Silt (ML)
- Sandy SILT (ML)
- Gravelly SILT (ML)
- Clayey SAND (SC)
- Silty SAND (SM)
- PEAT
- SHALE
- Conglomerate
- Phyllite
- Gneiss
- Schist

GENERALIZED SUBSURFACE CROSS SECTION B-B'
ONSHORE FACILITIES
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE 14

N:\Projects\04_2013\04_1013_0058_LeluIsland\Outputs\2013_12_23_FinalPreFEED\mxd\Plate14_ProfB.mxd, 12/18/2013, CDean



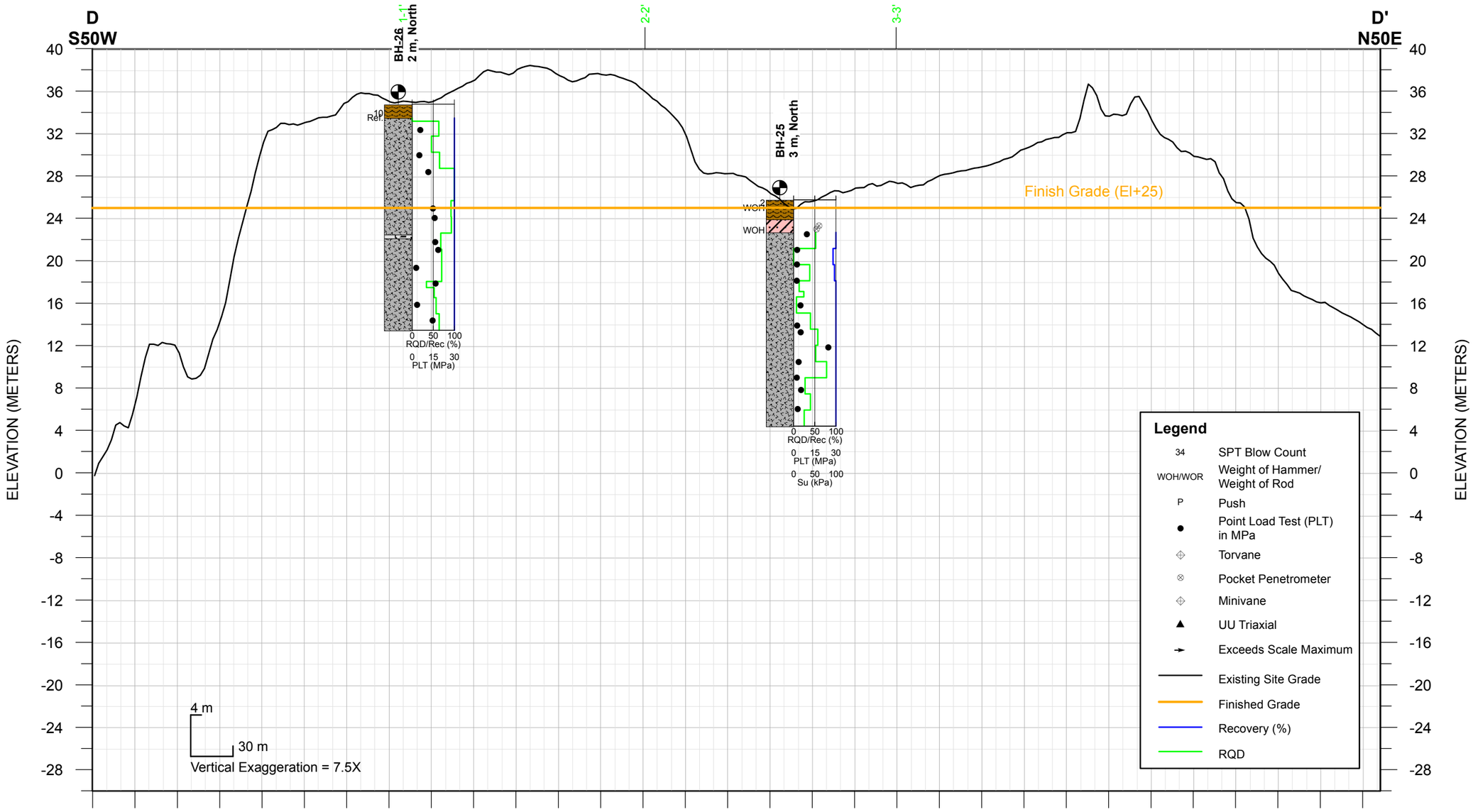
Soil/Rock Legend

Lean CLAY (CL)	Sandy Lean Clay (CL)	Sandy SILT (ML)	Silty SAND (SM)	Conglomerate	Schist
Silty CLAY (CL-ML)	Fat CLAY (CH)	Gravelly SILT (ML)	PEAT	Phyllite	
Lean CLAY with Sand (CL)	Silt (ML)	Clayey SAND (SC)	SHALE	Gneiss	

GENERALIZED SUBSURFACE CROSS SECTION C-C'
ONSHORE FACILITIES
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE 15

N:\Projects\04_2013\04_1013_0058_LeluIsland\Outputs\2013_12_23_FinalPreFEED\mxd\Plate15_ProfC.mxd, 12/18/2013, CDean



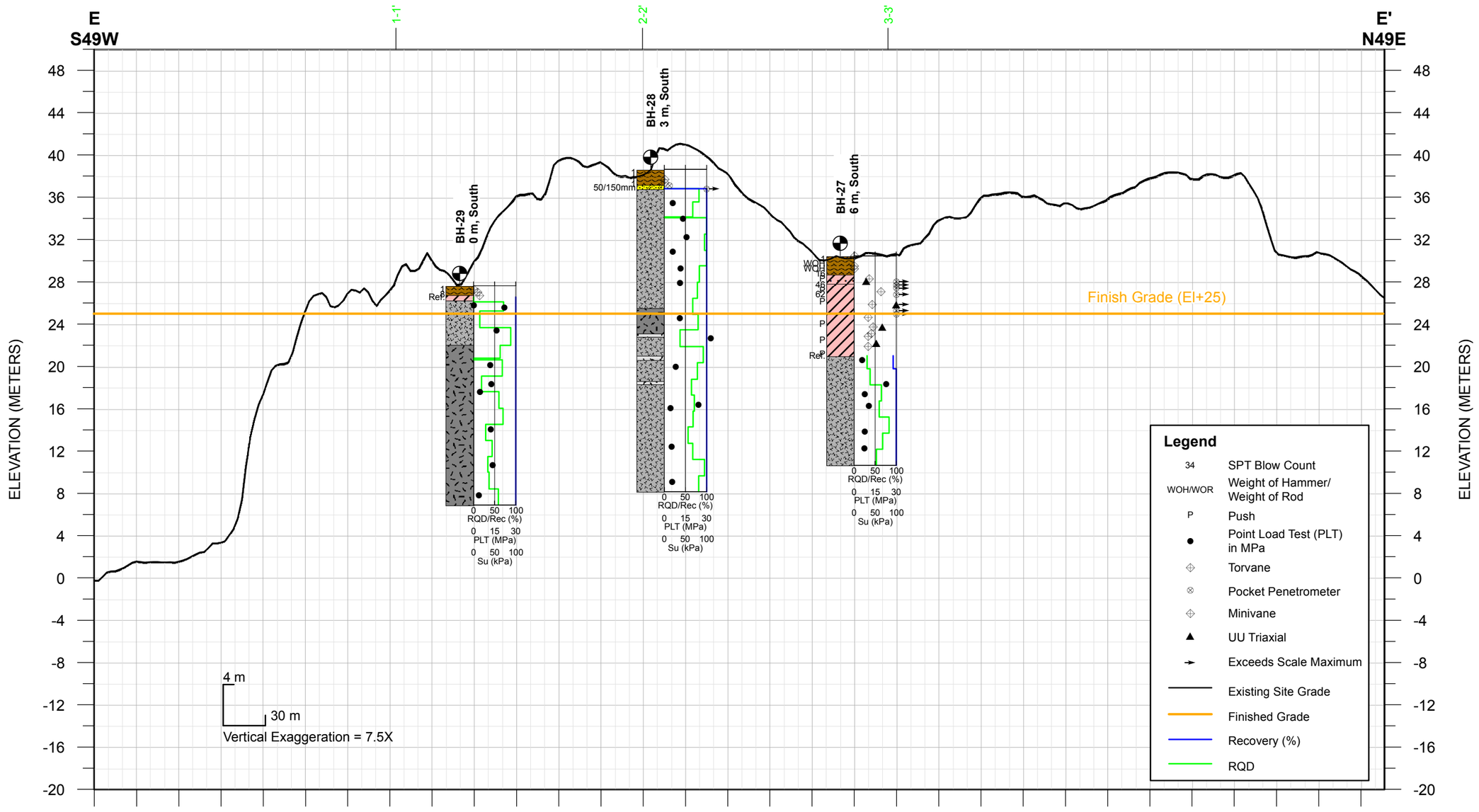
Soil/Rock Legend

Lean CLAY (CL)	Sandy Lean Clay (CL)	Sandy SILT (ML)	Silty SAND (SM)	Conglomerate	Schist
Silty CLAY (CL-ML)	Fat CLAY (CH)	Gravelly SILT (ML)	PEAT	Phyllite	
Lean CLAY with Sand (CL)	Silt (ML)	Clayey SAND (SC)	SHALE	Gneiss	

GENERALIZED SUBSURFACE CROSS SECTION D-D'
ONSHORE FACILITIES
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE 16

N:\Projects\04_2013\04_1013_0058_LeluIsland\Outputs\2013_12_23_FinalPreFEED\mxd\Plate16_ProfD.mxd, 12/18/2013, CDean



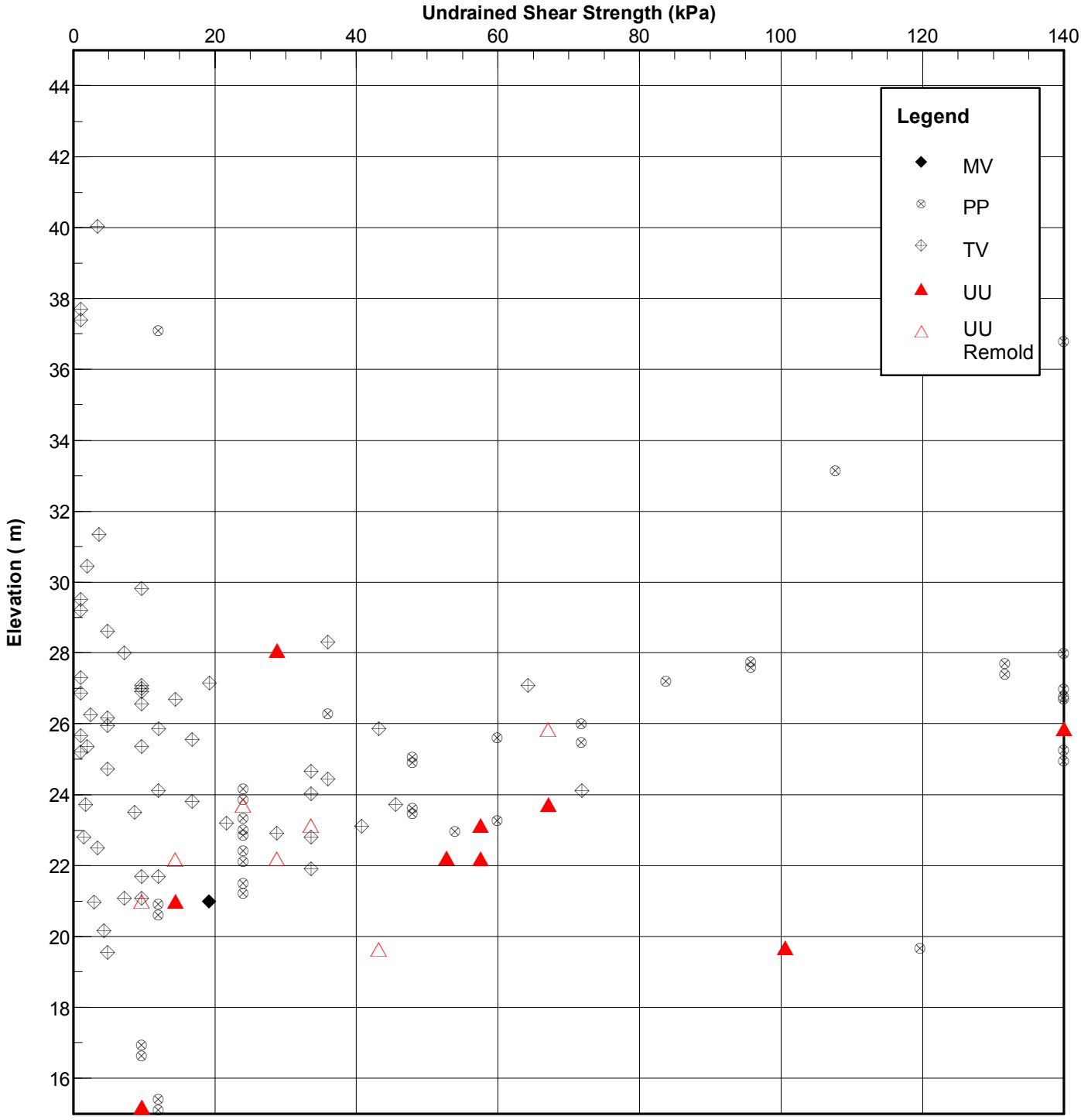
Soil/Rock Legend

- Lean CLAY (CL)
- Silty CLAY (CL-ML)
- Lean CLAY with Sand (CL)
- Sandy Lean Clay (CL)
- Fat CLAY (CH)
- Silt (ML)
- Sandy SILT (ML)
- Gravelly SILT (ML)
- Clayey SAND (SC)
- Silty SAND (SM)
- PEAT
- SHALE
- Conglomerate
- Phyllite
- Gneiss
- Schist

GENERALIZED SUBSURFACE CROSS SECTION E-E'
ONSHORE FACILITIES
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE 17

N:\Projects\04_2013\04_1013_0068_LeluIsland\Outputs\2013_12_23_FinalPreFEED\mxd\Plate17_ProfE.mxd, 12/18/2013, CDean

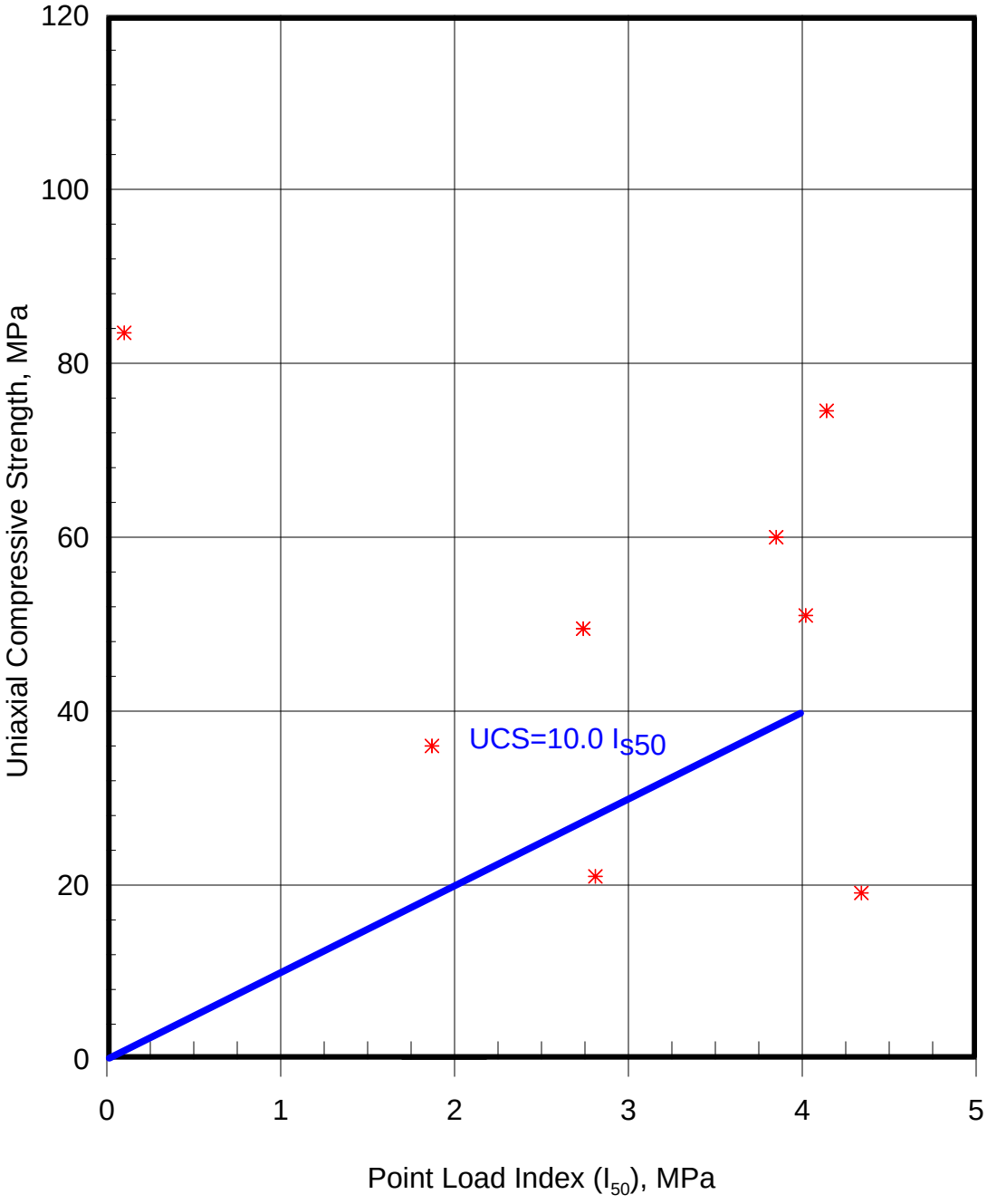


SOIL SHEAR STRENGTH VS ELEVATION
ONSHORE FACILITIES

PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE 18

N:\Projects\04_2013\04_1013_0058_LeluIsland\Outputs\2013_12_23_FinalPreFEED\mxd\Plate18_Su_Elev_Onshore.mxd, 12/18/2013, CDean



NOTES:

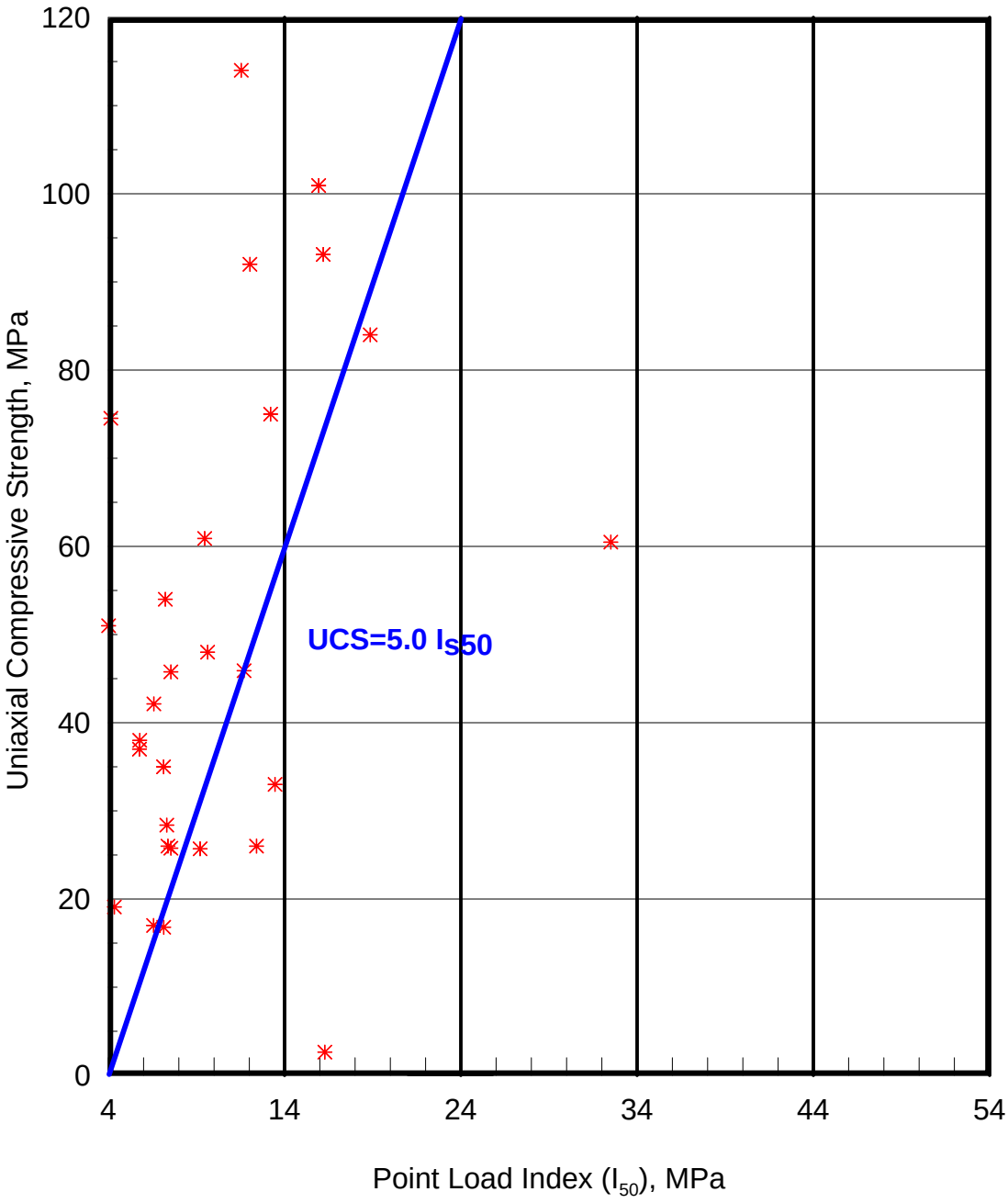
1. A correlation value of UCS of phyllites being equal to 10 times point load test strengths (Is(50)) was estimated for this study for Is(50) values less than 4 MPa .

2. The above correlation is for load application parallel to the foliations.

POINT LOAD INDEX VS UNIAXIAL COMPRESSIVE STRENGTH (ROCK)

PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE 19a



NOTES:

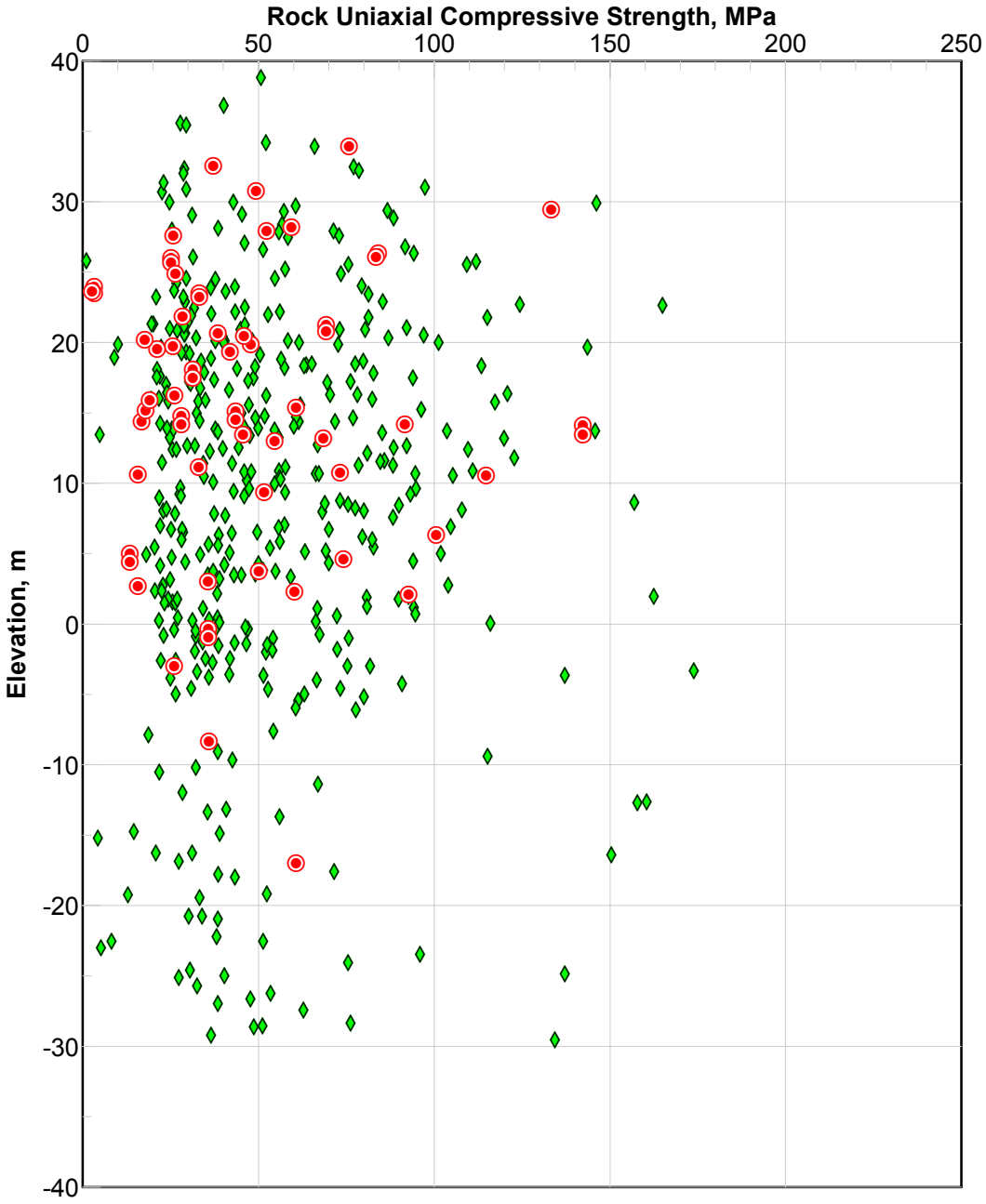
1. A correlation value of UCS of phyllites being equal to 5 times point load test strengths (Is(50)) was estimated for this study for Is(50) values greater than 4 MPa .

2. The above correlation is for load application normal to the foliations.

POINT LOAD INDEX VS UNIAXIAL COMPRESSIVE STRENGTH (ROCK)

PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE 19b



Legend

- Uniaxial Compressive Strength Test Result
- From Point Load Tests

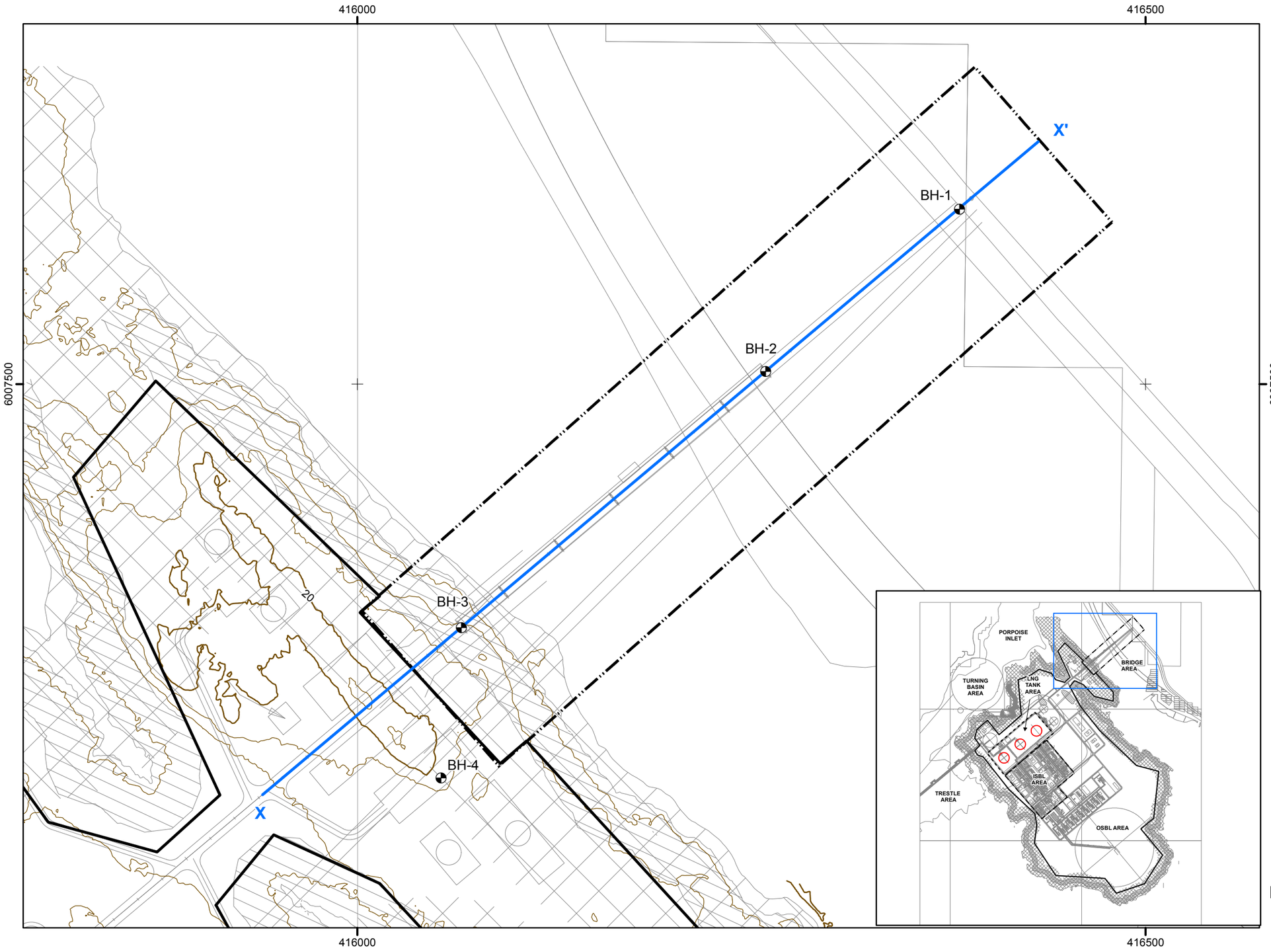
Note: Rock compressive strength from point load tests are based on qu =10 Is(50)) for point load values <= 4 and qu =5 Is(50)) for point load values > 4.

ROCK STRENGTH VS ELEVATION
ONSHORE FACILITIES

PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE 20

N:\Projects\04_2013\04_1013_0058_LeluIsland\Outputs\2013_12_23_FinalPreFEED\mxd\Plate20_Rock_UC_Elev_Onshore.mxd, 12/18/2013, CDean



Legend

- Borings
- LNG Tanks
- Cross Section Line
- Major contour, interval = 20m
- Minor contour, interval = 5 m
- Site Plan
- ISBL Area
- OSBL Area
- Bridge Area
- LNG Tank Area

Notes:

1) Base Drawing provided by KBR

2) Boring locations are approximate

N

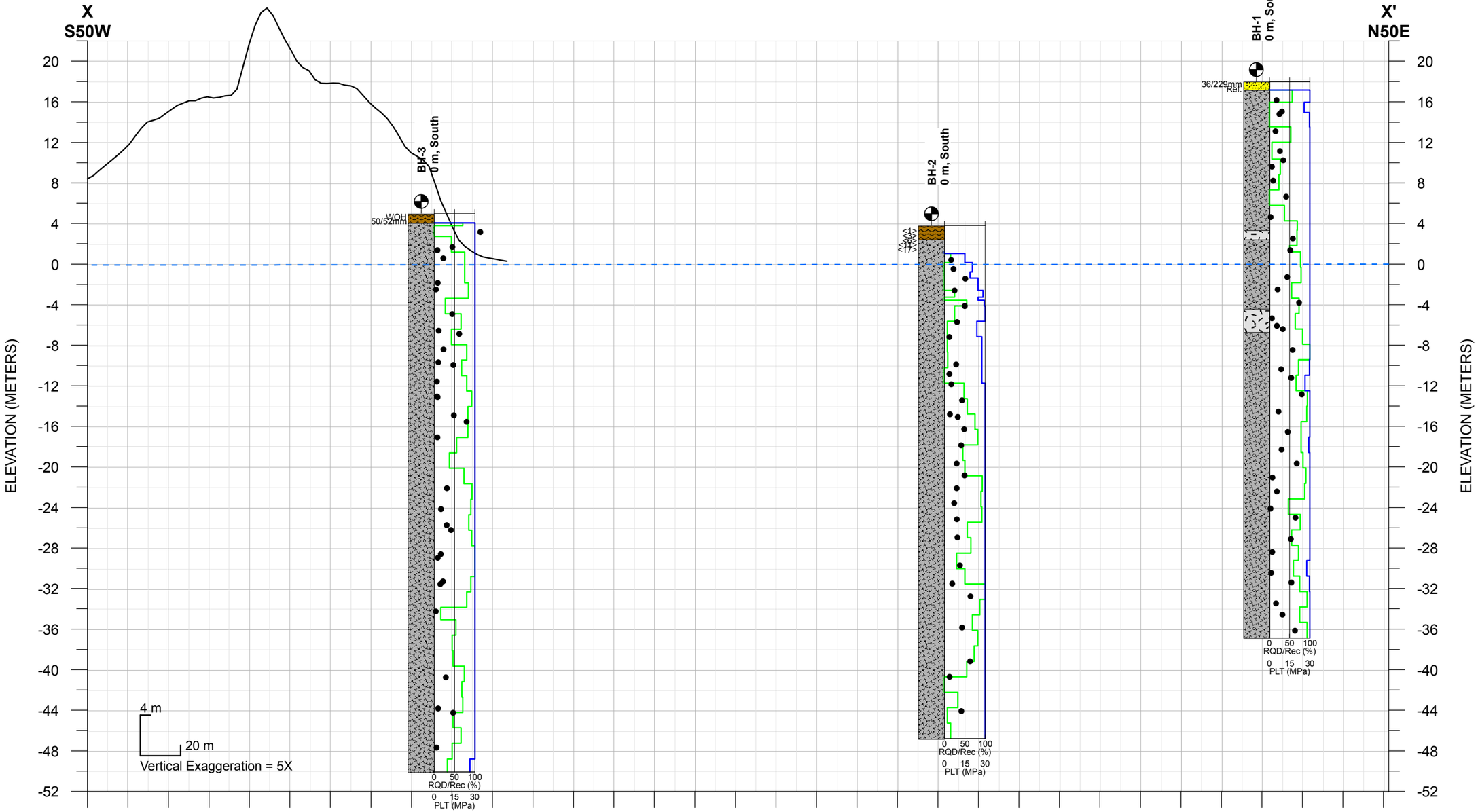
1:2,500

50 25 0 50 Meters

PLAN OF BORINGS
BRIDGE CROSSING
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE 21

N:\Projects\04_2013\04_1013_0058_LeluIsland\Outputs\2013_12_23_FinalPreFEED\mxd\Plate21_BridgePlanView.mxd, 12/18/2013, CDean



Soil/Rock Legend

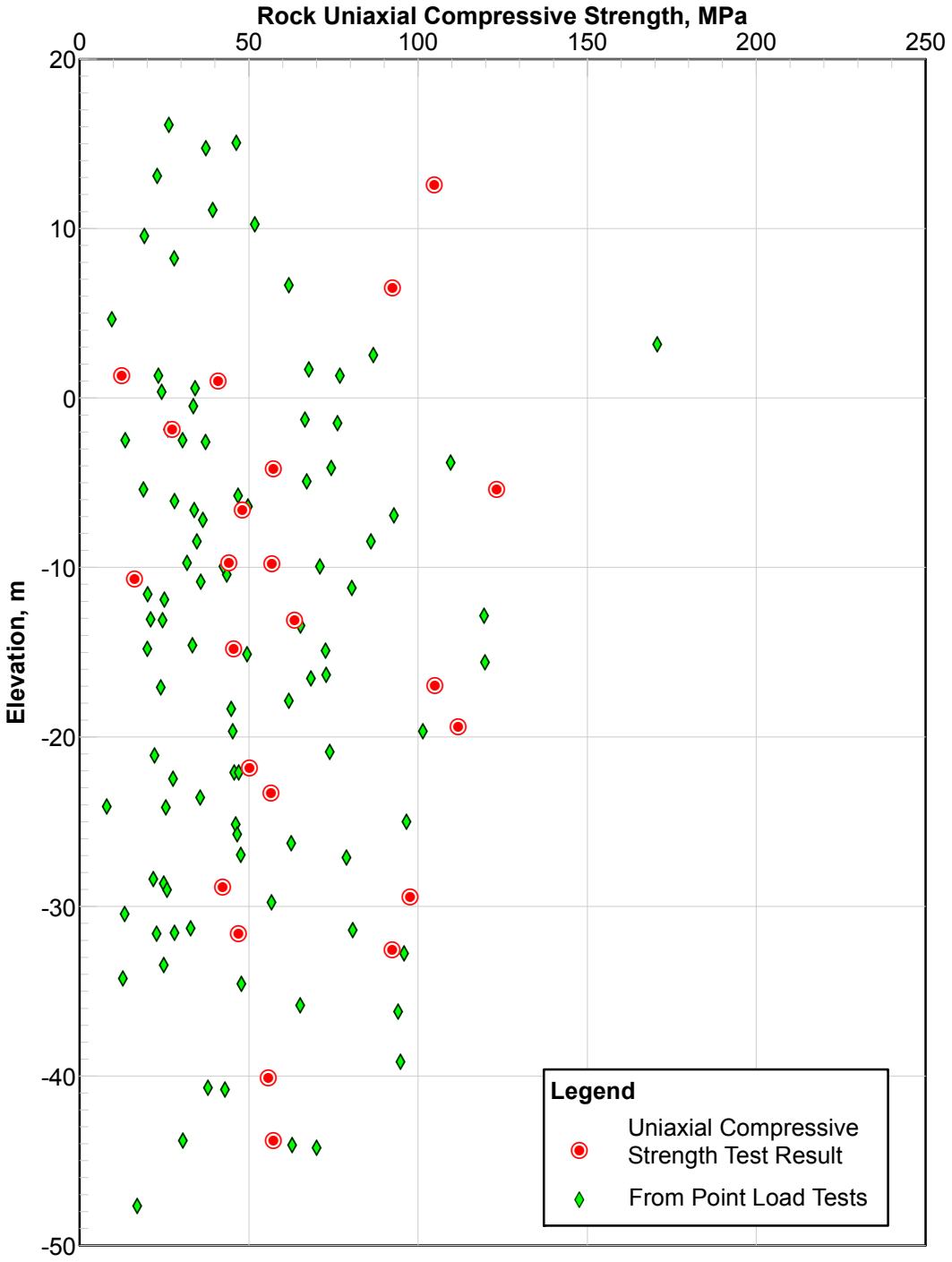
- Clayey SAND (SC)
- PEAT
- SHALE
- Phyllite
- Gneiss
- Existing Site Grade
- Water Elevation
- 34 SPT Blow Count
- <17> Modified California Sampler Blow Count Converted to Equivalent SPT Blow Count
- WOH Weight of Hammer
- Point Load Test (PLT)
- Recovery (%)
- RQD

GENERALIZED SUBSURFACE CROSS SECTION X-X' BRIDGE CROSSING

PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE 22

N:\Projects\04_2013\04_1013_0058_LeluIsland\Outputs\2013_12_23_FinalPreFEED\mxd\Plate22_BridgeXsect.mxd, 12/18/2013, CDean

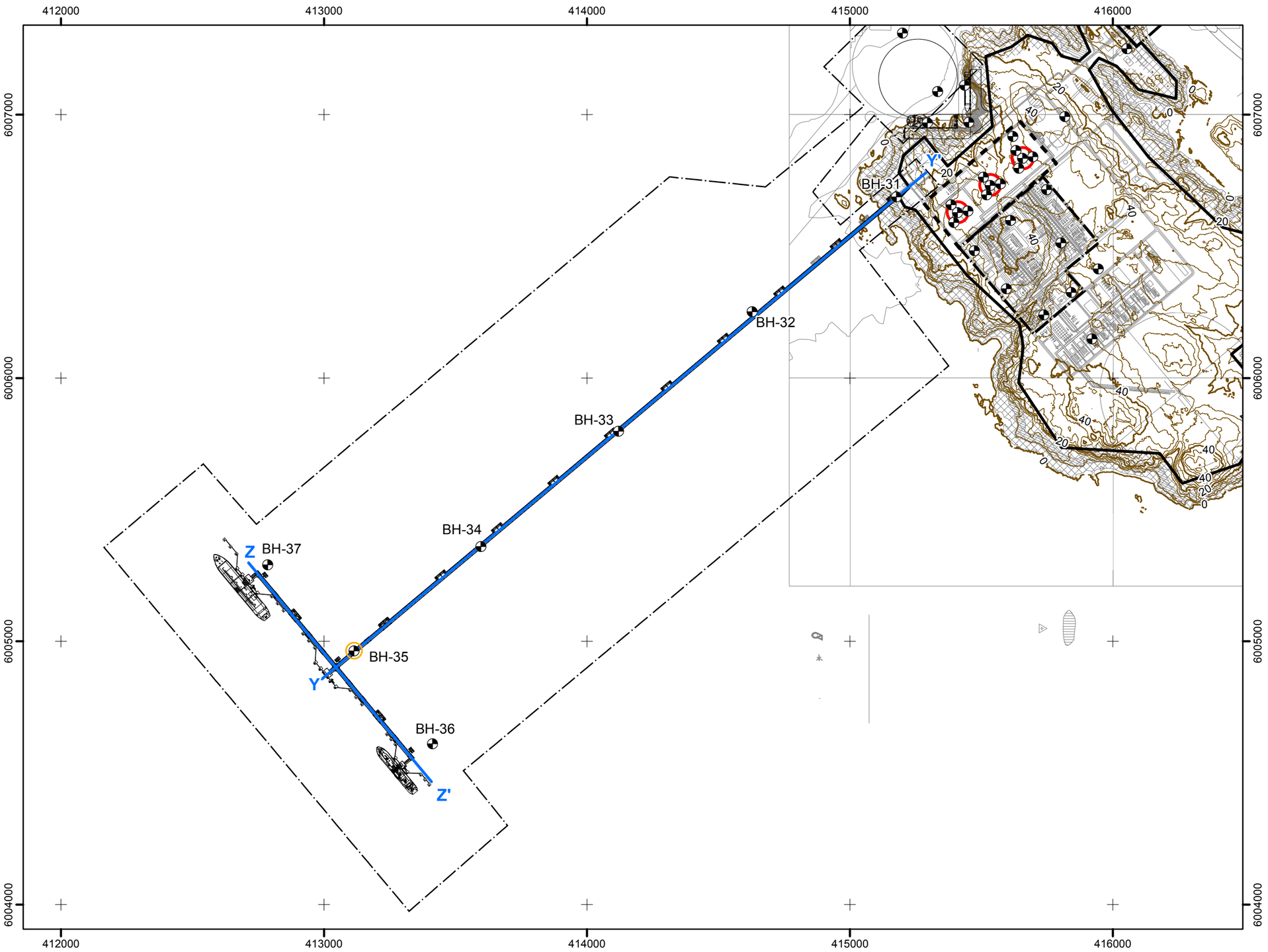


Note: Rock compressive strength from point load tests are based on qu =10 Is(50)) for point load values <= 4 and qu =5 Is(50)) for point load values > 4.

ROCK STRENGTH VS ELEVATION
BRIDGE CROSSING
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE 23

N:\Projects\04_2013\04_1013_0058_LeluIsland\Outputs\2013_12_23_FinalPreFEED\mxd\Plate23_Rock_UC_Elev_Bridge.mxd, 12/18/2013, CDean



Legend

- Borings
- PS Logging Borings
- LNG Tanks
- Cross Section Lines
- Site Plan
- Nearshore Geophysical Survey Area

Topography Contours

- Major contour, interval = 20m
- Minor contour, interval = 5 m

Notes:

1) Base drawing provided by KBR

2) Boring locations are approximate

N

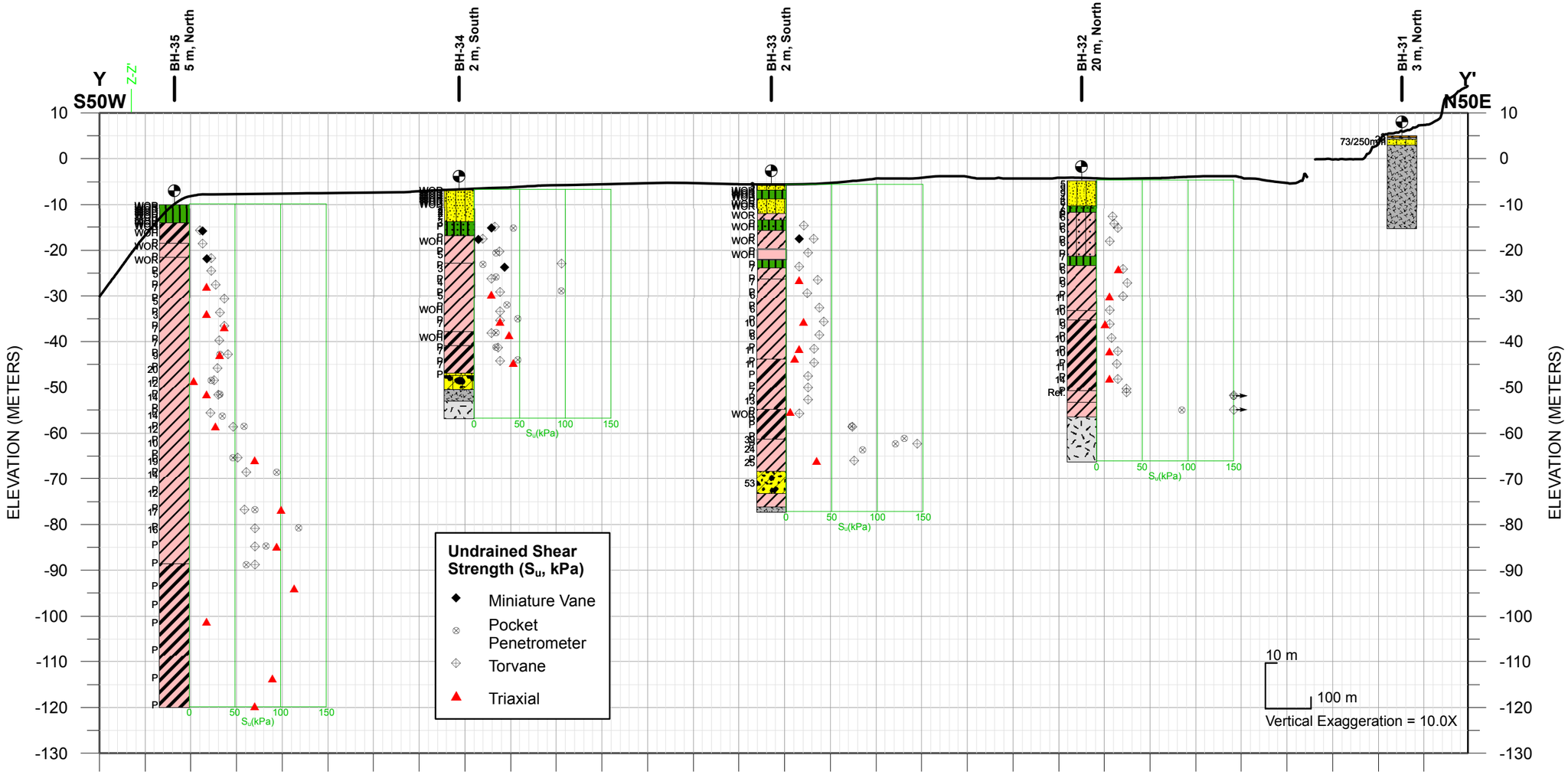
1:15,000

200 100 0 200
Meters

PLAN OF BORINGS
TRESTLE AND JETTY
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE 24

N:\Projects\04_2013\04_1013_0056_LeluIsland\Outputs\2013_12_23_FinalPreFEED\mxd\Plate24_PlanofExpl.mxd, 12/18/2013, CDean



Soil/Rock Legend

- Lean CLAY (CL)
- Silty CLAY (CL-ML)
- Sandy Lean Clay (CL)
- Lean to Fat CLAY (CL-CH)
- Fat CLAY (CH)
- Silt (ML)
- SILT with Sand (ML)
- Sandy SILT (ML)
- Silty SAND (SM)
- Clayey GRAVEL (GC)
- Low-Plasticity Organic (OL)
- PEAT
- Conglomerate
- Phyllite
- Gneiss
- 6 SPT Blow Count
- WOH Weight of Hammer
- WOR Weight of Rod
- P Push

GENERALIZED SUBSURFACE CROSS SECTION Y-Y' - TRESTLE

PACIFIC NORTHWEST LNG PROJECT
PETRONAS
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE 25

N:\Projects\04_2013\04_1013_0058_LeluIsland\Outputs\2013_12_23_FinalPreFEEDmxd\Plate25_ProfY_Su.mxd, 12/18/2013, CDean

Z
N40W

Z'
S40E

BH-37
53 m, East

BH-35
94 m, East

BH-36
96 m, East

Y-Y'

ELEVATION (METERS)

10 m
30 m
Vertical Exaggeration = 3X

S_u(kPa)

Undrained Shear Strength (S_u, kPa)

- Miniature Vane
- Pocket Penetrometer
- Torvane
- Triaxial

Soil/Rock Legend

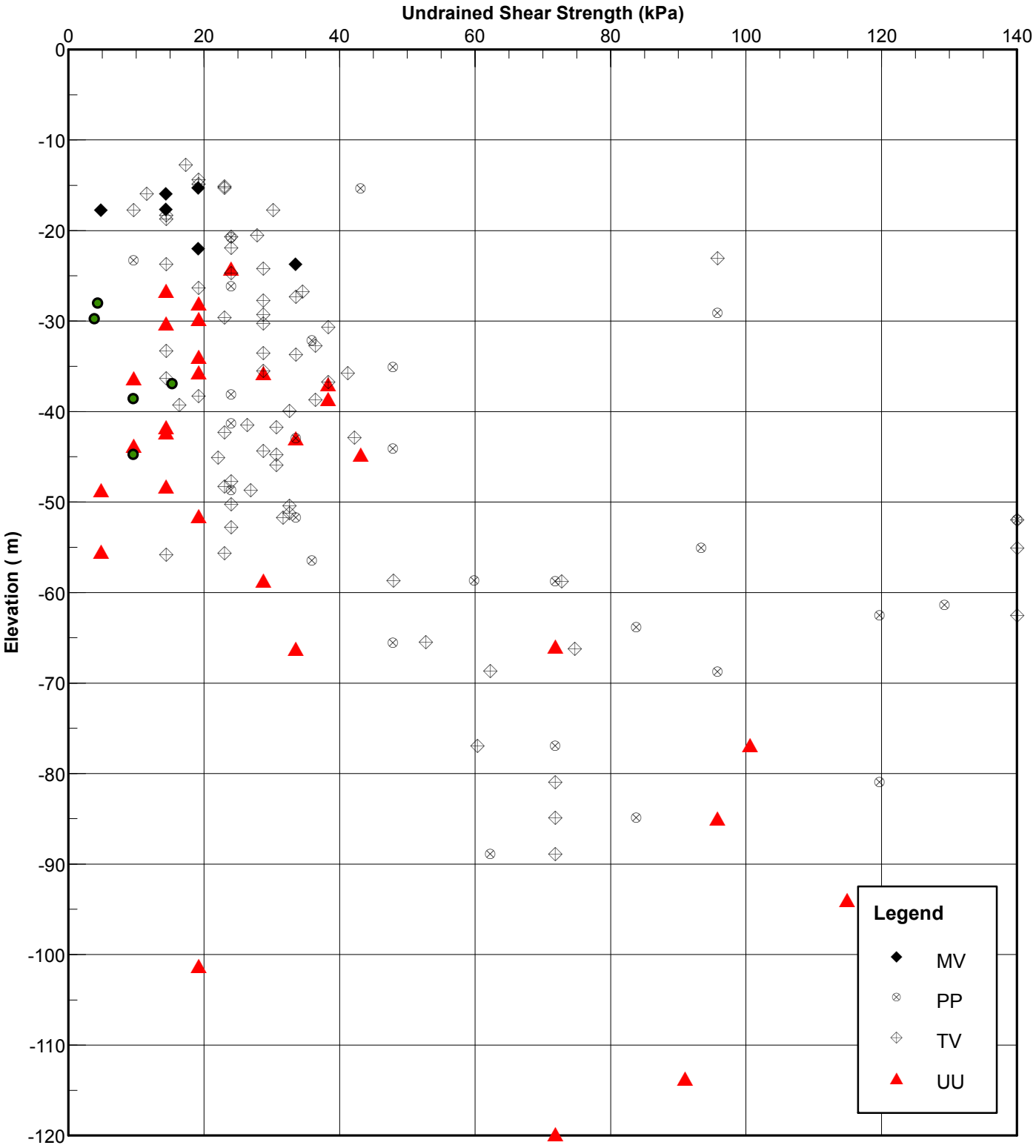
- Lean CLAY (CL)
- Silty CLAY (CL-ML)
- Sandy Lean Clay (CL)
- Lean to Fat CLAY (CL-CH)
- Fat CLAY (CH)
- Silt (ML)
- SILT with Sand (ML)
- Sandy SILT (ML)
- Silty SAND (SM)
- Clayey GRAVEL (GC)
- Low-Plasticity Organic (OL)
- PEAT
- Conglomerate
- Phyllite
- Gneiss

6 SPT Blow Count
WOH Weight of Hammer
WOR Weight of Rod
P Push

GENERALIZED SUBSURFACE CROSS SECTION Z-Z' - JETTY
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE 26

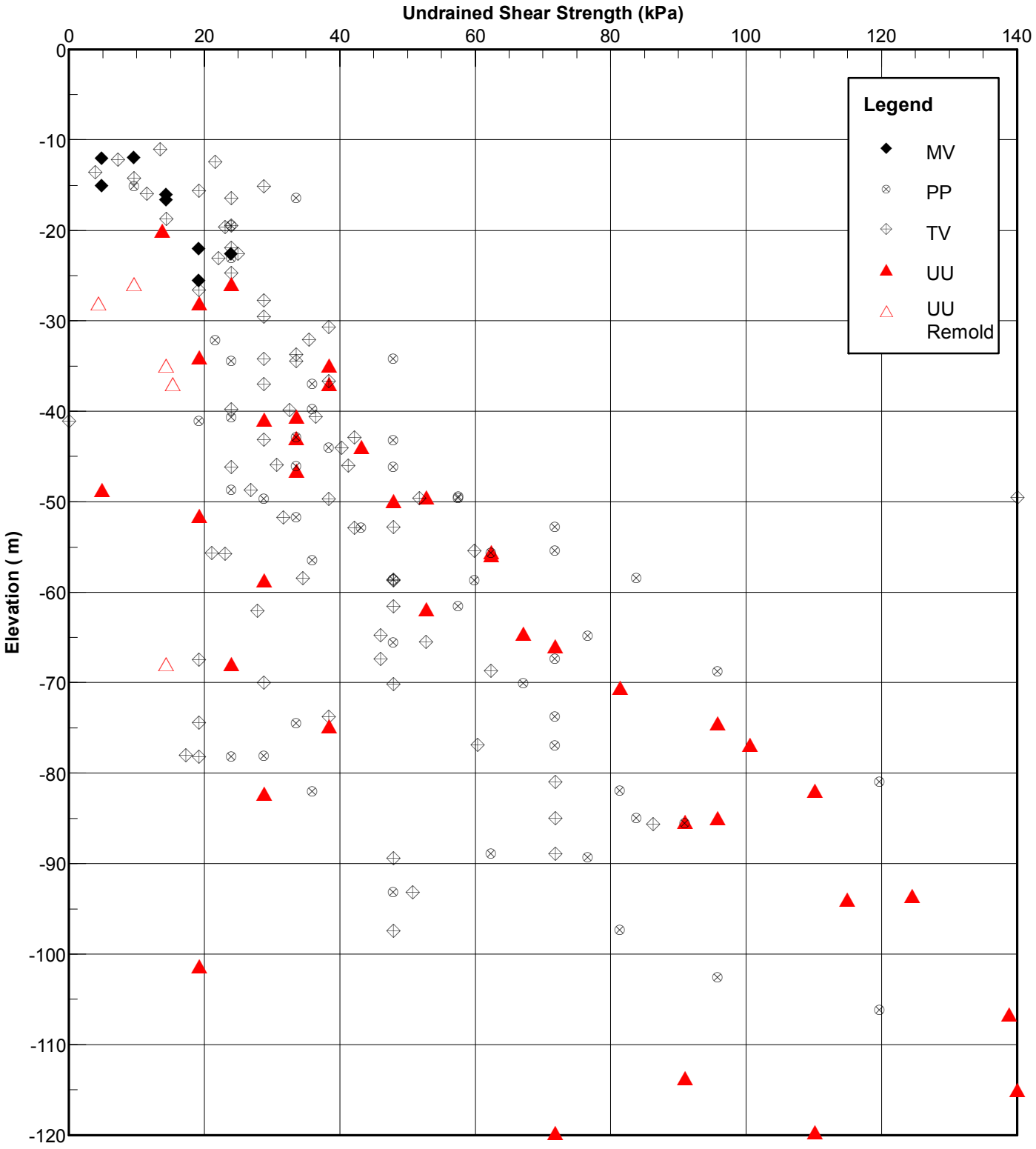
N:\Projects\04_2013\04_1013_0058_LeluIsland\Outputs\2013_11_11_DraftPreFEED\mxd\Plate26_ProfZ_Su.mxd, 11/11/2013, CDean



SOIL SHEAR STRENGTH VS ELEVATION
TRESTLE
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE 27

N:\Projects\04_2013\04_1013_0058_LeluIsland\Outputs\2013_12_23_FinalPreFEED\mxd\Plate27_Su_Elev_Trestle.mxd, 12/18/2013, CDean



SOIL SHEAR STRENGTH VS ELEVATION
JETTY
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE 28

N:\Projects\04_2013\04_1013_0058_LeluIsland\Outputs\2013_12_23_FinalPreFEED\mxd\Plate28_Su_Elev_Jetty.mxd, 12/18/2013, CDean

F
N31W

F'
S31E

BH-39
0 m, East

BH-38
0 m, West

WOR
P
12/ref.

48

ELEVATION (METERS)

-4
-6
-8
-10
-12
-14
-16
-18
-20
-22
-24
-26
-28
-30
-32
-34
-36
-38
-40
-42
-44

0 50 100
RQD/Rec (%)
0 15 30
PLT (MPa)

2 m
10 m
Vertical Exaggeration = 5X

Soil/Rock Legend

- Silt (ML)
- SHALE
- Phyllite

Legend

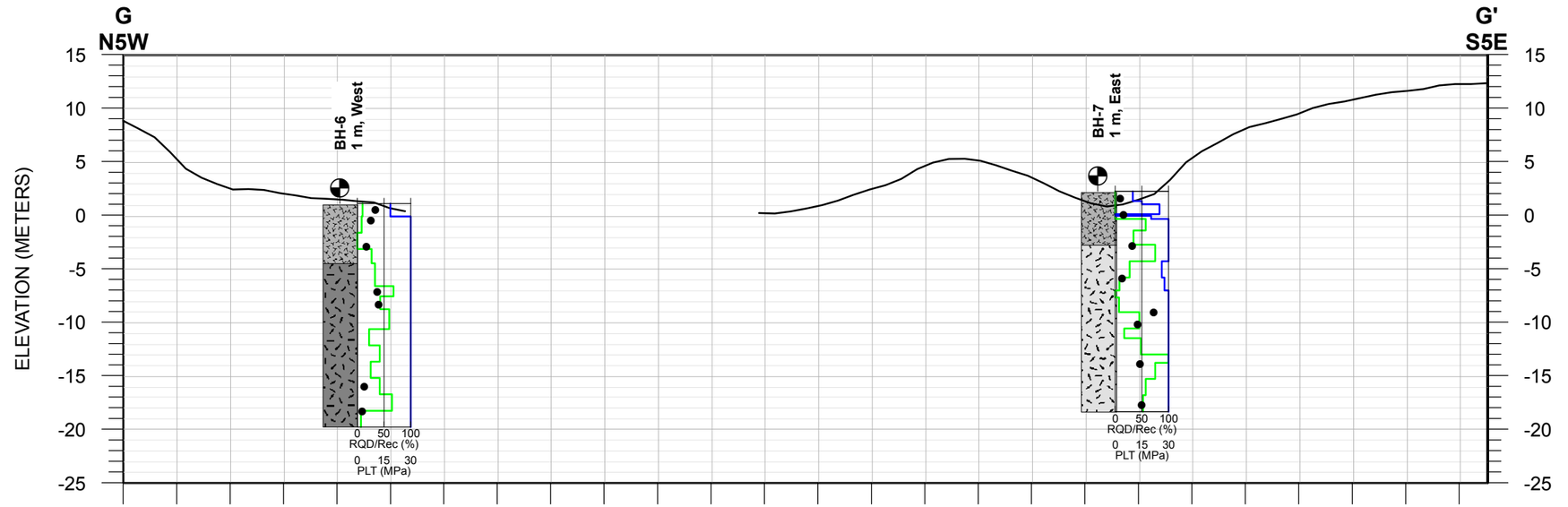
- 34 — SPT Blow Count
- WOR — Weight of Rod
- P — Push
- ● — Point Load Test (PLT) in MPa
- ▲ — UU Test
- Existing Site Grade
- Recovery (%)
- RQD

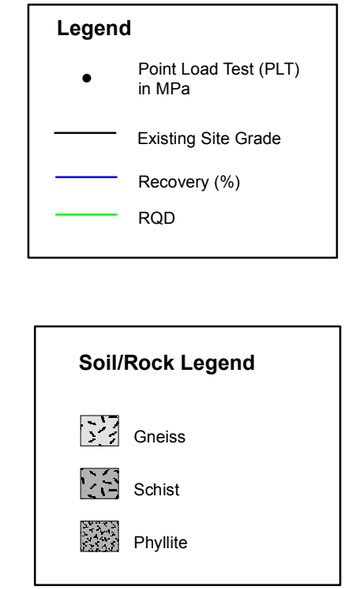
0 50 100
RQD/Rec (%)
0 15 30
PLT (MPa)
0 50 100
Su (kPa)

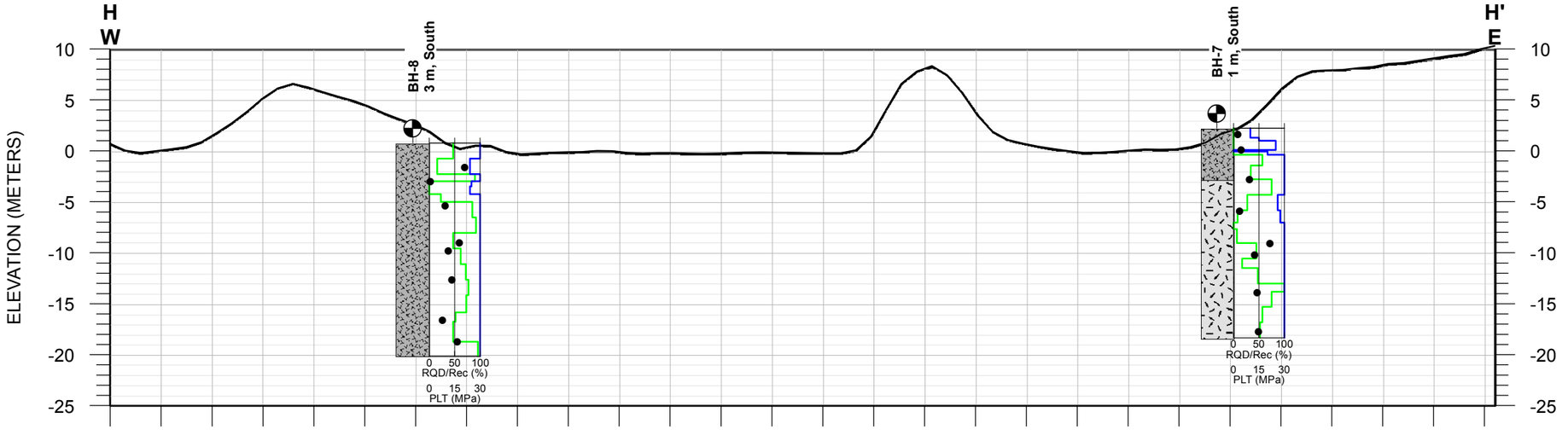
GENERALIZED SUBSURFACE CROSS SECTION F-F'
TURNING BASIN
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

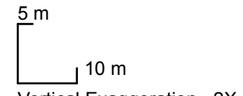
PLATE 29

N:\Projects\04_2013\04_1013_0058_LeluIsland\Outputs\2013_12_23_FinalPreFEED\mxd\Plate29_ProfF.mxd, 12/19/2013, CDean





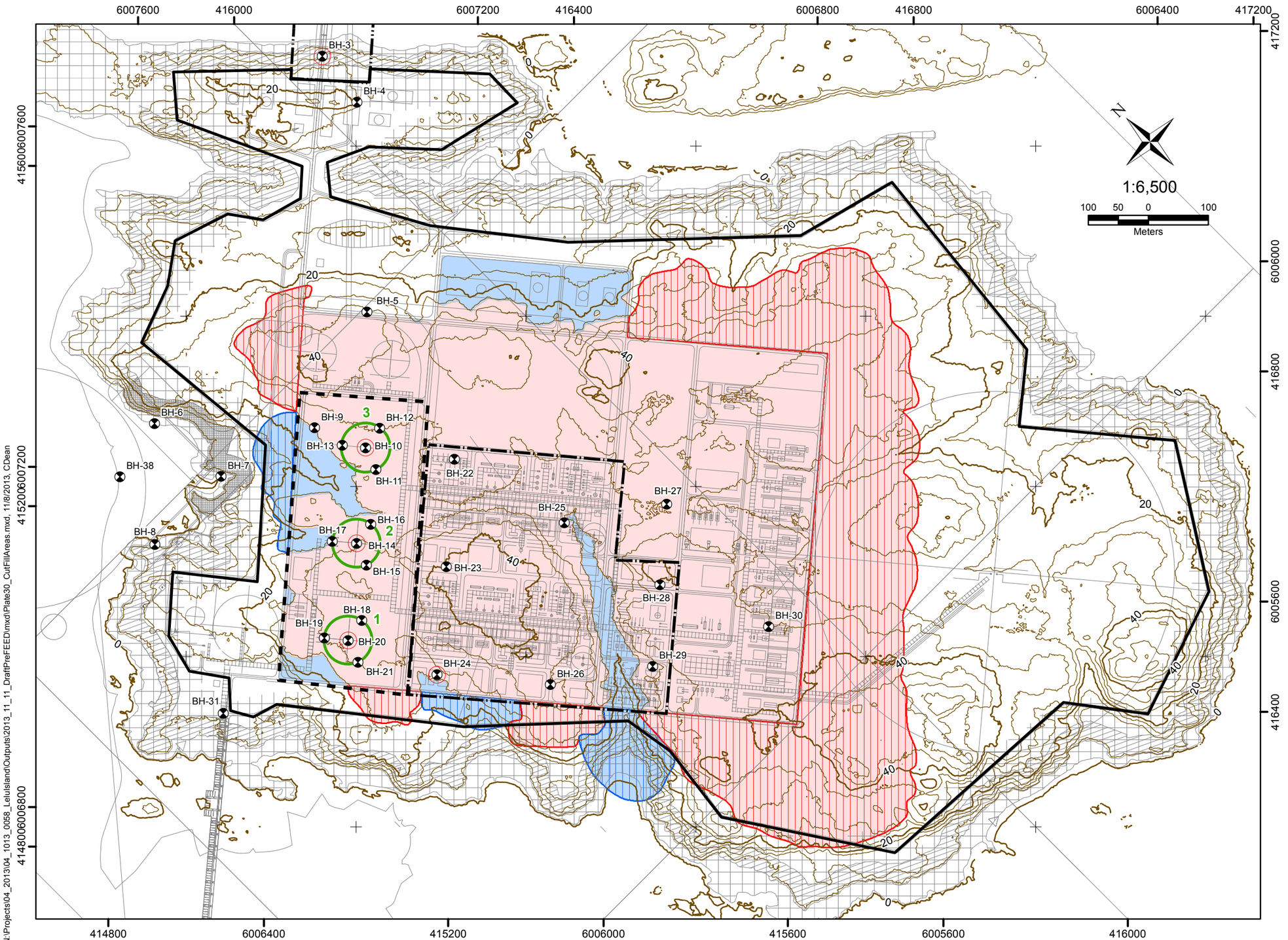




GENERALIZED SUBSURFACE CROSS SECTION G-G'
MOF AREA
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE 30

N:\Projects\04_2013\04_1013_0058_LeluIsland\Outputs\2013_12_23_FinalPreFEED\mxd\Plate30_ProfG_H.mxd, 12/18/2013, CDean



Legend

- Borings
- PS Logging/Acoustic Televiewer Borings
- LNG Tank and Tank Number
- Major contour, interval = 20m
- Minor contour, interval = 5 m
- Site Plan
- ISBL Area
- OSBL Area
- Bridge Area
- LNG Tank Area
- Cut Area
- Fill Area
- Cut Slope Area
- Fill Slope Area

Notes:

1) Final Site Grade is assumed at El+25 m based on information provided by KBR

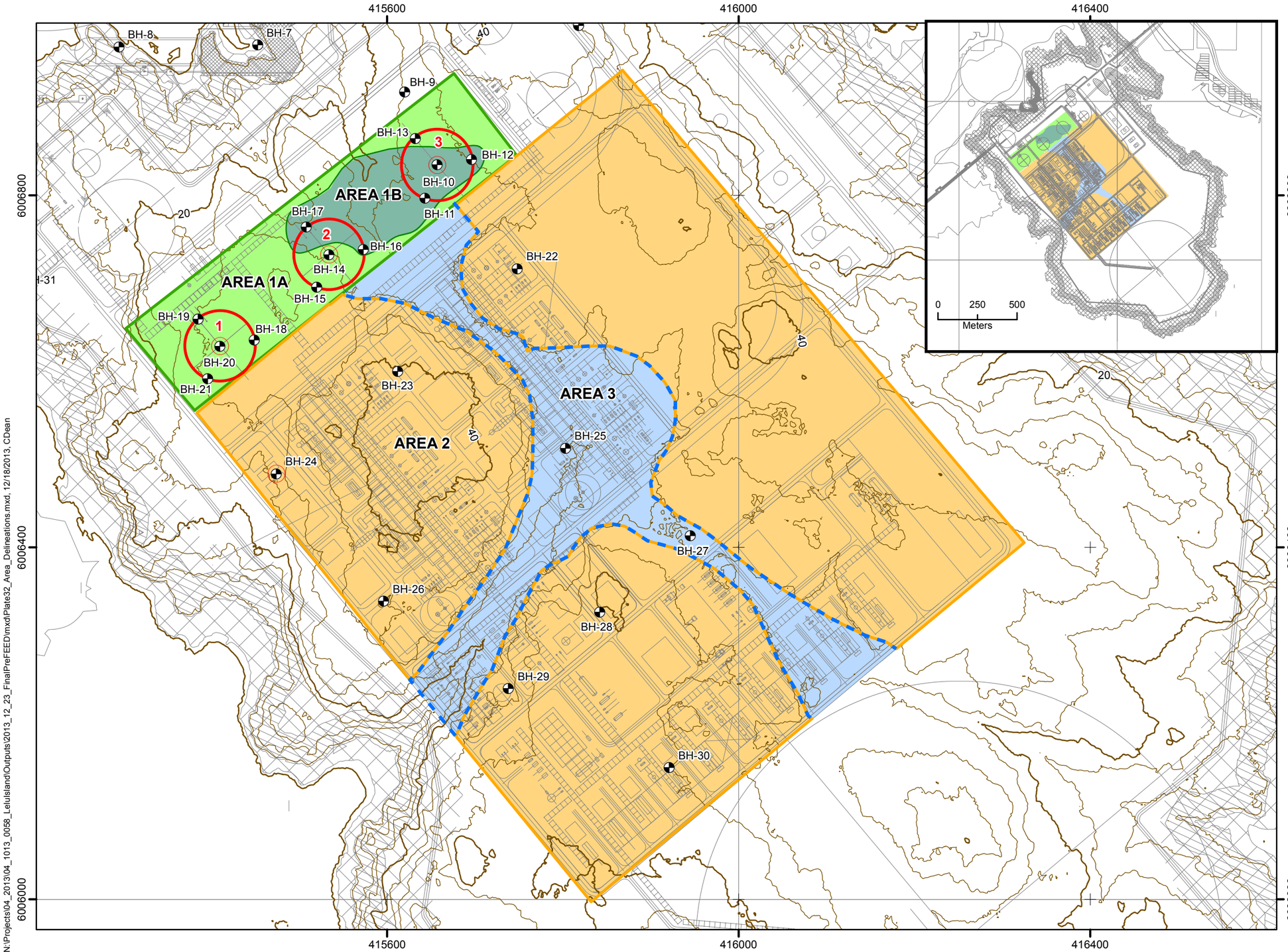
2) Base drawing provided by KBR

3) Boring locations are approximate

SITE GRADING- CUT AND FILL AREAS
ONSHORE FACILITIES
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE 31

N:\Projects\04_2013\04_1013_0068_LeluIsland\Outputs\2013_11_11_DraftPreFEED\mxd\Plate30_CutFillAreas.mxd, 11/8/2013, CDean



Legend

- Borings
- PS Logging/Acoustic Televiewer Borings
- 2 — LNG Tank and Tank Number
- Major contour, interval = 20m
- Minor contour, interval = 5 m
- Site Plan (provided by KBR)

Area

- Tank Area - Area 1A
- Tank Fill Area - Area 1B (Clay below El+25 m)
- ISBL/OSBL Rock Area - Area 2
- ISBL/OSBL Soft/Fill Area- Area 3
- Approximate Limits of Peat/ Cohesive Soils and/or Fill Areas

Notes:

1) Base drawing provided by KBR

2) Boring locations are approximate

N

1:4,500

100 50 0 100 Meters

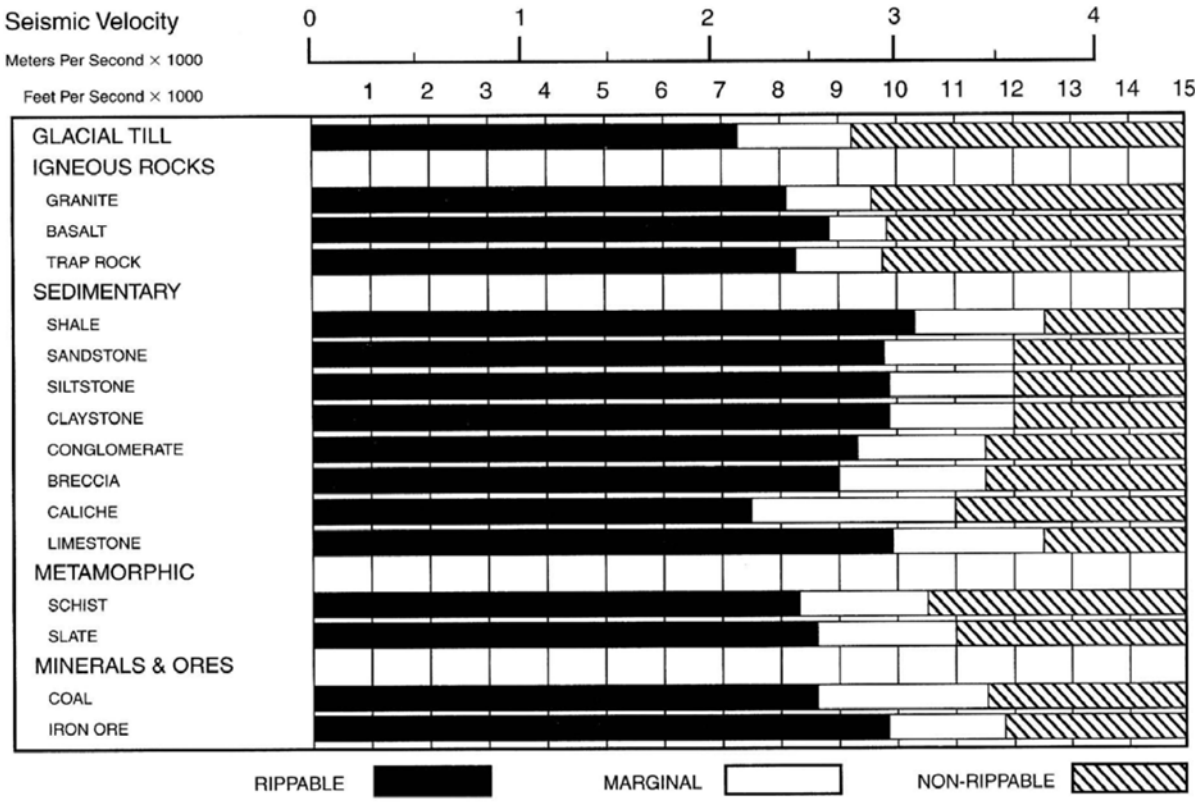
AREA DELINEATIONS
ONSHORE FACILITIES
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE 32

N:\Projects\04_2013\04_1013_0058_LeluIsland\Outputs\2013_12_23_FinalPreFEED\mxd\Plate32_Area_Delineations.mxd, 12/18/2013, CDean

D11R

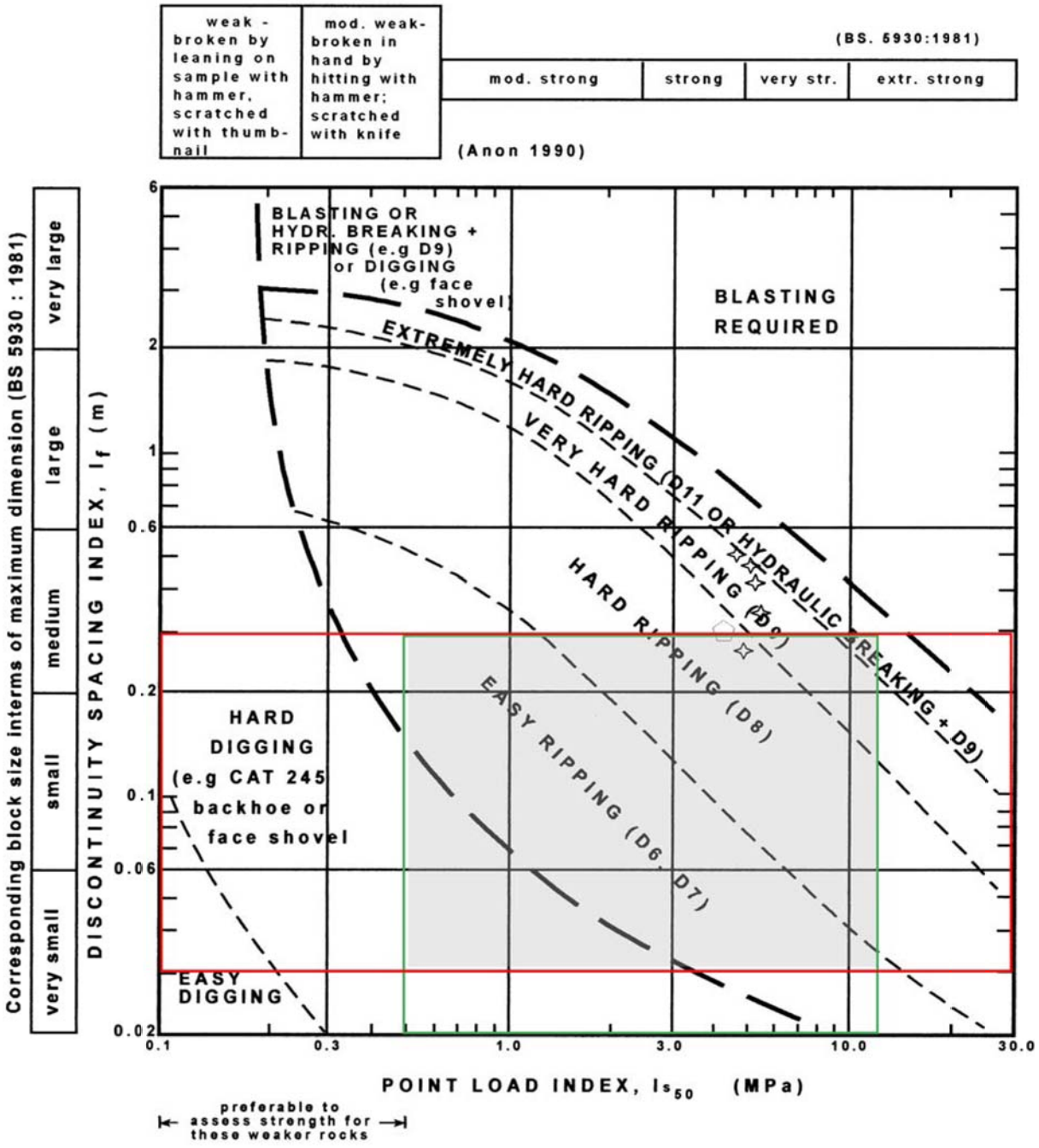
- **Multi or Single Shank No. 11 Ripper**
- **Estimated by Seismic Wave Velocities**



"D11R" chart from Caterpillar's Performance Handbook (2000)

N:\Projects\04_2013\04_1013_0058_LeluIsland\Outputs\2013_12_23_FinalPreFEED\mxd\Plate33_Rippability.mxd, 12/18/2013, CDean

GENERAL RIPPABILITY / BLASTING VALUES
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA



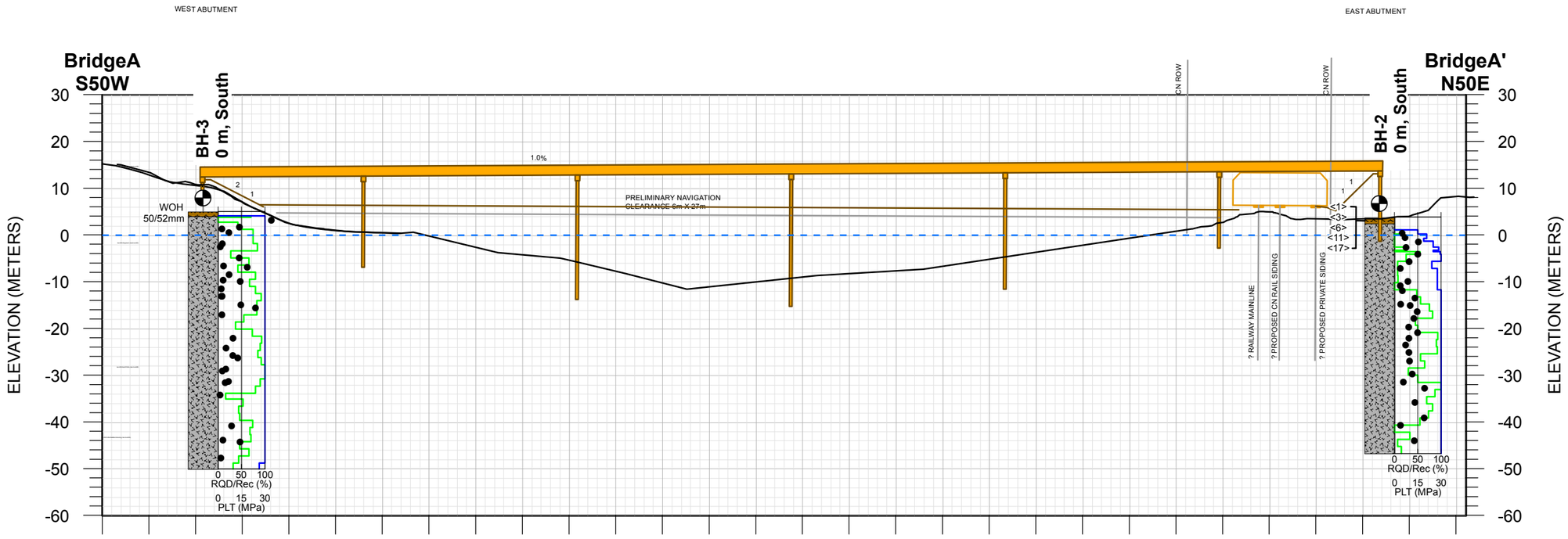
PETTIFER AND FOOKES (1994) RIPPABILITY /BLASTING CHART

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE 34

N:\Projects\04_2013\04_1013_0058_LeluIsland\Outputs\2013_12_23_FinalPreFEED\mxd\Plate34_RippabilityBlasting.mxd, 12/18/2013, CDean



Legend

PEAT
Phyllite
Existing Site Grade
Water Elevation
Proposed Bridge
34 SPT Blow Count
<17> Modified California Sampler Blow Count Converted to Equivalent SPT Blow Count
WOH Weight of Hammer
Point Load Test (PLT)
Recovery (%)
RQD

10 m
10 m
No Vertical Exaggeration

Notes:

1) Drawing provided by KBR

2) Boring locations are approximate

BRIDGE CROSSING SCHEMATIC
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

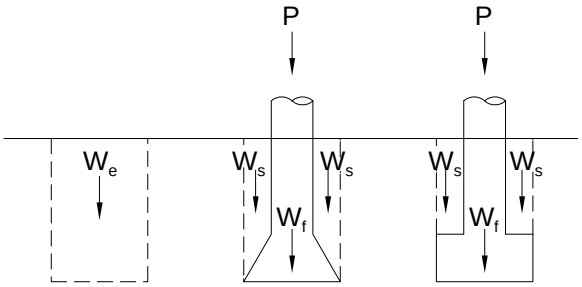
PLATE 35

N:\Projects\04_2013\04_1013_0058_LeluIsland\Outputs\2013_11_11_DraftPreFEED\mxd\Plate35_BridgeCrSchematic.mxd, 11/8/2013, CDean

FOUNDATION DESIGN CRITERIA

A properly-sized foundation must satisfy the two following criteria with respect to the supporting soil.

1. For soil strength. The bearing pressure created on the base of the foundation by the maximum design load must be less than that which would cause shear failure in the soil. A factor of safety of 2 or more with respect to the soil shear strength is generally used.
2. For soil compressibility. The bearing pressure created on the base of the foundation by the sustained load must not produce sufficient consolidation in the underlying soil to result in foundation settlement that is detrimental to the safety or utility of the structure.



SYMBOLS

TERMS AND SYMBOLS

P = Column load (subscript can be used to denote character of load: P_s = sustained load, P_n = normal operating load, P_m = maximum design load).

W_e = Weight of soil located above base of foundation excavation and lowest adjacent grade.*

W_s = Weight of soil located above foundation.*

W_f = Weight of foundation.*

A = Area of base of foundation.

p = Average bearing pressure acting on soil (subsript can be used to correspond to column load: P_s, P_n, P_m).

* Position of groundwater level must be considered in determining weights. Effective, or buoyant, unit weights should be used below the highest expected groundwater level.

BEARING PRESSURES

Gross Bearing Pressure, p, for any column load is the total pressure acting on the base of the foundation.

$$p = 1/A\ (P + W_s + W_f)$$

Net Bearing Pressure, p', for any column load is the difference between the gross bearing pressure acting on the base of the foundation and the soil pressure existing at that elevation from the lowest overlying or adjacent soils.

$$p' = 1/A\ (P + W_s + W_f - W_e)$$

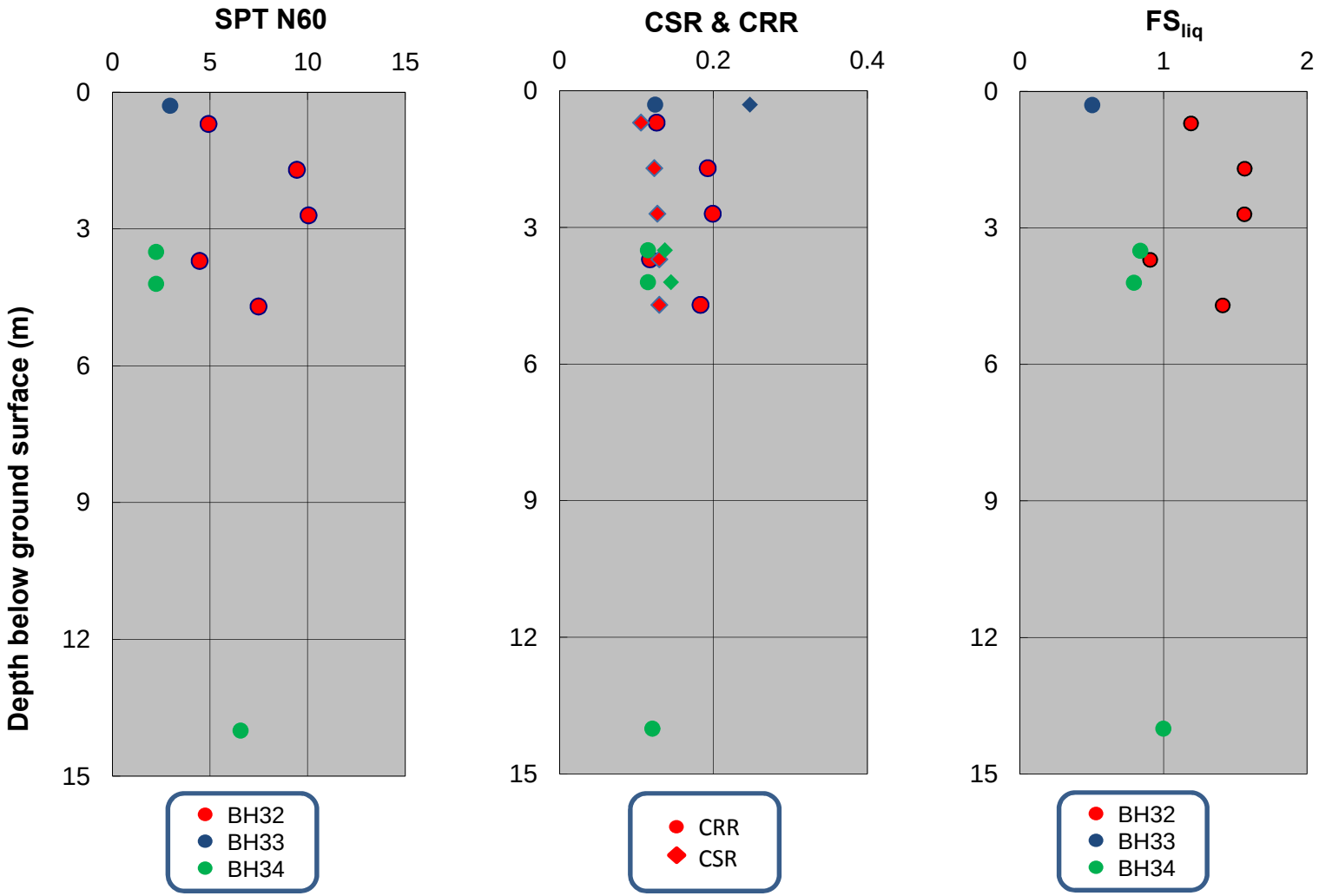
For analysis with regard to the first design criterion, soil strength, the column load in the above equations should usually be the maximum design load, P_m. Occasionally, the normal operating load, P_n, may also be used. If footing is loaded eccentrically, the increase in edge bearing pressure due to the eccentricity should be computed in the usual manner.

For analysis with regard to the second design criterion, soil compressibility, the column load in the above equations should be the sustained load, P_s. This load is the dead load plus the sustain live load.

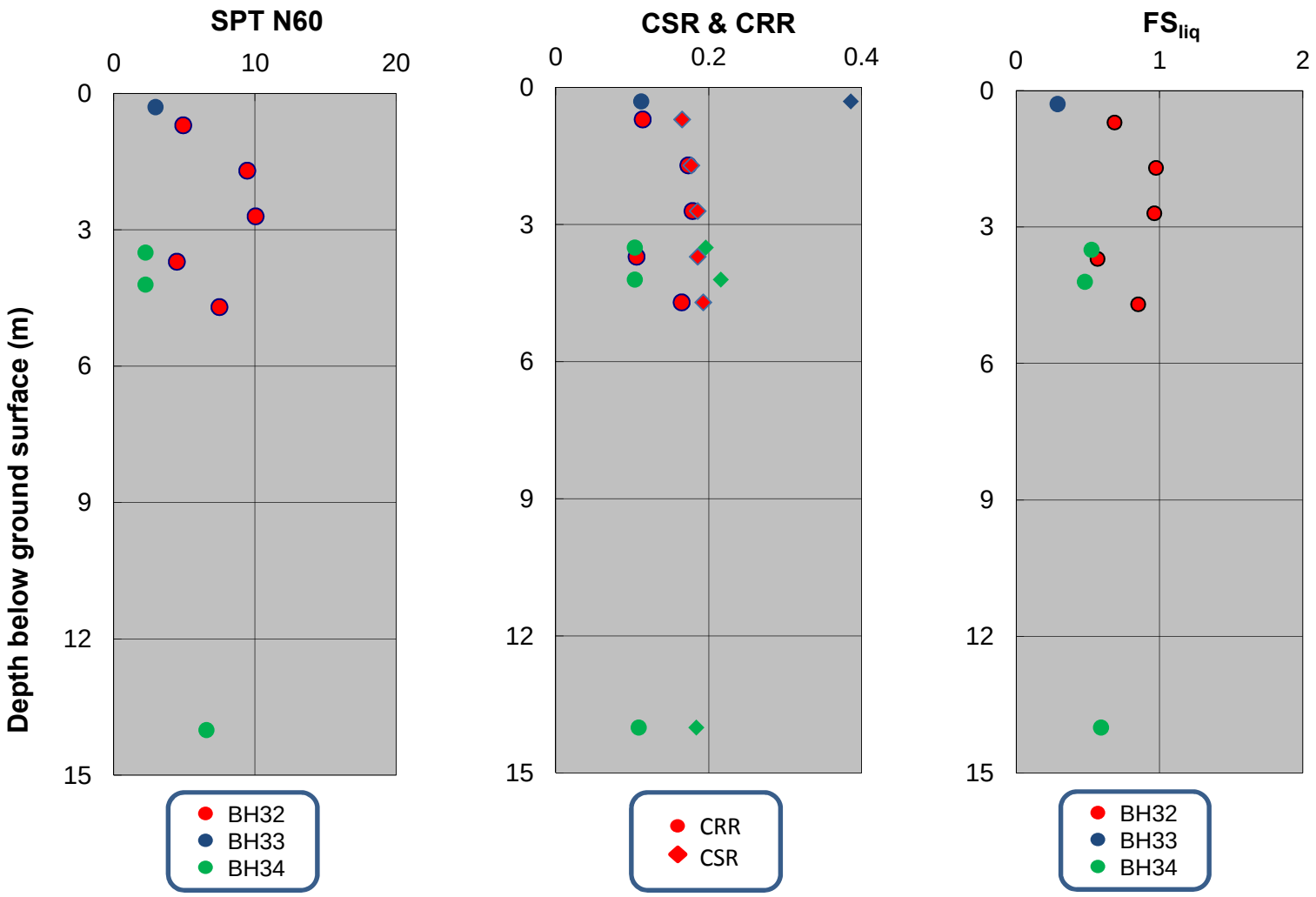
For further references, see pp. 506 - 512, "Soil Mechanics in Engineering Practice" by Karl Terzaghi and Ralph B. Peck (2nd edition); and pp. 564 - 565, "Fundamentals of Soil Mechanics" by Donald W. Taylor.

COMPUTATION OF BEARING PRESSURES
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

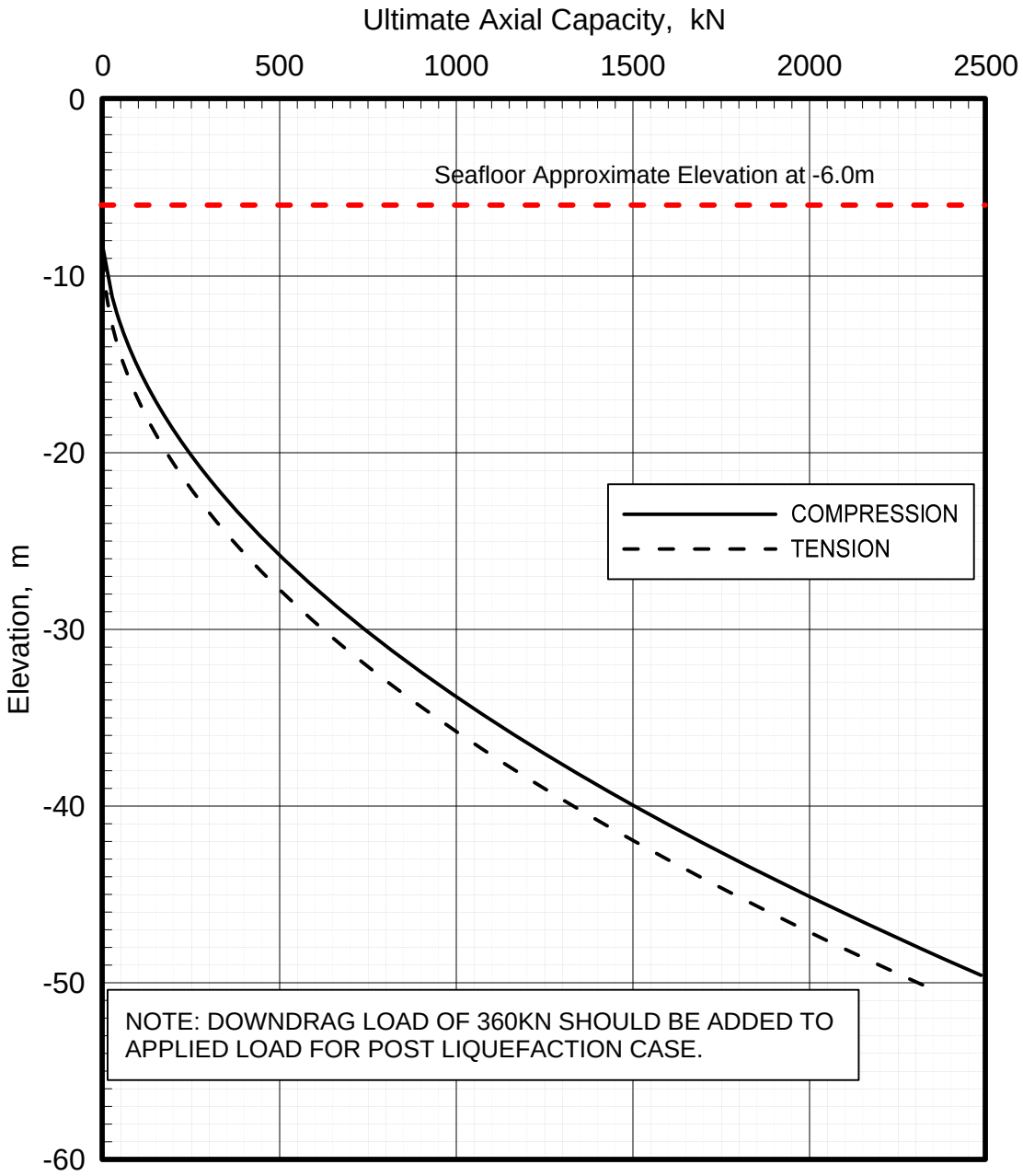
PLATE 36



LIQUEFACTION POTENTIAL FOR OBE CASE (475-YR)
TRESTLE
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA



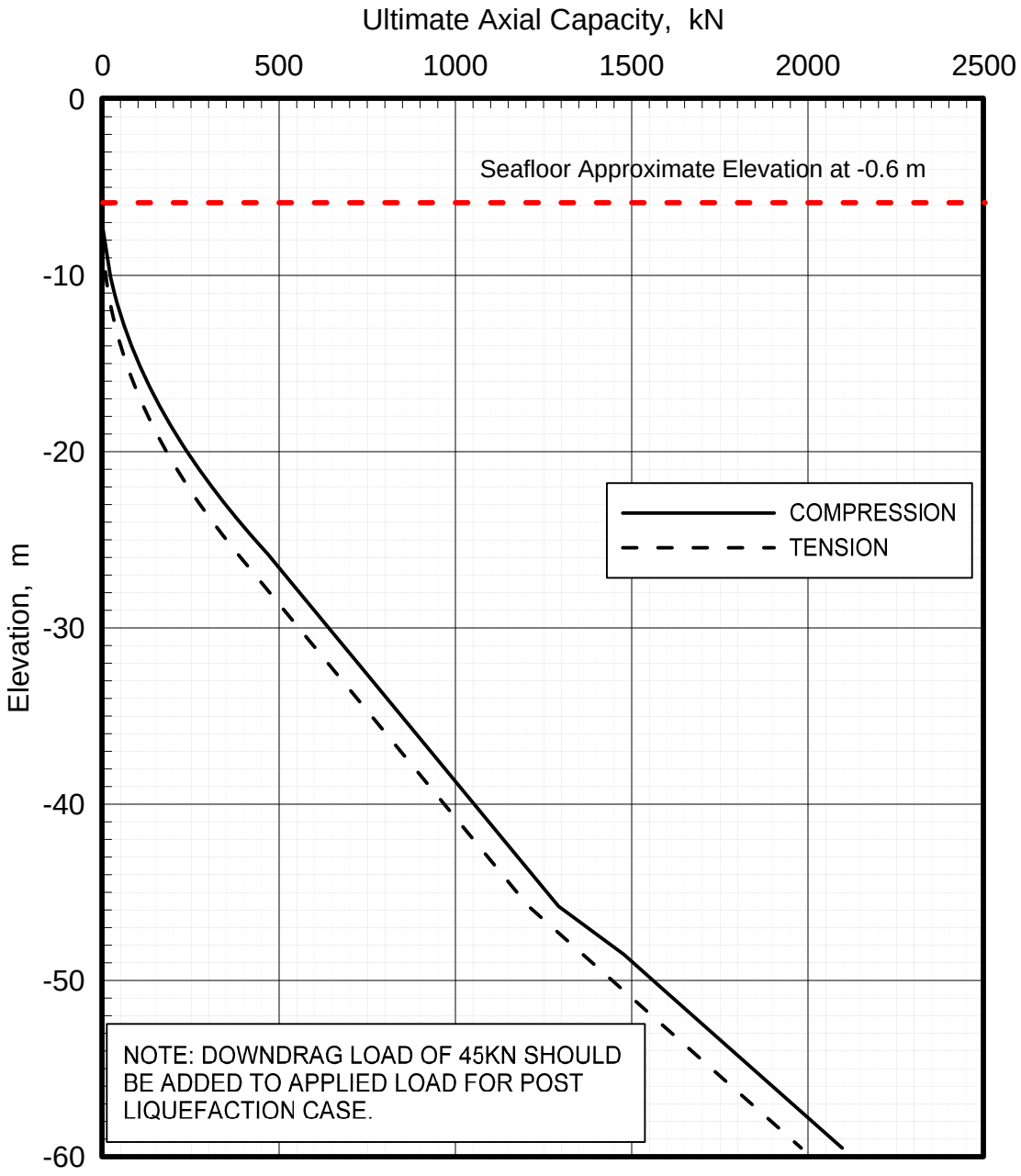
LIQUEFACTION POTENTIAL FOR SSE CASE (2475-YR)
TRESTLE
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA



NOTES:

1. These curves represent ultimate values for compression and tension. A safety factor of 2.0 should be applied for sustained compressive loads or transient tensile loads and a safety factor of 3.0 should be applied for sustained tensile loads.
2. These curves are for a single isolated pile. Group effects are discussed in the report.
3. Construction considerations are discussed in the report.

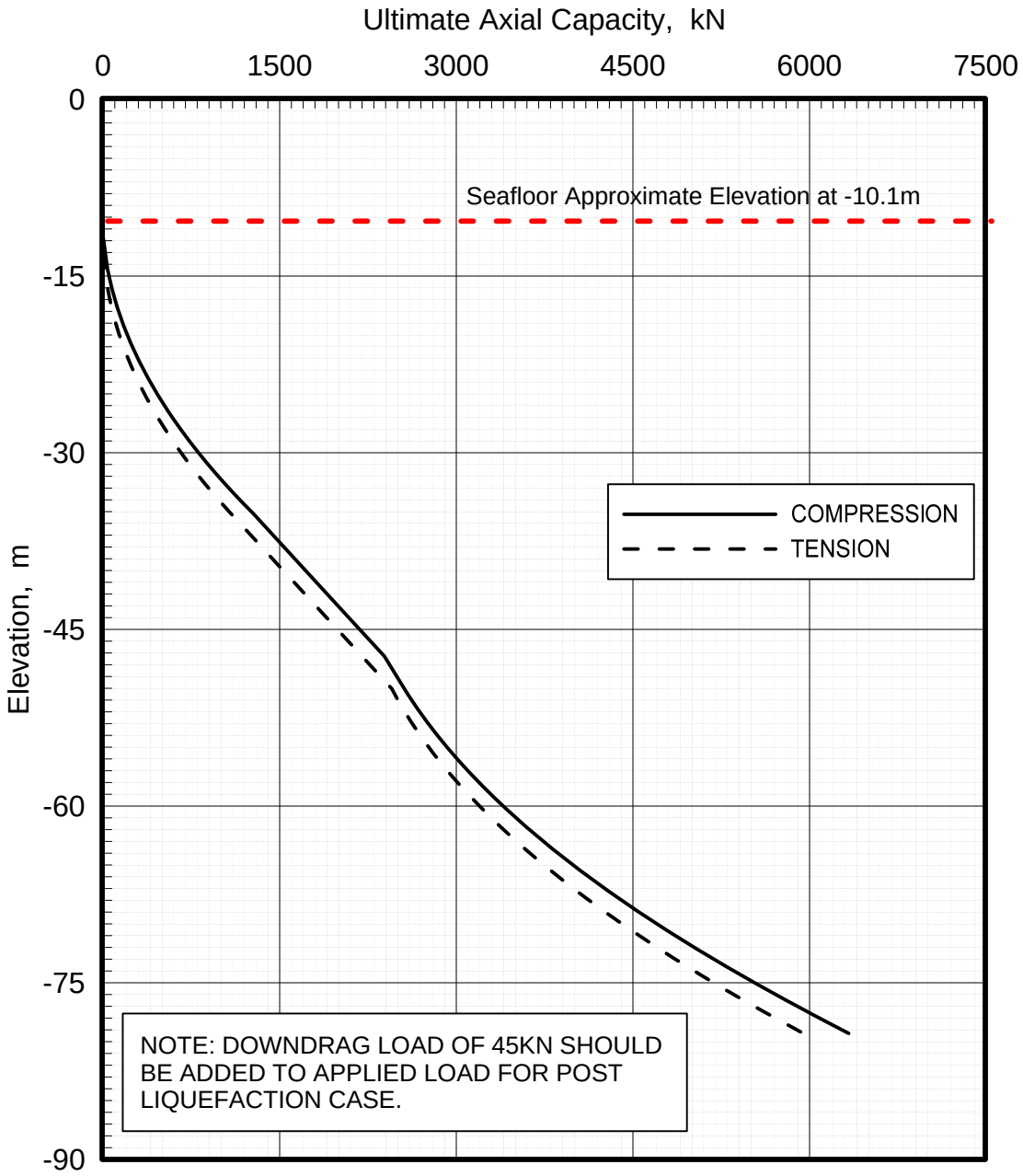
ULTIMATE AXIAL CAPACITY CURVES
TRESTLE - BORING BH-34
915-MM OPEN ENDED STEEL PIPE PILE
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA



NOTES:

1. These curves represent ultimate values for compression and tension. A safety factor of 2.0 should be applied for sustained compressive loads or transient tensile loads and a safety factor of 3.0 should be applied for sustained tensile loads.
2. These curves are for a single isolated pile. Group effects are discussed in the report.
3. Construction considerations are discussed in the report.

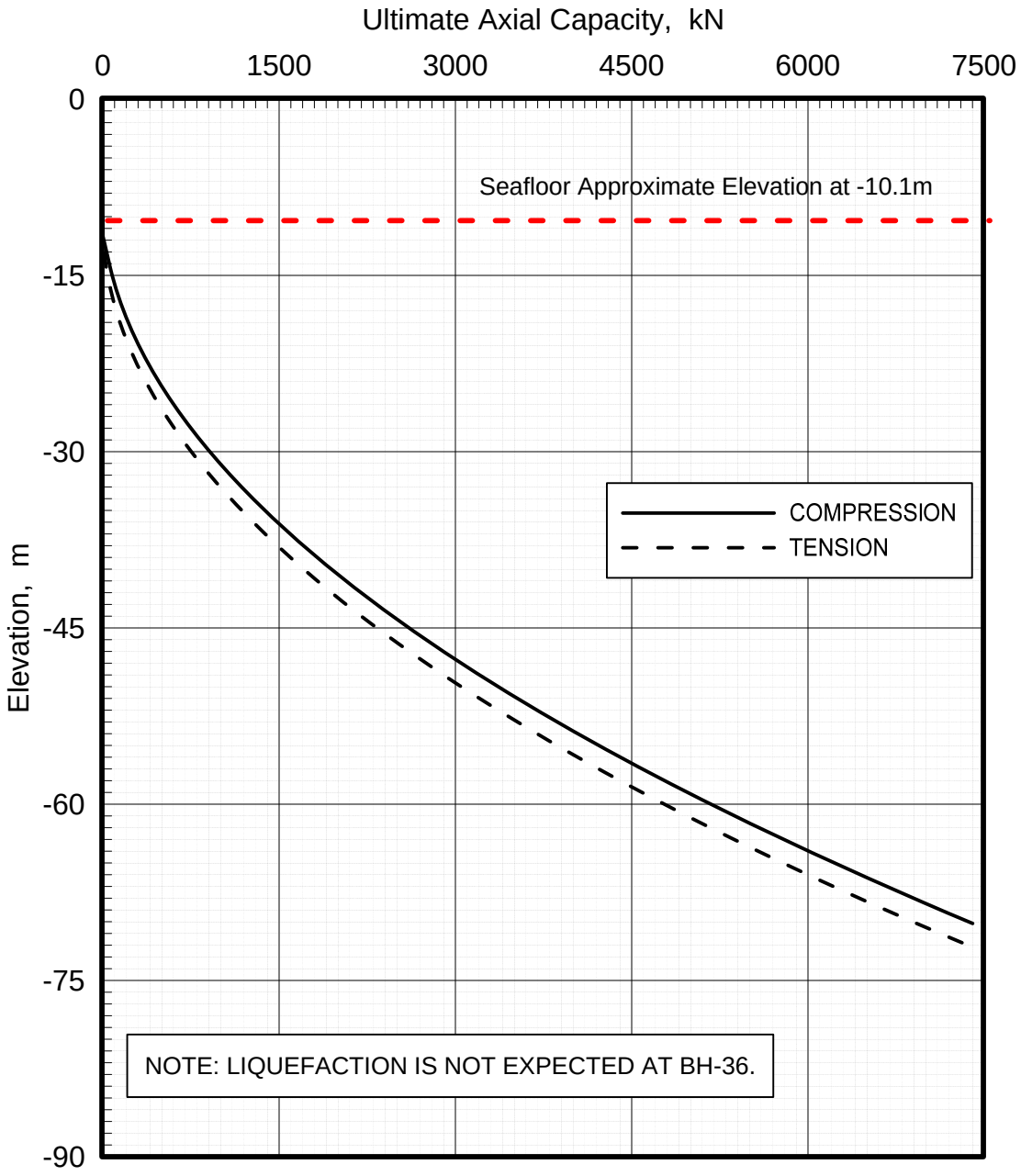
ULTIMATE AXIAL CAPACITY CURVES
TRESTLE - BORINGS BH-32 AND BH-33
915-MM OPEN ENDED STEEL PIPE PILE
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA



NOTES:

1. These curves represent ultimate values for compression and tension. A safety factor of 2.0 should be applied for sustained compressive loads or transient tensile loads and a safety factor of 3.0 should be applied for sustained tensile loads.
2. These curves are for a single isolated pile. Group effects are discussed in the report.
3. Construction considerations are discussed in the report.

ULTIMATE AXIAL CAPACITY CURVES
LNG JETTY - BORINGS BH-35 AND BH-37
915-MM OPEN ENDED STEEL PIPE PILE
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA



NOTES:

1. These curves represent ultimate values for compression and tension. A safety factor of 2.0 should be applied for sustained compressive loads or transient tensile loads and a safety factor of 3.0 should be applied for sustained tensile loads.
2. These curves are for a single isolated pile. Group effects are discussed in the report.
3. Construction considerations are discussed in the report.

ULTIMATE AXIAL CAPACITY CURVES
LNG JETTY - BORING BH-36

915-MM OPEN ENDED STEEL PIPE PILE
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

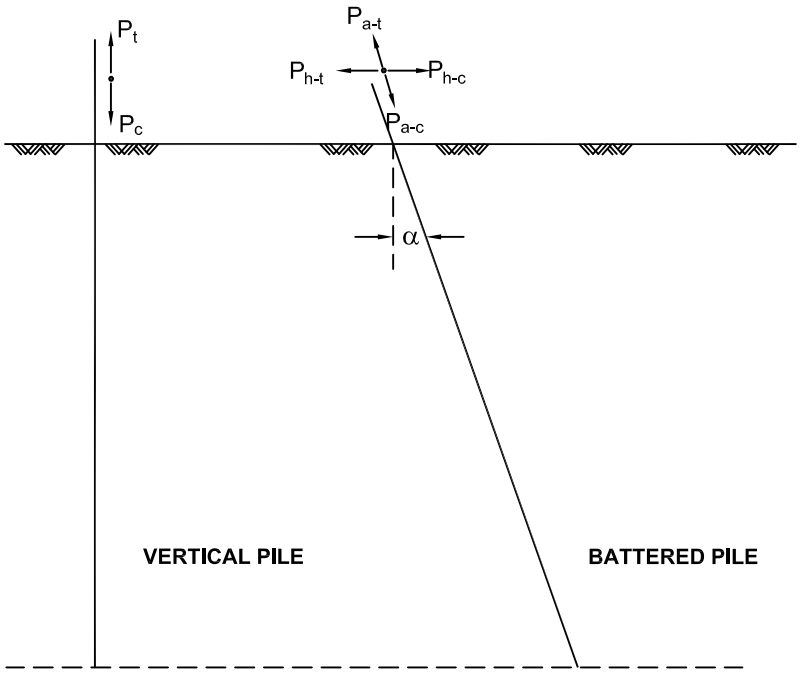
STEPS FOR COMPUTING BATTERED PILE CAPACITY

1. Determine ultimate tensile capacity (P_t) and ultimate compressive capacity (P_c) for vertical piles using curve on Plate 14.
2. Compute ultimate end bearing capacity of vertical pile as $P_e = P_c - P_t$.
3. Compute skin friction component of battered pile (P_s) by multiplying P_t by the secant of the batter angle (sec α).

4a. For battered piles loaded in compression, compute the ultimate axial capacity of the pile (P_{a-c}) by adding the skin friction (P_s) and end bearing (P_e) capacities.

4b. For battered piles loaded in tension, the ultimate axial capacity of the pile (P_{a-t}) is equal to the skin friction capacity (P_s).

5a & 5b. To compute the horizontal capacity (P_h) of the battered pile, multiply the ultimate axial capacity by the sine of the batter angle (sin α).



$P_s = P_t \ SEC\ \alpha$

$P_e = P_c - P_t$

$P_{a-c} = P_s + P_e$

$P_{a-t} = P_s$

$P_{h-c} = P_{a-c} \ SIN\ \alpha$

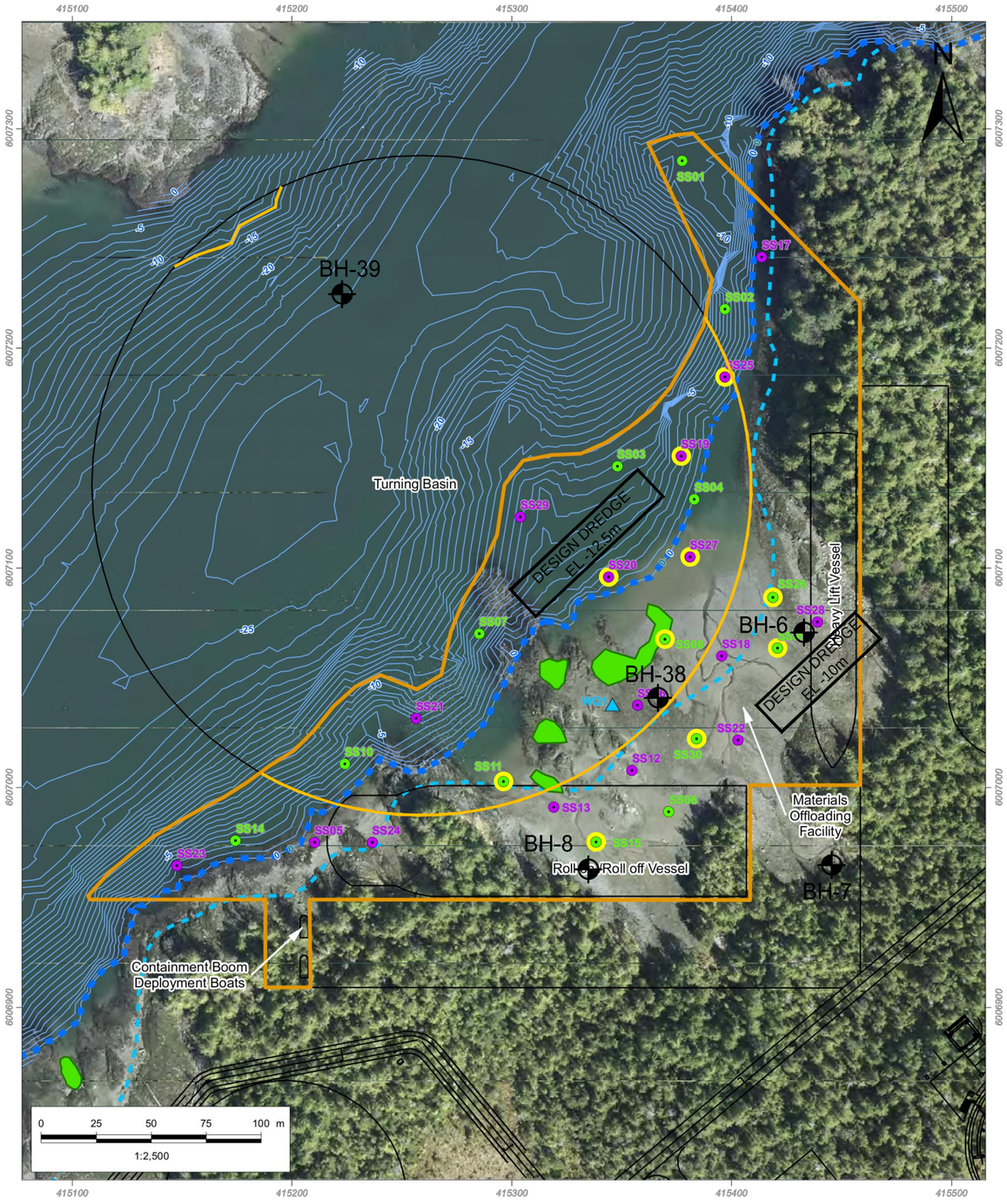
$P_{h-t} = P_{a-t} \ SIN\ \alpha$

NOTES:

1. Factor of safety of at least 2.0 recommended for compression and temporary tension.
2. Factor of safety of at least 3.0 recommended for sustained tension.
3. Vertical and battered piles must penetrate to equal elevations for this method to be applicable.
4. See text for other recommendations for battered piles.
5. Additional horizontal capacity can be developed due to flexural stiffness of battered pile. The method shown here does not include the flexural capacity of battered piles.

ULTIMATE CAPACITY OF BATTERED PILES
COMPUTATION METHOD

PLATE 43

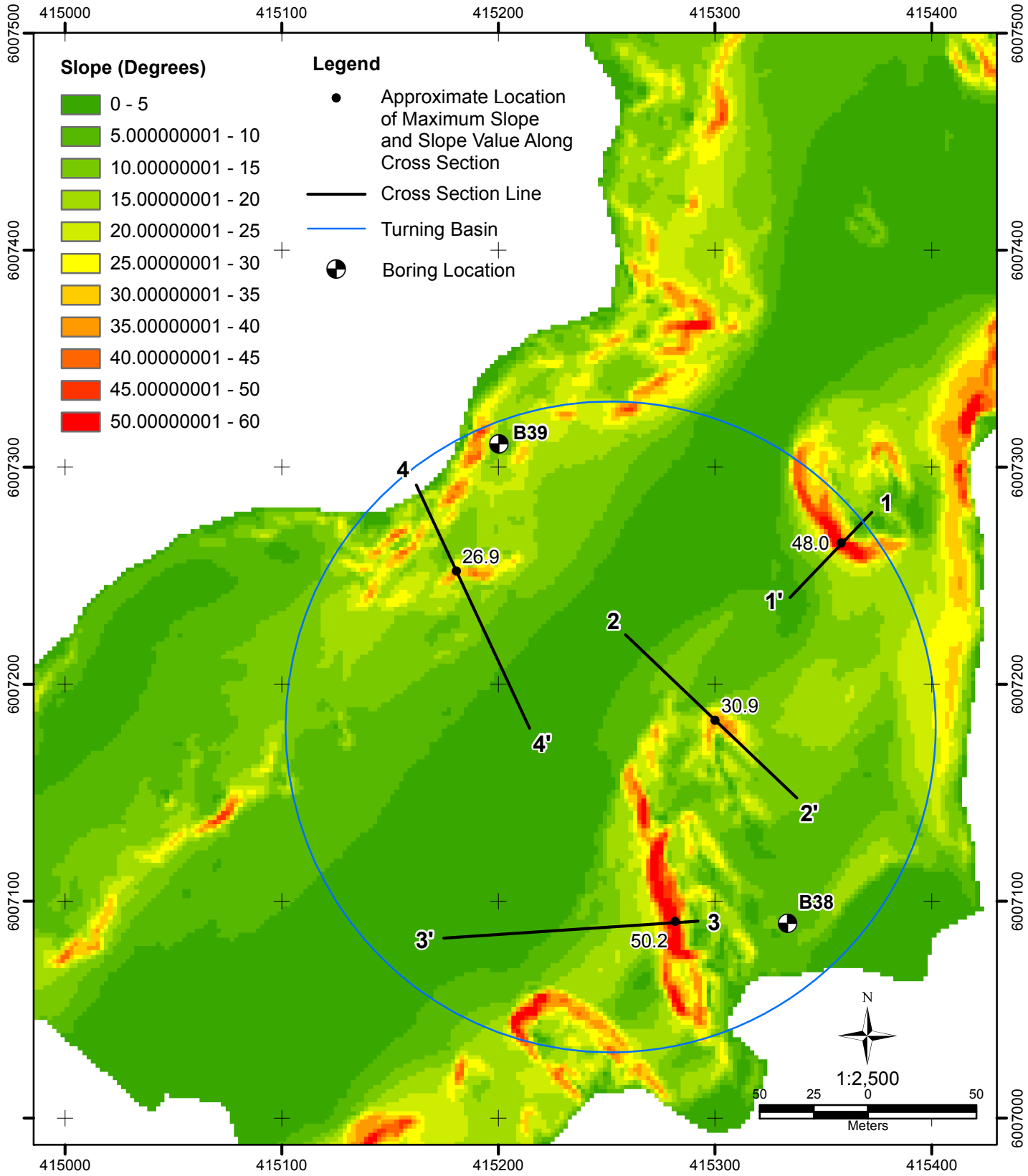


LEGEND

- Borings
- EelGrass Bed
- Surface Grab Sample
- Water Quality Sample
- Surface Sample
- Sediment Sample (Core)
- Proposed Dredge Boundary

NOTES:
1. BASE DRAWING PROVIDED BY STANTEC/MCELHANNEY CONSULTING SERVICES.
2. BATHYMETRY CONTOURS ARE IN METERS AND REFERENCED TO CVC28BC - CANADIAN VERTICAL DATUM/LOWEST ASTRONOMIC TIDE (LAT).

PROPOSED DREDGE PLAN
TURNING BASIN AND MOF
PACIFIC NORTHWEST LNG
LELU ISLAND, BRITISH COLUMBIA, CANADA



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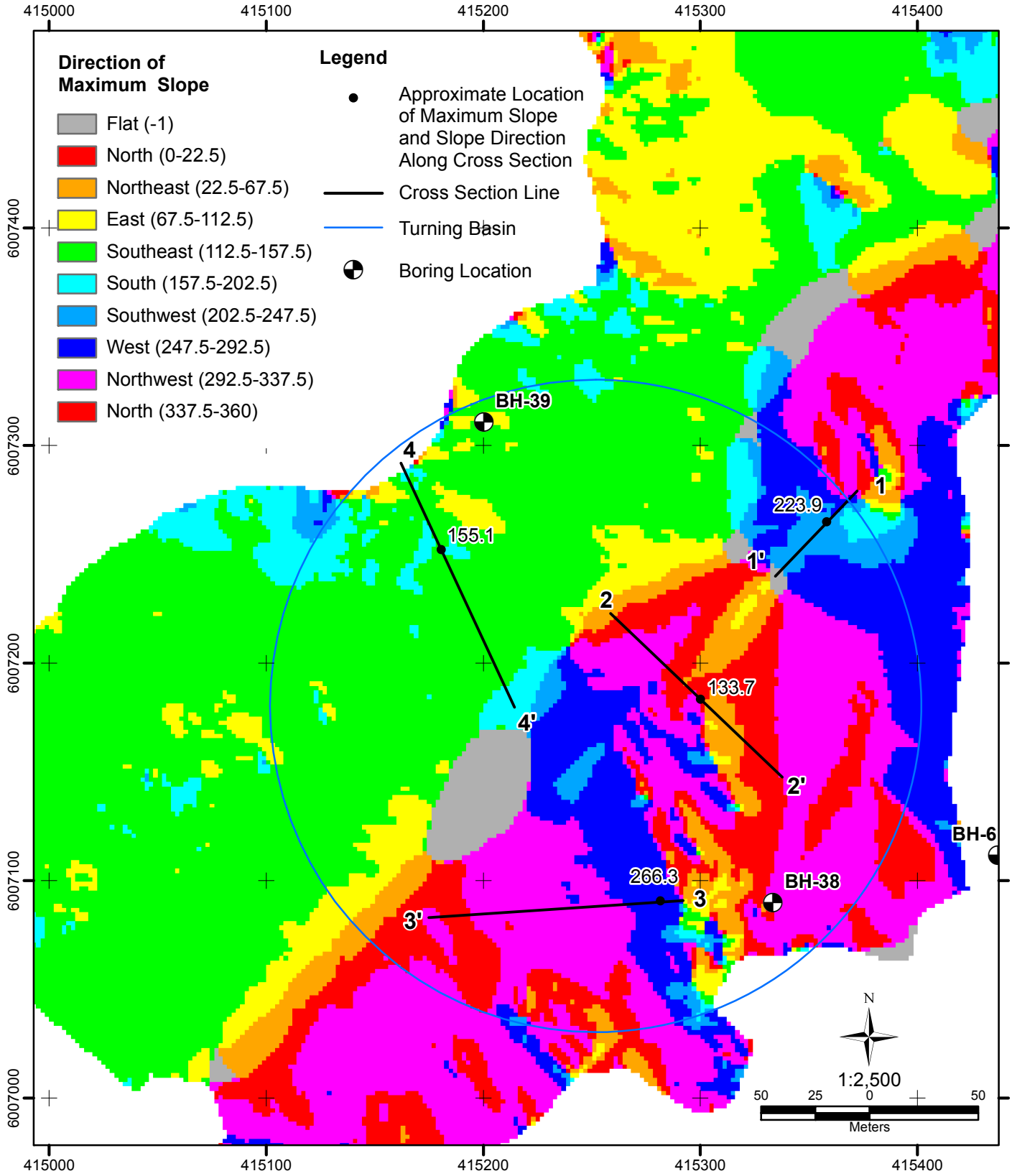
SLOPE ANGLE INTERPRETATION
TURNING BASIN
PACIFIC NORTHWEST LNG
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE 45



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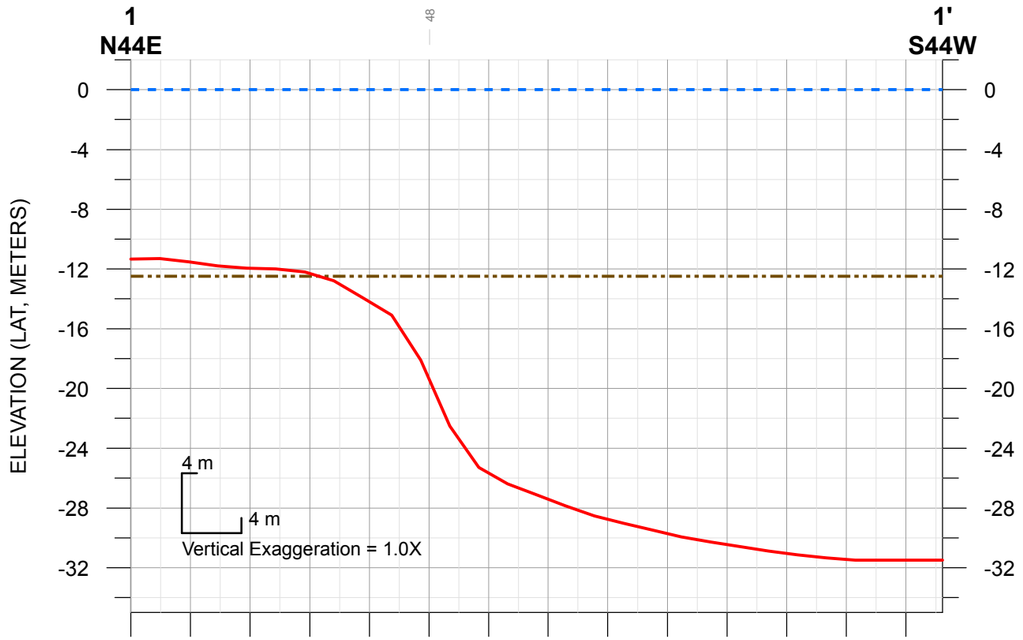
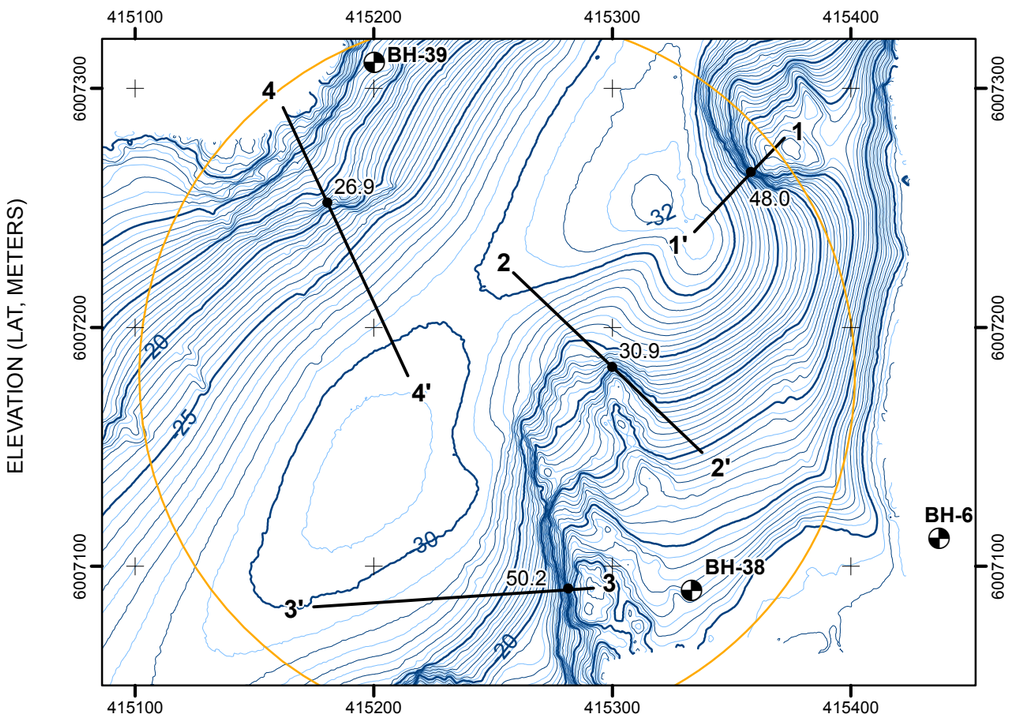
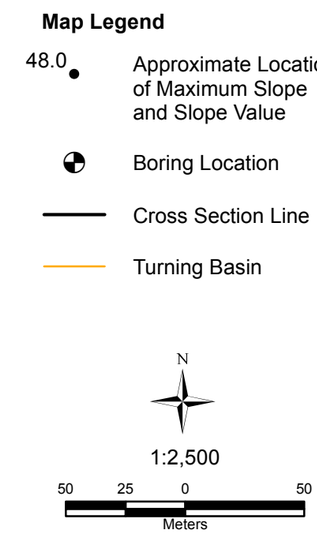
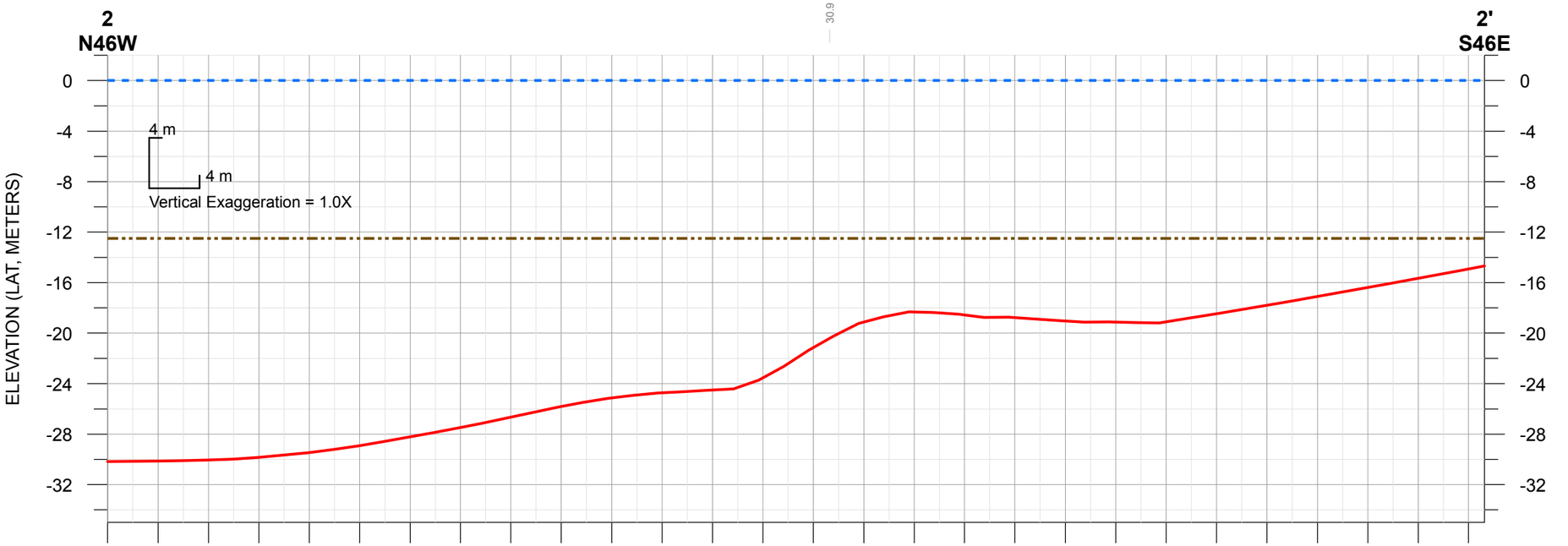
SLOPE ORIENTATION INTERPRETATION
TURNING BASIN
PACIFIC NORTHWEST LNG
LELU ISLAND, BRITISH COLUMBIA, CANADA

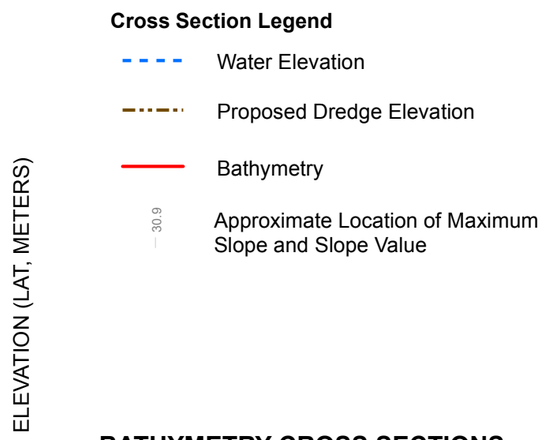
PLATE 46







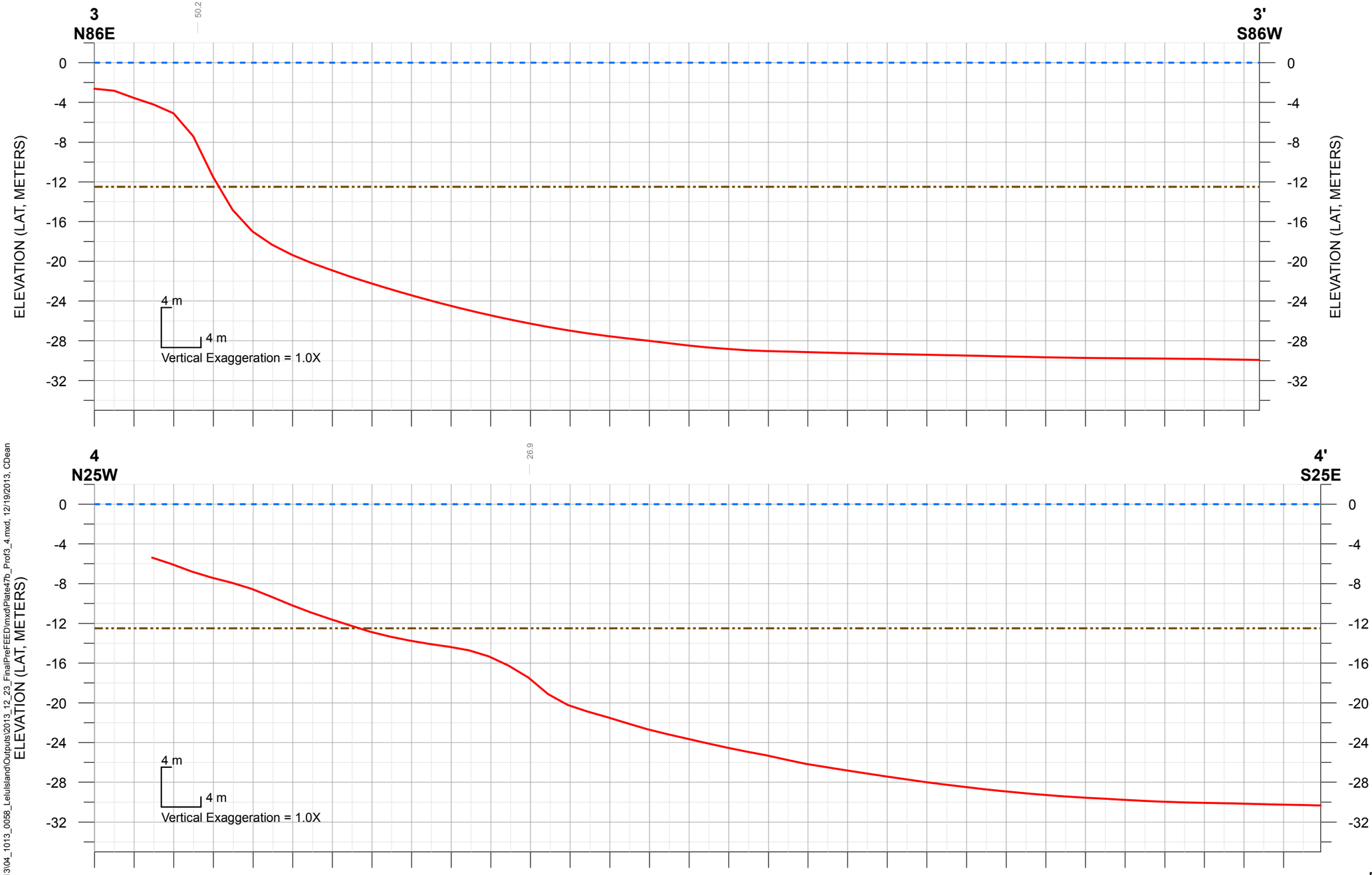




BATHYMETRY CROSS SECTIONS
TURNING BASIN
PACIFIC NORTHWEST LNG
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE 47a

N:\Projects\04_2013\04_1013_0058_LeluIsland\Outputs\2013_12_23_FinalPreFEED\mxd\Plate47a_Prof1_2.mxd, 12/19/2013, CDean



Cross Section Legend

- Water Elevation
- Proposed Dredge Elevation
- Bathymetry
- 30.9 — Approximate Location of Maximum Slope and Slope Value

Note: See PLATE 9 for Map of Cross Section Locations

BATHYMETRY CROSS SECTIONS

TURNING BASIN

PACIFIC NORTHWEST LNG

LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE 47b

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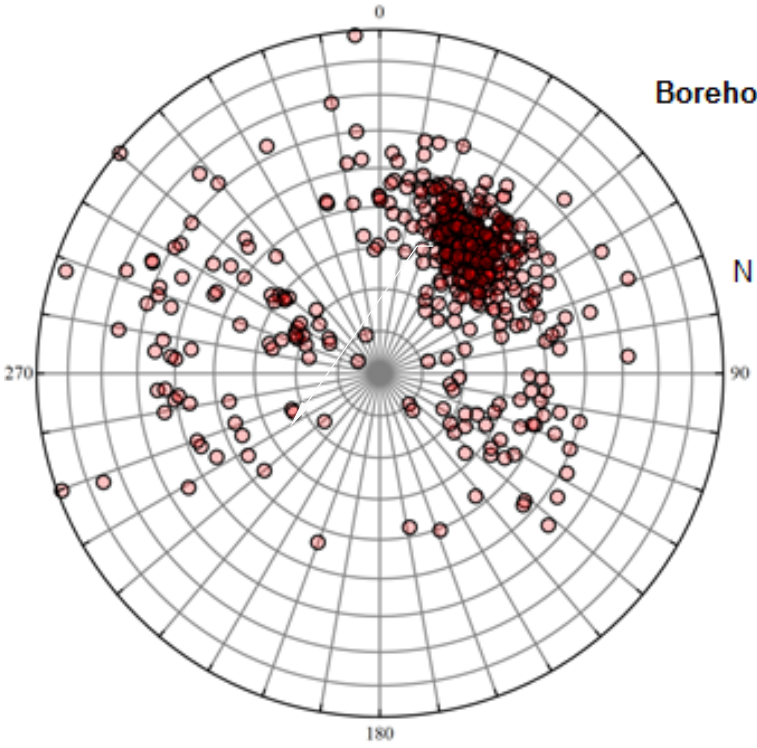
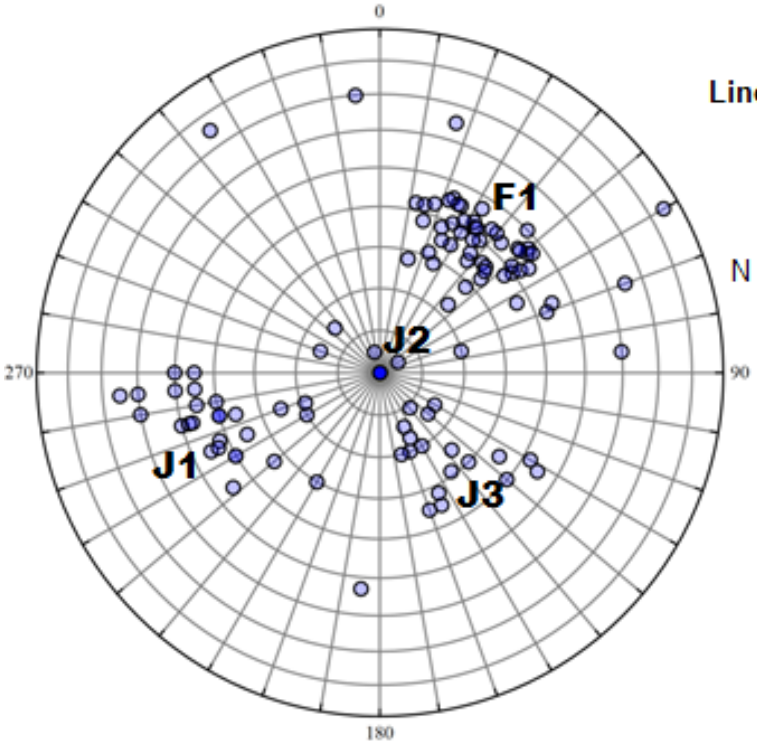


Borehole B-20 and B-24
Televiewer Data

Dip Vector Plot

N = 518 dip vectors



Lineament Analysis
Outcrop Data

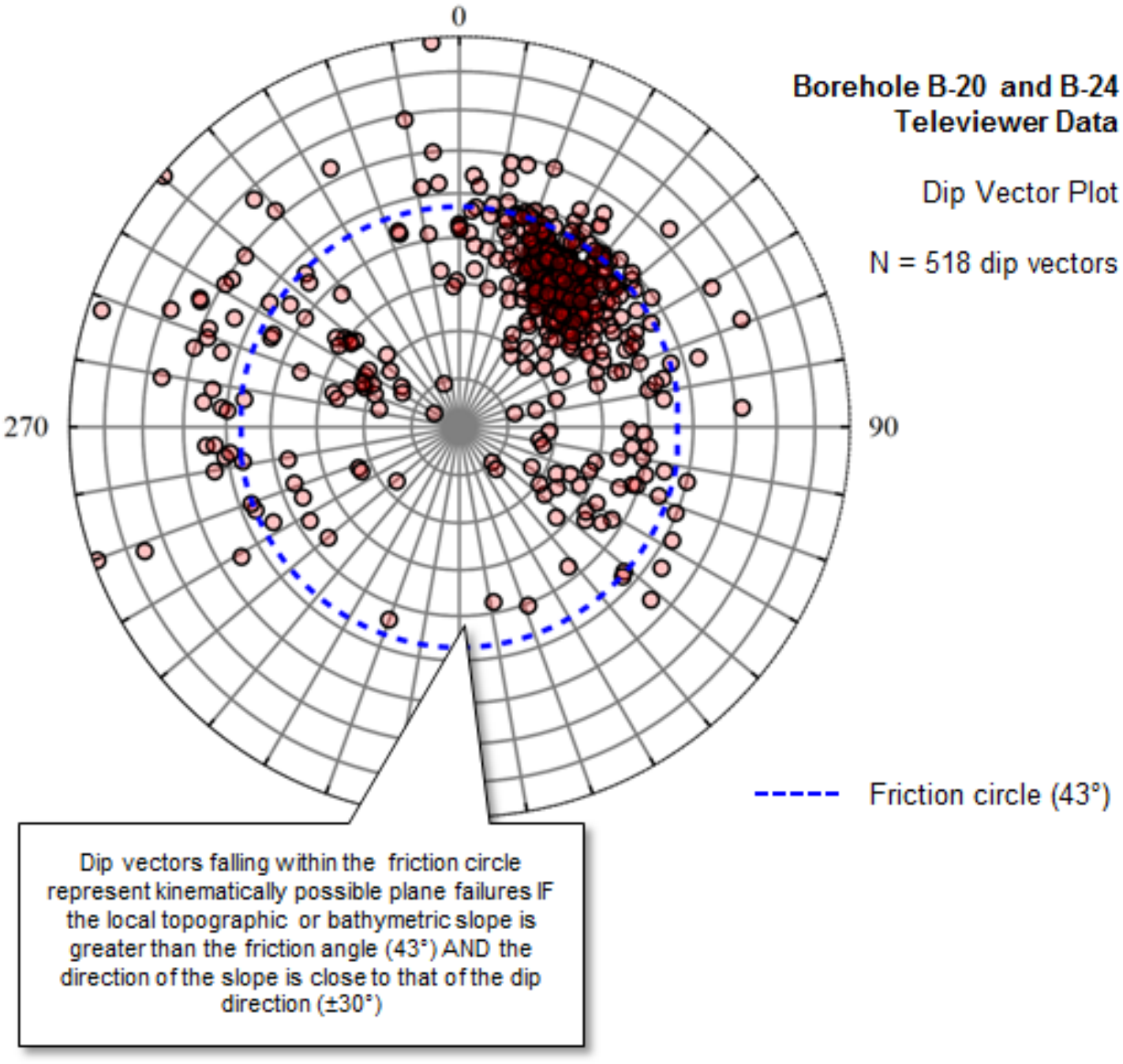
Dip Vector Plot

N = 116 dip vectors

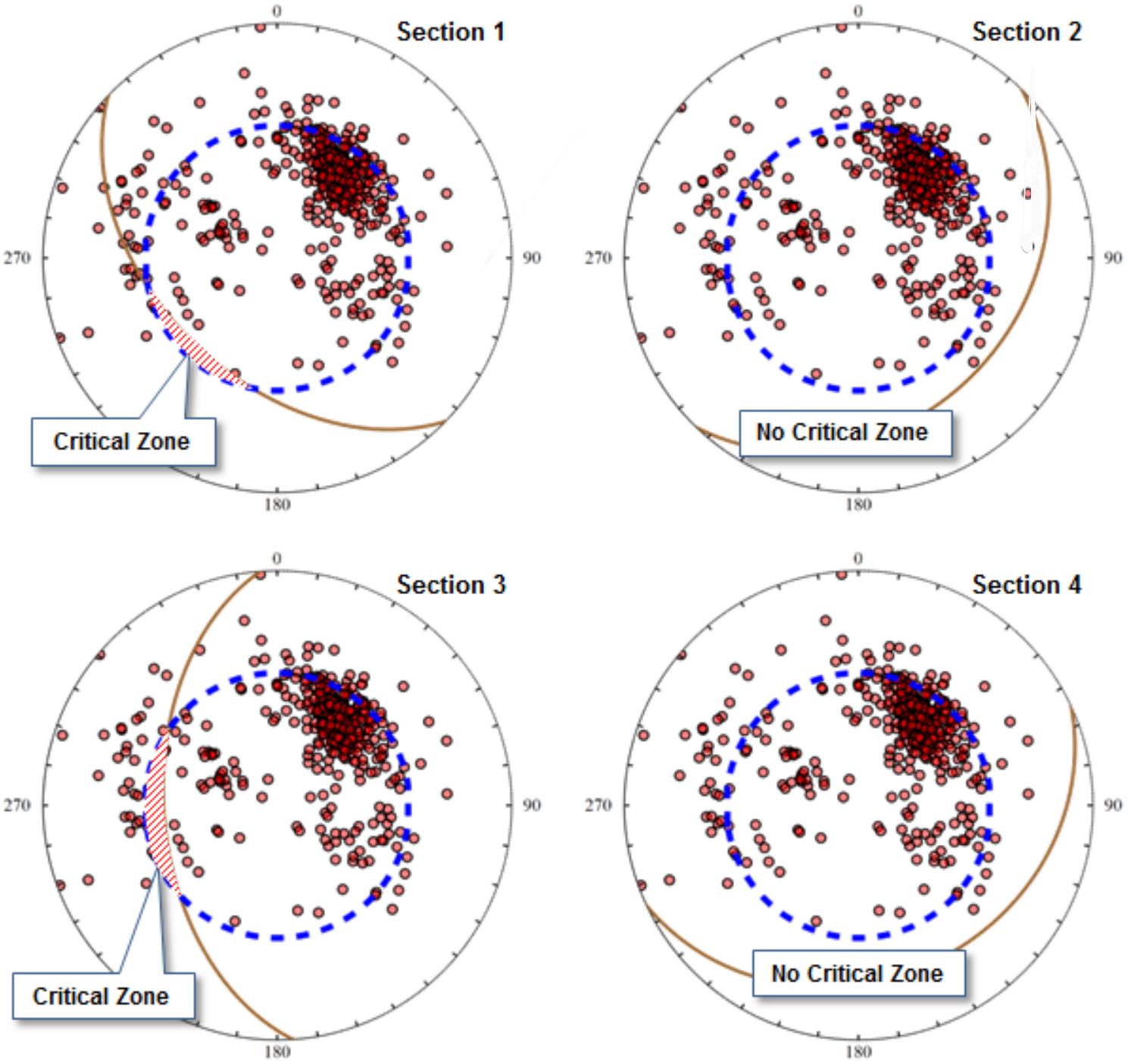
SUMMARY OF ROCK MASS DISCONTINUITY ORIENTATIONS

PACIFIC NORTHWEST LNG

LELU ISLAND, BRITISH COLUMBIA, CANADA



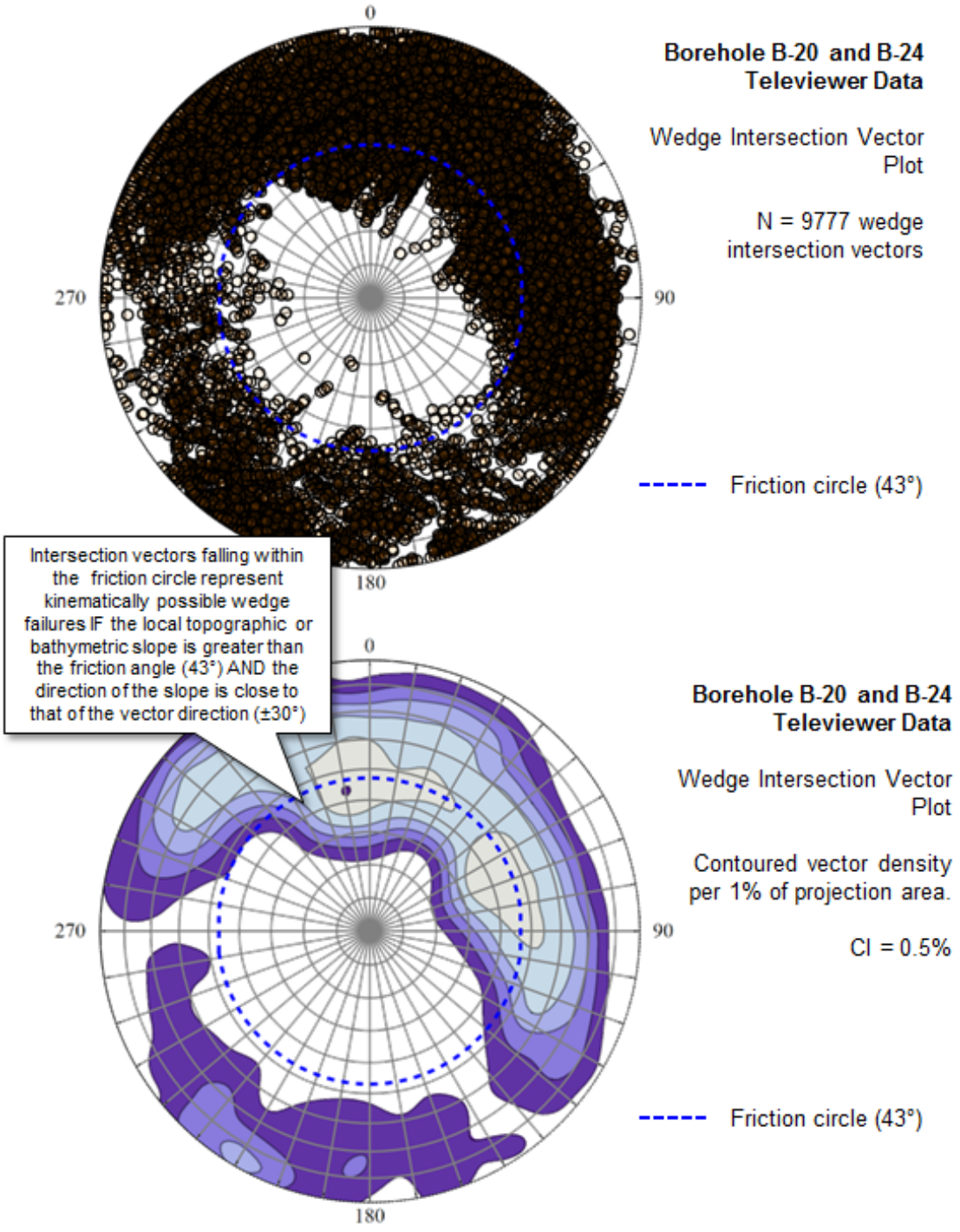
PLANAR SLIDING FAILURE
PACIFIC NORTHWEST LNG
LELU ISLAND, BRITISH COLUMBIA, CANADA



PLANAR SLIDING FAILURE-SLOPE 1-1' THROUGH 4-4'

PACIFIC NORTHWEST LNG

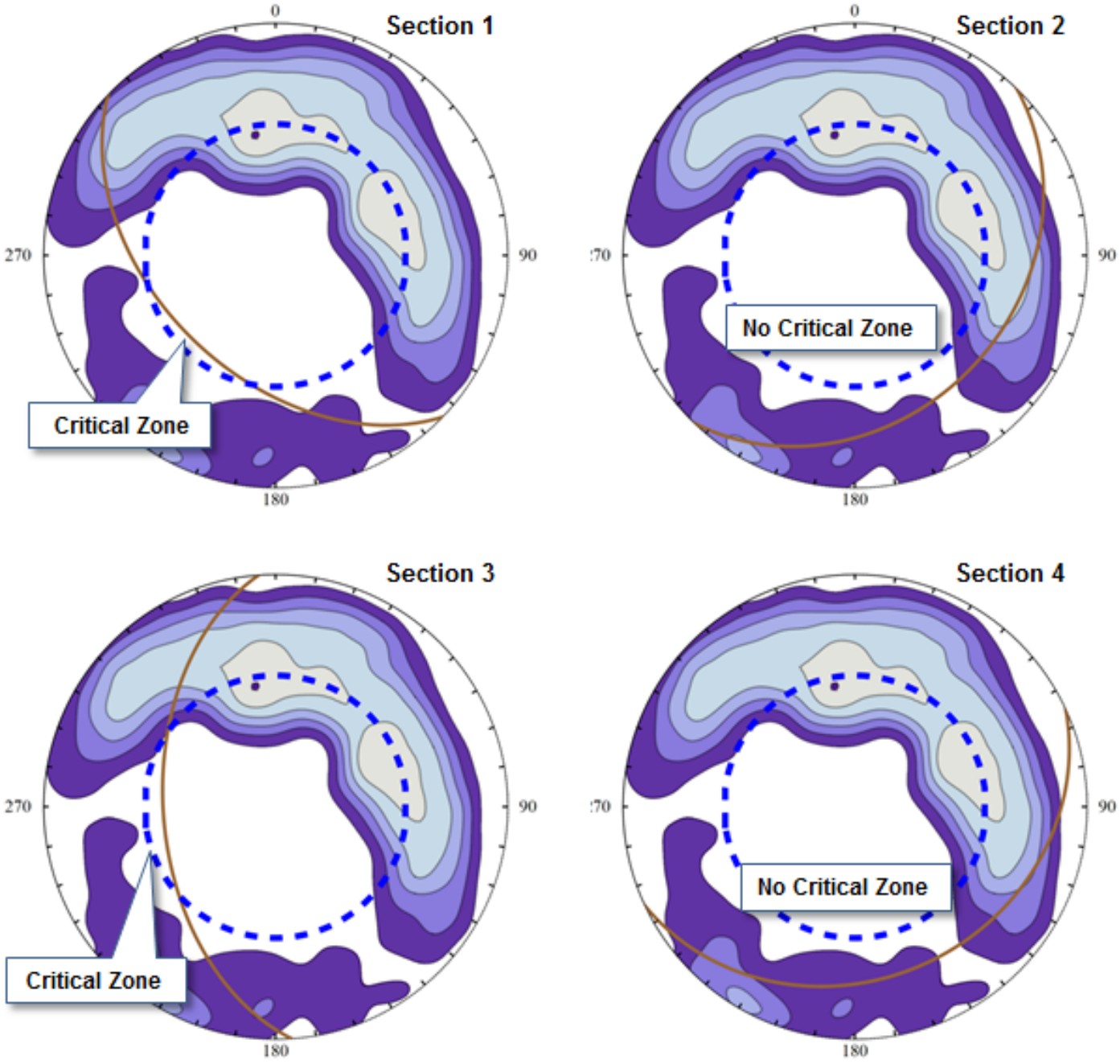
LELU ISLAND, BRITISH COLUMBIA, CANADA



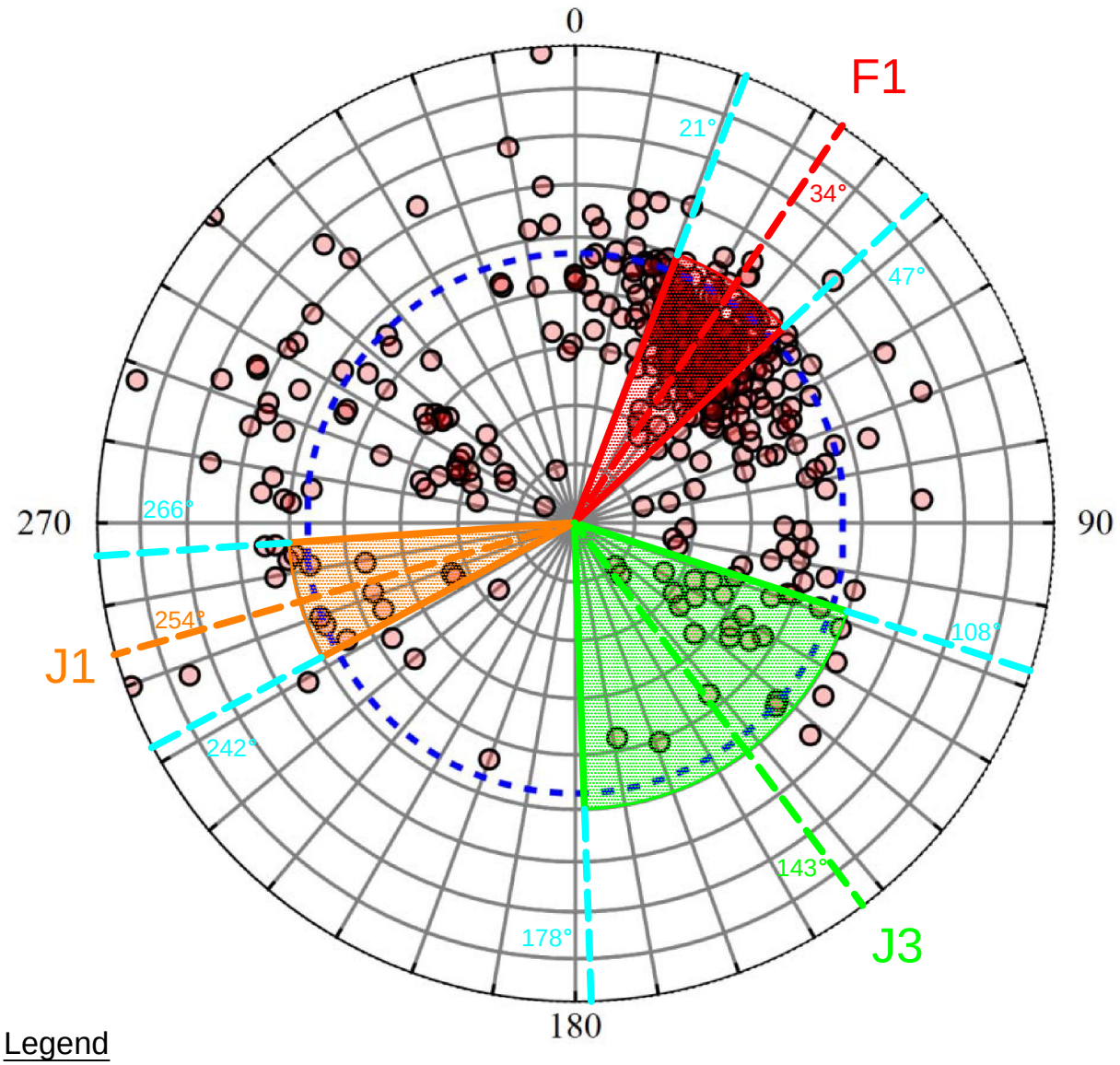
WEDGE FAILURE

PACIFIC NORTHWEST LNG

LELU ISLAND, BRITISH COLUMBIA, CANADA



WEDGE FAILURE-SLOPE SECTIONS 1-1' THROUGH 4-4'
PACIFIC NORTHWEST LNG
LELU ISLAND, BRITISH COLUMBIA, CANADA



Legend

F1 / J1 / J3 Discontinuity Sets

Static Friction Angle

J1 Dip Directions of the Discontinuity Sets

Boundaries of the critical areas

Critical Area

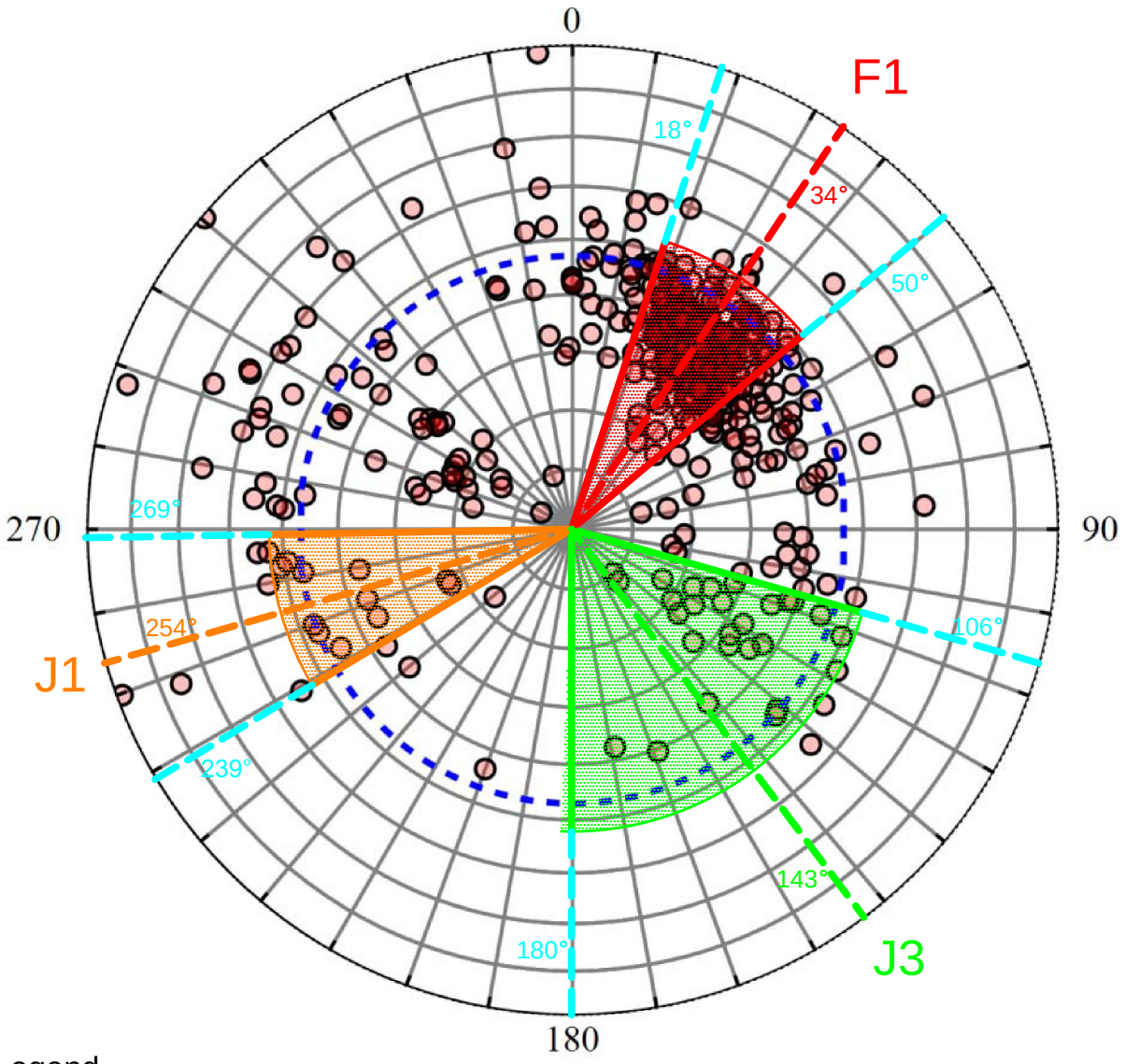
SIMPLIFIED PSEUDO-STATIC SLOPE FAILURE CRITERIA

OBE CASE (475-YR) - TURNING BASIN

PACIFIC NORTHWEST LNG

LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE 53a



Legend

F1 / J1 / J3 Discontinuity Sets

Static Friction Angle

J1 Dip Directions of the Discontinuity Sets

Boundaries of the critical areas

Critical Area

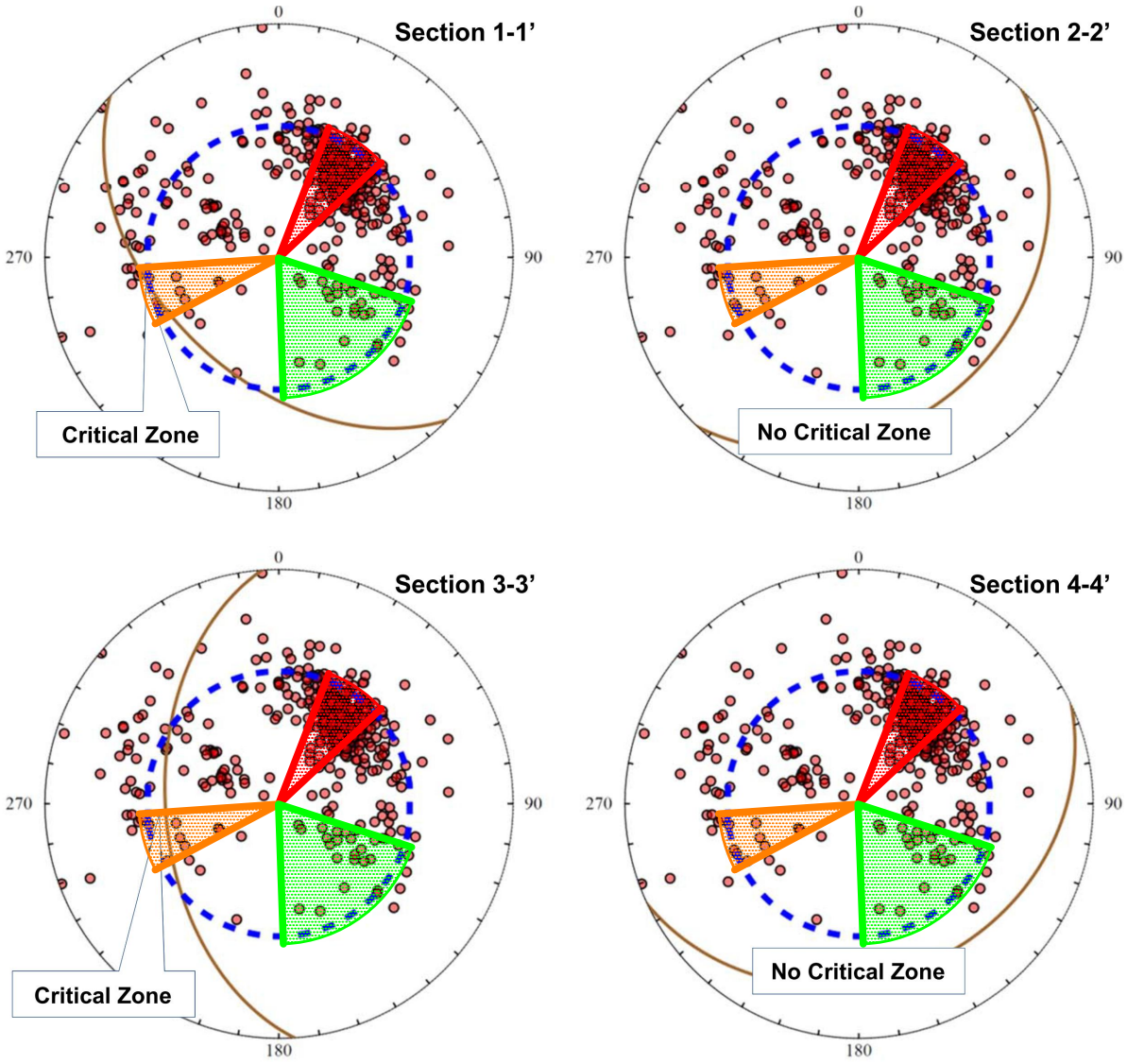
SIMPLIFIED PSEUDO-STATIC SLOPE FAILURE CRITERIA

SSE CASE (2475-YR) - TURNING BASIN

PACIFIC NORTHWEST LNG

LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE 53b



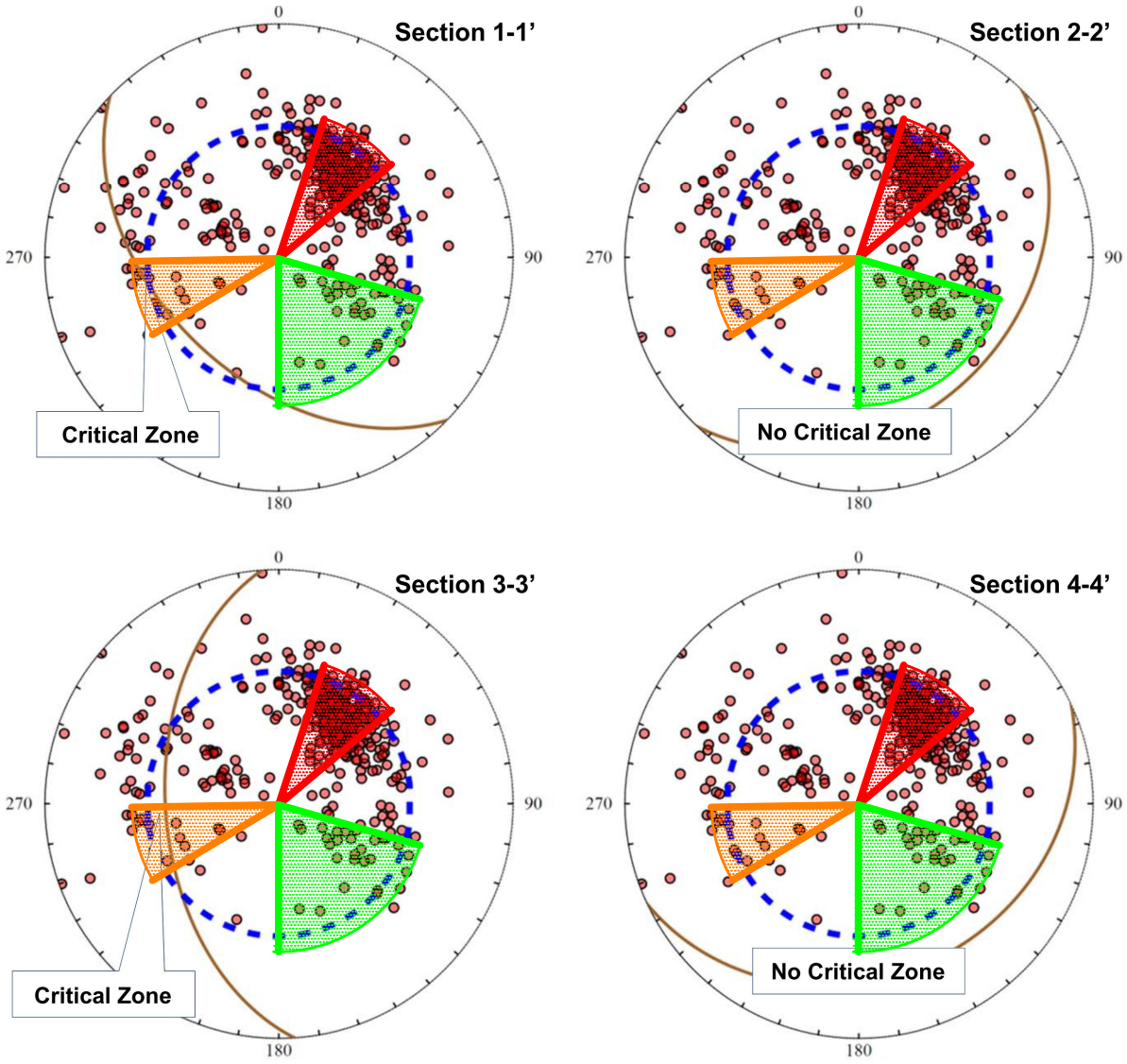
SIMPLIFIED PSEUDO-STATIC SLOPE FAILURE CRITERIA - SECTIONS 1-1' THROUGH 4-4'

OBE CASE (475-YR) - TURNING BASIN

PACIFIC NORTHWEST LNG

LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE 54a



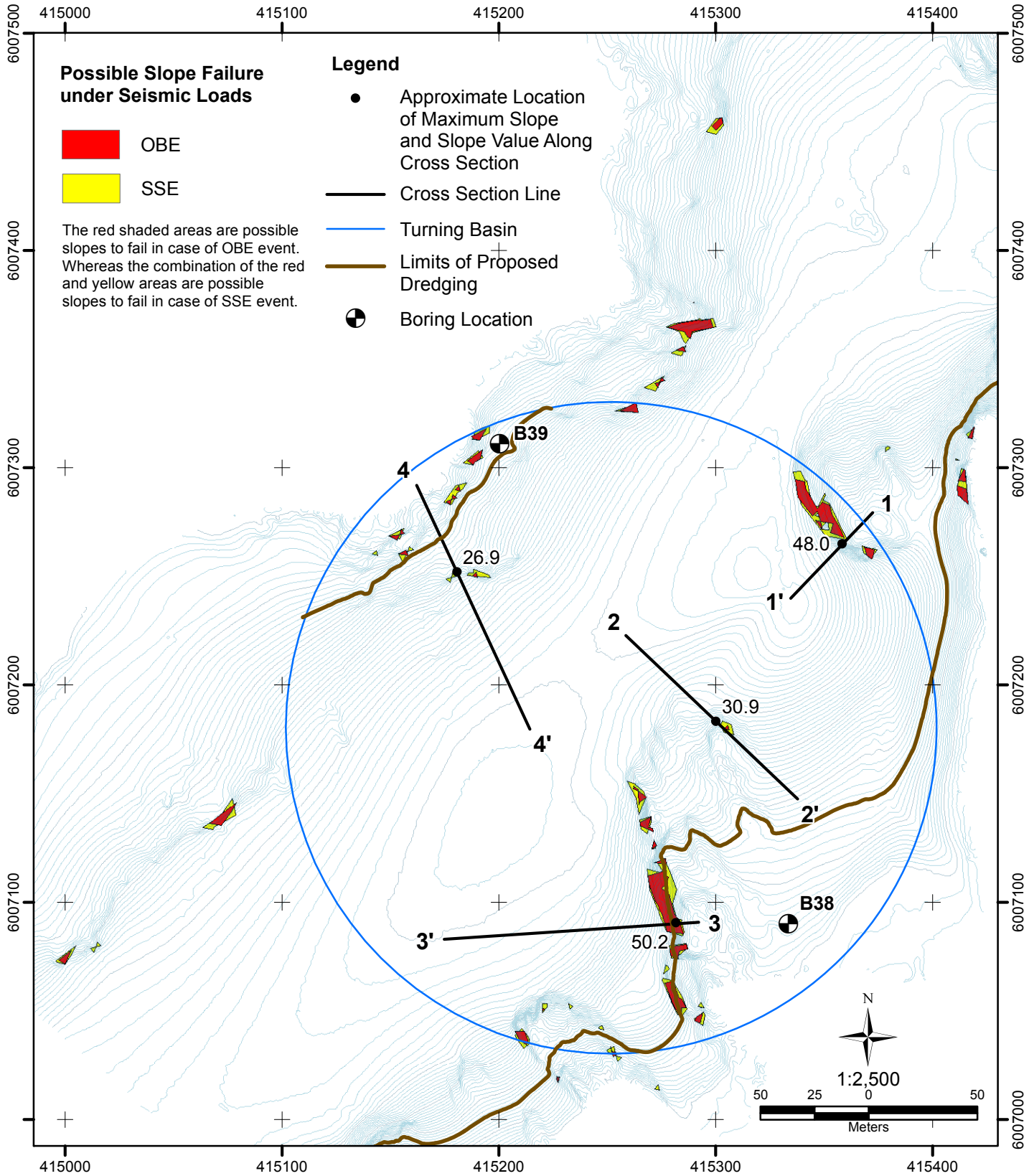
SIMPLIFIED PSEUDO-STATIC SLOPE FAILURE CRITERIA - SECTIONS 1-1' THROUGH 4-4'

SSE CASE (2475-YR) - TURNING BASIN

PACIFIC NORTHWEST LNG

LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE 54b



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SEISMIC SLOPE FAILURE CRITERIA
TURNING BASIN
PACIFIC NORTHWEST LNG
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE 55

APPENDIX A

Log of Borings and Terms & Symbols

LOCATION: See Plate 2
COORDINATES: N 6007611m
E 416382m

SURFACE EL. 17.98 m

DEPTH, METERS	SYMBOL	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS	UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
		1	36/229mm	**ARTIFICIAL FILL (af)** Clayey SAND with gravel (SC): dense, brownish gray, moist to wet, Road base material							
		2	Ref.	- sampler bouncing, at 6.56m	17.2						
1		C1		**UNDIVIDED PHYLLITE (OTa)** PHYLLITE (Rx): moderately weathered, moderately hard to hard, gray, slightly to moderately fractured, planar fractures 35 degrees along foliations, with iron oxide staining - 7.62cm-thick light gray gneissic lens, at 1.34m - discontinuous quartzose augen structure, at 1.62m				0			
2		C2		- near-vertical iron oxide stains, from 2.10 to 2.19m - extremely fractured, with iron oxide stain on fracture surfaces, darker gray, less foliated, from 2.19 to 2.32m - 0.10 to 0.20cm-thick quartz seams along foliation, from 2.51 to 2.56m				0			
3		C3		- minor iron oxide staining, below 3.14m - intensely fractured, with fine pyrite and quartz mineralization on fracture surfaces, from 3.35 to 3.60m - near-vertical fractures, with greenish mineralization, rough, planar, from 3.60 to 4.48m				0			
4		C4		- fine quartzose augen structure, from 4.72 to 4.97m							
5						27					
6		C5						0			
7		C6						0			
8				- steeply dipping, 75 to 80 degrees, stepped, rough to planar fractures with green mineralization, from 8.08 to 8.32m - fine quartzose augen structure, at 8.23m							
9		C7		- extremely fractured, from 9.14 to 9.36m - intensely fractured, at 9.30m - stepped, 0.10 to 0.20cm-thick, near-vertical, totally healed fractures, from 9.36 to 9.54m				0			
10				- near-vertical discontinuous quartzose fracture, totally healed, approximately 0.20 to 0.50cm-thick, foliations dip approximately 30 degrees, at 9.75m - intensely fractured, at 10.15m - 0.10 to 0.30cm-thick quartz filling along foliations, at 10.21m							
11		C8				27		0			
				- intensely fractured, common slickensided surfaces, stepped, chlorite-filled fracture surfaces, from 11.70 to 11.98m							

CLASSIFICATION

SHEAR STRENGTH / UCS
□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
✳ UCS
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE —— Min./m: 10 20 30 40
REC. —— SCR · · · RQD ——
%: 20 40 60 80

NOTES:
▽ : Initial Ground Water Depth ▼ : Static Ground Water Depth
1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:
Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 10 July, 2013
TOTAL DEPTH: 54.86m
CAVED DEPTH: N/A
CORING: 177.3 m
WET ROTARY: 2.7 m
BACKFILL: Grout
LOGGER: LPrentice, CEG
DRILLER: Geotech Drilling

C:\USERS\BBINATLI\DESKTOP\04.10130058\GINT\04_1013_0058_FE13B-122313 - WITH TORVANE CORRECTION.GPJ FUGRO_S_(LAB)_IND GRP_A3_ONSHORE_REV03 12/24/2013

LOG OF BORING BH-1
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-1a

LOCATION: See Plate 2
COORDINATES: N 6007611m
E 416382m

SURFACE EL. 17.98 m

DEPTH, METERS	SYMBOL	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS
13		C9		- intensely fractured, at 11.89m - fine pyrite along foliation/bedding surfaces, at 12.10m - 0.25cm-thick dark gray to black shale banding/bedding, with slickensided surfaces, at 12.13m - phyllite interbedded with shale and gneiss, dipping approximately 30 degrees, highly fractured, from 12.15 to 12.80m - 70 degree to near-vertical slickensided surfaces, from 12.80 to 13.11m - thinly interbedded phyllite and schist, below 13.11m - thinly laminated, with quartz infilled planes, below 12.19m	
14		C10			
15		C11		- 5cm-thick schist lens, at 14.39m - 2.5cm-thick discontinuous quartzose inclusion, at 14.48m GNEISS (Rx): fresh, very hard, light gray, faint fine foliation to massive, unfractured	3.4
16		C12		PHYLLITE (Rx): fresh, very hard, dark greenish gray, interbedded with fine gneissic laminations with quartz and pyrite filled thin fractures at contact with gneiss above, very few fractures - 10cm-thick gneissic band, at 16.15m - common fine quartzose foliations, from 16.38 to 16.76m	2.4
17		C13			
18		C14		- hairline, eneschellon quartz-filled fractures, from 18.20 to 18.53m	
19				- highly fractured, from 18.71 to 18.99m - hairline, irregular, steeply dipping quartz-filled fractures, below 18.90m - 2.5cm-thick coarse gneissic band, wavy structure, intensely fractured, approximately 45 degree dip, possible shear zone, at 18.99m - 3cm-thick gneissic bands, from 19.20 to19.39m	
20		C15		- without foliation, at 19.42m	
21				- moderately foliated, fractures along approximately 25 degree foliations, planar, thin quartzose filling, slightly micaceous sheen, from 20.24 to 20.42m	
22		C16		GNEISS (Rx): fresh, very hard, light gray, few fractures	-4.4
23		C17		- 2cm-thick quartzose band, at 22.80m	

CLASSIFICATION

UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
26		0			
		0			
		0			
		0			
		0			
27					

SHEAR STRENGTH / UCS

□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
✳ UCS
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE —— Min./m: 10 20 30 40
REC. —— SCR · · · RQD ——
%: 20 40 60 80

NOTES:

▽ : Initial Ground Water Depth ▼ : Static Ground Water Depth

1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:

Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 10 July, 2013
TOTAL DEPTH: 54.86m
CAVED DEPTH: N/A
CORING: 177.3 m
WET ROTARY: 2.7 m
BACKFILL: Grout
LOGGER: LPrentice, CEG
DRILLER: Geotech Drilling

C:\USERS\BBINATLI\DESKTOP\04.10130058\GINT\04_1013_0058_FE13B-122313 - WITH TORVANE CORRECTION.GPJ FUGRO_S_(LAB)_IND GRP_A3_ONSHORE_REV03 12/24/2013

LOG OF BORING BH-1
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-1b

LOCATION: See Plate 2
COORDINATES: N 6007611m
E 416382m

SURFACE EL. 17.98 m

DEPTH, METERS	SYMBOL	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS
		C18			
				PHYLLITE (Rx): fresh, very hard, moderate gray, few fine quartzose laminations approximately 25 to 30 degrees	-6.7
25				- few fine quartzose laminations, below 24.99m	
				- gneissic interbeds, below 25.33m	
26		C19			
				- few fine to hairline, healed, 75 degree fractures, below 26.21m	
				- 2.2cm-thick quartzose wavy band, at 26.46m - few gneissic bands, below 26.52m	
27		C20			
				- 45 degree fractures, planar, slightly rough, with trace quartz on fracture surfaces, at 27.04m	
				- irregular, 40 to 45 degree, 1.0 to 1.5cm-thick, quartzose band, at 27.61m - 80 degree, 0.1cm wide quartz and pyrite filled fractures, from 27.74 to 28.13m, with 2cm offset in flower structure, at 27.74m	
28				- steeply dipping to near vertical hairline, irregular, totally healed fractures, with spotty pyrite on fresh surfaces, below 28.04m	
		C21			
29				- 15cm-thick gneissic bands, at 28.96m	
				- 75 degree, narrow, quartz-healed fractures, from 29.26 to 29.63m - 15cm-thick gneissic bands, at 29.29m	
				- greenish mineralization (chlorite?), from 29.57 to 29.81m - feathered, discontinuous, interbedded mafic lenses, from 29.69 to 29.81m	
30				- greenish mineralization (chlorite?), at 30.18m	
		C22			
31				- few laminations, below 31.15m	
		C23			
32				- moderately fractured, from 32.54 to 32.89m - 2cm-thick quartzose band, 25 to 30 degrees, at 32.67m - chlorite and spotty pyrite on fracture surfaces, at 32.67m	
33					
		C24			
34				- 2cm-thick quartz bands, at 33.65m - tight, totally healed, irregular, hairline, 75 degree fractures at 3 to 5cm spacing, from 33.68 to 33.83m - 2cm-thick quartz bands, at 33.83m - 2cm-thick quartz bands, at 34.05m - irregular, steeply inclined, discontinuous chlorite-infilled fractures, at 34.14m - spotty chlorite mineralization and pyrite on fracture surfaces, below 34.14m	
35		C25		- greenish-white clay infill along fractures, sub-parallel to foliations, at 34.75m	

CLASSIFICATION: UNIT DRY WT, kN/m³ | PASSING NO. 200 SIEVE, % | WATER CONTENT, % | LIQUID LIMIT | PLASTIC LIMIT | PLASTICITY INDEX (PI)

SHEAR STRENGTH / UCS
□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
✳ UCS
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE — Min./m: 10 20 30 40
REC. SCR RQD %: 20 40 60 80

WATER CONTENT, %: 0 0 0 0 0 0 0 0

27

NOTES:

▽ : Initial Ground Water Depth ▼ : Static Ground Water Depth

1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:

Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 10 July, 2013
TOTAL DEPTH: 54.86m
CAVED DEPTH: N/A
CORING: 177.3 m
WET ROTARY: 2.7 m
BACKFILL: Grout
LOGGER: LPrentice, CEG
DRILLER: Geotech Drilling

C:\USERS\BBINATLI\DESKTOP\04.10130058\GINT\04_1013_0058_FE13B-122313 - WITH TORVANE CORRECTION.GPJ FUGRO_S_(LAB)_IND GRP_A3_ONSHORE_REV03 12/24/2013

LOG OF BORING BH-1
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-1c

LOCATION: See Plate 2
COORDINATES: N 6007611m
E 416382m

SURFACE EL. 17.98 m

DEPTH, METERS	SYMBOL	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS	UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
37		C26		- 5cm-thick quartz vein, at 36.64m - 1.2cm-thick quartz bands, at 36.88m - thinly laminated with quartz veins, greenish mineralization on fracture surfaces, with fine pyrite and schistose luster, from 37.11 to 38.80m - 75 degree, discontinuous, hairline, totally healed planar fractures, at 37.12m				0			
38		C27						1			
39		C28		- few quartzose augen structures, sub-parallel to parallel with foliations, from 39.01 to 39.24m - with discontinuous feather-structured shale lens, below 39.24m				0			
40								0			
41		C29		- near-vertical, stepped, very fine to hairline, totally healed fractures, from 41.27 to 41.64m - steep-dipping rough fracture with quartz and pyrite infilling, at 41.36m							
42				- highly fractured shale, from 41.76 to 42.06m, with 0.3cm-thick claystone seam at upper contact				0			
43		C30		- common discontinuous wavy and irregular quartz laminations and healed fractures, from 42.82 to 43.34m				0			
44		C31		- 2.6cm-thick, wavy, possibly offset quartz banding, at 43.75m - stepped, very fine, totally healed, near-vertical quartz fractures, from 44.20 to 44.53m							
45				- wavy and irregular quartzose, 3cm-thick, from 44.78 to 44.87m - moderately fractured, with 30 and 80 degree fractures, with quartz and green mineralization (chlorite?) and pyrite infilling, from 45.17 to 45.60m				0			
46		C32									
47		C33		- discontinuous, near-vertical, totally healed fractures, hairline to 0.2cm-thick, stepped, at 46.12m - foliations oriented approximately 25 to 30 degrees, with 45 degree, irregular, 0.2 to 0.3cm-thick quartzose band, at 46.18m - very irregular 2cm-thick quartzose band, 45 degrees, at 46.36m - thin quartzose fracture along 25 degree foliation, at 46.42m - very thin to hairline, nearly-horizontal fractures with medium green mineralization, at 46.51m - very thin to hairline, nearly-horizontal fractures with medium green mineralization, at 46.70m - few nearly-horizontal to 20 degree 0.2 to 0.3cm-thick quartz bands, from 46.82 to 47.00m - 45 degree hairline, planar, quartz-filled fracture, at 46.94m - very thin to hairline nearly-horizontal fractures with medium green mineralization, at 47.03m - clay zone, possible shear zone and zone of core loss, at 47.55m				0			

CLASSIFICATION

SHEAR STRENGTH / UCS
□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
✳ UCS
MPa (◆, ✳) 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲) 20 40 60 80 100

CORING RATE —— Min./m 10 20 30 40
REC. —— SCR · · · RQD —— % 20 40 60 80

NOTES:
▽ : Initial Ground Water Depth ▼ : Static Ground Water Depth
1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:
Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 10 July, 2013
TOTAL DEPTH: 54.86m
CAVED DEPTH: N/A
CORING: 177.3 m
WET ROTARY: 2.7 m
BACKFILL: Grout
LOGGER: LPrentice, CEG
DRILLER: Geotech Drilling

C:\USERS\BBINATLI\DESKTOP\04.10130058\GINT\04_1013_0058_FE13B-122313 - WITH TORVANE CORRECTION.GPJ FUGRO_S_(LAB)_IND GRP_A3_ONSHORE_REV03 12/24/2013

LOG OF BORING BH-1
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-1d

LOCATION: See Plate 2
COORDINATES: N 6007611m
E 416382m

SURFACE EL. 17.98 m

DEPTH, METERS	SYMBOL	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS
49				- massive, with few hairline quartz seams approximately 30 degrees, below 47.55m - moderately fractured, with quartz and pyrite filling, from 48.28 to 48.77m	
		C34		- highly fractured, from 48.77 to 50.29m	
50				- near-vertical, hairline, totally healed, wavy fractures, from 49.99 to 50.29m - moderately fractured, below 49.99m	
		C35		- 75 to 80 degree, totally healed, irregular, very thin, quartzose-filled fractures, at 50.29m - quartzose augen structure, from 50.29 to 50.63m - gneissic banding, below 50.29m - faintly laminated, at about 30 degrees, from 50.63 to 51.21m	
51				- 75 to 80 totally healed, irregular, very thin quartzose-filled fractures, at 50.99m	
		C36		- 45 degree quartz-filled fractures, at 51.89m	
52				- clay seam, at 52.52m - slightly fractured, planar, slightly rough along foliation, below 52.58m	
53					
		C37		- 45 degree fractures, from 53.40 to 53.52m, totally healed, approximately 0.1cm wide, planar to slightly rough	
54					
					-36.9
55				NOTE: Performed acoustic televiewer and PS geophysical logging on 10 July, 2013. **TD = 54.86m**	
56					
57					
58					
59					

CLASSIFICATION

UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
		0			
		0			
		0			
		1			
		0			
		0			

SHEAR STRENGTH / UCS

□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
UCS ✳
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE ——
Min./m: 10 20 30 40
REC. —— SCR · · · RQD ——
%: 20 40 60 80

NOTES:

▽ : Initial Ground Water Depth ▼ : Static Ground Water Depth

1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:

Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 10 July, 2013
TOTAL DEPTH: 54.86m
CAVED DEPTH: N/A
CORING: 177.3 m
WET ROTARY: 2.7 m
BACKFILL: Grout
LOGGER: LPrentice, CEG
DRILLER: Geotech Drilling

C:\USERS\BBINATLI\DESKTOP\04.10130058\GINT\04_1013_0058_FE13B-122313 - WITH TORVANE CORRECTION.GPJ FUGRO_S_(LAB)_IND GRP_A3_ONSHORE_REV03 12/24/2013

LOG OF BORING BH-1
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-1e

LOCATION: See Plate 2
COORDINATES: N 6007508m
E 416259m

SURFACE EL. 3.81 m

DEPTH, METERS	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS
0			**PEAT** PEAT (PT): very soft, dark brown, wet, with fibrous and woody material	
	1	2		
			- soft, at 0.75m	
1	2	5	**UNDIVIDED PHYLLITE (OTa)** PHYLLITE (Rx): moderately weathered, moderately hard, dark gray, highly fractured, phyllite rock fragments and dark gray sandy silt recovered in modified California sampler at 1.37m	2.4
	3	9	- with dark gray sandy silt, root fragments, and phyllite fragments recovered in modified California sampler, at 2.60m	
2	4	17		
		27		
	C1		- initiate HQ3 wireline coring at 2.74m - with fine steeply-dipping, rough, totally healed fractures, below 2.74m - moderately weathered, moderately hard to hard, from 2.74 to 3.14m - core barrel blocking, recovery affected by blocking and redrilling, from 2.74 to 4.27m	
3			- 75 degree fracture, steep, rough, with spotty pyrite infill, at 3.41m	
	C2		- 80 degree fracture, steep, totally healed, about 0.1 to 0.2cm-thick from 3.75 to 3.36m	
4				
	C3		- with pyrite mineralization on irregular fracture surfaces and common chlorite staining on foliation surfaces, at 4.57m	
5	C4		- finely foliated, from 5.2 to 5.3m - 75 to 80 degree fracture, about 0.3cm-thick, with quartz, chlorite, and pyrite infill, from 5.18 to 5.79m	
6			- increased quartz foliations, from 5.97 to 6.31m	
	C5		- 1.0 to 1.5cm-thick quartz foliations, from 6.31 to 6.40m - core blocking, poor recovery from 6.40 to 7.39m	
7	C6			
	C7		- 4cm-thick zone of fine quartz foliations, at 6.95m	
8	C8		- vertical to 80 degree fractures, 8 to 15cm spacing, irregular, partially healed to healed, below 8.08m - 0.3 to 0.5cm-thick quartz foliations, at 8.15m - 0.3 to 0.5cm-thick quartz foliations, at 8.35m	
9	C9		- 2.5cm-thick quartz banding, at 9.14m	
10			- highly to extremely fractured, from 9.81 to 9.94m - highly fracture, along 35 to vertical foliations, irregular, rough, with chlorite infill, from 10.21 to 10.45m	
11	C10		- highly fractured, below 9.45m	
			- quartz foliations, from 11.80 to 11.95m	

CLASSIFICATION

UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
	15				
	17				
26		0			
		0			
		0			
		0			
27		0			
		0			
		0			

SHEAR STRENGTH / UCS

□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
UCS ✳
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE —— Min./m: 10 20 30 40
REC. —— SCR · · · RQD ——
%: 20 40 60 80

NOTES:

1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:

Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 19 August, 2013
TOTAL DEPTH: 50.60m
CAVED DEPTH: N/A
CORING: 157 m
WET ROTARY: 9 m
BACKFILL: Piezometer
LOGGER: LPrentice, CEG
DRILLER: MoreCore Drilling

C:\USERS\BBINATLI\DESKTOP\04.10130058\GINT\04_1013_0058_FE13B-122313 - WITH TORVANE CORRECTION.GPJ FUGRO_S_(LAB)_IND GRP_A3_ONSHORE_REV03 12/24/2013

LOG OF BORING BH-2
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-2a

LOCATION: See Plate 2
COORDINATES: N 6007508m
E 416259m

SURFACE EL. 3.81 m

DEPTH, METERS	SAMPLES	STRATUM DESCRIPTION	STRATUM ELEV, METERS	UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
13	C11	- extremely fractured along foliations and near vertical to about 75 degree fractures, at about 5 to 13cm spacing, from 12.04 to 12.44m - finely foliated, from 12.65 to 12.89m - 1cm-diameter pyrite inclusion on 45 degree fracture surface, at 12.98m - thin pyrite infill on planar fracture along foliation, at 13.20m - 8cm-thick quartz vein with evidence of contact metamorphism along lower contact of foliation, at 13.41m		27		0			
14	C12	- less than 0.1cm-thick, irregular, near vertical, totally healed joint, at 14.02m - highly fractured, below 14.17m							
15		- highly to extremely fractured, below 14.51m - with quartz lace structure, from 14.63 to 14.69m - extremely fractured, from 14.78 to 15.03m				0			
16	C13	- 45 degree foliations, below 15.54m - 0.2cm-thick, irregular quartz vein, at 15.70m - 0.5cm-thick chlorite and quartzose foliation or vein, with fine pyrite at margins, at 15.94m				0			
17		- discontinuous fine quartzose foliations, from 16.40 to 16.52m - with few fractures, below 17.47m							
18	C14	- intensely fractured to fine angular fragments, from 17.16 to 17.31m - near vertical to vertical fracture, healed, from 17.22 to 17.47m - 0.2 to 0.3cm-thick quartzose foliation, at 17.65m - 0.2cm-thick quartzose foliations, 2 to 7cm spacing, from 17.74 to 18.01m				0			
19	C15	- near vertical to 80 degree, 0.1 to 0.2cm-thick, quartzose fracture, rough, totally healed, stepped, at 18.93m - near vertical, discontinuous, irregular, partially healed fractures, 0.3 to 0.6cm spacing, at 19.26m		27		0			
20	C16	- unfractured, from 20.12 to 20.57m - moderately fractured, from 20.42 to 21.64m - with chlorite stain and infill and spotty pyrite on fracture surfaces, below 20.42m				0			
21									
22	C17	- finely foliated, below 21.64m - steeply dipping, planar, chlorite-healed fracture, at 21.87m				0			
23	C18	- steeply dipping, 80 degree to near vertical fracture, rough, with pyrite and thin quartz filling, from 22.80 to 23.10m - fewer foliations, below 23.77m - near vertical fracture, discontinuous, rough, fine, totally healed, at 23.87m		27		0			

SHEAR STRENGTH / UCS: □ Penetrometer, ◇ Torvane, Remold Testing ○ △ ▽, Unconfined ▼, Triaxial ●, Miniature Vane ▲, Point Load ◆, UCS ✳
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE —— Min./m: 10 20 30 40
REC. —— SCR · · · RQD — —
%: 20 40 60 80

NOTES:
1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:
Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 19 August, 2013
TOTAL DEPTH: 50.60m
CAVED DEPTH: N/A
CORING: 157 m
WET ROTARY: 9 m
BACKFILL: Piezometer
LOGGER: LPrentice, CEG
DRILLER: MoreCore Drilling

C:\USERS\BBINATLI\DESKTOP\04.10130058\GINT\04_1013_0058_FE13B-122313 - WITH TORVANE CORRECTION.GPJ FUGRO_S_(LAB)_IND GRP_A3_ONSHORE_REV03 12/24/2013

LOG OF BORING BH-2
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-2b

LOCATION: See Plate 2
COORDINATES: N 6007508m
E 416259m

SURFACE EL. 3.81 m

DEPTH, METERS	SYMBOL	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS
25		C19		- light gray gneissic banding, from 24.11 to 24.29m - massive, dark gray, below 24.29m - few fractures to unfractured, below 24.84m - finely foliated, below 24.84m	
26		C20		- irregular, discontinuous, wavy, quartzose banding, at 26.06m - irregular, discontinuous, wavy, quartzose banding, at 26.30m - 30 degree, 1 to 2cm-thick quartz band, at 26.44m - near vertical, discontinuous, fine, totally healed fracture, at 26.67m	
27		C21		- 30 degree, 1cm-thick quartzose band, at 26.88m - 30 degree, 1cm-thick quartzose band, at 27.05m - 3cm-thick quartzose foliation, at 27.80m	
28		C22		- 4cm-thick, 30 to 35 degree, quartzose band, at 27.95m - 3cm-thick, 30 to 35 degree quartzose band, at 28.10m - light and dark gray banding, from 28.16 to 28.77m - 45 degree, planar, healed, chlorite- and quartz-filled fracture, steeper-dipping than foliations, at 28.50m	
29		C23		- finely foliated, below 28.96m - possible shear, at 29.63m - foliations dip about 30 to 40 degrees, below 29.63m	
30		C24		- highly fractured, from 30.39 to 30.54m - moderately fractured, from 30.78 to 31.39m - 45 degree fractures, rough, sub-parallel to foliation, with spotty quartz and pyrite, some chlorite on fracture surfaces, with pyritic sheen on core, between 30.78 to 31.55m	
31		C25		- thin pyrite foliations, at 32.00m - moderately fractured along foliations and 45 to 60 degree fractures surfaces, from 32.31 to 32.92m - 0.2cm-thick calcite infilling, at 32.52m	
32		C26		- highly to intensely fractured, from 32.92 to 33.22m - moderately fractured and lighter gray, below 33.22m	
33				- highly fractured, predominately along foliation surfaces, below 33.83m - 75 to 80 degree intersecting fractures that form "X" pattern, at 34.44m - few to moderate fractures, below 34.44m - very fine, stepped to wavy, totally healed fractures, from 34.44 to 35.36m - few fractures, below 34.75m	
34					
35					

CLASSIFICATION

UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
27		0			
		0			
27		0			
		0			
27		0			
		0			

SHEAR STRENGTH / UCS

□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
UCS ✳
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE —— Min./m: 10 20 30 40
REC. —— SCR · · · RQD ——
%: 20 40 60 80

NOTES:

1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:

Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 19 August, 2013
TOTAL DEPTH: 50.60m
CAVED DEPTH: N/A
CORING: 157 m
WET ROTARY: 9 m
BACKFILL: Piezometer
LOGGER: LPrentice, CEG
DRILLER: MoreCore Drilling

C:\USERS\BBINATLI\DESKTOP\04.10130058\GINT\04_1013_0058_FE13B-122313 - WITH TORVANE CORRECTION.GPJ FUGRO_S_(LAB)_IND GRP_A3_ONSHORE_REV03 12/24/2013

LOG OF BORING BH-2
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-2c

LOCATION: See Plate 2
COORDINATES: N 6007508m
E 416259m

SURFACE EL. 3.81 m

DEPTH, METERS	SYMBOL	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS
37		C27		- fine to hairline, 45 to 50 degree, rough, totally healed fracture, at 36.06m - very steep to vertical hairline fracture, totally healed, with calcite infill, from 36.06 to 36.52m	
38		C28		- very steep to vertical hairline fracture, totally healed, with calcite infill, from 37.11 to 37.41m - with pyritic inclusions and infill within vugs, at 37.49m - moderately fractured, from 37.58 to 37.92m - unfractured, below 37.92m - 0.2 to 0.3cm-thick quartzose band, at 38.16m - moderately fractured along foliation surfaces and along 45 degree cross-cutting fractures, planar, totally healed, with calcite and spotty pyrite, below 38.40m	
39		C29		- finely foliated, below 39.01m - 2cm-thick, highly irregular, folded quartzose band, at 39.32m - moderately to few fractures, below 39.32m - totally healed, near vertical to 80 degree fractures at 1 to 15cm spacing, below 39.62m - with few fractures along foliations, below 39.62m	
40		C30			
41		C31		- fine feathered quartz structure, at 41.00m - fine feathered quartz structure, at 41.21m - increasing schistosity, below 41.45m	
42		C32		- 0.1 to 0.2cm-thick quartzose foliations, at 2 to 9cm intervals, from 42.15 to 42.67m - highly fractured, from 42.82 to 42.92m	
43		C33		- with fine feathered flow structure, from 43.37 to 43.43m - with slickensided fracture surfaces, at 43.43m - with slickensided fracture surfaces, at 43.80m - 0.1 to 0.3cm-thick, 80 degree to near vertical fractures, with calcite and pyrite infill, from 44.04 to 44.90m - highly fractured, predominately along foliations, below 44.20m	
44					
45		C34		- extremely to highly fractured along foliations and intersecting 75 to 80 degree to near vertical fractures, with calcite and chlorite infill and spotty pyrite on fracture surfaces, below 45.54m - light gray, gneissic from 45.87 to 46.57m - with slickensided shear zone, at 46.11m - thinly foliated, from 46.57 to 47.15m - extremely fractured and sheared, phyllite bedrock material is less indurated, moderately hard within sheared zone, from 47.15 to 47.70m	
46					
47					

CLASSIFICATION

UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
27		0			
		0			
		0			
		0			
		0			
		0			

SHEAR STRENGTH / UCS

□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
UCS ✳
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE — Min./m: 10 20 30 40
REC. SCR RQD
%: 20 40 60 80

NOTES:
1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:
Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 19 August, 2013
TOTAL DEPTH: 50.60m
CAVED DEPTH: N/A
CORING: 157 m
WET ROTARY: 9 m
BACKFILL: Piezometer
LOGGER: LPrentice, CEG
DRILLER: MoreCore Drilling

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LOG OF BORING BH-2
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-2d

LOCATION: See Plate 2
COORDINATES: N 6007508m
E 416259m

SURFACE EL. 3.81 m

DEPTH, METERS	SYMBOL	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS
49		C35		- highly fractured, predominately along foliations and 45 degree cross-cutting fractures, with calcite, chlorite, and fine spotty pyrite on fracture surfaces, below 47.70m - finely banded, discontinuous, irregular quartzose foliations, from 48.22 to 48.35m	
50				- moderately fractured along foliations, minor evidence of shearing/slickensides on fracture surfaces, below 49.38m	
51				- highly fractured, 75 degree to near vertical cross-cutting pattern, hairline to 0.1cm-thick, irregular, stepped, continuous to discontinuous, below 50.29m - 2cm-thick possible shear zone, extremely fractured, at 50.29m - near vertical chlorite-filled fracture, with spotty fine pyrite, at 50.51m **TD = 50.60m**	-46.8
52					
53					
54					
55					
56					
57					
58					
59					

CLASSIFICATION: UNIT DRY WT, kN/m³ | PASSING NO. 200 SIEVE, % | WATER CONTENT, % | LIQUID LIMIT | PLASTIC LIMIT | PLASTICITY INDEX (PI)

SHEAR STRENGTH / UCS
□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
✳ UCS
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE —— Min./m: 10 20 30 40
REC. —— SCR · · · RQD ——
%: 20 40 60 80

NOTES:
1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:
Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 19 August, 2013
TOTAL DEPTH: 50.60m
CAVED DEPTH: N/A
CORING: 157 m
WET ROTARY: 9 m
BACKFILL: Piezometer
LOGGER: LPrentice, CEG
DRILLER: MoreCore Drilling

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LOG OF BORING BH-2
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-2e

LOCATION: See Plate 2
COORDINATES: N 6007346m
E 416066m

SURFACE EL. 5.00 m

DEPTH, METERS	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS
0	1	WOH	**PEAT** PEAT (PT): very soft, brown, wet, moss on surface, up to 18 percent silt and lean CLAY (CL), massive, amorphous, abundant fine to medium roots	
	2	50/52mm	- with an organic content of 81%, at 0.61m	4.4
1	C1		**UNDIVIDED PHYLLITE (OTa)** PHYLLITE (Rx): fresh to slightly weathered, very hard, very dark gray, 60 degree dip on foliations, abundant muscovite and pyrite - 2.54cm medium grained sand lens, at 0.82m - silt and fine sand at contact, medium dense, gray, phyllite-derived, at 0.94m - parallel joints, with chlorite mineralization on fracture and joints faces, from 1.22 to 1.52m	
2	C2		- anomalous granitic, phaneritic, slightly weathered with highly weathered ring, from 1.83 to 1.92m	
3	C3		- slickensided, undulating, 60 degree dip, at 2.26m - 40 degree dip on foliations, at 2.29m - fresh, below 2.29m	
4	C4		- very thin quartz-filled fractures, healed, 50 degree dip, wavy, crosses foliations without visible offset, from 2.80 to 3.17m	
5	C5		- multiple intersecting fractures, rough, open, with chlorite mineralization on fracture surfaces, from 3.81 to 4.18m	
6			- with trace phlogopite throughout foliations, from 5.82m	
7	C6		- 70 to 90 degree fractures, wavy to stepped, open, chlorite and pyrite on face, from 7.19 to 7.65m - with quartz infill, below 7.53m - 70 to 90 degree fracture, rough, open, extremely narrow, undulating, chlorite and pyrite mineralization on fracture surfaces, occasional minor slickensides, no visible striations or offset, from 7.71 to 8.02m	
8	C7		- subvertical fracture, rough, open, extremely narrow, undulating, minor chlorite on face, from 8.66 to 8.75m	
9			- 60 to 90 degree fracture, rough, open, arcuate, extremely narrow, undulating, partially healed with quartz and chlorite, from 9.11 to 9.24m - 75 to 90 degree fracture, rough, open, arcuate, extremely narrow, with chlorite, pyrite, and quartz mineralization, from 9.33 to 9.66m	
10	C8			
11	C9		- possible slickensides on foliated parallel joint, striated, at 11m - joint, planar, open, tight, with 65 degree dipping foliations, chlorite on face, at 11.58m	

CLASSIFICATION: UNIT DRY WT, kN/m³ | PASSING NO. 200 SIEVE, % | WATER CONTENT, % | LIQUID LIMIT | PLASTIC LIMIT | PLASTICITY INDEX (PI)

UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %
	22	540
		0
27		0
		0
27		0
		0
27		0

SHEAR STRENGTH / UCS
□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
UCS ✳
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE — Min./m: 10 20 30 40
REC. — SCR · · · RQD — %: 20 40 60 80

NOTES:
1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:
Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 14 July, 2013
TOTAL DEPTH: 55.08m
CAVED DEPTH: N/A
CORING: 177.6 m
WET ROTARY: 3.1 m
BACKFILL: Piezometer
LOGGER: TGlidden
DRILLER: Geotech Drilling

C:\USERS\BBINATLI\DESKTOP\04.10130058\GINT\04_1013_0058_FE13B-122313 - WITH TORVANE CORRECTION.GPJ FUGRO_S_(LAB)_IND GRP_A3_ONSHORE_REV03 12/24/2013

LOG OF BORING BH-3
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-3a

LOCATION: See Plate 2
COORDINATES: N 6007346m
E 416066m

SURFACE EL. 5.00 m

DEPTH, METERS	SYMBOL	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS	CLASSIFICATION: UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
13		C10		- joint, healed, extremely narrow, 65 degree dip, undulating, crosses foliation, at 11.64m - joint, planar, rough, open, extremely narrow, 60 degree dip, chlorite coat, crosses foliations, from 11.89 to 11.98m - cross foliation joint juncture, rough, open, extremely narrow, undulating, 70 degree dip, quartz, chlorite, and pyrite on face, from 12.07 to 12.34m				0		
14		C11		- subvertical fracture, open, extremely narrow, undulating, pyrite, chlorite, and quartz on face, from 12.89 to 13.50m - compositional banding, pronounced, from 12.95 to 13.01m - brittle deformation on 0.5cm-thick healed veins, from 13.50 to 13.66m		27		0		
15				- 80 degree fracture, tight, anastomosed, with 2.5cm offset of quartz vein, at 14.17m - 75 to 90 degree fracture, quartz-filled, healed, extremely narrow, undulating, from 14.48 to 14.69m - 45 degree joint, planar, healed, tight, crosses foliations, at 14.75m - joint, planar, healed to open, extremely narrow, undulating, from 14.90 to 15.06m						
16		C12		- very thinly spaced phlogopite rich foliations, from 16.31 to 16.46m				0		
17				- thinly to very thinly spaced phlogopite, rich foliations, from 17.01 to 17.28m						
18		C13		- 2.5cm-wide pale compositional band, at 17.68m		27		0		
19		C14		- 55 degree joint, planar, tight, crosses foliations, slickensided with subvertical striation, at 18.56m - joint, rough, open, extremely narrow, undulating, 60 degree dip, crosses foliations, at 18.65m						
20				- 15 degree fracture, rough, open, extremely narrow, undulating, at 19.84m				0		
21		C15		- 4.45cm-thick phlogopite rich zone, at 21.03m - parallel joints, planar, rough, open, extremely narrow, undulating, crosses foliation, from 21.43 to 21.61m				0		
22		C16				27		0		
23		C17		- gneissic, with healed vertical fracture, from 22.31 to 22.71m - fracture is undulatory with multiple splays, from 22.40 to 22.71m - increased schistosity, from 23.77 to 23.84m						

SHEAR STRENGTH / UCS
□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
UCS ✳
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE —— Min./m: 10 20 30 40
REC. —— SCR · · · RQD ——
%: 20 40 60 80

NOTES:
1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:
Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 14 July, 2013
TOTAL DEPTH: 55.08m
CAVED DEPTH: N/A
CORING: 177.6 m
WET ROTARY: 3.1 m
BACKFILL: Piezometer
LOGGER: TGlidden
DRILLER: Geotech Drilling

C:\USERS\BBINATLI\DESKTOP\04.10130058\GINT\04_1013_0058_FE13B-122313 - WITH TORVANE CORRECTION.GPJ FUGRO_S_(LAB)_IND GRP_A3_ONSHORE_REV03 12/24/2013

LOG OF BORING BH-3
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-3b

LOCATION: See Plate 2
COORDINATES: N 6007346m
E 416066m

SURFACE EL. 5.00 m

DEPTH, METERS	SYMBOL	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS
25		C18		- subvertical fractures, healed, extremely narrow, white mineral infill, from 23.84 to 24.11m - irregular, 1.5cm-thick quartz band, at 24.05m - 65 degree joint, planar, smooth, open, extremely narrow, crosses foliation, at 24.29m - subvertical fracture, rough, healed, open, undulating, extremely narrow, from 24.66 to 25.69m	
26		C19			
27				- 70 to 85 degree fracture, open, extremely narrow, from 27.10 to 27.31m	
28		C20		- ductile deformation, weathered along foliation and compositional bands, from 28.10 to 28.29m	
29				- ductile deformation, compositional banding, folding axis parallel to foliation, at 28.83m - 75 to 90 degree fracture, rough, open to healed, extremely narrow, undulating, from 29.17 to 29.69m	
30		C21			
31					
32		C22		- 75 to 90 degree fracture, rough, open, healed, extremely narrow, undulating, from 31.61 to 31.94m - 40 to 90 degree fracture, rough, open, extremely narrow, stepped between two foliations, from 32.12 to 32.22m	
33		C23		- 60 to 90 degree fracture, rough, open to 33.80m, healed below 33.80m, undulating, from 33.01 to 33.86m	
34		C24		- 55 degree fracture, planar, healed, extremely narrow, from 33.86 to 33.92m - 40 degree joint, stepped, rough, open, extremely narrow, at 34.38m	
35		C25		- compositional band of chlorite and phlogopite, from 34.99 to 35.11m	

CLASSIFICATION

UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
27		0			
		0			
27		0			
		0			
		0			
27					

SHEAR STRENGTH / UCS

□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
UCS ✳
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE —
Min./m: 10 20 30 40
REC. SCR RQD
%: 20 40 60 80

NOTES:

1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:

Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 14 July, 2013
TOTAL DEPTH: 55.08m
CAVED DEPTH: N/A
CORING: 177.6 m
WET ROTARY: 3.1 m
BACKFILL: Piezometer
LOGGER: TGlidden
DRILLER: Geotech Drilling

C:\USERS\BBINATL\DESKTOP\04.10130058\GINT\04_1013_0058_FE13B-122313 - WITH TORVANE CORRECTION.GPJ FUGRO_S_(LAB)_IND GRP_A3_ONSHORE_REV03 12/24/2013

LOG OF BORING BH-3
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-3c

LOCATION: See Plate 2
COORDINATES: N 6007346m
E 416066m

SURFACE EL. 5.00 m

DEPTH, METERS	SYMBOL	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS
37		C26		- 50 degree joint, planar, smooth, open, crosses foliation, extremely narrow, at 35.87m	
38				- fracture, tight, healed, 0.3cm offset, with 85 degree dip, wavy, from 37.61 to 37.95m - zone of brittle and ductile deformation, at 38.37m	
39		C27		- pegmatitic quartz feldspar, from 38.86 to 39.11m - brecciated zone associated with pegmatitic quartz, 38.95 to 39.04m - parallel feldspar dikes, less than 1cm-thick, from 39.26 to 39.53m	
40		C28		- slatey interval, from 34.46 to 39.99m - intensely fractured, from 40.20 to 40.45m	
41		C29		- subvertical fracture, rough, open, extremely narrow, undulating, from 40.45 to 40.57m - ductile deformation, at 40.66m - 80 degree joint, smooth, open to healed, extremely narrow, from 40.84 to 40.97m - 60 degree joint, smooth, open, tight, undulating, extremely narrow, with slickensides and lineations, at 41.24m - 45 degree joint, planar, rough, open, extremely narrow, crosses foliations, at 41.45m	
42				- joint along foliation, with 1cm-thick of soft micaceous infill, at 41.97m - ductile deformation, undulating and parallel folding, from 42.00 to 42.34m	
43		C30			
44		C31		- ductile deformation, from 43.86 to 43.98m - highly weathered slickensided joint, 40 degrees, at 43.98m	
45				- subvertical fracture, rough, stepped, tight, partly healed, at 45.14m - 75 to 90 degree subparallel fractures, rough, stepped, open, tight, extremely narrow, from 45.35 to 45.48m	
46		C32		- 35 degree joint, smooth, undulating, extremely narrow, crosses foliation, at 46.45m	
47		C33		- ductile deformation zone, from 47.09 to 47.46m - 70 degree fracture, planar, rough, open, extremely narrow, at 47.67m	

CLASSIFICATION: UNIT DRY WT, kN/m³ | PASSING NO. 200 SIEVE, % | WATER CONTENT, % | LIQUID LIMIT | PLASTIC LIMIT | PLASTICITY INDEX (PI)

UNIT DRY WT, kN/m³: 27 | 1 | 0 | 27 | 0

SHEAR STRENGTH / UCS
□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
✳ UCS
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE — Min./m: 10 20 30 40
REC. — SCR · · · RQD — %: 20 40 60 80

NOTES:
1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:
Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 14 July, 2013
TOTAL DEPTH: 55.08m
CAVED DEPTH: N/A
CORING: 177.6 m
WET ROTARY: 3.1 m
BACKFILL: Piezometer
LOGGER: TGlidden
DRILLER: Geotech Drilling

C:\USERS\BBINATLI\DESKTOP\04.10130058\GINT\04_1013_0058_FE13B-122313 - WITH TORVANE CORRECTION.GPJ FUGRO_S_(LAB)_IND GRP_A3_ONSHORE_REV03 12/24/2013

LOG OF BORING BH-3
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-3d

LOCATION: See Plate 2
COORDINATES: N 6007346m
E 416066m

SURFACE EL. 5.00 m

DEPTH, METERS	SYMBOL	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS
49				- 50 degree joint, planar, healed, extremely narrow, crosses foliation, at 47.88m - pegmatite vein, 50 degree dip, crosses foliation, at 48.01m - 35 degree joint, planar, smooth, open, extremely narrow, crosses foliation, slickensided, at 48.28m - joint, planar, healed, narrow, crosses foliation, 40 degree dip, at 48.52m - 40 degree joint, rough, open, extremely narrow, crosses foliation, at 48.83m	
50		C34		- 70 degree joint, rough, open, undulating, extremely narrow, at 49.23m - 70 degree joint, planar, rough, open, extremely narrow, at 49.44m - chlorite rich interval, shattered, moderately hard, at 49.50m - slightly weathered, at 49.87m	
51		C35		- 45 to 50 degree joint, planar, healed, extremely narrow, crosses foliation, with white mineral infill, at 50.81m - 65 degree joint, planar to stepped, healed, extremely narrow, crosses foliation, with white mineral infill, from 50.84 to 50.96m	
52		C36		- moderately hard and slightly weathered, from 51.97 to 52.18m - zone of brittle and ductile deformation, from 51.97 to 52.36m	
53				- subvertical fracture, planar, open, very narrow, from 53.34 to 53.55m	
54		C37			
55				NOTE: Performed acoustic televiewer and PS geophysical logging on 14 July, 2013. **TD = 55.08m**	-50.1
56					
57					
58					
59					

CLASSIFICATION

UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
27		0			
		1			

SHEAR STRENGTH / UCS

□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
UCS ✳
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE —— Min./m: 10 20 30 40
REC. —— SCR · · · RQD ——
%: 20 40 60 80

NOTES:
1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:
Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 14 July, 2013
TOTAL DEPTH: 55.08m
CAVED DEPTH: N/A
CORING: 177.6 m
WET ROTARY: 3.1 m
BACKFILL: Piezometer
LOGGER: TGlidden
DRILLER: Geotech Drilling

C:\USERS\BBINATLI\DESKTOP\04.10130058\GINT\04_1013_0058_FE13B-122313 - WITH TORVANE CORRECTION.GPJ FUGRO_S_(LAB)_IND GRP_A3_ONSHORE_REV03 12/24/2013

LOG OF BORING BH-3
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-3e

LOCATION: See Plate 2
COORDINATES: N 6007251m
E 416053m

SURFACE EL. 16.92 m

DEPTH, METERS	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS
0		1	**PEAT** PEAT (PT): very soft, brown, wet, moss on surface, massive, fibrous, abundant fine to very fine roots and woody debris	
		50/50mm	**UNDIVIDED PHYLLITE (OTa)** PHYLLITE (Rx): intensely weathered to decomposed, very soft, greenish gray, moist, weathered to lean CLAY (CL) with relic bedrock fabric/structure	16.4
1	C1		- with an organic content of 29%, at 0.61m PHYLLITE (Rx): highly weathered, low to moderate hardness, dark gray, slatey cleavage	16.1
2	C2		- highly oxidized foliation planes, common 45 degree joints along foliation, open, smooth, planar, extremely narrow, at 1.95m	
3	C3		- without oxidation on foliation and joint surfaces, below 3.99m - 40 degree joint, crosses foliation, planar, open, rough, extremely narrow, at 4.11m	
4			- highly to intensely weathered, very weak to weak, from 4.48 to 4.57m - 1cm-thick thinly spaced weathered zones, highly weathered, very weak, from 4.57 to 4.88m	
5	C4			
	C5		- 75 degree joint, undulating, smooth, open, extremely narrow, highly weathered, from 5.24 to 5.30m	
6			- 40 degree joint, crosses foliations, stepped, open, extremely narrow, rough chlorite-filled surface, at 5.76m - fresh, very hard, slightly fractured, with faint foliations, below 5.79m - with irregular 10.2cm-thick quartz band, at 6.10m	
7	C6		- with iron oxide stains, possible shear/fault zone, from 6.37 to 6.71m	
8	C7		- 45 to 50 degree planar joint, moderately fractured, foliated, medium gray, with common quartz banding and irregular contacts, at 7.62m	
9	C8		- few fractures, below 8.35m	
10	C9		- thinly foliated, approximately 45 degrees, at 9.57m	
			- thin quartz laminations, from 10.46 to 10.32m	
11	C10		- 75 degree fracture, less than about 1cm-thick, rough, stepped, healed, at 10.67m - 70 to 80 degree fracture, less than about 1cm-thick, filled, healed, at 10.79m	
			- few foliations, from 11.86 to 12.65m	

CLASSIFICATION

UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
		935			
		180			
		0			
		0			
		0			
27					
		0			
		0			
27					
		0			
		0			
		0			

SHEAR STRENGTH / UCS

□ Penetrometer ◇ Torvane Remold Testing ○ △ ▽
Unconfined ▼ Triaxial ● Miniature Vane ▲ Point Load ◆ UCS ✳
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE —— Min./m: 10 20 30 40
REC. SCR RQD
%: 20 40 60 80

NOTES:

1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:

Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 21 July, 2013
TOTAL DEPTH: 20.42m
CAVED DEPTH: N/A
CORING: 64.3 m
WET ROTARY: 2.7 m
BACKFILL: Grout
LOGGER: TGlidden
DRILLER: Geotech Drilling

C:\USERS\BBINATLI\DESKTOP\04.10130058\GINT\04_1013_0058_FE13B-122313 - WITH TORVANE CORRECTION.GPJ FUGRO_S_(LAB)_IND GRP_A3_ONSHORE_REV03 12/24/2013

LOG OF BORING BH-4
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-4a

LOCATION: See Plate 2
COORDINATES: N 6007251m
E 416053m

SURFACE EL. 16.92 m

DEPTH, METERS	SYMBOL	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS	UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
13		C11						0			
14		C12		- 35 degree fracture, very rough, stepped, crosses foliation, at 14.54m							
15				- fractures, thin, filled, with white quartz bands at 15.02m - fractures, thin, filled, at 15.36m				0			
16		C13		- fracture, filled, healed, near vertical, discontinuous, wavy, at 15.73m SHALE (Rx): fresh, moderately soft to moderately hard, highly fractured, healed, with chlorite, quartz, and pyrite infilling shear zone	0.8						
17				- with very hard quartz phyllite layer, from 16.98 to 17.07m				0			
		C14		PHYLLITE (Rx): fresh, hard, medium gray, with 45 degree foliations, few fractures	-0.2						
18				- increased foliation, below 17.56m - 7.6cm-thick quartz layer, at 17.77m - 12.7cm-thick quartz layer, at 18.01m - fracture, moderately rough, steeply dipping, healed, with spotty infill, at 18.47m							
19		C15									
20				- thin fracture zone, at 19.45m - 7.6 to 10.2cm-thick moderately fractured zone, at 19.51m - 5.1cm-thick quartz layer, at 19.60m - highly fractured, healed, filled, 70 degree dip, crosses foliation, below 20.00m							
				TD = 20.42m	-3.5						
21											
22											
23											

CLASSIFICATION

SHEAR STRENGTH / UCS
□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
UCS ✳
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE —— Min./m: 10 20 30 40
REC. —— SCR · · · RQD ——
%: 20 40 60 80

NOTES:
1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:
Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 21 July, 2013
TOTAL DEPTH: 20.42m
CAVED DEPTH: N/A
CORING: 64.3 m
WET ROTARY: 2.7 m
BACKFILL: Grout
LOGGER: TGlidden
DRILLER: Geotech Drilling

C:\USERS\BBINATLI\DESKTOP\04.10130058\GINT\04_1013_0058_FE13B-122313 - WITH TORVANE CORRECTION.GPJ FUGRO_S_(LAB)_IND GRP_A3_ONSHORE_REV03 12/24/2013

LOG OF BORING BH-4
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-4b

LOCATION: See Plate 2
COORDINATES: N 6006993m
E 415818m

SURFACE EL. 33.21 m

DEPTH, METERS	STRATUM DESCRIPTION	STRATUM ELEV, METERS
0	**PEAT** PEAT (PT): very soft, brown to dark brown, wet, organic, fibrous	33.2
	SEDIMENTARY DEPOSITS Silty SAND (SM): very loose, dark gray to dark yellowish brown, wet - few to little gravel, subangular, at 0.12m - with an organic content of 15%, at 0.36m - fine sand, dark gray, with angular, medium to slightly weathered, rock fragments, blow counts affected by gravel content, at 0.46m	32.6
1	**UNDIVIDED PHYLLITE (OTa)** PHYLLITE (Rx): extremely to moderately weathered, hard to very hard, gray to dark gray, intensely fractured, 42 degrees, planar, thinly foliated to laminated, with mica schist bands - 60 degree joints, rough to stepped, moderately open to open, at 0.67m - 65 degree joint, rough to stepped, moderately open, at 0.70m - moderately fractured, at 1.28m	
2		
3	- very intensely fractured, from 2.68 to 2.96m	
	MICA SCHIST (Rx): fresh, hard to very hard, very dark gray to gray, moderately fractured, thinly foliated to laminated at 43 degrees, planar, with biotite, common phyllite bands, and trace garnet inclusions	30.1
4		
5	- 73 degree joint, rough, open, with moderate pyrite mineralization, at 2.96m - 65 to 75 degree joints, slightly rough to rough, healed to not healed, with moderate chlorite and quartz mineralization, from 4.69 to 5.12m	
6	- 65 degree and 85 degree joints, moderately rough to rough, moderately open to open, with oxidized surfaces, at 5.67m - moderately to slightly fractured, at 6.10m	
7		
8	- with garnet inclusions, from 7.32 to 8.05m - chlorite vein/nodule, with amorphous, brecciated mica schist fragments, at 7.41m - 75 degree joint, moderately rough to rough, moderately open, at 7.89m - increased deformation, from 8.02 to 8.20m - 60 degree joint, slightly rough to moderately rough, moderately open to open, stepped, healed, intersected by sub-vertical microjoint, at 8.20m	
9	- 45 degree joints, planar to slightly rough, healed, from 8.99 to 9.11m	
10	- 72 degree joint, slightly rough, moderately open, with moderate mineralization intersected by 75 degree to sub-vertical joints, rough to stepped, moderately healed to healed, at 9.72m - increased deformation, from 10.06 to 10.61m	
11	- 40 degree joint, rough to stepped, moderately open, at 11.40m	

SAMPLES	BLOWS PER 300mm
1	67/127mm
3	Ref.
C1	
C2	
C3	
C4	
C5	
C6	
C7	
C8	
C9	
C10	

CLASSIFICATION

UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
		328			
		0			
		0			
27					
		0			
		0			
30					
27					
		0			
28					
		0			
		0			

SHEAR STRENGTH / UCS

□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
UCS ✳
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE — Min./m: 10 20 30 40
REC. SCR RQD
%: 20 40 60 80

NOTES:

▽ : Initial Ground Water Depth ▼ : Static Ground Water Depth

1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:

Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 23 July, 2013
TOTAL DEPTH: 21.00m
CAVED DEPTH: N/A
CORING: 66.9 m
WET ROTARY: 2 m
BACKFILL: Grout
LOGGER: GEckrich, CEG
DRILLER: Geotech Drilling

C:\USERS\BBINATLI\DESKTOP\04.10130058\GINT\04_1013_0058_FE13B-122313 - WITH TORVANE CORRECTION.GPJ FUGRO_S_(LAB)_IND GRP_A3_ONSHORE_REV03 12/24/2013

LOG OF BORING BH-5
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-5a

LOCATION: See Plate 2
COORDINATES: N 6006993m
E 415818m

SURFACE EL. 33.21 m

DEPTH, METERS	SYMBOL	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS
13				- intensely fractured, at 12.19m - 75 degree to sub-vertical joints, rough to stepped, partly healed to healed, from 12.22 to 14.94m	
14		C11		- 48 degree joint, moderately rough to rough, moderately open to open, at 12.95m	
15		C12		- quartz vein/boudin, at 14.08m - 67 degree joint, slightly rough to smooth, slightly open to tight, with moderate mineralization, at 14.72m - 70 degree joints, stepped, healed, at 15.12m	
16				- 40 degree joint, slightly rough to moderately rough, moderately open, at 15.51m - 85 degree joint, slightly rough to moderately rough, partly healed, at 16.03m	
17		C13		- sub-vertical joints, stepped, healed, at 16.52m - increased deformation, with about 4cm-thick quartz veins/boudins, from 16.73 to 17.04m - 46 degree joint, stepped, moderately open to open, intersected by 72 degree to sub-vertical joint, stepped, slightly open to open, at 16.79m - micro-joints, from 16.92 to 17.16m	
18		C14			
19				- quartz vein/boudin, and sub-vertical joint, stepped, slightly open to tight, at 18.72m - 5cm-thick gneiss band, at 19.02m - 30 degree joint, moderately rough to rough, open, at 19.23m	
20		C15		- 32 degree joints, rough to stepped, slightly open to tight, from 19.78 to 19.95m - 30 degree joint, rough, slightly open to tight, at 19.90m	
21				- quart vein/boudin, at 20.60m - 70 degree joint, moderately rough, moderately open to open, at 20.82m **TD = 21.00m**	12.2
22					
23					

CLASSIFICATION

UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
		0			
		0			

SHEAR STRENGTH / UCS

□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
UCS ✳
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE —— Min./m: 10 20 30 40
REC. —— SCR · · · RQD ——
%: 20 40 60 80

NOTES:

▽ : Initial Ground Water Depth ▼ : Static Ground Water Depth

1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:

Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 23 July, 2013
TOTAL DEPTH: 21.00m
CAVED DEPTH: N/A
CORING: 66.9 m
WET ROTARY: 2 m
BACKFILL: Grout
LOGGER: GEckrich, CEG
DRILLER: Geotech Drilling

C:\USERS\BBINATLI\DESKTOP\04.10130058\GINT\04_1013_0058_FE13B-122313 - WITH TORVANE CORRECTION.GPJ FUGRO_S_(LAB)_IND GRP_A3_ONSHORE_REV03 12/24/2013

LOG OF BORING BH-5
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-5b

LOCATION: See Plate 2
COORDINATES: N 6007112m
E 415437m

SURFACE EL. 1.08 m

DEPTH, METERS	SYMBOL	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS
0		C1		**UNDIVIDED PHYLLITE (OTa)** PHYLLITE (Rx): hard to very hard, dark gray, slightly to moderately weathered, intensely to very intensely fractured, thinly foliated to laminated at 51 degree, planar	
1		C2		- very intensely fractured, from 1.52 to 1.68m	
2					
3		C3		- intensely weathered to decomposed, from 3.02 to 3.14m - 50 to 60 degree joints, rough, moderately open to open, at 3.35m 50 to 60 degree joints, rough, moderately open to open, at 3.41m	
4		C4		- very intensely fractured, from 3.66 to 4.27m	
5		C5		- increased deformation and plication, from 4.27 to 4.36m - mica schist band (5.08cm-thick), at 4.36m - 60 degree joint, slightly rough to moderately rough, moderately open, moderately mineralized, at 4.60m - 35 degree joint, slightly rough to smooth, slightly open, moderately mineralized, at 4.79m - very intensely fractured, from 5.18 to 5.43m	
6		C6		MICA SCHIST (Rx): hard to very hard, dark gray to dark brown, fresh, intensely to moderately fractured, thinly foliated to laminated at 35 degree, planar, phyllite bands common - quartz veins and boudins (1.27cm-thick), from 6.10 to 6.25m	-4.5
7		C7		- quartz vein, amorphous, micaceous, at 7.10m - moderately fractured, at 7.16m	
8		C8		- quartz vein, tabular to amorphous, micaceous, from 8.02 to 8.14m - 64 degree joint, slightly rough, slightly open to tight, moderately mineralized, at 8.44m	
9				- quartz vein, tabular to amorphous (1.27bm thick), at 9.11m - intensely fractured, at 9.21m - 48167 joint, slightly rough, slightly open to tight, moderately mineralized, at 9.24m - quartz vein (1.27cm-thick), at 9.60m	
10		C9		- 70 degree joint, rough to stepped, healed, at 9.91m	
11				- 70 degree joint, moderately rough to rough, moderately open to open, with sub parallel shears and microshears, moderately rough to rough, healed, at 10.33m - 65 degree joint, rough to stepped, moderately open, moderately mineralized, at 10.67m - amphibolite band, massive, with 1.27cm quartz vein, from 10.82 to 11.31m	
		C10		- augen structure and plication, from 11.40 to 11.52m	

CLASSIFICATION

UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
		0			
		4			
		0			
		0			
27		0			

SHEAR STRENGTH / UCS

□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
UCS ✳
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE —— Min./m: 10 20 30 40
REC. —— SCR · · · RQD ——
%: 20 40 60 80

NOTES:

▽ : Initial Ground Water Depth

1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:

Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 26 July, 2013
TOTAL DEPTH: 20.88m
CAVED DEPTH: N/A
CORING: 68.5 m
WET ROTARY: N/A m
BACKFILL: Grout
LOGGER: GEckrich, CEG
DRILLER: Geotech Drilling

C:\USERS\BBINATLI\DESKTOP\04.10130058\GINT\04_1013_0058_FE13B-122313 - WITH TORVANE CORRECTION.GPJ FUGRO_S_(LAB)_IND GRP_A3_ONSHORE_REV03 12/24/2013

LOG OF BORING BH-6
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-6a

LOCATION: See Plate 2
COORDINATES: N 6007112m
E 415437m

SURFACE EL. 1.08 m

DEPTH, METERS	SYMBOL	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS
13		C11		- 75 degree to sub-vertical joints, microjoints, and microshears, moderately rough to stepped, healed to not healed, moderately mineralized, from 12.10 to 12.86m - 32 degree joint, smooth, slightly open to tight, at 12.83m - decomposed band, with CLAYEY SAND (SC), fine to coarse, at 13.05m	
14				- 35 degree joint, rough to stepped, moderately open to open, at 13.81m - quartz vein, amorphous, micaceous, at 14.17m - increasing deformation and boudinage, from 14.60 to 15.03m	
15		C12			
16				- 26 degree joint, smooth, slightly open to tight, with quartz vein, amorphous, micaceous, at 15.58m - 45 degree joint, slightly rough to smooth, tight, at 15.76m - 50 degree joints, slightly rough to smooth, slightly open to tight, at 16.03m - 50 degree joints, slightly rough to smooth, slightly open to tight, at 16.76m	
17		C13		- increase in schistosity, from 16.31 to 13.52m - quartz vein and boudin, micaceous, at 16.76m - quartz veins and boudins, at 17.28m	
18		C14		- 70 degree joint, rough, moderately open, at 17.71m quartz veins and boudins, at 17.74m quartz veins and boudins, at 17.89m - increase in schistosity, from 18.01 to 18.20m - 30 degree joint, smooth, slightly open to tight, at 18.35m	
19				60 degree joints, moderately rough, healed, at 18.90m - 60 degree joints, moderately rough, healed, at 19.14m	
20		C15		- 59 degree joints, slightly rough to moderately rough, healed to not healed, moderate mineralization, at 19.36m - 59 degree joints, slightly rough to moderately rough, healed to not healed, moderate mineralization, at 19.42m - increase in deformation, from 19.57 to 19.75m - quartz vein, amorphous, at 20.00m - 58 degree shear, healed, planar, at 20.03m - sub parallel joint, stepped, moderately healed, with differential movement, at 20.12m	
21				- 85 degree joint, slightly rough to moderately rough, slightly open to moderately open, moderately mineralized, at 20.67m **TD = 20.88m**	-19.8
22					
23					

CLASSIFICATION

UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
		0			
		0			
27					

SHEAR STRENGTH / UCS

□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
UCS ✳
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE —
Min./m: 10 20 30 40
REC. SCR RQD
%: 20 40 60 80

NOTES:

▽ : Initial Ground Water Depth

1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:

Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 26 July, 2013
TOTAL DEPTH: 20.88m
CAVED DEPTH: N/A
CORING: 68.5 m
WET ROTARY: N/A m
BACKFILL: Grout
LOGGER: GEckrich, CEG
DRILLER: Geotech Drilling

C:\USERS\BBINATLI\DESKTOP\04.10130058\GINT\04_1013_0058_FE13B-122313 - WITH TORVANE CORRECTION.GPJ FUGRO_S_(LAB)_IND GRP_A3_ONSHORE_REV03 12/24/2013

LOG OF BORING BH-6
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-6b

LOCATION: See Plate 2
COORDINATES: N 6006971m
E 415453m

SURFACE EL. 2.22 m

DEPTH, METERS	SYMBOL	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS
0		C1		**PEAT** PEAT (PT): very soft, brown, wet, organic, fibrous	2.2
				UNDIVIDED PHYLLITE (OTa) PHYLLITE (Rx): hard, dark gray, moderately to slightly weathered, very intensely fractured, thinly foliated to laminated, 43 degree planar foliation - moderate to intensely fractured, at 0.61m - slightly weathered to fresh, at 0.76m	
1		C2			
		C3		- very intensely fractured, from 1.22 to 1.31m	
				- very intensely fractured, from 1.74 to 2.38m	
2		C4			
		C5			
		C6			
3				- sub-vertical joint, stepped, healed, at 2.90m	
				- sub-vertical joint, slightly rough to moderately rough, healed, from 3.14 to 3.99m - very intensely fractured, from 3.41 to 3.57m	
4		C7		- 30 degree joint, rough to stepped, moderately healed to tight, at 4.15m	
				- 26 degree joint, moderately rough, moderately open, partially mineralized, at 4.45m	
5		C8		**UNDIVIDED PHYLLITE (OTa)** GNEISS (Rx): hard to very hard, dark gray to white, moderately fractured, thinly foliated to laminated at 43 degree, planar to undulating foliation, with trace to few garnet inclusions, mica schist, and quartz bands - 35 degree joint, moderately rough to rough, slightly open to moderately open, at 5.52m	-2.8
6					
		C9		-	
7				- 28 degree joint, slightly rough to smooth, slightly open to tight, at 6.89m intensely to very intensely fractured, at 6.89m - 35 degree joint, rough to stepped, moderately open to open, at 7.10m - very intensely fractured, from 7.22 to 7.41m	
8		C10		- 55 degree joint, rough, open, at 7.74m - very intensely fractured, from 7.83 to 8.20m	
				- 38 degree joint, stepped, moderately open to open, at 8.23m - 50 degree joint, rough to stepped, moderately open to open, with sub parallel microjoint, moderately healed to healed, at 8.32m	
9		C11		- 60 degree joint, rough, slightly open to moderately open, intersected by 80 degree to sub-vertical joint, stepped, healed, at 8.69m - 80 degree joint, rough to stepped, moderately healed to healed, intersected by 40 degree joint, slightly rough to smooth, open, with dark gray CLAYEY SAND with Gravel (SC) infilling (5.08cm-thick), fine to coarse, fine to medium subrounded, at 8.93m and 8.99m	
10		C12			
				- 60 to 65 degree joints, slightly rough, slightly open, at 10.52m	
11		C13		- 75 degree joint, slightly rough, moderately open to open, at 10.88m - 85 degree joint, moderately rough to rough, open, at 11.10m	

CLASSIFICATION: UNIT DRY WT, kN/m³ | PASSING NO. 200 SIEVE, % | WATER CONTENT, % | LIQUID LIMIT | PLASTIC LIMIT | PLASTICITY INDEX (PI)

UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
		0			
		0			
27		0			
		0			
27		0			

SHEAR STRENGTH / UCS
□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
UCS ✳
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE —— Min./m: 10 20 30 40
REC. —— SCR · · · RQD —— %: 20 40 60 80

NOTES:
1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:
Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 25 July, 2013
TOTAL DEPTH: 20.57m
CAVED DEPTH: N/A
CORING: 67.5 m
WET ROTARY: N/A m
BACKFILL: Grout
LOGGER: GEckrich, CEG
DRILLER: Geotech Drilling

C:\USERS\BBINATLI\DESKTOP\04.10130058\GINT\04_1013_0058_FE13B-122313 - WITH TORVANE CORRECTION.GPJ FUGRO_S_(LAB)_IND GRP_A3_ONSHORE_REV03 12/24/2013

LOG OF BORING BH-7
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-7a

LOCATION: See Plate 2
COORDINATES: N 6006971m
E 415453m

SURFACE EL. 2.22 m

DEPTH, METERS	SYMBOL	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS
13		C14		- 40 degree joint, stepped, moderately open, at 11.98m - increasing deformation with recumbent folding, from 12.44 to 12.68m - 52 degree joint, slightly rough to moderately rough, moderately open to open, at 12.65m	
14		C15		- very intensely fractured, from 13.26 to 13.38m - very intensely fractured, from 13.59 to 13.72m - 47 degree joint, slightly rough to moderately rough, tight, partly mineralized, at 13.93m	
15		C16		- 22 degree joint, slightly rough to smooth, tight, at 14.42m - 70 degree joint, slightly rough, slightly open, at 14.63m - 45 degree joint, slightly rough, slightly open to tight, at 14.94m	
16		C17		- light gray to light green with increase in chlorite, at 15.48m - randomly oriented joint and microjoints, rough to stepped, healed from 15.88 to 17.10m - 33 degree joint, slightly rough, moderately open, at 16.19m	
17				- 49 degree joint, slightly rough, slightly open to tight, moderately mineralized, at 16.55m	
18		C18			
19		C19		- 75 degree joint, moderately rough, moderately open to open, at 18.50m - 58 degree joint, slightly rough, slightly open to tight, at 19.05m - sub parallel joint, stepped, healed, at 19.08m - 35 degree joint, rough to stepped, moderately open to open, at 19.14m	
20				- increased deformation, from 19.72 to 19.87m	
				TD = 20.57m	-18.4
21					
22					
23					

CLASSIFICATION

UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
		0			
		0			
28		0			

SHEAR STRENGTH / UCS

□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
UCS ✳
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE —
Min./m: 10 20 30 40
REC. SCR RQD
%: 20 40 60 80

NOTES:

1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:

Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 25 July, 2013
TOTAL DEPTH: 20.57m
CAVED DEPTH: N/A
CORING: 67.5 m
WET ROTARY: N/A m
BACKFILL: Grout
LOGGER: GEckrich, CEG
DRILLER: Geotech Drilling

C:\USERS\BBINATLI\DESKTOP\04.10130058\GINT\04_1013_0058_FE13B-122313 - WITH TORVANE CORRECTION.GPJ FUGRO_S_(LAB)_IND GRP_A3_ONSHORE_REV03 12/24/2013

LOG OF BORING BH-7
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-7b

LOCATION: See Plate 2
COORDINATES: N 6006969m
E 415295m

SURFACE EL. 0.77 m

DEPTH, METERS	SYMBOL	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS
1		C1		**UNDIVIDED PHYLLITE (OTa)** PHYLLITE (Rx): medium hard, dark gray, lightly weathered, extremely fractured, with abundant FeO2 stains - hard, dark grayish green, slightly weathered, foliated, at 0.15m	
				- extremely fractured, from 0.70 to 0.76m	
				- finely foliated, below 0.91m - with quartz layer (1cm-thick) and pyrite and possible fine garnet, at 0.94m	
2		C2		- with a gneiss layer, from 1.22 to 1.37m	
3		C3		- vertical fracture, healed, from 3.41 to 3.66m	
4		C4			
		C5		- no recovery, from 4.27 to 4.57m	
5		C6			
				- highly fractured with slickensides, from 5.49 to 5.64m	
6		C7		- with faint to moderate augen structure, from 5.88 to 6.32m - rough surfaces, at 5.97m	
				- with faint to moderate augen structure, from 6.55 to 6.63m	
7		C8		- with pyrite and garnet, from 7.01 to 7.09m - with irregular quartz, from 7.16 to 7.32m	
				- with irregular quartz, from 7.62 to 7.71m - finely foliated to faint augen structure, from 7.71 to 8.08m	
8					
				- with heavy augen structure, from 8.46 to 9.57m	
9		C9			
10		C10		- highly to extremely fractured, with common planar 45 degree fractures, none to some infilling, <1cm-thick quartz fractures, rough and stepped, healed, from 9.68 to 10.36m	
				- augen to foliated structure, below 10.36m	
11		C11		- moderately fractured, finely foliated, below 10.76m	
				- with few augen structure, from 11.46 to 11.74m	

CLASSIFICATION: UNIT DRY WT, kN/m³ | PASSING NO. 200 SIEVE, % | WATER CONTENT, % | LIQUID LIMIT | PLASTIC LIMIT | PLASTICITY INDEX (PI)

WATER CONTENT, %: 0 | 0 | 0

SHEAR STRENGTH / UCS
□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
UCS ✳
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE — Min./m: 10 20 30 40
REC. SCR RQD
%: 20 40 60 80

NOTES:

1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:

Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 22 July, 2013
TOTAL DEPTH: 20.94m
CAVED DEPTH: N/A
CORING: 68.7 m
WET ROTARY: N/A m
BACKFILL: Grout
LOGGER: LPrentice, CEG
DRILLER: Geotech Drilling

C:\USERS\BBINATLI\DESKTOP\04.10130058\GINT\04_1013_0058_FE13B-122313 - WITH TORVANE CORRECTION.GPJ FUGRO_S_(LAB)_IND GRP_A3_ONSHORE_REV03 12/24/2013

LOG OF BORING BH-8
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-8a

LOCATION: See Plate 2
COORDINATES: N 6006969m
E 415295m

SURFACE EL. 0.77 m

DEPTH, METERS	SYMBOL	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS
13				- with quartz band (1.91cm-thick) at 12.01m with augen structure, from 12.01 to 12.19m - partly foliated, below 12.19m	
14		C12		- with rough fracture surface and spotty pyrite infill, at 13.26m - slightly to moderately fractured with few quartz layers, below 13.41m	
15		C13			
16					
17		C14		- moderately fractured, below 16.98m - fracture zone (7.62cm-thick), at 17.22m - augen structure, from 17.37 to 17.83m	
18		C15			
19				- with augen structure and few banding, from 18.29 to 18.59m increased nearly vertical to 70 degree fracturing, rough, stepped, healed, with quartz infill and spotty fine pyrite, below 18.29m	
20		C16			
21				**TD = 20.94m**	-20.2
22					
23					

CLASSIFICATION: UNIT DRY WT, kN/m³ | PASSING NO. 200 SIEVE, % | WATER CONTENT, % | LIQUID LIMIT | PLASTIC LIMIT | PLASTICITY INDEX (PI)

WATER CONTENT, %: 0 | 0 | 0

SHEAR STRENGTH / UCS
□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
UCS ✳
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE —— Min./m: 10 20 30 40
REC. SCR RQD
%: 20 40 60 80

C:\USERS\BBINATLI\DESKTOP\04.10130058\GINT\04_1013_0058_FE13B-122313 - WITH TORVANE CORRECTION.GPJ FUGRO_S_(LAB)_IND GRP_A3_ONSHORE_REV03 12/24/2013

NOTES:

1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:

Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 22 July, 2013
TOTAL DEPTH: 20.94m
CAVED DEPTH: N/A
CORING: 68.7 m
WET ROTARY: N/A m
BACKFILL: Grout
LOGGER: LPrentice, CEG
DRILLER: Geotech Drilling

LOG OF BORING BH-8

PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-8b

LOCATION: See Plate 2
COORDINATES: N 6006918m
E 415620m

SURFACE EL. 25.01 m

DEPTH, METERS	SYMBOL	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS
0		1	1	**PEAT** PEAT (PT): soft, grayish brown, moist, with silt and sand, organics (roots), amorphous	
		2	50/25mm	Sandy SILT with clay (ML): loose, gray, moist, with organics	24.4
		C1		**UNDIVIDED PHYLLITE (OTa)** PHYLLITE (Rx): slightly to moderately weathered, moderately hard, dark gray, intensely foliated, intensely to very intensely fractured, quartz seams 0.2 to 0.3cm-thick, foliations at 40 to 45 degrees, fractures along foliations, planar, smooth to slightly rough, tight to very narrow, no filling, spotty pyrite joint at 60 degrees, wavy, rough, very narrow, no filling, no stain, slaty cleavage	24.2
1		C2		- some stain, spotty, on foliation faces, at 1.68m	
2		C3		- quartz vein, from 2.87 to 2.93m - very intensely fractured, at 3.05m	
3		C4			
4		C5		- quartz vein, from 3.60 to 4.24m - quartz vein, increase in pyrite content, from 4.34 to 4.39m	
5		C6		- slightly weathered, spotty pyrite filling along foliation breaks, at 4.88m	
6		C7		- quartz vein, from 5.33 to 5.43m - slightly to moderately weathered, moderately hard, very intensely foliated and fractured, fractures along foliation, planar, tight to narrow, smooth to slightly rough, with spotty pyrite filling and slaty cleavage, at 5.64m	
7		C8		- slightly weathered to fresh, at 6.10m - quartz veins 2.5 to 5.1cm-thick, at 6.19m - quartz veins 2.5 to 5.1cm-thick, at 6.55m - quartz veins 2.5 to 5.1cm-thick, at 6.86m	
8		C9		- quartz veins 2.5 to 5.1cm-thick, at 7.50m - fresh, at 7.77m - quartz veins with biotite, from 7.92 to 8.14m	
9		C10			
10		C11		- quartz veins with biotite, from 9.91 to 9.94m	
11		C12		- fresh, intensely foliated at 40 to 45 degrees, intensely fractured along foliation, fractures planar, smooth, tight to very narrow, no filling or stain, few spotty pyrite, quartz seams and veins 0.16 to 5.08cm-thick, slaty cleavage, below 11.0m	

CLASSIFICATION

UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
	25	31			
		0			
		0			
		0			
		0			
		0			
		0			

SHEAR STRENGTH / UCS

□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
UCS ✳
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE —— Min./m: 10 20 30 40
REC. —— SCR ··· RQD ——
%: 20 40 60 80

NOTES:
▽ : Initial Ground Water Depth ▼ : Static Ground Water Depth
1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:
Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 29 June, 2013
TOTAL DEPTH: 30.48m
CAVED DEPTH: N/A
CORING: 97.5 m
WET ROTARY: 2.5 m
BACKFILL: Grout
LOGGER: DMarlow, CEG
DRILLER: Geotech Drilling

C:\USERS\BBINATLI\DESKTOP\04.10130058\GINT\04_1013_0058_FE13B-122313 - WITH TORVANE CORRECTION.GPJ FUGRO_S_(LAB)_IND GRP_A3_ONSHORE_REV03 12/24/2013

LOG OF BORING BH-9
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-1a

LOCATION: See Plate 2
COORDINATES: N 6006918m
E 415620m

SURFACE EL. 25.01 m

DEPTH, METERS	SYMBOL	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS
13		C13		- quartz seams 1.0cm-thick, from 12.68 to 12.80m	
				- quartz seam 0.6cm-thick, at 13.26m	
14		C14		- very intensely fractured, primarily along foliation, at 13.72m	
15		C15		- 60 degree quartz healed joints, from 15.45 to 15.54m	
16				- 60 degree joint, stepped, rough, tight to very narrow, no stain, no filling, at 15.85m - quartz vein 7.6cm-thick, at 16.15m	
17		C16		- small scale folds in quartz seams, from 16.46 to 16.61m - no recovery, from 16.61 to 16.76m	
18		C17			
19		C18		- quartz vein, at 18.29m	
20		C19		- moderately to very intensely fractured along foliation, at 19.81m	
21				- quartz vein with flow structure (deformed), from 20.12 to 20.27m - quartz vein along foliation, at 20.42m - quartz vein with flow structure (deformed), at 20.73m	
22		C20		- quartz vein 2.5cm-thick, at 2.33m	
23		C21		- quartz vein 1.3cm-thick, at 22.86m	

CLASSIFICATION

UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
		0			
		0			
		0			
		0			
		0			

SHEAR STRENGTH / UCS

□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
UCS ✳
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE —— Min./m: 10 20 30 40
REC. —— SCR · · · RQD ——
%: 20 40 60 80

NOTES:

▽ : Initial Ground Water Depth ▼ : Static Ground Water Depth

1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:

Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 29 June, 2013
TOTAL DEPTH: 30.48m
CAVED DEPTH: N/A
CORING: 97.5 m
WET ROTARY: 2.5 m
BACKFILL: Grout
LOGGER: DMarlow, CEG
DRILLER: Geotech Drilling

C:\USERS\BBINATLI\DESKTOP\04.10130058\GINT\04_1013_0058_FE13B-122313 - WITH TORVANE CORRECTION.GPJ FUGRO_S_(LAB)_IND GRP_A3_ONSHORE_REV03 12/24/2013

LOG OF BORING BH-9
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-1b

LOCATION: See Plate 2
COORDINATES: N 6006918m
E 415620m

SURFACE EL. 25.01 m

DEPTH, METERS	SYMBOL	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS
25		C22		- quartz vein, from 25.37 to 25.45m	
26		C23			
27		C24		- partial clay filling 0.2cm-wide along foliation, at 26.76m - no recovery, from 27.28 to 27.43m	
28					
29		C25		- shear zone with sand and gravel-size rock fragments, from 28.80 to 28.86m	
30				- discontinuity, sheared, brecciated, and relithified, from 30.24 to 30.39m, no foliation or foliation incongruent with foliation noted above	-5.5
31				**TD = 30.48m**	
32					
33					
34					
35					

CLASSIFICATION

UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
		0			
		0			
		0			
		0			
		0			

SHEAR STRENGTH / UCS

□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
UCS ✳
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE — Min./m: 10 20 30 40
REC. SCR RQD
%: 20 40 60 80

NOTES:

▽ : Initial Ground Water Depth ▼ : Static Ground Water Depth

1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:

Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 29 June, 2013
TOTAL DEPTH: 30.48m
CAVED DEPTH: N/A
CORING: 97.5 m
WET ROTARY: 2.5 m
BACKFILL: Grout
LOGGER: DMarlow, CEG
DRILLER: Geotech Drilling

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LOG OF BORING BH-9
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-1c

LOCATION: See Plate 2
COORDINATES: N 6006835m
E 415657m

SURFACE EL. 27.80 m

DEPTH, METERS	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS
	1	1	**PEAT** PEAT (PT): very soft, dark brown to reddish brown, moist, organic, fibrous, non-plastic	
	2	WOH	- with an organic content of 96%, at 0.46m	
1	3	WOH	- amorphous, wet, at 0.91m	
	4	WOH		
	5A	WOH	- with an organic content of 91%, at 1.83m	
2	5	Push	**SEDIMENTARY DEPOSITS** Lean CLAY (CL): very soft, gray to greenish gray, wet, trace fine to medium sand	25.4
	6		- soft, dark gray, at 2.74m	
3		7	- gray, below 3.10m	
	7		- firm to stiff below 3.35m - phyllite cobbles and coarse gravel-size fragments with coring scars at bottom of HQ split, at 3.51m, angular	
		7	- coarse, subrounded gravel, at 3.66m	
4	8	Push		
5			- few to little fine to coarse sand, roots, at 4.88m	
			- decrease in sand content, at 5.49m	
6	10	Push		
	C1		- soft, with rootlets, at 6.71m	21.0
7			**UNDIVIDED PHYLLITE (OTa)** PHYLLITE (Rx): slightly weathered to fresh, hard to very hard, dark gray, moderately fractured, thinly foliated to laminated at 43 degrees, planar foliation, mica schist bands common - 65 to 70 degree joint, at 7.13m, rough to stepped, slightly open	
	C2		- tight, sub-parallel joints/microjoints, from 7.47 to 7.59m	
8			- intersecting 45 to 50 degree joints, at 7.80m, slightly rough to smooth, slightly open	
			- 27 degree joint/fault, at 8.20m, moderately rough to rough, open, approximately 2.5cm of coarse sand to fine gravel - 45 degree joint, at 8.35m, slightly rough, slightly to moderately open	
9	C3		- increase in deformation/schistosity, from 8.75 to 9.75m	
10			- approximately 60 degree joint, at 10.15m, slightly rough, moderately open to open - increased deformation, from 10.21 to 10.49m	
	C4		- moderately to intensely fractured, at 10.79m	
11			- approximately 60 degree joint, at 11.13m, moderately rough to rough, slightly open, partly mineralized (quartz) - randomly oriented microjoints/microshears, from 9.74 to 11.46m, planar/smooth to stepped, totally healed, with approximately 0.2cm-differential movement - 27 degree joint, at 11.40m, smooth, slightly open to tight	

CLASSIFICATION

UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
		299			
		1065	38	22	16
	84		28	17	11
		28	32	19	13
15 15	97	28 28			
13 11		43 48 50	36	18	18
		0			
27					
		0			
		0			
28					

SHEAR STRENGTH / UCS

□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
✳ UCS
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE —— Min./m: 10 20 30 40
REC. —— SCR • • • RQD ——
%: 20 40 60 80

NOTES:
▽ : Initial Ground Water Depth ▼ : Static Ground Water Depth
1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:
Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 06 July, 2013
TOTAL DEPTH: 54.86m
CAVED DEPTH: N/A
CORING: 157.7 m
WET ROTARY: 22.3 m
BACKFILL: Grout
LOGGER: GEckrich, CEG
DRILLER: Geotech Drilling

C:\USERS\BBINATLI\DESKTOP\04.10130058\GINT\04_1013_0058_FE13B-122313 - WITH TORVANE CORRECTION.GPJ FUGRO_S_(LAB)_IND GRP_A3_ONSHORE_REV03 12/24/2013

LOG OF BORING BH-10
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-2a

LOCATION: See Plate 2
COORDINATES: N 6006835m
E 415657m

SURFACE EL. 27.80 m

DEPTH, METERS	SAMPLES	STRATUM DESCRIPTION	STRATUM ELEV, METERS
	C5	- approximately 15 degree joint, at 11.89m, rough to stepped, moderately open to open	
13		MICA SCHIST (Rx): fresh, hard to very hard, brown, very slightly fractured, thinly foliated to laminated at 43 degrees, planar foliation, quartz veins/boudins to approximately 1.9cm-wide	15.3
	C6	PHYLLITE (Rx): slightly weathered to fresh, hard to very hard, dark gray	14.4
14	C7	- 20 degree joint, at 13.78m, rough to stepped, moderately open to open - approximately 45 degree joint, at 13.90m, stepped, moderately open to open, moderately mineralized (quartz) - increased deformation, from 14.05 to 14.23m	
15		- 33 degree joint, at 14.45m, moderately rough to rough, slightly open, moderately mineralized	
16	C8	- very intensely fractured, from 15.24 to 15.58m, (fault zone), moderately rough - increased deformation, from 15.67 to 13.63m	
17	C9	- approximately 55 degree joint, at 16.86m, smooth, slightly open to tight - approximately 25 degree joint, at 16.98m, smooth, slightly open to tight, truncated by foliation plane - approximately 70 degree joint, at 17.01m, slightly rough, slightly open to tight - 52 degree joint, at 17.13m, slightly rough to smooth, slightly open - approximately 65 degree shear, at 17.22m, stepped, slightly open, slickensided, sub-parallel, with perpendicular microshears from 17.19 to 17.34m, totally healed	
18		- approximately 65 degree joint, at 17.98m, rough, moderately open, slickensided - intensely fractured, from 18.17 to 18.50m	
19	C10	- approximately 45 degree joint, at 19.17m, rough, slightly open - 30 degree joint, at 19.19m, smooth, slightly open to tight, partly mineralized	
20	C11	- 80 degree joint, at 19.80m, slightly rough to smooth, tight - 75 degree joint, at 19.93m, rough, open, intersected by 20 degree joint, smooth, slightly open to tight - increased deformation/randomly oriented microjoints, from 19.93 to 20.57m, stepped, totally healed	
21		- increased deformation, from 20.91 to 21.03m - 45 degree joint, at 21.06m, smooth, slightly open, partly mineralized	
22	C12	- increased deformation/recumbent folding with associated microjoints, from 21.73 to 22.43m, microjoints totally healed - predominantly sub-vertical microjoints, from 22.46m to 22.71m, stepped to undulating, totally healed	
23		- sub-horizontal joint, at 22.80m, rough, slightly open	

CLASSIFICATION

UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
		0			
		0			
27					
		0			
		0			
		0			
		0			

SHEAR STRENGTH / UCS

□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
UCS ✳
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE —— Min./m: 10 20 30 40
REC. —— SCR · · · RQD ——
%: 20 40 60 80

NOTES:

▽ : Initial Ground Water Depth ▼ : Static Ground Water Depth

1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:

Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 06 July, 2013
TOTAL DEPTH: 54.86m
CAVED DEPTH: N/A
CORING: 157.7 m
WET ROTARY: 22.3 m
BACKFILL: Grout
LOGGER: GEckrich, CEG
DRILLER: Geotech Drilling

C:\USERS\BBINATLI\DESKTOP\04.10130058\GINT\04_1013_0058_FE13B-122313 - WITH TORVANE CORRECTION.GPJ FUGRO_S_(LAB)_IND GRP_A3_ONSHORE_REV03 12/24/2013

LOG OF BORING BH-10
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-2b

LOCATION: See Plate 2
COORDINATES: N 6006835m
E 415657m

SURFACE EL. 27.80 m

DEPTH, METERS	SYMBOL	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS
25		C13		- 25 degree joint, at 24.05m, smooth, slightly open to tight - 35 degree joint, at 24.14m, smooth, slightly open to tight - 85 degree joint, at 24.26m, rough to stepped, slightly to moderately open, moderately mineralized (quartz) - 25 degree joint, at 24.69m, smooth, tight, moderately mineralized (quartz) - increased deformation/recumbent folding, from 24.90 to 25.21m - approximately 85 degree joint, at 25.02m, stepped, slightly open - 40 degree joint, at 21.77m, smooth, tight, partly mineralized (chlorite)	
26		C14		- approximately 35 degree joint, at 26.12m, slightly rough to smooth, slightly to moderately open, partly mineralized - increased deformation/recumbent folding, from 26.43 to 26.70m, foliation at 65 degrees with pyrite/mica schist margins - 20 degree joint, at 26.73m, slightly to moderately rough, slightly open to tight - approximately 25 degree joint, at 26.79m, stepped, slightly to moderately open - three quartz veins/boudins with pyrite/mica schist margins, from 26.90 to 27.13m, approximately 2.5cm-wide - 17 degree joint, at 27.19m, smooth, slightly open, moderately mineralized - 72 degree joint, at 27.22m, slightly rough to smooth, slightly open to tight - 30 degree joint, at 27.25m, slightly rough to smooth, slightly open - 40 degree joint, at 27.40m, smooth, tight, partly healed	
27		C15			
28		C16		- approximately 20 degree joint, at 27.86m, moderately rough, slightly to moderately open - fault/shear zone, from 28.25 to 28.41m, two prominent approximately 60 to 70 degree shears, stepped, moderately to totally healed, with approximately 0.6cm-differential movement - increased deformation, from 28.74 to 28.96m - approximately 65 degree shear, at 28.80m, stepped, totally healed, with approximately 0.2cm-differential movement - four approximately 20 to 25 degree joints, from 29.11 to 29.47m, rough to smooth, moderately open to tight - 33 degree joint, at 29.75m, smooth, slightly open to tight	
29					
30		C17			
31				- increased deformation/foliation at approximately 70 degrees, from 31.18 to 31.55m	
32		C18		- predominantly 80 degree to sub-vertical microjoints, from 32.13 to 32.61m, stepped, totally healed - intensely fractured, at 32.16m	
33		C19		- intensely to very intensely fractured, at 33.38m	
34		C20		- increased deformation/approximately 80 degrees to sub-vertical joints/microjoints, from 33.68 to 35.27m, stepped, partly to totally healed - thin to very thin clay infilling, at 33.74m	
35		C21		- intensely to moderately fractured, at 35.05m	

CLASSIFICATION

UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
		0			
		0			
		0			
		0			
		0			
28					
		0			
		0			
		0			

SHEAR STRENGTH / UCS

□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
✳ UCS
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE —— Min./m: 10 20 30 40
REC. —— SCR · · · RQD ——
%: 20 40 60 80

NOTES:

▽ : Initial Ground Water Depth ▼ : Static Ground Water Depth

1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:

Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 06 July, 2013
TOTAL DEPTH: 54.86m
CAVED DEPTH: N/A
CORING: 157.7 m
WET ROTARY: 22.3 m
BACKFILL: Grout
LOGGER: GEckrich, CEG
DRILLER: Geotech Drilling

C:\USERS\BBINATLI\DESKTOP\04.10130058\GINT\04_1013_0058_FE13B-122313 - WITH TORVANE CORRECTION.GPJ FUGRO_S_(LAB)_IND GRP_A3_ONSHORE_REV03 12/24/2013

LOG OF BORING BH-10
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-2c

LOCATION: See Plate 2
COORDINATES: N 6006835m
E 415657m

SURFACE EL. 27.80 m

DEPTH, METERS	SYMBOL	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS
37		C22		- approximately 50 degree fault/shear zone, from 35.81 to 36.03m, slightly rough to rough, pyrite inclusions, partly to totally healed - thin clay infilling on shear plane, at 35.87m - slightly to moderately fractured, at 36.58m - approximately 40 to 60 degree shears/microshears, from 36.58 to 36.94m, stepped, totally healed, with approximately 0.2cm-differential movement	
38		C23		- 30 degree joint, at 37.52m, smooth, slightly open - increased deformation, from 37.64 to 38.10m	
39				- increased deformation, from 38.56 to 40.26m - approximately 55 degree joint, at 39.01m, slightly rough, slightly to moderately open - approximately 55 degree joint, at 39.32m, slightly rough, slightly to moderately open	
40		C24			
41		C25		- 65 degree joint, at 40.66m, slightly rough, slightly to moderately open, moderately mineralized (quartz) - 32 degree joint, at 40.84m, smooth, slightly open moderately mineralized (quartz) - increased deformation, from 40.97 to 41.67m	
42				- increased deformation, from 41.76 to 44.29m, associated perpendicular microjoints/microshears, totally healed, with approximately 1.6cm- differential movement - approximately 30 degree joint, at 42.12m, stepped, slightly open	
43		C26		- approximately 45 degree joint, at 42.46m, rough - three approximately 40 degree joints, from 42.52 to 42.73m, stepped, open - intensely fractured, from 42.98 to 43.31m	
44		C27		- increased deformation, from 43.19 to 43.37m, some to few garnet inclusions, at 43.19m - prominent approximately 65 degree joints, at 43.22m, stepped to undulating, slightly to moderately open - quartz vein, at 43.80m, approximately 5.1cm-wide	
45					
46		C28		- 53 degree joint, at 45.7m, smooth, slightly open to tight - randomly oriented microjoints/microshears, from 45.87 to 46.36m, stepped to undulating, totally healed, with approximately 0.6cm-differential movement	
47		C29		- approximately 80 degree joint, at 46.42m, smooth, moderately open, undulating - increased deformation, predominantly 65 degree to sub-vertical microshears, from 46.57 to 47.12m, stepped, totally healed, with approximately 0.2cm-differential movement - approximately 60 degree joint, at 47.15m, moderately rough, slightly open - slightly to very slightly fractured, at 47.24m - quartz veins/boudins, from 47.24 to 47.58m, approximately 1.9cm-wide	

CLASSIFICATION: UNIT DRY WT, kN/m³ | PASSING NO. 200 SIEVE, % | WATER CONTENT, % | LIQUID LIMIT | PLASTIC LIMIT | PLASTICITY INDEX (PI)

WATER CONTENT, %: 0 | 0 | 0 | 0 | 0 | 0

SHEAR STRENGTH / UCS
□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
UCS ✳
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE —— Min./m: 10 20 30 40
REC. —— SCR · · · RQD — %: 20 40 60 80

NOTES:
▽ : Initial Ground Water Depth ▼ : Static Ground Water Depth
1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:
Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 06 July, 2013
TOTAL DEPTH: 54.86m
CAVED DEPTH: N/A
CORING: 157.7 m
WET ROTARY: 22.3 m
BACKFILL: Grout
LOGGER: GEckrich, CEG
DRILLER: Geotech Drilling

C:\USERS\BBINATLI\DESKTOP\04.10130058\GINT\04_1013_0058_FE13B-122313 - WITH TORVANE CORRECTION.GPJ FUGRO_S_(LAB)_IND GRP_A3_ONSHORE_REV03 12/24/2013

LOG OF BORING BH-10
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-2d

LOCATION: See Plate 2
COORDINATES: N 6006835m
E 415657m

SURFACE EL. 27.80 m

DEPTH, METERS	SYMBOL	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS
				- approximately 52 degree joint, at 48.16m, planar, totally healed, approximately 0.6cm-wide	
49		C30		CHLORITE SCHIST (Rx): fresh, hard to very hard, green to dark green, slightly to very slightly fractured, thinly bedded to laminated at 45 degrees, planar to undulating foliation, quartz veins/greenstone bands common - 30 degree joint, at 48.49m, smooth, slightly open to tight - approximately 80 degree to sub-vertical joint, at 48.62m, stepped, moderately open to open	-20.6
50		C31		- three approximately 80 degree joints, at 50.57m, stepped, partly to totally healed	
51				- approximately 55 degree joint, at 51.27m, stepped, moderately open to open - approximately 45 degree joint, at 51.57m, stepped, slightly to moderately open	
52		C32		- shears/microshears predominantly dipping approximately 75 degrees, from 51.82 to 52.73m, planar to stepped, totally healed, with approximately 0.2cm-differential movement	
53		C33		- increased deformation, from 52.85 to 53.10m	
54				PHYLLITE (Rx): slightly weathered to fresh, hard to very hard, dark gray, slightly fractured - approximately 5.1cm-wide mica schist band, at 53.52m - approximately 5.1cm-wide mica schist band, at 53.74m - approximately 40 degree joint, at 53.83m, slightly rough to smooth, slightly open - approximately 5.1cm-wide mica schist band, at 53.95m	-25.7 -26.2
				CHLORITE SCHIST (Rx): fresh, hard to very hard, green to dark green	-26.5
55				PHYLLITE (Rx): slightly weathered to fresh, hard to very hard, dark gray, slightly fractured	-27.1
				NOTE: Performed acoustic televiewer and PS geophysical logging on 7 July, 2013. **TD = 54.86m**	
56					
57					
58					
59					

CLASSIFICATION: UNIT DRY WT, kN/m³ | PASSING NO. 200 SIEVE, % | WATER CONTENT, % | LIQUID LIMIT | PLASTIC LIMIT | PLASTICITY INDEX (PI)

WATER CONTENT, %: 13; 0; 29; 0; 0; 0

SHEAR STRENGTH / UCS
□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
✳ UCS
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE — Min./m: 10 20 30 40
REC. — SCR · · · RQD —
%: 20 40 60 80

NOTES:

▽ : Initial Ground Water Depth ▼ : Static Ground Water Depth

1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:

Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 06 July, 2013
TOTAL DEPTH: 54.86m
CAVED DEPTH: N/A
CORING: 157.7 m
WET ROTARY: 22.3 m
BACKFILL: Grout
LOGGER: GEckrich, CEG
DRILLER: Geotech Drilling

C:\USERS\BBINATLI\DESKTOP\04.10130058\GINT\04_1013_0058_FE13B-122313 - WITH TORVANE CORRECTION.GPJ FUGRO_S_(LAB)_IND GRP_A3_ONSHORE_REV03 12/24/2013

LOG OF BORING BH-10
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-2e

LOCATION: See Plate 2
COORDINATES: N 6006797m
E 415643m

SURFACE EL. 27.49 m

DEPTH, METERS	SYMBOL	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS
0		1	WOH	**PEAT** PEAT (PT): very soft, brown to reddish brown, wet, organic, fibrous to amorphous, non-plastic - no recovery with SPT sampling, 0.0m to 0.9m	
1				- samples recovered by HQ core assembly, 0.9m to 2.3m	
2				- highly plastic at 2.3m - no recovery with HQ core assembly, below 2.3m	
				SEDIMENTARY DEPOSITS	24.9
3		5	Push	Lean CLAY (CL): firm to stiff, dark gray, wet, trace to few roots	
4		6	Push	- very soft to soft, below 3.66m	
		7	Push	- firm, at 4.57m	
5					
6		9	Push	- with silt pockets, 2.74m to 6.40m	
7					
8		11	Push		
9			Push		
10			Push		
11		12	WOR		
		C1			15.7

CLASSIFICATION

UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
		996			
		1163			
	12	1419	627	194	433
	98	27	37	17	20
	98	31 29			
	99	30	39	18	21
	95		37	17	20
13	99	40	37	18	19
		42			

SHEAR STRENGTH / UCS

□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
✳ UCS
MPa (◆, ✳) 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲) 20 40 60 80 100

CORING RATE —— Min./m 10 20 30 40
REC. —— SCR • • • RQD —— % 20 40 60 80

NOTES:
▽ : Initial Ground Water Depth ▼ : Static Ground Water Depth
1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:
Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 14 July, 2013
TOTAL DEPTH: 33.53m
CAVED DEPTH: N/A
CORING: 71.5 m
WET ROTARY: 38.5 m
BACKFILL: Piezometer
LOGGER: GEckrich, CEG
DRILLER: Geotech Drilling

C:\USERS\BBINATLI\DESKTOP\04.10130058\GINT\04_1013_0058_FE13B-122313 - WITH TORVANE CORRECTION.GPJ FUGRO_S_(LAB)_IND GRP_A3_ONSHORE_REV03 12/24/2013

LOG OF BORING BH-11
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-3a

LOCATION: See Plate 2
COORDINATES: N 6006797m
E 415643m

SURFACE EL. 27.49 m

DEPTH, METERS	SYMBOL	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS
13		C2		**UNDIVIDED PHYLLITE (OTa)** GNEISS (Rx): fresh, hard to very hard, dark gray to dark greenish gray, intensely to moderately weathered, thinly foliated to laminated at 43 degrees, planar to undulating foliation - 50 degree joint, at 12.10m, slightly to moderately rough, slightly open to tight, partly mineralized (pyrite) - 80 degree joint, at 12.19m, slightly rough, slightly open to tight, partly mineralized (pyrite), truncated by foliation - approximately 80 degree joint, at 12.53m, rough to stepped, moderately open to open, moderately to totally mineralized (quartz) - foliation dipping approximately 56 degrees, at 12.68m - approximately 33 degree joint, at 13.20m, moderately rough, slightly to moderately open - 36 degree joint, at 13.32m, slightly rough to smooth, slightly open to tight - 36 degree joint, at 13.38m, slightly rough to smooth, slightly open to tight, slickensided - approximately 4 degree to sub-horizontal joint, at 13.84m, slightly rough, slightly open to tight, moderately mineralized (chlorite) - 36 degree joint, at 13.93m, slightly to moderately rough, slightly to moderately open, slickensided, partly mineralized (chlorite) - foliation dipping approximately 65 degrees, at 13.99m - approximately 40 degree shear, at 14.11m, rough to stepped, approximately 5.1cm-wide, medium gravel to coarse sand clasts infill, reddish brown lean clay gouge on surface, at 14.17m - increased deformation, from 14.17 to 14.23m - sub-parallel microshears from 14.17 to 15.45m, with approximately 0.5cm differential movement - 80 degree joint, at 14.51m, planar to moderately rough, moderately to totally healed, approximately 7.6cm-wide - 38 degree joint, at 14.90m, moderately rough to rough, slightly to moderately open, partly mineralized (quartz) - 23 degree joint, at 15.03m, moderately rough to rough, slightly to moderately open, partly mineralized (quartz) - four mica schist bands, from 15.06 to 15.76m, approximately 2.5cm-wide - 49 degree joint, at 15.70m, moderately rough to stepped, slightly open to tight - 35 degree joint, at 16.06m, rough to stepped, slightly open to tight	
14		C3			
15		C4			
16					11.3
17		C5		PHYLLITE (Rx): fresh, very hard to extremely hard, dark gray, moderately fractured, thinly foliated to laminated at approximately 55 degrees, planar foliation - increased deformation - 66 degree joint, at 16.67m, slightly rough to smooth, slightly open to tight - randomly-oriented microjoints, from 16.67 to 18.68m - mica schist band, from 17.01 to 16.61m	
18		C6		- extremely hard quartz vein, from 18.07 to 18.26m - approximately 65 degree joint, at 18.14m, stepped, moderately open to open, partly mineralized (muscovite)	
19				- foliation dipping 65 degrees, at 19.51m	
20		C7		- approximately 25 degree joint, at 19.93m, slightly rough, slightly open to tight - mica schist band, from 20.27 to 20.42m, increased deformation along upper margin	7.1
21		C8		GNEISS (Rx): fresh, hard to very hard, dark gray to dark greenish gray, moderately fractured - 23 degree joint, at 21.12m, moderately rough, slightly open to tight	
22				- two 68 degree joints, at 21.70m, slightly to moderately rough, slightly open to tight, moderately to totally healed, quartz infilling - approximately 45 degree joint, at 21.95m, slightly to moderately rough, slightly open, approximately 0.6cm quartz infilling	5.2
23		C9		PHYLLITE (Rx): fresh, very hard to extremely hard, dark gray, moderately fractured, common quartz veins/boudins - approximately 45 degree joint, at 22.31m, rough to stepped, moderately open - 55 degree joint, at 22.43m, slightly rough to smooth, tight, slickensided - 30 degree joint, at 22.71m, slightly to moderately rough, slightly open to tight, moderately to slightly fractured - 47 degree joint, at 22.98m, slightly rough to smooth, slightly open to tight - 60 degree joint, at 23.44m, moderately rough to rough, slightly open, partly mineralized (quartz)	

CLASSIFICATION

UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
29					
29					
28					

SHEAR STRENGTH / UCS

□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
UCS ✳
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE — Min./m: 10 20 30 40
REC. — SCR · · · RQD —
%: 20 40 60 80

NOTES:

▽ : Initial Ground Water Depth ▼ : Static Ground Water Depth

1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:

Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 14 July, 2013
TOTAL DEPTH: 33.53m
CAVED DEPTH: N/A
CORING: 71.5 m
WET ROTARY: 38.5 m
BACKFILL: Piezometer
LOGGER: GEckrich, CEG
DRILLER: Geotech Drilling

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LOG OF BORING BH-11
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-3b

LOCATION: See Plate 2
COORDINATES: N 6006797m
E 415643m

SURFACE EL. 27.49 m

DEPTH, METERS	SYMBOL	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS
25		C10		- 50 degree joint, at 23.80m, slightly rough to smooth, slightly open, partly to moderately mineralized (quartz/pyrite) - quartz veins, from 23.80 to 24.05m, amorphous, approximately 7.6cm-wide - 50 degree joint, at 23.81m, slightly rough to smooth, slightly open, partly to moderately mineralized (quartz/pyrite) - 33 degree joint, at 24.08m, moderately rough to rough, slightly open - slightly to very slightly fractured, at 24.44m - sub-parallel joints, at 24.78m, stepped, totally healed - 45 degree joint, at 24.87m, slightly rough, moderately open, partly mineralized (chlorite) - sub-parallel joints, at 24.93m, stepped, totally healed	
26		C11		- 24 degree joint, at 25.36m, slightly rough, slightly to moderately open - 24 degree joint, at 25.39m, slightly rough, slightly to moderately open - approximately 30 degree joint, at 26.60m, stepped, moderately open to open, partly mineralized (pyrite) - increased deformation, from 25.91 to 26.73m	
27		C12		- amphibolite vein, at 26.97m, approximately 2.5cm-wide, randomly-oriented pyrite lineations along margins - 68 degree joint, at 27.04m, rough, slightly to moderately open, moderately mineralized (quartz) - foliation dipping approximately 33 degrees, at 27.31m	
28				- approximately 8 degree joint, at 27.89m, stepped, moderately open - approximately 8 degree joint, at 27.95m, stepped, moderately open - approximately 50 degree joint, at 28.25m, stepped, slightly open to moderately open	
29		C13		- 65 degree joint, at 58.68m, slightly rough, slightly open to tight - approximately 81 degree to sub-vertical joint, from 28.74 to 29.17m, stepped, moderately open to open - intensely to very intensely fractured, at 28.80m	
30		C14		- 22 degree joint, at 29.41m, rough to stepped, open, partly mineralized (pyrite) - 60 degree joint, at 29.47m, slightly rough to smooth, tight - 38 degree joint, at 29.72m, moderately rough to rough, slightly open	
31		C15		- approximately 25 degree joint, at 30.02m, rough, open - approximately 30 degree joint, at 30.11m, rough, open - approximately 30 degree joint, at 30.14m, rough, open - approximately 25 degree joint, at 30.33m, stepped, moderately open to open - approximately 40 degree joint, at 30.45m, moderately open to open - very intensely fractured, from 26.26 to 31.00m, randomly-oriented joints/microjoints - approximately 60 degree joint, at 30.69m, moderately rough, slightly open to tight	
32		C16		- 35 degree joint, at 31.24m, slightly rough to rough, moderately open to open - 40 degree joint, at 31.30m, slightly rough to rough, moderately open to open - gneiss band, from 31.36 to 31.52m - 20 degree joint, at 31.36m, slightly rough to rough, moderately open to open - 23 degree joint, at 31.61m, rough, slightly open to tight - 23 degree joint, at 31.67m, rough, slightly open to tight - 23 degree joint, at 31.79m, rough, slightly open to tight - 23 degree joint, at 31.85m, rough, slightly open to tight, totally healed - 45 degree joint, at 27.62m, smooth, tight, partly healed	
33				- 12 degree joint, at 28.17m, moderately rough, moderately open - 43 degree joint, at 32.77m, moderately rough, slightly open, moderately mineralized (quartz) - 70 degree joint, at 28.28m, stepped, slightly open, partly mineralized - 40 degree joint, at 32.95m, rough, slightly open, moderately mineralized (quartz) - 75 degree joint, at 33.13m, stepped, slightly open to tight - 75 degree joint, at 33.28m, stepped, slightly open to tight	-6.0
34				NOTE: Installed 5cm-diameter PVC piezometer to 20m; refer to piezometer detail log. **TD = 33.53m**	
35					

CLASSIFICATION

UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
27					

SHEAR STRENGTH / UCS

□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
UCS ✳
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE — Min./m: 10 20 30 40
REC. SCR RQD
%: 20 40 60 80

NOTES:

▽ : Initial Ground Water Depth ▼ : Static Ground Water Depth

1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:

Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 14 July, 2013
TOTAL DEPTH: 33.53m
CAVED DEPTH: N/A
CORING: 71.5 m
WET ROTARY: 38.5 m
BACKFILL: Piezometer
LOGGER: GEckrich, CEG
DRILLER: Geotech Drilling

C:\USERS\BBINATLI\DESKTOP\04.10130058\GINT\04_1013_0058_FE13B-122313 - WITH TORVANE CORRECTION.GPJ FUGRO_S_(LAB)_IND GRP_A3_ONSHORE_REV03 12/24/2013

LOG OF BORING BH-11
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

LOCATION: See Plate 2
COORDINATES: N 6006841m
E 415696m

SURFACE EL. 29.84 m

DEPTH, METERS	STRATUM DESCRIPTION	STRATUM ELEV, METERS	UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
0	**PEAT** PEAT (PT): very soft, dark brown to reddish brown, moist, fibrous, with organic odor, some roots and rootlets							
	- wet, at 0.39m					40	20	20
1	- drilled and sampled 0 to 7.3m using HQ core assembly; no drive samples collected due t safety issues with hammer assembly				870			
2	- with an organic content of 97%, at 1.22m							
	- brown to black, at 1.52m							
3 ▼				87	26			
	SEDIMENTARY DEPOSITS Lean CLAY (CL): soft, gray to bluish gray, moist, with few rootlets	26.6				30	19	11
4 ▽	- driller noted change in drilling characteristics, below 3.81m - firm, 3.96m to 6.00m							
5	- driller reports possible boulder, 4.07m to 4.88m							
	- gray, wet, at 5.79m			99	43	40	20	20
6	- very soft below 6.00m							
7	- driller noted bedrock at 7.47m during drilling	22.4			0			
	UNDIVIDED PHYLLITE (OTa) SLATE (Rx): fresh to moderately weathered, moderately hard to hard, dark gray, laminated at 45 degrees, moderately to intensely fractured, undulating to planar, minor staining, very narrow to tight - coarse granodiorite/diorite core pieces from 7.77m to 7.85m - coarse granodiorite/diorite core pieces from 8.15 to 8.20m							
8	- grades to phyllite, dark gray, fresh, moderately hard to hard, thinly to intensely foliated, moderately to intensely fractured, quartz vein with pyrite inclusions, from 8.30 to 8.38m - approximately 30 degree joint, at 8.35m - approximately 60 degree joint, at 8.41m - very intensely fractured from 8.53 to 8.61m - thinly bedded to laminated at 44 degrees, intensely fractured, planar, top 10.2cm with dark gray fine to medium clayey sand, at 8.84m - tight, totally healed sub-vertical joint from 8.99 to 9.74m				0			
9								
10	- approximately 0.6cm-thick quartz vein at 9.91m - tight, totally healed sub-vertical joint from 8.80 to 10.27m				0			
11	- minor staining and mineralization on discontinuity surfaces, pyrite inclusions, at 10.82m - tight, totally healed approximately 75 degree joint from 11.37 to 11.46m - grades to phyllite from 11.43 to 11.51m, thinly laminated, undulating							

SHEAR STRENGTH / UCS: □ Penetrometer, ◇ Torvane, Remold Testing ○ △ ▽, Unconfined ▼, Triaxial ●, Miniature Vane ▲, Point Load ◆, UCS ✳
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE — Min./m: 10 20 30 40
REC. — SCR · · · RQD —
%: 20 40 60 80

NOTES:
▽ : Initial Ground Water Depth ▼ : Static Ground Water Depth
1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:
Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 23 June, 2013
TOTAL DEPTH: 34.75m
CAVED DEPTH: N/A
CORING: 90 m
WET ROTARY: 24 m
BACKFILL: Grout
LOGGER: GEckrich, CEG
DRILLER: Geotech Drilling

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LOG OF BORING BH-12
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-4a

LOCATION: See Plate 2
COORDINATES: N 6006841m
E 415696m

SURFACE EL. 29.84 m

DEPTH, METERS	SYMBOL	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS
13				- approximately 5.1cm-thick quartz vein from 10.63 to 12.47m	
		C5		- increased mineralization on discontinuity surfaces from 12.95 to 13.05m - 1.3cm-thick thin foliations at 13.01m	
14				- very intensely fractured from 14.02 to 14.55m	
				- randomly-oriented discontinuities within approximately 80 to 85 degree fault/shear band, with lean clay gouge infilling, pyrite inclusions, undulating and rough surfaces at 14.55m	15.2
15		C6		PHYLLITE (Rx): fresh to slightly weathered, moderately hard to hard, dark gray, thinly foliated to laminated at 44 degrees, intensely fractured, planar stepped and rough surfaces with mineralization (biotite and pyrite)	
16					
		C7			
17				- approximately 10.2cm-thick quartz vein with pyrite inclusions from 16.95 to 17.04m - 1.3cm-thick 60 degree joint infilled with gouge (lean clay) from 17.01 to 17.21m - approximately 35 degree joint, rough and planar, very narrow, at 17.37m - approximately 45 degree joint, rough and planar, moderately open, at 17.53m	
18		C8		BIOTITE SCHIST (Rx) from 17.98 to 18.38m	11.9
				PHYLLITE (Rx): fresh to slightly weathered, moderately hard to hard, dark gray	11.5
19				- approximately 75 degree joint, planar, moderately open, at 19.05m - approximately 75 degree intersecting joints, rough and undulating, mineralized, from 19.05 to 19.31m - approximately 1.9cm-thick boudinage band at 19.29m	
20		C9		- three approximately 75 to 80 degree joints, rough, undulating, from 19.81 to 20.12m, moderately open, tight, healed at 20.03m - approximately 1.3cm-thick band biotite schist at 19.92m	
21		C10		- increase in schistosity at 21.18m - approximately 70 degree joint, rough, stepped to undulating, from 21.28 to 21.37m	
22				- approximately 70 degree joint, rough, stepped to undulating, from 21.61 to 21.70m - approximately 70 degree joint, rough, stepped to undulating, from 21.79 to 21.88m - approximately 30 degree joint, rough, planar, at 21.88m - increase in boudinage bands from 21.95 to 22.16m, - very intensely fractured from 22.31 to 22.56m, randomly oriented discontinuities, moderately open to tight, rough and planar, predominantly healed - quartz vein from 22.68 to 22.74m	
23		C11		- very intensely fractured from 22.95 to 23.62m, randomly oriented, rough, planar and undulating, predominantly to totally healed - increase in foliation from 23.38 to 23.71m, approximately 44 degrees undulating to planar thin foliations/laminations	

CLASSIFICATION

UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
		0			
		1			
		0			
		0			
27		1			
		0			
		0			

SHEAR STRENGTH / UCS

□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
✳ UCS
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE —
Min./m: 10 20 30 40
REC. SCR RQD
%: 20 40 60 80

NOTES:

▽ : Initial Ground Water Depth ▼ : Static Ground Water Depth

1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:

Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 23 June, 2013
TOTAL DEPTH: 34.75m
CAVED DEPTH: N/A
CORING: 90 m
WET ROTARY: 24 m
BACKFILL: Grout
LOGGER: GEckrich, CEG
DRILLER: Geotech Drilling

C:\USERS\BBINATLI\DESKTOP\04.10130058\GINT\04_1013_0058_FE13B-122313 - WITH TORVANE CORRECTION.GPJ FUGRO_S_(LAB)_IND GRP_A3_ONSHORE_REV03 12/24/2013

LOG OF BORING BH-12
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-4b

LOCATION: See Plate 2
COORDINATES: N 6006841m
E 415696m

SURFACE EL. 29.84 m

DEPTH, METERS	SYMBOL	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS
25		C12		- approximately 70 degree joints, very narrow to tight, at 21.03m - approximately 70 degree joints, very narrow to tight, at 24.57m	
26		C13		- very intensely fractured, with increase in pyrite inclusions at 24.87m - approximately 5.1cm-thick biotite schist vein at 25.97m with approximately 1.3cm-thick band of increased foliation above - approximately 2.5cm-thick quartz vein at 26.37m - increased foliation, from 26.55 to 26.61m	
27		C14		- very intensely fractured, from 23.17 to 27.28m - moderately to intensely fractured, at 27.28m - approximately 65 degree joint, rough and planar, mineralized surface, at 27.51m	
28					
29		C15		- approximately 25 degree joint, rough and planar, at 28.74m - approximately 12.7cm-thick quartz vein, at 28.77m - approximately 65 degree joint, from 29.14 to 29.32m, rough and undulating, tight, totally healed, with oxidation staining	
30		C16		- approximately 70 degree joint, at 29.57m, rough and stepped - approximately 50 degree joint at 29.66m, planar, slightly open - moderately fractured, approximately 60 degree joint at 30.27m, rough and planar, slightly open - sub-vertical joints, totally healed, at 30.56m	
31				- sub-vertical joints, totally healed, at 31.01m - biotite schist from 31.12 to 31.61m, approximately 2.5cm-thick band of increased foliation above	
32		C17		- intensely to very intensely fractured, from 31.82 to 31.93m; possibly mechanical breakage dure to difficult coring conditions - rough, planar, 60 degree joint, about 0.1 to 1.3cm-wide, at 31.93m - with quartz veins from 32.10 to 32.22m	
33					
34		C18		- intensely fractured from 33.59 to 33.74m, randomly oriented, tight, totally healed - with two, 1.3 to 2.5cm-wide biotite schist bands from 33.83 to 33.91m; lower band truncated by about 40 degree, planar, moderately rough joint/shear with no evidence of displacement	
35				**TD = 34.75m**	-4.9

CLASSIFICATION: UNIT DRY WT, kN/m³ | PASSING NO. 200 SIEVE, % | WATER CONTENT, % | LIQUID LIMIT | PLASTIC LIMIT | PLASTICITY INDEX (PI)

UNIT DRY WT, kN/m³	WATER CONTENT, %
27	1
26	0

SHEAR STRENGTH / UCS
□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
UCS ✳
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE —— Min./m: 10 20 30 40
REC. —— SCR · · · RQD ——
%: 20 40 60 80

NOTES:
▽ : Initial Ground Water Depth ▼ : Static Ground Water Depth
1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:
Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 23 June, 2013
TOTAL DEPTH: 34.75m
CAVED DEPTH: N/A
CORING: 90 m
WET ROTARY: 24 m
BACKFILL: Grout
LOGGER: GEckrich, CEG
DRILLER: Geotech Drilling

C:\USERS\BBINATLI\DESKTOP\04.10130058\GINT\04_1013_0058_FE13B-122313 - WITH TORVANE CORRECTION.GPJ FUGRO_S_(LAB)_IND GRP_A3_ONSHORE_REV03 12/24/2013

LOG OF BORING BH-12
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

LOCATION: See Plate 2
COORDINATES: N 6006865m
E 415632m

SURFACE EL. 27.92 m

DEPTH, METERS	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS
	1	WOH	**PEAT** PEAT (PT): very soft, brown and black, moist to wet, fibrous, non plastic	
	2	WOH	- reddish brown, wet, with roots, at 0.75m	
1	3	WOH	- with trace silt, pudding-like consistency, below 1.22m - with wood debris from 1.37 to 1.45m	
2	C1		Silty SAND (SM): soft, brown to gray, wet, with clay, fine gravel, trace to some roots and organics	26.0
	C2		**UNDIVIDED PHYLLITE (OTa)** SLATE (Rx): highly weathered, moderately hard, dark gray, thinly bedded, planar bedding, smooth surfaces	25.8
3			- moderately to highly weathered, moderately hard, thinly bedded, dips about 30 to 40 degrees, planar, smooth, with trace pyrite, at 2.90m	
	C3			
	C4			
	C5		- grading to slightly weathered below 3.51m, with 1.3cm-thick quartz seam, at 3.55m	
	C6		- bedding, at about 40 degrees, moderately to highly fractured, most fractures along bedding, tight, planar, smooth, with slight stain on fracture surfaces	
4				
			BIOTITE SCHIST (Rx): slightly weathered, moderately hard, greenish gray, with 40 degree foliations, planar fractures, smooth to rough, with some staining along fracture surfaces, and with trace chlorite and quartz inclusions	23.3
5	C7		SLATE (Rx): slightly weathered, moderately hard to hard, gray, highly to moderately fractured, bedding at 40 degrees, fractures predominately along bedding, planar, smooth, tight, with trace of staining on fracture surfaces	23.0
			- with quartz veins along bedding at 5.33 to 5.64m and nearly perpendicular to bedding at 6.55 to 6.71m	
6				
	C8		- moderately to highly fractured, 6.55 to 7.38m	
7				
			- with 17.8cm-thick greenish gray, slightly weathered, moderately hard to hard, biotite schist layer with 40 degree foliations, at 7.38m	20.5
			PHYLLITE (Rx): slightly weathered, moderately hard to hard, dark gray, highly to moderately fractured, fractures are tight, planar, smooth to slightly rough, with quartz and pyrite, gradational upper contact	
8	C9		- slightly weathered to fresh, hard, slightly fractured, tight, planar, smooth to slightly rough, 40 degree foliations with increased pyrite content along foliations, and with quartz and pyrite mineralization	
9				
10	C10		- phyllite interbedded with biotite schist with quartz veins, between 10.06 to 11.28m	
11	C11		SCHIST (Rx): fresh, hard, dark gray, gradational upper contact, 40 degree foliations, slightly fractured, tight, planar, smooth, fractures occur along foliations, with biotite - with quartz veins and trace pyrite, 11.58 to 11.65m	16.6

CLASSIFICATION

UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
	21	36			

SHEAR STRENGTH / UCS

□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
UCS ✳
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE —— Min./m: 10 20 30 40
REC. —— SCR · · · RQD ——
%: 20 40 60 80

0	
0	
0	
0	
0	

NOTES:

▽ : Initial Ground Water Depth

1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:

Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 18 June, 2013
TOTAL DEPTH: 31.09m
CAVED DEPTH: N/A
CORING: 96 m
WET ROTARY: 6 m
BACKFILL: Grout
LOGGER: DMarlow, CEG
DRILLER: Geotech Drilling

C:\USERS\BBINATLI\DESKTOP\04.10130058\GINT\04_1013_0058_FE13B-122313 - WITH TORVANE CORRECTION.GPJ FUGRO_S_(LAB)_IND GRP_A3_ONSHORE_REV03 12/24/2013

LOG OF BORING BH-13
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-5a

LOCATION: See Plate 2
COORDINATES: N 6006865m
E 415632m

SURFACE EL. 27.92 m

DEPTH, METERS	SYMBOL	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS
13		C12		PHYLLITE (Rx): fresh, hard, dark gray, slaty cleavage, slightly to highly fractured, fractures are planar, smooth, tight, no apparent filling or stain; interlayered with quartz seams to about 0.6cm-thick and 0.1 to 0.3cm diameter quartz inclusions	15.1
14		C13		- slightly fractured, below 14.63m	
15					
16		C14		- with near vertical, narrow, wavy, quartz-healed fracture, from 15.85 to 16.15m - - slightly to highly fractured, with smooth to rough, tight, planar to stepped fractures, below 16.15m	
17		C15		- greenish gray, moderately to highly fractured, with increased chlorite content, below 17.53m	
18					
19		C16		GNEISS (Rx): fresh, hard to very hard, slightly fractured, banded with quartz, planar to stepped, slightly rough to rough, tight fractures with no apparent stain or infilling	9.0
20				- with quartz veins, at 19.81m PHYLLITE (Rx): fresh, hard, grayish brown and white, moderately to highly fractured, with slaty cleavage at about 40 degrees, quartz seams along bedding/foliation, and with tight, planar, smooth fractures along bedding/foliation	8.1
21		C17			
22		C18		- with clay-filled fracture along foliation; possible shear, at 21.79m - fresh, hard to very hard, gray, slightly to moderately fractured, with tight, planar to stepped, smooth to slightly rough fractures, below 22.05m	
23		C19		- slightly to moderately fractured, at 23.56m	

CLASSIFICATION

UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
		0			
		0			
		0			
		0			
		0			

SHEAR STRENGTH / UCS

□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
UCS ✳
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE —— Min./m: 10 20 30 40
REC. —— SCR • • • RQD ——
%: 20 40 60 80

NOTES:

▽ : Initial Ground Water Depth

1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:

Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 18 June, 2013
TOTAL DEPTH: 31.09m
CAVED DEPTH: N/A
CORING: 96 m
WET ROTARY: 6 m
BACKFILL: Grout
LOGGER: DMarlow, CEG
DRILLER: Geotech Drilling

C:\USERS\BBINATLI\DESKTOP\04.10130058\GINT\04_1013_0058_FE13B-122313 - WITH TORVANE CORRECTION.GPJ FUGRO_S_(LAB)_IND GRP_A3_ONSHORE_REV03 12/24/2013

LOG OF BORING BH-13
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-5b

LOCATION: See Plate 2
COORDINATES: N 6006865m
E 415632m

SURFACE EL. 27.92 m

DEPTH, METERS	SYMBOL	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS
25		C20		- with slaty 40 degree cleavage, quartz seams along foliation/bedding, slightly fractured with planar, tight, smooth to slightly rough fractures, and with increased pyrite content, below 24.99m	
26		C21			
27				- highly fractured, from 27.74m to 28.27m	
28		C22		- moderately fractured, below 28.27m - slightly fractured below 28.80m	
29					
30		C23		- hard to very hard, slightly fractured with tight, planar to rough fracture surfaces, no visible stain or filling along fracture surfaces, with some quartz along foliations below 29.57m	
31				**TD = 31.09m**	-3.2
32					
33					
34					
35					

CLASSIFICATION

UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
27		0 0 0 0 0			

SHEAR STRENGTH / UCS

□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
✳ UCS
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE —— Min./m: 10 20 30 40
REC. —— SCR • • • RQD ——
%: 20 40 60 80

NOTES:

▽ : Initial Ground Water Depth

1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:

Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 18 June, 2013
TOTAL DEPTH: 31.09m
CAVED DEPTH: N/A
CORING: 96 m
WET ROTARY: 6 m
BACKFILL: Grout
LOGGER: DMarlow, CEG
DRILLER: Geotech Drilling

C:\USERS\BBINATLI\DESKTOP\04.10130058\GINT\04_1013_0058_FE13B-122313 - WITH TORVANE CORRECTION.GPJ FUGRO_S_(LAB)_IND GRP_A3_ONSHORE_REV03 12/24/2013

LOG OF BORING BH-13
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-5c

LOCATION: See Plate 2
COORDINATES: N 6006733m
E 415534m

SURFACE EL. 29.63 m

DEPTH, METERS	SYMBOL	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS
0		1	WOH	**PEAT** PEAT (PT): very soft, dark brown to dark grayish brown, moist, fibrous, organic	29.6
				SILT with gravel (ML): very loose, dark grayish brown, moist, with trace fine sand, intensely weathered to decomposed approximately 2.5cm-angular phyllite gravel-size fragments with oxidized foliation surfaces	29.5
1		C1		**UNDIVIDED PHYLLITE (OTa)** PHYLLITE (Rx): intensely to moderately weathered, hard to very hard, dark gray, intensely to very intensely fractured, thinly foliated to laminated at approximately 50 degrees, planar foliation	
				- slightly weathered, at 1.37m	
		C2		- moderately to slightly fractured, at 1.52m	
2				- increase in deformation, folded over quartz veins with schist margins, from 1.74 to 1.92m - fresh, at 1.77m - three approximately 45 degree joints, randomly-oriented microjoints, from 2.04 to 2.56m, planar, totally healed	
3		C3		- 75 degree joint, at 3.54m, planar, slightly rough, moderately open, slightly mineralized, sub-parallel microjoints	
4		C4		- approximately 70 degree joint, at 7.01m, planar to stepped, moderately rough, slightly open, slightly mineralized (quartz) - 60 degree joint, at 4.42m, planar, slightly rough, slightly open - slightly to very slightly fractured, at 4.57m	
5					
6		C5		- moderately fractured, at 4.91m - 45 degree joint, at 5.79m, planar, stepped, moderately open, slightly mineralized - 50 degree joint, at 5.88m, planar, smooth, partly mineralized - 55 degree joint, at 6.04m, planar, moderately rough, moderately open	
7				- approximately 70 degree joint, at 7.01m, planar to stepped, moderately rough, slightly open, slightly mineralized (quartz)	
8		C6		- sub-vertical to vertical joint, at 7.62m, planar, moderately rough, moderately open to open, slightly mineralized - 75 degree joint, at 7.80m, planar, slightly to moderately rough, slightly open, slightly mineralized	
9		C7		- 65 degree joint, at 8.41m, stepped, slightly rough, slightly open, partly mineralized - increase in deformation/schistosity, from 9.36 to 10.40m	
10		C8			
11				- 77 degree joint, at 9.74m, planar, slightly rough, slightly to moderately open, slightly mineralized - biotite schist band and quartz veins, bands to 2.5cm, from 10.19 to 12.10m	

CLASSIFICATION

UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
28		0			
		0			
		0			
27					
27					
		0			
		0			
		0			

SHEAR STRENGTH / UCS

□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
UCS ✳
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE —— Min./m: 10 20 30 40
REC. SCR RQD
%: 20 40 60 80

NOTES:
▽ : Initial Ground Water Depth ▼ : Static Ground Water Depth
1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:
Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 04 July, 2013
TOTAL DEPTH: 59.44m
CAVED DEPTH: N/A
CORING: 194.5 m
WET ROTARY: 0.5 m
BACKFILL: Grout
LOGGER: GEckrich, CEG
DRILLER: Geotech Drilling

C:\USERS\BBINATLI\DESKTOP\04.10130058\GINT\04_1013_0058_FE13B-122313 - WITH TORVANE CORRECTION.GPJ FUGRO_S_(LAB)_IND GRP_A3_ONSHORE_REV03 12/24/2013

LOG OF BORING BH-14
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-6a

LOCATION: See Plate 2
COORDINATES: N 6006733m
E 415534m

SURFACE EL. 29.63 m

DEPTH, METERS	SAMPLES	STRATUM DESCRIPTION
13	C9	- slightly fractured, at 12.34m - increase in deformation, from 12.37 to 13.50m
14	C10	- approximately 25 degree joint, at 13.47m, planar, moderately rough, slightly open - approximately 50 to 80 degree microjoints, from 13.90 to 14.48m, stepped, totally healed - increase in deformation, biotite schist bands, from 13.99 to 14.75m
15	C11	- approximately 70 degree microshears, from 14.48 to 14.72m, stepped, totally healed, with approximately 0.2cm-differential movement - 60 degree joint, at 14.90m, planar, moderately rough to rough, slightly open - 60 degree joint, at 15.09m, planar, moderately rough to rough, slightly open
16	C12	- increased deformation, from 15.94 to 17.13m - quartz veins, at 16.55m, tabular to amorphous, to approximately 15.2cm-wide
17	C13	- quartz veins, at 16.86m, tabular to amorphous, to approximately 15.2cm-wide - increase in deformation, quartz veins/boudins, from 17.59 to 18.11m
18	C14	- intensely fractured, at 18.29m - quartz veins/boudins with biotite schist margins, from 18.38 to 18.59m, to 1.3cm-wide
19	C15	- 50 degree joint at 19.20m, planar, slightly rough to smooth, moderately open, slightly to partly mineralized - slightly fractured, at 19.42m
20	C16	- quartz vein/boudin, at 19.93m, approximately 0.6cm-wide - 60 to 65 degree joint, at 20.18m, stepped, totally healed - sub-parallel microjoints, from 20.33 to 20.39m, planar, totally healed
21		- approximately 65 to 75 degree joint, at 21.21m, planar, smooth, slightly open - gneiss band, from 21.34 to 21.58m - approximately 55 to 85 degree joint, at 21.40m, stepped, rough, moderately open to open, partly to totally mineralized/infilled with chlorite/dark greenish blue lean clay
22		- approximately 60 degree joint, 75 degree microjoint, at 21.88m, planar, partly to totally healed - intensely to very intensely fractured, from 22.16 to 22.92m - increase in deformation, from 22.31 to 23.56m
23		- 33 degree joint, at 23.53m, slightly rough to smooth, slightly open to tight - intensely to very intensely fractured, from 23.62 to 24.11m

CLASSIFICATION: UNIT DRY WT, kN/m³ | PASSING NO. 200 SIEVE, % | WATER CONTENT, % (0 at 13, 14, 16, 17, 18, 19, 20, 21, 22, 23) | LIQUID LIMIT | PLASTIC LIMIT | PLASTICITY INDEX (PI)

SHEAR STRENGTH / UCS: ☐ Penetrometer, ◇ Torvane, Remold Testing ○ △ ▽, Unconfined ▼, Triaxial ●, Miniature Vane ▲, Point Load ◆, UCS ✳
MPa (◆, ✳): 50 100 150 200 250
kPa (☐, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE — Min./m: 10 20 30 40
REC. SCR RQD — %: 20 40 60 80

NOTES:
▽ : Initial Ground Water Depth ▼ : Static Ground Water Depth
1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:
Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 04 July, 2013
TOTAL DEPTH: 59.44m
CAVED DEPTH: N/A
CORING: 194.5 m
WET ROTARY: 0.5 m
BACKFILL: Grout
LOGGER: GEckrich, CEG
DRILLER: Geotech Drilling

C:\USERS\BBINATLI\DESKTOP\04.10130058\GINT\04_1013_0058_FE13B-122313 - WITH TORVANE CORRECTION.GPJ FUGRO_S_(LAB)_IND GRP_A3_ONSHORE_REV03 12/24/2013

LOG OF BORING BH-14
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-6b

LOCATION: See Plate 2
COORDINATES: N 6006733m
E 415534m

SURFACE EL. 29.63 m

DEPTH, METERS	SAMPLES	STRATUM DESCRIPTION	STRATUM ELEV, METERS
25	C17	- approximately 75 degree joint, at 23.87m, stepped, moderately open to open - 30 degree joint, at 24.23m, smooth, slightly to moderately open, intersected by 60 to 80 degree microjoints, planar to undulating, totally healed - 45 to 55 degree joint, at 24.38m, stepped, totally healed, with 0.3cm-differential movement, branched microshears along upper margin, totally healed	
26	C18	- 55 and 85 degree intersecting joints, at 25.51m, slightly rough to stepped, slightly to moderately open, slightly to partly mineralized (quartz/chlorite) GNEISS (Rx): fresh, hard to very hard, dark gray to white, very slightly fractured, thinly foliated to laminated at approximately 45 degrees - increased deformation, from 26.46 to 26.79m	4.0
27	C19	PHYLLITE (Rx): intensely to moderately weathered, hard to very hard, dark gray, intensely to very intensely fractured, thinly foliated to laminated at approximately 50 degrees, planar foliation - 60 degree joint, at 27.34m, stepped, slightly to moderately open, slightly mineralized (chlorite) - moderately fractured, at 27.43m	2.8
28		- approximately 70 degree microjoint, at 28.29m, stepped, totally healed - intensely fractured, at 24.65m - 55 degree joint, at 28.74m, stepped, open	
29	C20	- approximately 45 degree joint, at 29.02m, stepped, moderately open to open - increase in deformation, quartz veins/boudins, from 29.02 to 29.72m - approximately 75 degree joint, at 29.35m, stepped, partly to totally healed	
30	C21		
31		- intensely fractured, from 30.57 to 31.30m - approximately 75 degree joint, at 30.57m, rough, slightly open to moderately open, partly mineralized (quartz/pyrite) - approximately 40 degree fault/shear, at 31.15m, moderately rough to slickensided, approximately 2.5cm-wide, infilled with lean clay gouge/decomposed phyllite - 30 degree joint, at 31.24m, slightly rough to smooth, moderately open, slightly mineralized, intersected by approximately 75 degree sub-vertical microjoints, undulating, totally healed (pyrite) - 40 degree joint, at 31.67m, smooth, slightly open to tight, slightly mineralized (chlorite) - randomly-oriented microjoints, from 31.70 to 32.10m, totally healed - 70 degree joint, at 31.79m, smooth, slightly open to tight - increase in deformation/schistosity, quartz veins/boudins, from 32.11 to 33.01m	
32	C22		
33	C23	- approximately 55 degree to sub-vertical microshears, from 32.89 to 33.07m, totally healed, with approximately 0.2cm-differential movement - quartz veins with biotite schist margins, from 33.19 to 33.44m	
34		- 45 degree joint, at 34.35m, slightly rough to smooth, moderately open	
35	C24	- 55 degree joint, at 35.27m, rough to stepped, moderately open, intersected by approximately 80 degree to sub-vertical joint, stepped, moderately open, partly mineralized (chlorite/pyrite) - sub-vertical microjoints, from 35.63 to 35.69m, totally healed	

CLASSIFICATION: UNIT DRY WT, kN/m³ = 27; PASSING NO. 200 SIEVE, %; WATER CONTENT, % = 0, 0, 0, 0, 0; LIQUID LIMIT; PLASTIC LIMIT; PLASTICITY INDEX (PI)

SHEAR STRENGTH / UCS: □ Penetrometer, ◇ Torvane, Remold Testing ○ △ ▽, Unconfined ▼, Triaxial ●, Miniature Vane ▲, Point Load ◆, UCS ✳; MPa (◆, ✳) 50 100 150 200 250; kPa (□, ◇, ○, △, ▼, ●, ▲) 20 40 60 80 100

CORING RATE — Min./m 10 20 30 40; REC. SCR RQD %; 20 40 60 80

NOTES:

▽ : Initial Ground Water Depth ▼ : Static Ground Water Depth

1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:

Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 04 July, 2013
TOTAL DEPTH: 59.44m
CAVED DEPTH: N/A
CORING: 194.5 m
WET ROTARY: 0.5 m
BACKFILL: Grout
LOGGER: GEckrich, CEG
DRILLER: Geotech Drilling

C:\USERS\BBINATLI\DESKTOP\04.10130058\GINT\04_1013_0058_FE13B-122313 - WITH TORVANE CORRECTION.GPJ FUGRO_S_(LAB)_IND GRP_A3_ONSHORE_REV03 12/24/2013

LOG OF BORING BH-14
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-6c

LOCATION: See Plate 2
COORDINATES: N 6006733m
E 415534m

SURFACE EL. 29.63 m

DEPTH, METERS	SYMBOL	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS
37		C25		- 65 degree joint, at 36.24m, slightly rough, moderately open to open, partly mineralized (quartz/pyrite)	
38		C26		- biotite schist bands, from 37.58 to 37.70m - approximately 45 degree microjoint, at 38.22m, slightly rough to smooth, moderately open - quartz vein/boudin, at 38.62m, approximately 2.5cm-wide	-9.1
39		C27		GNEISS (Rx): fresh, hard to very hard, dark gray to white, very slightly fractured, thinly foliated to laminated at approximately 45 degrees - approximately 50 degree joint, at 39.17m, stepped, slightly open	-9.7
40				PHYLLITE (Rx): intensely to moderately weathered, hard to very hard, dark gray, intensely to moderately fractured - quartz vein with pyrite inclusions, from 39.47 to 39.68m, sharp contacts	-10.3
41		C28		GNEISS (Rx): fresh, hard to very hard, dark gray to white, unfractured	-10.6
42		C29		PHYLLITE (Rx): intensely to moderately weathered, hard to very hard, dark gray, intensely to moderately fractured - 75 degree joint, at 40.33m, stepped, slightly open, slightly mineralized (quartz) - sub-vertical microjoints, from 40.84 to 41.61m, undulating to stepped, totally healed, pyrite inclusions - quartz vein, from 41.36 to 41.51m, amorphous - increased deformation, randomly-oriented microjoints/microshears, from 41.39 to 42.09m, discontinuities totally healed, with approximately 2.5cm-differential movement	
43		C30		- increase in deformation, from 42.58 to 42.73m - biotite schist bands, from 42.95 to 45.42m, to approximately 6.4cm-wide	
44		C31		- 45 degree joint, at 44.32m, slightly rough to smooth, slightly open - 25 degree joint, at 44.87m, rough to stepped, open, slightly mineralized (chlorite) - 40 degree joint, at 44.93m, slightly rough to rough, open, slightly mineralized (chlorite) - approximately 10 degree joint, at 44.96m, rough, open, slightly mineralized (chlorite) - 55 degree joint, at 45.26m, slightly to moderately rough, slightly open to tight, partly mineralized (chlorite)	
45					
46		C32		- very intensely fractured, from 46.66 to 48.01m	
47				- decomposed phyllite with coarse sand clasts and lean clay gouge, possible fault zone, from 46.94 to 47.15m	

CLASSIFICATION: UNIT DRY WT, kN/m³ | PASSING NO. 200 SIEVE, % | WATER CONTENT, % | LIQUID LIMIT | PLASTIC LIMIT | PLASTICITY INDEX (PI)

SHEAR STRENGTH / UCS
□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
UCS ✳
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE — Min./m: 10 20 30 40
REC. — SCR · · · RQD —
%: 20 40 60 80

CLASSIFICATION	WATER CONTENT, %	SHEAR STRENGTH / UCS
	0	◆
	0	
	0	
	0	
	1	
	0	

NOTES:
▽ : Initial Ground Water Depth ▼ : Static Ground Water Depth
1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:
Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 04 July, 2013
TOTAL DEPTH: 59.44m
CAVED DEPTH: N/A
CORING: 194.5 m
WET ROTARY: 0.5 m
BACKFILL: Grout
LOGGER: GEckrich, CEG
DRILLER: Geotech Drilling

C:\USERS\BBINATLI\DESKTOP\04.10130058\GINT\04_1013_0058_FE13B-122313 - WITH TORVANE CORRECTION.GPJ FUGRO_S_(LAB)_IND GRP_A3_ONSHORE_REV03 12/24/2013

LOG OF BORING BH-14
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-6d

LOCATION: See Plate 2
COORDINATES: N 6006733m
E 415534m

SURFACE EL. 29.63 m

DEPTH, METERS	SAMPLES	STRATUM DESCRIPTION	STRATUM ELEV, METERS
49	C33	- quartz vein with pyrite inclusions/margins, at 47.88m approximately 3.8cm-wide - 50 degree joint, at 47.95m, slightly rough, moderately to totally healed - 50 to 60 degree microjoints, from 48.37 to 63.33m, smooth, totally healed - 45 degree joint, at 48.68m, slightly rough to smooth, moderately open to open, moderately mineralized (chlorite) - quartz veins with pyrite margins, from 49.16 to 49.35m	
50	C34	- approximately 50 degree joint, at 49.62m, rough to stepped, moderately open to open - approximately 45 degree joint, at 49.90m, stepped to undulating, open - approximately 45 degree joint, at 49.93m, stepped, moderately open - intersecting 45 and 60 degree joints, at 50.14m, slightly to moderately rough, slightly to moderately open - thinly foliated to laminated at 46 degrees, at 50.29m	
51		- approximately 60 degree joint, at 50.57m, stepped, totally healed - approximately 65 degree to sub-vertical joint, at 51.18m, stepped, slightly open	
52	C35	- approximately 55 degree joint, at 51.63m, rough, moderately open to open - approximately 2.5cm-wide biotite schist band, at 52.09m, approximately 50 degree microjoint, stepped, totally healed	
53	C36	- 15 degree joint, at 52.49m, moderately to slightly rough, slightly open to tight, moderately mineralized (pyrite) - 55 degree joint, at 52.79m, slightly rough, slightly open to tight, truncated by foliation at 52.70m	
54		- 78 degree joint, at 54.01m, stepped, slightly to moderately open, moderately mineralized (chlorite) - approximately 60 degree joints, from 54.19 to 54.35m, smooth to planar, totally healed	
55	C37	- two sub-vertical joints, at 47.03m, stepped, slightly open to tight, moderately mineralized (chlorite) - very intensely fractured, from 54.86 to 55.47m	
56	C38	- approximately 35 degree joint, at 55.63m, rough to stepped, open, moderately mineralized (chlorite) - intersection 50 and 65 degree joints, at 55.87m, slightly rough to smooth, moderately open, partly mineralized (chlorite) - biotite schist band, increased deformation/schistosity, from 56.17 to 56.30m - quartz vein, at 56.30m, approximately 3.8cm-wide	
57	C39	- 55 degree joint, at 56.35m, slightly rough to smooth, moderately open, partly mineralized (chlorite) - randomly-oriented discontinuities, from 56.57 to 56.91m, stepped, slightly open to tight, partly to totally mineralized (pyrite/chlorite) - 15 degree joint, at 56.91m, slightly rough, moderately mineralized (chlorite) - 50 degree joint, at 57.03m, smooth, slightly open - quartz vein, at 57.12m, approximately 10.2cm-wide	
58	C40	- 60 to 85 degree microjoint, at 58.06m, stepped, totally healed	
59		- 45 degree joint truncated by vertical joint, at 58.43m, smooth, planar and stepped respectively, both totally healed - approximately 80 degree joint, at 58.95m, moderately rough to rough	
		NOTE: Performed acoustic televiewer and PS geophysical logging on 4 July, 2013. **TD = 59.44m**	-29.8

CLASSIFICATION: UNIT DRY WT, kN/m³ | PASSING NO. 200 SIEVE, % | WATER CONTENT, % | LIQUID LIMIT | PLASTIC LIMIT | PLASTICITY INDEX (PI)

WATER CONTENT, %: 0 | 0 | 0 | 0 | 0 | 0

SHEAR STRENGTH / UCS
□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
✳ UCS
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE — Min./m: 10 20 30 40
REC. — SCR · · · RQD —
%: 20 40 60 80

NOTES:
▽ : Initial Ground Water Depth ▼ : Static Ground Water Depth
1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:
Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 04 July, 2013
TOTAL DEPTH: 59.44m
CAVED DEPTH: N/A
CORING: 194.5 m
WET ROTARY: 0.5 m
BACKFILL: Grout
LOGGER: GEckrich, CEG
DRILLER: Geotech Drilling

C:\USERS\BBINATLI\DESKTOP\04.10130058\GINT\04_1013_0058_FE13B-122313 - WITH TORVANE CORRECTION.GPJ FUGRO_S_(LAB)_IND GRP_A3_ONSHORE_REV03 12/24/2013

LOG OF BORING BH-14
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-6e

LOCATION: See Plate 2
COORDINATES: N 6006696m
E 415520m

SURFACE EL. 30.97 m

DEPTH, METERS	SYMBOL	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS
0		1	WOH	**PEAT** PEAT (PT): very soft, reddish brown, saturated, organic, fibrous, amorphous roots and moss, trace silt, boring located in standing water	
		2	<1		
1		3	WOH	- with an organic content of 66%, at 1.22m - few 2.5cm-diameter wood fragments, at 1.52m	
		4	4	- dark brown, at 2.13m	
2		5A/5B	14	**SEDIMENTARY DEPOSITS** Clayey SAND (SC): medium dense, light gray, very moist to wet, trace organics, approximately 0.3cm-diameter root or stick, fine to medium sand, trace silt, fine gravel-size fragments	28.5
3		6A/6B	36	Sandy Lean CLAY (CL): very stiff to hard, gray, moist, fine sand, trace shell fragments, massive, phyllite and granitic/granite pegmatite (quartz and biotite) fragments to 2.5cm diameter	27.8
		7	45	- artesian flow from boring at about 3.66m; estimated at less than 1.9 liter/minute Lean CLAY with silt (CL): very stiff to hard, massive, with phyllite rock fragments to 2.5cm, trace fine gravel and coarse sand	26.9
4		8	68	Lean CLAY (CL): stiff to very stiff, light gray, moist, massive, trace silt	26.4
		9	22	- very moist, at 5.18m	
5		10	85/178mm	- fine sand seam approximately 0.2cm-thick at 5.49m, with gravel-size fragments - rubble, no recovery 5.67 to 6.40m	25.2
		C1		**UNDIVIDED PHYLLITE (OTa)** PHYLLITE (Rx): slightly to moderately weathered, moderately hard, dark gray, intensely to very intensely fractured, intensely foliated at 40 to 45 degrees, fractures planar to wavy, tight to very narrow, smooth to rough, with spotty chlorite and pyrite on fracture surfaces, slaty cleavage, with interbeds of quartz 0.2 to 0.3cm-thick along foliation, most fractures along foliation with few joints perpendicular to foliation	
6		C2			
7		C3		- shear at 7.47m with slickensided surface perpendicular to foliation plane	
8		C4		- shattered, with quartz, at 8.53m - with near vertical healed fractures, hairline, with white filling, stepped, rough, tight, at 8.84m - without chlorite filling, decrease pyrite traces, below 9.14m	
9				- moderately fractured, at 9.75m	
10		C5		PHYLLITE with quartz banding (Rx): moderately hard to hard, slightly weathered, moderately fractured, fractures along foliation at 40 to 45 degrees, fractures tight to narrow, planar, smooth to slightly rough, few thin seams of biotite schist 0.2 to 0.3cm-thick, traces of pyrite	20.9
11		C6		- spotty greenish white filling on fractures, at 11.89m	
12					

UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
		876			
	11		532	247	285
	38		532	336	196
	32	15	21	16	5
		15	34	17	17
		13	27	16	11
		22	37	19	18
		18			
		31	43	19	24
		39			
		0			
		0			
		0			
		0			
		0			

SHEAR STRENGTH / UCS
□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
✳ UCS
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE —— Min./m: 10 20 30 40
REC. —— SCR · · · RQD ——
%: 20 40 60 80

60
26
167.6
186.7

NOTES:
▽ : Initial Ground Water Depth ▼ : Static Ground Water Depth Not Encountered
1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:
Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 24 June, 2013
TOTAL DEPTH: 35.97m
CAVED DEPTH: N/A
CORING: 99.4 m
WET ROTARY: 18.6 m
BACKFILL: Grout
LOGGER: DMarlow, CEG
DRILLER: Geotech Drilling

C:\USERS\BBINATLI\DESKTOP\04.10130058\GINT\04_1013_0058_FE13B-122313 - WITH TORVANE CORRECTION.GPJ FUGRO_S_(LAB)_IND GRP_A3_ONSHORE_REV03 12/24/2013

LOG OF BORING BH-15
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-7a

LOCATION: See Plate 2
COORDINATES: N 6006696m
E 415520m

SURFACE EL. 30.97 m

DEPTH, METERS	SYMBOL	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS	UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
14		C7		- little to no pyrite, at 13.11m - near vertical hairline fractures, healed, with quartz, tight, planar to wavy, from 13.41 to 13.72m - near vertical fractures from 13.72 to 14.02m, wavy, rough, tight, very narrow, partially healed, with quartz - becoming more silicisic, hard to very hard, below 14.02m				0		
15		C8		- no recovery from 14.54 to 14.63m - gray to greenish gray, moderately to very intensely fractured, intensely foliated at 40 to 45 degrees, silicic from 14.63 to 15.54m							
16		C9		- no recovery from 16.08 to 16.15m - slightly to moderately fractured, at 16.46m				0			
17		C10		- 2.5cm-thick quartz lens, at 16.86m - gneissic banding with augen structure, from 17.07 to 17.37m		27					
18								0			
19		C11		- spotty pyrite filling in vertical fractures, at 18.50m - seams of quartz 0.2 to 1.3cm-thick, fractures along foliation, planar, tight to very narrow, smooth, no filling, spotty pyrite, fractures from 75 degrees to near vertical, wavy to stepped, very narrow, green stain, no filling, below 19.20m	11.8						
20				PHYLLITE (Rx): fresh, hard to very hard, dark gray, intensely foliated at 40 to 45 degrees, quartz seams along foliation 0.2 to 0.3cm-thick, moderately to intensely fractured, fractures along foliation, tight to very narrow, planar to wavy, smooth to slightly rough, no filling, no stain - spotty pyrite, from 19.57m to 20.73m				0			
21		C12		- moderately to very intensely fractured, sheared, 80 degrees to near vertical, healed, very narrow, at 21.18m - numerous hairline, healed fractures, from 21.18 to 21.64m - green chlorite stain on fracture surfaces, and spotty pyrite on most fractures along foliation, below 21.64m				0			
22		C13		- intensely fractured along foliation, at 22.40m							
23				- no recovery from 23.62 to 23.77m				0			
24		C14		- gneissic from 23.93 to 24.23m - biotite schist bands, from 24.38 to 24.46m				0			
25				- gneissic, segregation of mafic minerals and quartz with augen structure, at 24.99 to 25.30m							
		C15		- intensely fractured, at 25.45m - few biotite schist bands from 25.76 to 25.91m				0			

CLASSIFICATION

SHEAR STRENGTH / UCS
□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
UCS ✳
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE —— Min./m: 10 20 30 40
REC. —— SCR · · · RQD ——
%: 20 40 60 80

NOTES:
▽ : Initial Ground Water Depth ▼ : Static Ground Water Depth Not Encountered
1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:
Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 24 June, 2013
TOTAL DEPTH: 35.97m
CAVED DEPTH: N/A
CORING: 99.4 m
WET ROTARY: 18.6 m
BACKFILL: Grout
LOGGER: DMarlow, CEG
DRILLER: Geotech Drilling

C:\USERS\BBINATLI\DESKTOP\04.10130058\GINT\04_1013_0058_FE13B-122313 - WITH TORVANE CORRECTION.GPJ FUGRO_S_(LAB)_IND GRP_A3_ONSHORE_REV03 12/24/2013

LOG OF BORING BH-15
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-7b

LOCATION: See Plate 2
COORDINATES: N 6006696m
E 415520m

SURFACE EL. 30.97 m

DEPTH, METERS	SYMBOL	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS
27		C16		- few biotite schist bands from 26.37 to 26.52m - slightly to moderately fractured, healed, quartz-filled hairline fractures nearly perpendicular to foliation, from 26.82 to 27.13m	
28		C17		- schist bands from 27.58 to 28.04m - fresh, hard to very hard, intensely foliated, slaty cleavage, moderately fractured, foliation at 40 to 45 degrees, foliation fractures, planar, smooth to slightly rough, tight to very narrow, no stain, few spotty pyrite, below 28.35m - 0.9 to 1.3cm-thick quartz seam, at 28.50m - schistose band, at 28.80m - 0.9 to 1.3cm-thick quartz seam, at 28.99m - schistose band, at 29.05m - schistose band, at 29.17m	
29					
30		C18		- hairline fractures, perpendicular to foliation, wavy, rough, tight to very narrow, spotty pyrite filling, at 29.57m - slightly to moderately fractured, at 30.18m	
31		C19		- 1.3cm-thick schistose band, at 30.85m - 5.1cm-thick schistose band, at 30.93m	
32				- low angle fractures from 10 to 15 degrees, wavy to planar, very narrow to tight, slightly rough to rough, at 31.70m - schistose, from 31.70 to 32.71m	
33		C20		- - moderately to intensely fractured, at 32.92m	
34					
35		C21		- primarily quartz, from 34.30 to 34.42m - quartz veins to about 0.6cm-wide along foliation, from 35.17 to 35.36m	
36				**TD = 35.97m**	-5.0
37					
38					

CLASSIFICATION: UNIT DRY WT, kN/m³ | PASSING NO. 200 SIEVE, % | WATER CONTENT, % | LIQUID LIMIT | PLASTIC LIMIT | PLASTICITY INDEX (PI)

SHEAR STRENGTH / UCS
□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
UCS ✳
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE — Min./m: 10 20 30 40
REC. — SCR · · · RQD —
%: 20 40 60 80

WATER CONTENT, %: 0 0 0 0 0 0

NOTES:
▽ : Initial Ground Water Depth ▼ : Static Ground Water Depth Not Encountered
1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:
Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 24 June, 2013
TOTAL DEPTH: 35.97m
CAVED DEPTH: N/A
CORING: 99.4 m
WET ROTARY: 18.6 m
BACKFILL: Grout
LOGGER: DMarlow, CEG
DRILLER: Geotech Drilling

C:\USERS\BBINATLI\DESKTOP\04.10130058\GINT\04_1013_0058_FE13B-122313 - WITH TORVANE CORRECTION.GPJ FUGRO_S_(LAB)_IND GRP_A3_ONSHORE_REV03 12/24/2013

LOG OF BORING BH-15
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-7c

LOCATION: See Plate 2
COORDINATES: N 6006739m
E 415573m

SURFACE EL. 27.01 m

DEPTH, METERS	SYMBOL	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS	UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
0		1	1	**PEAT** PEAT (PT): soft, reddish brown, wet to saturated, non plastic, organic (moss and roots), fibrous, amorphous, with trace silt							
		2	1								
1		3	WOH	- with an organic conent of 94%, at 1.22m				762			
		4	1								
2		5	1	- highly plastic, at 2.44m			2		826	201	625
		6	WOH								
3		7	13	**SEDIMENTARY DEPOSITS** Lean CLAY (CL): firm, light gray, moist, trace silt, with fine sand and organics (root fragments), fine gravel-size fragments	23.4			25	27	15	12
4		8	Push	- trace shells and few rock fragments to 2.5cm-in diameter, at 4.88m		17	75	20	27	14	13
				- stiff, 4.88m to 6.0m		18		19			
5		9	10			18		19	32	17	15
6				soft below 6.0m							
				Lean CLAY with silt (CL): very soft to soft, light gray, very moist, trace sand	20.8						
7		10	Push	Lean CLAY (CL): soft, light gray, moist, trace silt and fine to medium gravel-size fragments	20.3						
				- stiff to very stiff at 7.13m		17	96	23	36	18	18
8						17		23			
		11	2				88	23	36	18	18
9											
10		12B	Push	- with silt, very moist, below 9.75m - no recovery with Shelby tube 9.75 to 10.36m; resampled with SPT				0			
11		13	Push			14	97	33	32	17	15
						14		36			
						14		33			

SHEAR STRENGTH / UCS
□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
✳ UCS
MPa (◆, ✳) 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲) 20 40 60 80 100

CORING RATE —— Min./m 10 20 30 40
REC. —— SCR • • • RQD —— % 20 40 60 80

NOTES:
▽ : Initial Ground Water Depth ▼ : Static Ground Water Depth Not Encountered
1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:
Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 27 June, 2013
TOTAL DEPTH: 32.61m
CAVED DEPTH: N/A
CORING: 65 m
WET ROTARY: 42 m
BACKFILL: Piezometer
LOGGER: DMarlow, CEG
DRILLER: Geotech Drilling

C:\USERS\BBINATLI\DESKTOP\04.10130058\GINT\04_1013_0058_FE13B-122313 - WITH TORVANE CORRECTION.GPJ FUGRO_S_(LAB)_IND GRP_A3_ONSHORE_REV03 12/24/2013

LOG OF BORING BH-16
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-8a

LOCATION: See Plate 2
COORDINATES: N 6006739m
E 415573m

SURFACE EL. 27.01 m

DEPTH, METERS	SYMBOL	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS
					14.4
13		C1		**UNDIVIDED PHYLLITE (OTa)** PHYLLITE (Rx): slightly to moderately weathered, hard to moderately hard, dark gray, intensely foliated, intensely to very intensely fractured, foliation at 40 to 45 degrees, fractures along foliation, fractures are planar to wavy, smooth to rough, tight to narrow, some green stain and spotty pyrite filling, with quartz seams 0.2 to 1.9cm-thick along foliation	
14		C2		- no recovery from 13.87 to 14.33m	
15					
16		C3		- very intensely fractured, at 15.85m	
17				- very intensely fractured, possible shear along foliation with clay filling, from 17.07 to 17.13m	
18		C4		- shear at 40 degrees along foliation, 0.3cm-clay gouge filling, planar to smooth, at 18.14m - no recovery from 18.29 to 18.90m, possible washout of shear zone	
19		C5		- no recovery from 16.33 to 19.20m, clay sand and phyllite gravel-size fragments; possible continuation of shear unit from above	
		C6		- shear from 19.11 to 19.19m, clay, sand, and phyllite gravel-size fragments - no recovery from 19.20 to 19.42m	
20					
21		C7		- fresh, hard to very hard, intensely foliated at 40 to 45 degrees, moderately fractured, fractures along foliation, planar to smooth, tight, horizontal and vertical fractures, wavy to stepped, rough, tight to very narrow, no filling, spotty white and green stain, with quartz seams from 0.2 to 0.3cm-thick, below 20.42m	
22		C8		- highly pyritized, from 21.95 to 22.86m	
23		C9		- greenstone and schist, from 22.86 to 23.07m - slightly to moderately fractured, at 23.62m	

CLASSIFICATION

UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
		0			
		0			
		0			
		0			
		0			
		27			
		0			

SHEAR STRENGTH / UCS

□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
✳ UCS
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE —— Min./m: 10 20 30 40
REC. —— SCR · · · RQD ——
%: 20 40 60 80

NOTES:

▽ : Initial Ground Water Depth ▼ : Static Ground Water Depth Not Encountered

1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:

Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 27 June, 2013
TOTAL DEPTH: 32.61m
CAVED DEPTH: N/A
CORING: 65 m
WET ROTARY: 42 m
BACKFILL: Piezometer
LOGGER: DMarlow, CEG
DRILLER: Geotech Drilling

C:\USERS\BBINATLI\DESKTOP\04.10130058\GINT\04_1013_0058_FE13B-122313 - WITH TORVANE CORRECTION.GPJ FUGRO_S_(LAB)_IND GRP_A3_ONSHORE_REV03 12/24/2013

LOG OF BORING BH-16
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-8b

LOCATION: See Plate 2
COORDINATES: N 6006739m
E 415573m

SURFACE EL. 27.01 m

DEPTH, METERS	SYMBOL	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS
25		C10		- very intensely fractured, at 24.84m - moderately fractured, at 25.30m - biotite schist and greenstone, at 25.45m	
26		C11		- biotite schist and quartz with flow structure, at 26.27m - fresh, hard to very hard, moderately fractured, intensely foliated with quartz seams 0.2 to 0.3cm-thick, and spotty pyrite from 26.52 to 27.49m, 40 to 45 degree foliation, fractures along foliation are planar, smooth to slightly rough, tight to very narrow, fractures not along foliation wavy to stepped, rough, very narrow to narrow, spotty pyrite and quartz filling	
27					
28		C12		- with quartz seams, slightly to moderately fractured, at 28.04m	
29					
30		C13			
31		C14		- moderately to intensely fractured, at 31.09m	
32					-5.6
33				NOTE: Installed 5cm-diameter PVC piezometer to 20m; refer to piezometer detail log. **TD = 32.61m**	
34					
35					

CLASSIFICATION: UNIT DRY WT, kN/m^3 | PASSING NO. 200 SIEVE, % | WATER CONTENT, % | LIQUID LIMIT | PLASTIC LIMIT | PLASTICITY INDEX (PI)

SHEAR STRENGTH / UCS
□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
UCS ✳
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE — Min./m: 10 20 30 40
REC. — SCR · · · RQD —
%: 20 40 60 80

WATER CONTENT, %: 0 0 0 0 0 0

NOTES:
▽ : Initial Ground Water Depth ▼ : Static Ground Water Depth Not Encountered
1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:
Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 27 June, 2013
TOTAL DEPTH: 32.61m
CAVED DEPTH: N/A
CORING: 65 m
WET ROTARY: 42 m
BACKFILL: Piezometer
LOGGER: DMarlow, CEG
DRILLER: Geotech Drilling

C:\USERS\BBINATLI\DESKTOP\04.10130058\GINT\04_1013_0058_FE13B-122313 - WITH TORVANE CORRECTION.GPJ FUGRO_S_(LAB)_IND GRP_A3_ONSHORE_REV03 12/24/2013

LOG OF BORING BH-16
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-8c

LOCATION: See Plate 2
COORDINATES: N 6006764m
E 415508m

SURFACE EL. 25.45 m

DEPTH, METERS	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS
	1	1	**PEAT** PEAT (PT): very soft, reddish brown, wet, fibrous, organic, trace silt, non-plastic	
			- recovered sample from HQ core barrel used to advance the hole, at 0.61m - with an organic content of 81%, at 0.61	
1	3	2	- soft, organic, with roots, at 1.37m	
	4		stiff below 1.7m - with an organic content of 93%, at 1.83m	23.5
2		7	**SEDIMENTARY DEPOSITS** Lean CLAY with silt (CL): firm, gray, very moist, with trace fine sand	
	5	7	- very moist to wet, trace organics (roots) with sand pockets at 2.74m - with few gravel to 2.5cm-diameter, at 2.90m	22.6
3	6	50/25mm	Silty SAND (SM): very dense, grayish brown, wet, with trace clay	22.3
	C1		**UNDIVIDED PHYLLITE (OTa)** PHYLLITE (Rx): moderately to slightly weathered, hard, dark gray, slaty cleavage, intensely foliated, 40 degree foliation, intensely to very intensely fractured, with quartz laminations along foliations, fractures tight, planar, smooth to rough, and with pyrite filling	
4	C2			
	C3			
5				
6	C4		- intensely fractured, at 6.10m	
	C5		- vertical fault, no gouge, with foliation offset of 1.3cm, 6.54 to 6.71m - intensely to very intensely fractured, fractures healed, 6.86 to 7.01m	
7				
			- fractures wavy, rough, tight to very narrow, stain and filling spotty, with chlorite on fracture surfaces, at 7.32m	
8	C6		- micro-folding gneissic bands from 7.16 to 8.23m	
			- fractured, planar, tight, smooth, slightly rough, no stain or filling, at 8.53m	
9				
	C7		- stepped, rough 65 degree fracture, at 9.45m - intensely foliated, slaty, foliation at 40 to 45 degrees, with seams of quartz 0.2cm-thick, moderately to intensely fractured, fractures along foliation and perpendicular to plane, wavy, tight, smooth to rough, no stain or filling, below 9.75m	
10				
	C8		-	
11			- biotite schist from 11.46 to 12.10m	

CLASSIFICATION

UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
		808			
		20			
		34	39	19	20
		0			
		0			
		0			
		0			
		0			
		0			

SHEAR STRENGTH / UCS

□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
UCS ✳
MPa (◆, ✳) 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲) 20 40 60 80 100

CORING RATE —— Min./m 10 20 30 40
REC. —— SCR · · · RQD —— % 20 40 60 80

NOTES:
▽ : Initial Ground Water Depth ▼ : Static Ground Water Depth
1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:
Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 21 June, 2013
TOTAL DEPTH: 31.09m
CAVED DEPTH: N/A
CORING: 91.4 m
WET ROTARY: 10.6 m
BACKFILL: Grout
LOGGER: DMarlow, CEG
DRILLER: Geotech Drilling

C:\USERS\BBINATLI\DESKTOP\04.10130058\GINT\04_1013_0058_FE13B-122313 - WITH TORVANE CORRECTION.GPJ FUGRO_S_(LAB)_IND GRP_A3_ONSHORE_REV03 12/24/2013

LOG OF BORING BH-17
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-9a

LOCATION: See Plate 2
COORDINATES: N 6006764m
E 415508m

SURFACE EL. 25.45 m

DEPTH, METERS	SYMBOL	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS
13		C9		- with quartz seams, at 12.19m	
14		C10		- increase in pyrite content along foliations, at 13.41m	
15		C11		- pyrite continuing through 14.94m, very intensely fractured - fractures tight, narrow, smooth to rough, planar to stepped, with spotty pyrite and quartz filling, at 15.24m	
16				- healed hairline fractures at 60 degrees with white mineral filling, from 16.31 to 16.52m	
17		C12		- chlorite stain on fracture surfaces, at 14.70m	
18				- very narrow to tight, wavy, rough vertical fracture, from 18.33 to 18.60m	
19		C13			
20		C14		- healed hairline fractures with mineral filling, at 20.12m	
21				- intensely fractured, at 21.34m	
22		C15		- heavily pyritized quartz vein, at 22.25m	
23		C16		- 1.3cm-thick biotite schist band, at 22.71m	

CLASSIFICATION: UNIT DRY WT, kN/m³ | PASSING NO. 200 SIEVE, % | WATER CONTENT, % | LIQUID LIMIT | PLASTIC LIMIT | PLASTICITY INDEX (PI)

SHEAR STRENGTH / UCS
□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
UCS ✳
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE — Min./m: 10 20 30 40
REC. SCR RQD
%: 20 40 60 80

WATER CONTENT, %: 0 0 0 0 0 0 0 0

NOTES:
▽ : Initial Ground Water Depth ▼ : Static Ground Water Depth
1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:
Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 21 June, 2013
TOTAL DEPTH: 31.09m
CAVED DEPTH: N/A
CORING: 91.4 m
WET ROTARY: 10.6 m
BACKFILL: Grout
LOGGER: DMarlow, CEG
DRILLER: Geotech Drilling

C:\USERS\BBINATLI\DESKTOP\04.10130058\GINT\04_1013_0058_FE13B-122313 - WITH TORVANE CORRECTION.GPJ FUGRO_S_(LAB)_IND GRP_A3_ONSHORE_REV03 12/24/2013

LOG OF BORING BH-17
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-9b

LOCATION: See Plate 2
COORDINATES: N 6006764m
E 415508m

SURFACE EL. 25.45 m

DEPTH, METERS	SYMBOL	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS
25		C17		- slickensided, tight, healed, near vertical, pyrite filling with green mineral (chlorite?), at 25.76m	
26		C18			
27					
28		C19		- with quartz seams, intensely fractured, fractures planar, smooth to rough, no stain, spotty mineral filling (quartz, pyrite, chlorite), below 28.04m	
				- with seams of pyrite, at 28.65m	
29				- with seams of pyrite, at 28.96 to 29.26m	
				- near vertical fracture from 29.41 to 29.57m	
		C20			
30				- mica schist bands 0.3cm-thick, from 30.02 to 30.22m	
				- very intensely fractured, at 30.48m	
31				**TD = 31.09m**	-5.6
32					
33					
34					
35					

CLASSIFICATION

UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
		0			
		0			
		0			
		0			
		0			

SHEAR STRENGTH / UCS

□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
UCS ✳
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE —
Min./m: 10 20 30 40
REC. SCR RQD
%: 20 40 60 80

NOTES:

▽ : Initial Ground Water Depth ▼ : Static Ground Water Depth

1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:

Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 21 June, 2013
TOTAL DEPTH: 31.09m
CAVED DEPTH: N/A
CORING: 91.4 m
WET ROTARY: 10.6 m
BACKFILL: Grout
LOGGER: DMarlow, CEG
DRILLER: Geotech Drilling

C:\USERS\BBINATLI\DESKTOP\04.10130058\GINT\04_1013_0058_FE13B-122313 - WITH TORVANE CORRECTION.GPJ FUGRO_S_(LAB)_IND GRP_A3_ONSHORE_REV03 12/24/2013

LOG OF BORING BH-17
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-9c

LOCATION: See Plate 2
COORDINATES: N 6006636m
E 415449m

SURFACE EL. 32.28 m

DEPTH, METERS	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS
0	1	WOH	**PEAT** PEAT (PT): very soft, dark reddish brown, moist, fibrous, organic	
	2	50/152mm		
	C1		- approximately 5.1cm-thick light brown lean CLAY (CL), at 0.9m	31.4
1	C2		**UNDIVIDED PHYLLITE (OTa)** PHYLLITE (Rx): slightly weathered to fresh, hard to very hard, dark gray, moderately fractured, thinly bedded to laminated at 45 degrees, planar bedding, common biotite	
2			- with an organic content of 77%, at 0.6m - approximately 1.3cm-thick quartz veins, from 1.89 to 1.92m	
3	C3		- approximately 5.1 to 10.2cm-thick quartz boudinage band with pyrite inclusions, from 2.50 to 2.59m	
4	C4		- approximately 70 degree joint, from 3.26 to 3.38m, rough, planar, narrow	
5	C5		- intensely to very intensely fractured, from 5.27 to 5.43m, randomly oriented discontinuities, planar to undulating, narrow to very narrow, at 5.31m - very dark gray to bluish gray, at 5.79m	
6			- biotite schist, from 6.22 to 6.25m - four approximately 50 degree joints, from 6.46 to 6.68m, stepped to planar, rough, mineralized	
7	C6		- very intensely fractured, from 7.07 to 7.71m, randomly oriented discontinuities, intensely weathered to decomposed	
8	C7		- approximately 70 degree joint, at 7.80m, rough and planar, very narrow, slightly oxidized and mineralized - gneiss band, from 8.11 to 8.23m	
9			- two subvertical joints, from 8.44 to 8.75m, rough, stepped, with slight mineralization - quartz vein, from 8.60 to 8.63m - sub-horizontal joint, at 8.66m, highly mineralized (pyrite), increased foliation, from 8.66 to 8.69m - recumbent foliation, from 8.84 to 8.93m - two intersecting approximately 30 degree joints, from 9.11 to 9.17m, smooth, planar	
10	C8			
11	C9		- approximately 40 degree joint, at 10.97m, rough, planar to stepped, oxidized surface	

CLASSIFICATION: UNIT DRY WT, kN/m³ | PASSING NO. 200 SIEVE, % | WATER CONTENT, % | LIQUID LIMIT | PLASTIC LIMIT | PLASTICITY INDEX (PI)

UNIT DRY WT, kN/m³: 27

WATER CONTENT, %: 687, 0, 0, 0, 0, 0, 0, 0

SHEAR STRENGTH / UCS
□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
UCS ✳
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE — Min./m: 10 20 30 40
REC. SCR RQD
%: 20 40 60 80

NOTES:
▽ : Initial Ground Water Depth ▼ : Static Ground Water Depth
1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:
Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 26 June, 2013
TOTAL DEPTH: 37.80m
CAVED DEPTH: N/A
CORING: 121.25 m
WET ROTARY: 2.75 m
BACKFILL: Grout
LOGGER: GEckrich, CEG
DRILLER: Geotech Drilling

C:\USERS\BBINATLI\DESKTOP\04.10130058\GINT\04_1013_0058_FE13B-122313 - WITH TORVANE CORRECTION.GPJ FUGRO_S_(LAB)_IND GRP_A3_ONSHORE_REV03 12/24/2013

LOG OF BORING BH-18
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-10a

LOCATION: See Plate 2
COORDINATES: N 6006636m
E 415449m

SURFACE EL. 32.28 m

DEPTH, METERS	SYMBOL	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS	UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
13				- approximately 1.9cm-thick quartz vein, from 11.95 to 11.98m - approximately 1.9cm-thick band of highly oxidized, intensely weathered to decomposed phyllite, possible shear, at 12.04m - sub-vertical discontinuities, from 12.28 to 12.44m, undulating to very narrow, totally healed - amorphous quartz vein, from 12.50 to 12.65m - moderately to slightly fractured, at 12.80m		27		0			
14		C10		- amorphous quartz vein, from 14.11 to 14.20m				0			
15		C11		- 0.6 to 1.3cm-thick quartz vein, from 14.57 to 14.69m - increased foliation, at 14.78m							
16				- 1.3 to 1.9cm-thick biotite schist and gneiss bands, from 15.24 to 15.54m - increased foliation and deformation, from 15.75 to 15.97m - quartz vein with biotite schist, from 16.12 to 16.22m							
17		C12				27		0			
18		C13		- 50 degree joint, at 17.10m, planar, moderately open, slightly rough - 40 to 43 degree joints, at 17.59m - 40 to 43 degree joints, at 17.74m - shear zone from 18.04 to 18.41m, approximately 0.6cm-offset, undulating, randomly oriented shears, totally healed, quartz veins with pyrite inclusions							
19		C14		- 30 degree joint, at 18.90m, planar, slightly rough to rough - randomly oriented microjoints, from 19.57 to 20.06m, tight, totally healed				0			
20				- 53 degree joint, at 19.80m, planar, rough, moderately open, oxidized - 53 degree joint, at 19.87m, planar, rough, moderately open, oxidized - very slightly fractured, at 19.92m				1			
21		C15		- 1.3cm-thick quartz vein with minor deformation (undulating margins), at 20.63m							
22				- 35 degree joint, at 21.49m, planar, slightly rough to rough, moderately open to open - moderately to slightly fractured, at 21.49m - 25 degree joint, at 21.52m, planar, slightly rough to rough, moderately open to open - 30 degree joint, at 21.56m, planar, slightly rough to rough, moderately open to open - 45 degree joint, at 22.17m, planar, slightly rough, moderately open, partially mineralized (calcite) - 53 degree joint, at 22.28m, planar, rough				0			
23		C16		- increased foliation/deformation, from 22.31 to 22.46m, quartz veins amorphous with biotite schist margins and pyrite inclusions - 30 degree joint, at 23.32m, planar, slightly rough, moderately open, partially mineralized (calcite) - approximately 75 degree joint, at 23.77m, planar to stepped, rough, open, mineralized (quartz)				0			

SHEAR STRENGTH / UCS: □ Penetrometer, ◇ Torvane, Remold Testing ○ △ ▽, Unconfined ▼, Triaxial ●, Miniature Vane ▲, Point Load ◆, UCS ✳
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE — Min./m: 10 20 30 40
REC. — SCR · · · RQD —
%: 20 40 60 80

NOTES:

▽ : Initial Ground Water Depth ▼ : Static Ground Water Depth

1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:

Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 26 June, 2013
TOTAL DEPTH: 37.80m
CAVED DEPTH: N/A
CORING: 121.25 m
WET ROTARY: 2.75 m
BACKFILL: Grout
LOGGER: GEckrich, CEG
DRILLER: Geotech Drilling

C:\USERS\BBINATLI\DESKTOP\04.10130058\GINT\04_1013_0058_FE13B-122313 - WITH TORVANE CORRECTION.GPJ FUGRO_S_(LAB)_IND GRP_A3_ONSHORE_REV03 12/24/2013

LOG OF BORING BH-18
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-10b

LOCATION: See Plate 2
COORDINATES: N 6006636m
E 415449m

SURFACE EL. 32.28 m

DEPTH, METERS	SYMBOL	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS
25		C17		- biotite schist band, from 24.48 to 24.81m, deformation of quartz vein along lower margin - 35 degree joint, at 24.54m, planar, slightly rough, moderately open to open - approximately 15 degree joint, at 24.69m, planar to undulating, slightly rough to rough, moderately open	
26		C18		- intensely fractured, at 25.60m	
27		C19		- approximately 80 degree joint, at 26.49m, planar, tight, moderately to totally healed - approximately 70 degree joint, at 27.13m, undulating, rough, moderately open, partly healed - slightly to very slightly fractured, at 27.31m - approximately 1.3cm-thick quartz vein, at 27.43m - increased schistosity, from 27.34 to 27.65m	
28		C20			
29				- approximately 0.6cm-thick quartz veins, from 28.77 to 28.86m - approximately 70 degree microjoint, at 28.80m, tight, totally healed	
30		C21		- 3.8cm-thick biotite schist band, at 29.50m, quartz veins along lower margin - quartz vein, from 29.69 to 29.87m, deformation bands/recumbent folded strata along upper margin - approximately 15 to 20 degree joint, at 29.87m, planar, slightly rough, open, moderately mineralized - moderately to intensely fractured, at 29.87m - sub-vertical microjoints, from 30.18 to 30.48m, tight, stepped, totally healed	
31				- shear zone, from 31.00 to 31.27m, two prominent 75 degree to sub-vertical shears, stepped to undulating, totally healed, to approximately 1.0cm-offset - approximately 50 degree joint, at 31.33m, planar, smooth to slightly rough, moderately open - approximately 60 degree to sub-vertical shear, from 27.12 to 27.09m, stepped to undulating, totally healed, to approximately 1.6cm-offset	
32		C22		- shear zone from 32.16 to 32.43m, prominent 58 degree fault, planar, lean clay gouge infilling, pyrite inclusions - approximately 20 degree joint, at 32.16m, planar, smooth to slightly rough - moderately fractured, at 32.61m	
33		C23		- intersecting approximately 60 degree microjoints, at 33.10m, tight, planar to stepped, totally healed	
34				- biotite schist bands, from 33.86 to 34.11m - randomly oriented microjoints, from 33.99 to 34.44m, planar, tight, totally healed	
35		C24		- approximately 80 degree joint, at 34.72m, planar, tight, totally healed - quartz veins/boudins, from 35.27 to 35.39m - approximately 65 degree microjoint, at 35.57m, planar, tight, totally healed	

CLASSIFICATION

UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)

LOCATION: See Plate 2
COORDINATES: N 6006636m
E 415449m

SURFACE EL. 32.28 m

DEPTH, METERS	SYMBOL	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS
37		C25		- shear zone, from 37.31 to 37.43m, approximately 40 to 75 degree microshears, planar, tight, totally healed, to 0.3cm-offset	
				TD = 37.80m	-5.5
38					
39					
40					
41					
42					
43					
44					
45					
46					
47					

CLASSIFICATION

UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
		0			

SHEAR STRENGTH / UCS

□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
UCS ✳
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE —— Min./m: 10 20 30 40
REC. —— SCR · · · RQD ——
%: 20 40 60 80

NOTES:

▽ : Initial Ground Water Depth ▼ : Static Ground Water Depth

1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:

Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 26 June, 2013
TOTAL DEPTH: 37.80m
CAVED DEPTH: N/A
CORING: 121.25 m
WET ROTARY: 2.75 m
BACKFILL: Grout
LOGGER: GEckrich, CEG
DRILLER: Geotech Drilling

C:\USERS\BBINATLI\DESKTOP\04.10130058\GINT\04_1013_0058_FE13B-122313 - WITH TORVANE CORRECTION.GPJ FUGRO_S_(LAB)_IND GRP_A3_ONSHORE_REV03 12/24/2013

LOG OF BORING BH-18
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-10d

LOCATION: See Plate 2
COORDINATES: N 6006660m
E 415385m

SURFACE EL. 29.99 m

DEPTH, METERS	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS	UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
0	1	1	**PEAT** PEAT (PT): very soft, brown to black, moist, organic, fibrous, non-plastic, approximately 5.1cm-of light brown to gray clayey sand at 0.55m, fine to medium sand	29.4			84			
1	C1		**UNDIVIDED PHYLLITE (OTa)** PHYLLITE (Rx): slightly weathered to fresh, hard to very hard, dark gray, moderately to intensely fractured, thinly foliated to laminated at 43 degrees, planar foliation, high biotite content with an organic content of 20%, at 0.61m - tree root, from 0.91m to 1.07m - approximately 20 degree joint at 1.49m, planar, slightly rough, moderately open to open, partly oxidized				0			
2	C2						0			
3			- prominent 70 degree joint at 3.26m, planar, slightly rough to rough, slightly open, slightly mineralized (quartz) - intensely fractured from 3.32 to 3.54m - quartz vein/boudin, from 3.72 to 3.74m							
4	C3		- approximately 30 degree joint at 4.08m, planar, slightly rough, slightly open, partly healed	25.7	27					
			GNEISS (Rx): fresh, very hard, white to dark gray, unfractured, deformation folds at top and bottom of unit				0			
5	C4		PHYLLITE (Rx): slightly weathered to fresh, hard to very hard, dark gray, moderately to intensely fractured	25.1						
6			- approximately 70 degree to sub-vertical joint, from 5.91 to 6.25m, stepped to undulating, rough, moderately open				0			
7	C5		- intensely fractured, from 6.61 to 8.58m - increase in deformation, recumbent folding, from 7.38 to 7.50m							
8	C6		- approximately 2.5cm-thick quartz vein/boudin, at 8.58m				0			
9			- gneiss band with increased foliation from 8.87 to 8.99m - approximately 25 to 45 degree joints from 9.02 to 9.14m, planar, slightly rough, moderately open to tight				0			
10	C7		- increased deformation/folding, from 9.60 to 10.06m - quartz veins, biotite schist bands, from 9.88 to 10.06m, - gneiss band from 10.27 to 10.52m, deformed, quartz veins, amorphous with biotite schist margins - increase in deformation from 10.67 to 10.82m							
11	C8		- increase in deformation and schistosity, from 11.37 to 11.49m				0			

SHEAR STRENGTH / UCS: □ Penetrometer, ◇ Torvane, Remold Testing ○ △ ▽, Unconfined ▼, Triaxial ●, Miniature Vane ▲, Point Load ◆, UCS ✳
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE —— Min./m: 10 20 30 40
REC. —— SCR · · · RQD ——
%: 20 40 60 80

NOTES:
▽ : Initial Ground Water Depth ▼ : Static Ground Water Depth
1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:
Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 29 June, 2013
TOTAL DEPTH: 36.00m
CAVED DEPTH: N/A
CORING: 115.1 m
WET ROTARY: 3 m
BACKFILL: Grout
LOGGER: GEckrich, CEG
DRILLER: Geotech Drilling

C:\USERS\BBINATLI\DESKTOP\04.10130058\GINT\04_1013_0058_FE13B-122313 - WITH TORVANE CORRECTION.GPJ FUGRO_S_(LAB)_IND GRP_A3_ONSHORE_REV03 12/24/2013

LOG OF BORING BH-19
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-11a

LOCATION: See Plate 2
COORDINATES: N 6006660m
E 415385m

SURFACE EL. 29.99 m

DEPTH, METERS	SYMBOL	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS
13		C9		- approximately 45 degree joint at 11.80m, planar, slightly rough, slightly open, partly healed, with lean clay infill; possible shear - approximately 35 degree joint at 12.13m, planar to stepped, slightly open, slightly rough - approximately 40 degree joint at 12.26m, planar to stepped, rough, slightly open - increase in deformation/schistosity, from 12.44 to 12.50m - approximately 2.5cm-thick biotite schist band at 12.77m, planar, slightly rough, slightly open to tight, slightly mineralized	
14				- approximately 60 degree to sub-vertical microjoint, from 13.87 to 14.02m, stepped to undulating, tight, totally healed - 0.6cm-thick quartz veins, from 14.33 to 14.45m - 42 degree joint at 12.54m, planar, slightly rough, slightly open, partly mineralized (quartz)	
15		C10		- 42 degree joint at 15.30m, stepped, slightly rough to rough, slightly to moderately open, slightly mineralized (quartz) - 32 degree joint at 15.36m, planar, slightly rough to rough, moderately open - quartz vein with biotite schist inclusions, from 15.42 to 15.58m - amorphous, approximately 10 degree joint, at 13.50m, planar, smooth, tight, intersecting 35 and 25 degree joints, at 15.94m. planar, smooth, slightly open, slightly mineralized (quartz) - deformed/folded 0.3cm-thick quartz veins from 15.82 to 15.90m, truncated by 35 degree joint noted above, no evidence of offset on joint surface - 25 and 35 degree joints at 15.90m, planar, smooth, slightly open, slightly mineralized (quartz) - intensely fractured, at 16.15m - sub-vertical joints from 16.70 to 17.22m, stepped, tight - 1.3cm-thick quartz veins/boudins, at 16.76m - 1.3cm-thick quartz veins/boudins, at 16.95m	
16					
17		C11			
18		C12		- approximately 2.5cm-thick dark gray silty sand seam, at 17.77m - quartz veins, from 17.86 to 18.01m, with biotite schist margins, minor deformation	
19				- tabular to amorphous 65 degree joint, at 18.44m - biotite schist band, from 18.47 to 18.56m - microjoints from 18.56 to 18.71m, totally healed, increased deformation/folding - quartz boudin with biotite schist margins, from 18.71 to 18.90m - biotite schist band from 19.11 to 19.20m, deformed quartz veins along margins	
20		C13		- increased deformation, recumbent folding/plication, from 19.54 to 20.12m - biotite schist band, from 19.66 to 19.81m	
21		C14		- approximately 50 degree joint, at 21.09m, stepped, slightly open to tight, partly healed - moderately fractured, at 21.18m - approximately 60 degree joint, at 21.34m, stepped, totally healed - approximately 60 degree joint, at 21.43m, stepped, totally healed	
22		C15			
23		C16		- approximately 40 degree joint, at 23.23m, planar, slightly rough to moderately rough, slightly open - slightly mineralized (quartz) 20 degree joint, at 23.38m, planar, smooth, tight - slightly mineralized (quartz) 40 degree joint, at 20.27m, stepped, slightly rough, moderately open - slightly mineralized, moderately to intensely fractured, at 23.77m	

CLASSIFICATION

UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
		0			
		0			
		0			
		0			
		0			
		0			

SHEAR STRENGTH / UCS

□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
UCS ✳
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE —— Min./m: 10 20 30 40
REC. —— SCR · · · RQD ——
%: 20 40 60 80

NOTES:

▽ : Initial Ground Water Depth ▼ : Static Ground Water Depth

1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:

Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 29 June, 2013
TOTAL DEPTH: 36.00m
CAVED DEPTH: N/A
CORING: 115.1 m
WET ROTARY: 3 m
BACKFILL: Grout
LOGGER: GEckrich, CEG
DRILLER: Geotech Drilling

C:\USERS\BBINATLI\DESKTOP\04.10130058\GINT\04_1013_0058_FE13B-122313 - WITH TORVANE CORRECTION.GPJ FUGRO_S_(LAB)_IND GRP_A3_ONSHORE_REV03 12/24/2013

LOG OF BORING BH-19
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-11b

LOCATION: See Plate 2
COORDINATES: N 6006660m
E 415385m

SURFACE EL. 29.99 m

DEPTH, METERS	SYMBOL	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS
25				- lean clay infilled foliation plane, at 23.87m - approximately 65 degree joint, at 24.20m, planar to stepped, rough, moderately open - gneiss band, from 24.41 to 24.63m - approximately 65 degree joint, at 24.54m, planar to stepped, rough, moderately open	
26		C17		- approximately 60 degree joint at 25.45m, stepped, totally healed - 75 degree joint at 25.60m, planar, rough, moderately open	
27		C18		- increased deformation/foliation, from 26.27 to 26.39m - approximately 60 degree joint, at 26.55m, planar, rough, moderately open to open - approximately 40 degree joint, at 26.61m, planar, smooth, slightly open to tight - approximately 2.5cm-thick quartz vein/boudin, at 26.76m	
28		C19		- biotite schist bands, quartz veins/boudins to 1.9cm, from 27.61 to 27.83m - increased deformation/recumbent folding, at 27.95m - quartz vein (amorphous), at 28.04m	
29		C20		- 67 degree joint at 28.41m, planar, smooth, slightly open, slightly mineralized (quartz) - randomly oriented microjoints from 28.65 to 28.96m, planar to undulating, totally healed, pyrite inclusions - gneiss band, from 29.05 to 29.11m - 65 degree shear at 29.08m, planar, totally healed, with 0.6cm-offset - quartz vein/boudin, at 29.32m - increased deformation/recumbent folding, from 29.63 to 30.05m	
30				- quartz vein with biotite schist margins, at 29.96m	
31				GNEISS (Rx): fresh, very hard, white to dark gray, very slightly fractured to unfractured - increased deformation bands, at 30.63m - increased deformation bands, at 30.88m - increased deformation bands, at 31.12m	-0.5
32		C21		PHYLLITE (Rx): slightly weathered to fresh, hard to very hard, dark gray, moderately to intensely fractured - very intensely fractured, from 31.52 to 32.03m - 65 degree shear/fault, at 31.58m, planar, infilled with fine gravel to coarse sand rock fragments, amount of offset undetectable - 62 degree joint at 31.61m, planar, smooth, slightly open to tight - 60 degree joint at 31.79m, planar, partly healed (pyrite) - randomly oriented microjoints, at 32.10m, planar to stepped, totally healed - randomly oriented microjoints, at 32.34m, planar to stepped, totally healed - quartz veins/boudins, at 32.34m - quartz veins/boudins, at 32.55m	-1.4
33		C22		- quartz veins/boudins, at 32.80m - increased deformation/randomly oriented tight, totally healed joints, from 33.01 to 33.28m	
34		C23		- biotite schist with quartz margins, at 33.65m - very intensely fractured, from 33.80 to 34.08m	
35		C24		- microjoints with quartz infilling, from 34.11 to 34.72m, totally healed - gneiss band, at 35.72m	

CLASSIFICATION: UNIT DRY WT, kN/m³ | PASSING NO. 200 SIEVE, % | WATER CONTENT, % | LIQUID LIMIT | PLASTIC LIMIT | PLASTICITY INDEX (PI)

SHEAR STRENGTH / UCS
□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
UCS ✳
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE — Min./m: 10 20 30 40
REC. — SCR · · · RQD —
%: 20 40 60 80

NOTES:
▽ : Initial Ground Water Depth ▼ : Static Ground Water Depth
1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:
Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 29 June, 2013
TOTAL DEPTH: 36.00m
CAVED DEPTH: N/A
CORING: 115.1 m
WET ROTARY: 3 m
BACKFILL: Grout
LOGGER: GEckrich, CEG
DRILLER: Geotech Drilling

C:\USERS\BBINATLI\DESKTOP\04.10130058\GINT\04_1013_0058_FE13B-122313 - WITH TORVANE CORRECTION.GPJ FUGRO_S_(LAB)_IND GRP_A3_ONSHORE_REV03 12/24/2013

LOG OF BORING BH-19
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-11c

LOCATION: See Plate 2
COORDINATES: N 6006660m
E 415385m

SURFACE EL. 29.99 m

DEPTH, METERS	SYMBOL	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS
				- 70 degree joint, at 35.78m, planar, slightly rough, moderately to slightly open, partly to totally healed	-6.0
				TD = 36.00m	

CLASSIFICATION: UNIT DRY WT, kN/m³ | PASSING NO. 200 SIEVE, % | WATER CONTENT, % | LIQUID LIMIT | PLASTIC LIMIT | PLASTICITY INDEX (PI)

SHEAR STRENGTH / UCS
□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ○ △ ▽ ▲ Miniature Vane
◆ Point Load
✳ UCS
MPa (◆, ✳) 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲) 20 40 60 80 100

CORING RATE — Min./m 10 20 30 40
REC. SCR RQD
% 20 40 60 80

37 38 39 40 41 42 43 44 45 46 47

NOTES:
▽ : Initial Ground Water Depth ▼ : Static Ground Water Depth
1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:
Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 29 June, 2013
TOTAL DEPTH: 36.00m
CAVED DEPTH: N/A
CORING: 115.1 m
WET ROTARY: 3 m
BACKFILL: Grout
LOGGER: GEckrich, CEG
DRILLER: Geotech Drilling

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LOG OF BORING BH-19
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-11d

LOCATION: See Plate 2
COORDINATES: N 6006660m
E 415385m

SURFACE EL. 29.99 m

DEPTH, METERS	STRATUM DESCRIPTION	STRATUM ELEV, METERS
0	**PEAT** PEAT (PT): very soft, brown to black, moist, .	
	UNDIVIDED PHYLLITE (OTa) PHYLLITE (Rx): slightly weathered to fresh, hard to very hard, dark gray, moderately to intensely fractured, thinly foliated to laminated at 43 degrees, planar foliation, common biotite	29.4
1	- with an organic content of 69%, at 1.22m	
2	- approximately 70 degrees to sub-vertical microjoints, from 1.60 to 1.74m - approximately 40 degree joint, at 1.68m, planar, slightly open, approximately 70 degrees to sub-vertical joint, from 1.68 to 1.89m, stepped to undulating, rough, moderately open to open, slightly mineralized (quartz) - undulating, tight, unfractured, at 2.13m - biotite schist with quartz vein, from 2.16 to 2.38m	
3	- with an organic content of 84%, at 3.05m	26.3
4	NOTE: Abandoned location due to difficult drilling conditions, at 3.7m. Offset location approximately 0.2m west and advanced boring to total depth of 36.0m as BH-19.	
	TD = 3.66m	
5		
6		
7		
8		
9		
10		
11		

SYMBOL: 1 (PEAT); C1, C2 (PHYLLITE)
SAMPLES: 1, C1, C2
BLOWS PER 300mm

CLASSIFICATION: UNIT DRY WT, kN/m³ | PASSING NO. 200 SIEVE, % | WATER CONTENT, % | LIQUID LIMIT | PLASTIC LIMIT | PLASTICITY INDEX (PI)

SHEAR STRENGTH / UCS
□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
✳ UCS
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE — Min./m: 10 20 30 40
REC. SCR RQD
%: 20 40 60 80

NOTES:
1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:
Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 27 June, 2013
TOTAL DEPTH: 3.66m
CAVED DEPTH: N/A
CORING: 10 m
WET ROTARY: 2 m
BACKFILL: Grout
LOGGER: GEckrich, CEG
DRILLER: Geotech Drilling

C:\USERS\BBINATLI\DESKTOP\04.10130058\GINT\04_1013_0058_FE13B-122313 - WITH TORVANE CORRECTION.GPJ FUGRO_S_(LAB)_IND GRP_A3_ONSHORE_REV03 12/24/2013

LOG OF BORING BH-19A
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-

LOCATION: See Plate 2
COORDINATES: N 6006629m
E 415410m

SURFACE EL. 30.63 m

DEPTH, METERS	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS
	1	1	**PEAT** PEAT (PT): very soft, brown, wet to saturated, brown fibers and roots (organic), amorphous, trace silt and clay	
	2	75/178mm		
1			Sandy Lean CLAY with silt (CL): stiff to hard, light gray, moist, with phyllite fragments, roots - SPT refusal, bouncing, at 1.10m	29.7 29.5
	C1		**UNDIVIDED PHYLLITE (OTa)** PHYLLITE (Rx): moderately weathered, moderately hard, dark gray, intensely foliated at 45 to 50 degrees, intensely fractured, fractures along foliation, planar, tight to very narrow, smooth to slightly rough, brown and green stain, no filling, few quartz seams 0.2 to 0.3cm-thick	
2	C2		- 85 degree fracture, from 1.98 to 2.13m, stepped, rough, narrow to very narrow, no stain, no filling, slaty cleavage - intensely to very intensely fractured, at 2.29m	
3			- 60 degree joints, wavy, smooth to slightly rough, tight to very narrow, no stain, no filling, at 2.74m	
4	C3		- evidence of folding, below 3.35m - quartz vein, from 3.41 to 3.47m - slightly to moderately weathered, very intensely fractured, at 3.66m	
5			- no recovery, from 4.72 to 5.18m	
6	C4		- slightly weathered, moderately hard to hard, at 5.18m	
7	C5 C6		- very intensely fractured along foliation at 50 degrees, at 6.71m	
8	C7		- few biotite schist bands 0.6cm-wide, at 8.47m	
9				
10	C8			
11	C9 C10			

CLASSIFICATION: UNIT DRY WT, kN/m³ | PASSING NO. 200 SIEVE, % | WATER CONTENT, % | LIQUID LIMIT | PLASTIC LIMIT | PLASTICITY INDEX (PI)

WATER CONTENT, %: 654; 0; 0; 0; 0; 27

SHEAR STRENGTH / UCS
□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
✳ UCS
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE — Min./m: 10 20 30 40
REC. — SCR • • • RQD —
%: 20 40 60 80

NOTES:
▽ : Initial Ground Water Depth ▼ : Static Ground Water Depth
1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:
Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 06 July, 2013
TOTAL DEPTH: 59.44m
CAVED DEPTH: N/A
CORING: 191 m
WET ROTARY: 4 m
BACKFILL: Grout
LOGGER: DMarlow, CEG
DRILLER: Geotech Drilling

C:\USERS\BBINATL\DESKTOP\04.10130058\GINT\04_1013_0058_FE13B-122313 - WITH TORVANE CORRECTION.GPJ FUGRO_S_(LAB)_IND GRP_A3_ONSHORE_REV03 12/24/2013

LOG OF BORING BH-20
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-12a

LOCATION: See Plate 2
COORDINATES: N 6006629m
E 415410m

SURFACE EL. 30.63 m

DEPTH, METERS	SYMBOL	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS
13		C11 C12		- very intensely fractured, at 12.95m	
14		C13		- no recovery, from 13.79 to 13.94m	
		C14		- no recovery, from 14.33 to 14.63m	
15					
				- spotty pyrite filling, at 15.70m	
16		C15			
17		C16 C17		- fresh, at 17.37m	
18				- fresh, hard, very intensely fractured, very intensely foliated at 50 degrees, spotty pyrite and chlorite filling on foliation faces, below 17.68m	
				- no recovery, from 18.59 to 18.90m	
19		C18		- gray to dark gray, moderately hard to hard, very intensely foliated at 50 degrees, very intensely fractured along foliation, planar to wavy, tight to very narrow, smooth to slightly rough, no stain, spotty pyrite, quartz, and chlorite filling, few quartz seams along foliation 0.2 to 0.3cm-thick, slaty cleavage, below 18.90m	
20				- biotite schistose bands, from 20.06 to 20.21m	
		C19		- no recovery, from 20.35 to 20.42m	
21					
				- no recovery, from 21.64 to 21.95m	
22		C20 C21		- no recovery, from 21.95 to 22.86m	
23					
		C22		- no recovery, from 23.47 to 23.77m	

CLASSIFICATION

UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
		0			
		0			
		0			
		0			
		0			

SHEAR STRENGTH / UCS

□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
UCS ✳
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE —— Min./m: 10 20 30 40
REC. SCR RQD
%: 20 40 60 80

NOTES:

▽ : Initial Ground Water Depth ▼ : Static Ground Water Depth

1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:

Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 06 July, 2013
TOTAL DEPTH: 59.44m
CAVED DEPTH: N/A
CORING: 191 m
WET ROTARY: 4 m
BACKFILL: Grout
LOGGER: DMarlow, CEG
DRILLER: Geotech Drilling

C:\USERS\BBINATLI\DESKTOP\04.10130058\GINT\04_1013_0058_FE13B-122313 - WITH TORVANE CORRECTION.GPJ FUGRO_S_(LAB)_IND GRP_A3_ONSHORE_REV03 12/24/2013

LOG OF BORING BH-20
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-12b

LOCATION: See Plate 2
COORDINATES: N 6006629m
E 415410m

SURFACE EL. 30.63 m

DEPTH, METERS	SYMBOL	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS
25		C23		- very intensely fractured along foliation, at 23.87m - fresh, hard, spotty pyrite and quartz filling along fractures, no stain, below 24.99m - moderately to intensely fractured, below 25.30m - increase in pyrite content, at 25.60m	
26		C24			
27		C25		- intensely to very intensely fractured, at 27.28m	
28		C26		- quartz vein with coarse grained tablets of muscovite-pegmatite, from 28.35 to 28.41m - very intensely foliated at 50 degrees, moderately fractured with quartz seams 0.2 to 0.3cm-thick, foliation fractures planar, smooth to slightly rough, tight to very narrow, no stain, no filling, below 28.65m	
29		C27			
30		C28		- 1.9cm-thick quartz vein, at 29.35m - spotty pyrite filling along 50 degree foliation, with horizontal and near vertical fractures, at 29.57m	
31		C29		- spotty pyrite and chlorite filling along foliation, below 30.78m - quartz vein, from 31.30 to 31.47m - mica schist, from 31.46 to 31.47m	
32		C30			
33		C31		- no recovery, from 32.61 to 32.77m - intensely fractured, at 32.92m	
34		C32		- scattered fine gravel-size fragments, at 34.29m - quartz vein 0.6cm-thick, at 34.56m	
35		C33		- 70 degree joint, at 35.20m	
		C34		- very intensely fractured, at 35.66m	

CLASSIFICATION

UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
27		0			
		0			
		0			
		0			
		0			

SHEAR STRENGTH / UCS

□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
UCS ✳
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE —
Min./m: 10 20 30 40
REC. SCR RQD
%: 20 40 60 80

NOTES:

▽ : Initial Ground Water Depth ▼ : Static Ground Water Depth

1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:

Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 06 July, 2013
TOTAL DEPTH: 59.44m
CAVED DEPTH: N/A
CORING: 191 m
WET ROTARY: 4 m
BACKFILL: Grout
LOGGER: DMarlow, CEG
DRILLER: Geotech Drilling

C:\USERS\BBINATLI\DESKTOP\04.10130058\GINT\04_1013_0058_FE13B-122313 - WITH TORVANE CORRECTION.GPJ FUGRO_S_(LAB)_IND GRP_A3_ONSHORE_REV03 12/24/2013

LOG OF BORING BH-20
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-12c

LOCATION: See Plate 2
COORDINATES: N 6006629m
E 415410m

SURFACE EL. 30.63 m

DEPTH, METERS	SYMBOL	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS
37		C35		- no recovery, from 35.97 to 36.27m - very intensely fractured, from 36.27 to 36.39m - quartz vein with pyrite, from 36.39 to 36.45m	
		C36		- intensely to very intensely fractured, with phyllite gravel-size fragments, at 37.49m - phyllite gravel-size fragments, at 37.80m	
38		C37		- no recovery, from 37.95 to 38.25m - phyllite gravel-size fragments, at 38.40m	
39		C38		- no recovery, from 38.71 to 39.62m	
		C39		- phyllite gravel-size fragments, from 39.62 to 39.67m - no recovery, from 40.08 to 40.23m	
40		C40		- very intensely fractured, spotty green stain on fracture faces, and spotty pyrite filling, at 40.45m	
41		C41		- gravel-size fragments, from 41.61 to 41.73m	
42		C42		- intensely fractured, at 42.06m	
43		C43			
		C44		- quartz, at 43.95m - quartz vein, from 44.12 to 44.20m, with biotite and pyrite - no recovery, from 44.20 to 44.81m	
44		C45		- phyllite gravel-size fragments, at 44.96m - no recovery, from 45.26 to 46.33m	
45		C46		- spotty pyrite and chlorite on foliation faces, at 46.33m - no recovery, from 46.56 to 46.63m	
46		C47		- fine sand, trace clay in core liner tube, grey, sand appears to be phyllite with mica cuttings generated during coring operations, at 47.24m	
47		C48			

CLASSIFICATION

UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
		0			
		0			
		0			
		0			

SHEAR STRENGTH / UCS

□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
UCS ✳
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE —— Min./m: 10 20 30 40
REC. —— SCR · · · RQD ——
%: 20 40 60 80

NOTES:

▽ : Initial Ground Water Depth ▼ : Static Ground Water Depth

1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:

Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 06 July, 2013
TOTAL DEPTH: 59.44m
CAVED DEPTH: N/A
CORING: 191 m
WET ROTARY: 4 m
BACKFILL: Grout
LOGGER: DMarlow, CEG
DRILLER: Geotech Drilling

C:\USERS\BBINATLI\DESKTOP\04.10130058\GINT\04_1013_0058_FE13B-122313 - WITH TORVANE CORRECTION.GPJ FUGRO_S_(LAB)_IND GRP_A3_ONSHORE_REV03 12/24/2013

LOG OF BORING BH-20
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-12d

LOCATION: See Plate 2
COORDINATES: N 6006629m
E 415410m

SURFACE EL. 30.63 m

DEPTH, METERS	SYMBOL	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS
49		C49		- no recovery, from 47.91 to 48.50m - no recovery, from 48.50 to 49.38m	
50		C50			
51		C51		- fresh, hard, gray to dark gray, very thinly foliated at 50 degrees, intensely fractured along foliation, below 50.60m	
52		C52		- no recovery, from 45.16 to 52.96m	
53				- healed fracture 5.1cm-thick, quartz-filled, 70 degree dip, at 53.34m	
54		C53			
55		C54		- soft to moderately soft, from 54.56 to 54.71m - no recovery, from 54.71 to 55.17m	
56				- very intensely fractured, below 56.08m	
57		C55		- no recovery, from 57.00 to 57.91m	
58				- soft, dark gray, very intensely fractured, from 57.91 to 58.37m	
59		C56		- no recovery from 58.52 to 58.61m - quartz pegmatite 5.1cm-thick, dips 40 degrees, with pyrite on surface, at 58.83m	
				NOTE: Performed acoustic televiewer and PS geophysical logging on 6 July, 2013. **TD = 59.44m**	-28.8

CLASSIFICATION: UNIT DRY WT, kN/m³ | PASSING NO. 200 SIEVE, % | WATER CONTENT, % | LIQUID LIMIT | PLASTIC LIMIT | PLASTICITY INDEX (PI)

WATER CONTENT, %: 0 (at 49 m); 0 (at 53 m); 0 (at 55 m); 0 (at 58 m)

SHEAR STRENGTH / UCS
□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
UCS ✳
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE — Min./m: 10 20 30 40
REC. SCR RQD
%: 20 40 60 80

NOTES:
▽ : Initial Ground Water Depth ▼ : Static Ground Water Depth
1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:
Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 06 July, 2013
TOTAL DEPTH: 59.44m
CAVED DEPTH: N/A
CORING: 191 m
WET ROTARY: 4 m
BACKFILL: Grout
LOGGER: DMarlow, CEG
DRILLER: Geotech Drilling

C:\USERS\BBINATLI\DESKTOP\04.10130058\GINT\04_1013_0058_FE13B-122313 - WITH TORVANE CORRECTION.GPJ FUGRO_S_(LAB)_IND GRP_A3_ONSHORE_REV03 12/24/2013

LOG OF BORING BH-20
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

LOCATION: See Plate 2
COORDINATES: N 6006592m
E 415396m

SURFACE EL. 30.39 m

DEPTH, METERS	SYMBOL	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS	UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
		1	50/50mm	**PEAT** PEAT (PT): very soft, dark brown, moist	30.2			42			
		C1		**SEDIMENTARY DEPOSITS** Sandy Lean CLAY (CL): very soft, brown to light brown, moist, fine sand	30.1						
1		C2		**UNDIVIDED PHYLLITE (OTa)** PHYLLITE (Rx): slightly weathered to fresh, hard to very hard, dark gray, moderately fractured - intensely fractured, thinly foliated to laminated at 43 to 47 degrees, planar foliation, common biotite, oxidized filling surfaces, from 1 to 1.37m				0			
2				- moderately to intensely fractured, at 1.37m							
3		C3		- increased deformation/foliation from 1.80 to 1.98m - gneiss band, from 2.26 to 2.41m - 60 degree joint, at 3.11m, stepped, slightly rough, open, partly mineralized (quartz) - approximately 0.3cm-thick quartz boudins, at 3.17m				0			
4	▽ ▼	C4		- two 1.3cm-thick quartz veins with schistose margins, at 3.84m - gneiss bands with quartz margins to 3.8cm-thick, from 4.02 to 4.30m							
5				- deformed biotite schist band, from 5.03 to 5.12m				65			
6		C5		- approximately 34 degree joint, at 5.52m, planar, slightly rough, moderately open, slightly to partly mineralized (quartz) - gneiss bands to 3.8cm-thick, from 6.28 to 6.92m				0			
7				- 60 degree joint, at 7.10m, planar, slightly rough to smooth, slightly open - 75 degree joint, at 7.47m, planar, slightly rough, slightly open							
8		C6		GNEISS (Rx): fresh, hard to very hard, white to dark gray, very slightly fractured to unfractured, thinly foliated to laminated at 43 degrees, planar foliation	22.3			0			
				PHYLLITE (Rx): slightly weathered to fresh, hard to very hard, moderately weathered, dark gray, moderately fractured	22.0						
9		C7		- approximately 5.1cm-thick gneiss band, from 9.11 to 9.24m							
10		C8		- approximately 2.5cm-thick biotite schist band with quartz veins/boudins, at 9.57m - approximately 3.8cm-thick gneiss band, at 10.06m				27 0			
11				- 65 degree joint, at 11.64m, stepped, rough, slightly open - approximately 6.4cm-thick gneiss band, at 11.80m				0			

SHEAR STRENGTH / UCS: □ Penetrometer, ◇ Torvane, Remold Testing ○ △ ▽, Unconfined ▼, Triaxial ●, Miniature Vane ▲, Point Load ◆, UCS ✳
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE — Min./m: 10 20 30 40
REC. — SCR · · · RQD —
%: 20 40 60 80

NOTES:
▽ : Initial Ground Water Depth ▼ : Static Ground Water Depth
1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:
Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 30 June, 2013
TOTAL DEPTH: 35.05m
CAVED DEPTH: N/A
CORING: 114 m
WET ROTARY: 1 m
BACKFILL: Grout
LOGGER: GEckrich, CEG
DRILLER: Geotech Drilling

C:\USERS\BBINATLI\DESKTOP\04.10130058\GINT\04_1013_0058_FE13B-122313 - WITH TORVANE CORRECTION.GPJ FUGRO_S_(LAB)_IND GRP_A3_ONSHORE_REV03 12/24/2013

LOG OF BORING BH-21
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-13a

LOCATION: See Plate 2
COORDINATES: N 6006592m
E 415396m

SURFACE EL. 30.39 m

DEPTH, METERS	SYMBOL	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS	UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
13		C9		- approximately 6.4cm-thick gneiss band, at 11.98m - approximately 6.4cm-thick quartz vein, at 12.37m - 75 degree to sub-vertical joint, at 12.95m, stepped to undulating, totally healed - intensely fractured, at 13.11m - increased deformation/folding, with quartz veins, from 13.38 to 13.50m - approximately 2.5cm-thick schist band, at 13.53m				0		
14		C10		- sub-vertical joint, at 14.02m, stepped, rough, moderately open - 30 degree joint, at 14.23m, planar, slightly rough, moderately open - 20 degree joint, at 14.33m, planar, rough, moderately open - 40 degree joint, at 14.48m, planar, smooth, open				0		
15		C11		- approximately 50 and 30 degree intersecting joints, at 14.78m, planar, slightly rough to smooth, moderately open - moderately fractured, at 15.24m - sub-vertical microjoints, from 15.27 to 15.61m, stepped, undulating, totally healed		27					
16								0			
17		C12		- 65 degree microshear, at 16.82m, planar, totally healed, approximately 0.3cm-offset - band of increased deformation/recumbent folding with increased schistosity, quartz vein margins, from 16.95 to 17.10m							
18				- 1.9cm-thick quartz veins/boudins, from 17.77 to 17.89m				0			
19		C13		- sub-parallel microjoints, from18.20 to 19.11m, stepped to undulating, totally healed - 1.9cm-thick quartz veins/boudins, at 18.23m - approximately 75 degree microshear, from 18.23 to 18.50m, stepped, totally healed, to 0.2cm-offset				1			
20		C14		- 65 degree shear/fault, at 19.19m, planar, approximately 1.3cm-wide, totally healed with quartz, offset greater than 10.2cm - randomly oriented microjoints, from 20.39 to 20.67m, planar to undulating, totally healed				1			
21		C15		- very intensely fractured, from 20.74 to 21.12m, randomly oriented joints/shears, totally healed, with approximately 2.2cm-offset - approximately 40 degree joint, at 21.24m, planar, slightly rough, moderately open, moderately mineralized - increased deformation/folding of strata/quartz veins, from 21.73 to 22.16m							
22				- approximately 1.3cm-thick quartz veins/boudins, at 22.52m - approximately 1.3cm-thick quartz veins/boudins, at 22.59m				0			
23		C16		- vertical joint, at 22.98m, stepped, rough, moderately open to open - quartz vein with biotite schist margins, from 23.68 to 23.84m - approximately 70 degree microjoint, at 23.90m, planar, totally healed				0			

CLASSIFICATION

SHEAR STRENGTH / UCS
□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
✳ UCS
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE —— Min./m: 10 20 30 40
REC. SCR RQD
%: 20 40 60 80

NOTES:
▽ : Initial Ground Water Depth ▼ : Static Ground Water Depth
1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:
Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 30 June, 2013
TOTAL DEPTH: 35.05m
CAVED DEPTH: N/A
CORING: 114 m
WET ROTARY: 1 m
BACKFILL: Grout
LOGGER: GEckrich, CEG
DRILLER: Geotech Drilling

C:\USERS\BBINATLI\DESKTOP\04.10130058\GINT\04_1013_0058_FE13B-122313 - WITH TORVANE CORRECTION.GPJ FUGRO_S_(LAB)_IND GRP_A3_ONSHORE_REV03 12/24/2013

LOG OF BORING BH-21
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-13b

LOCATION: See Plate 2
COORDINATES: N 6006592m
E 415396m

SURFACE EL. 30.39 m

DEPTH, METERS	SAMPLES	STRATUM DESCRIPTION	STRATUM ELEV, METERS
25	C17	- very intensively fractured, from 24.02 to 24.35m - 65 degree intersecting joints, at 24.44m, planar, totally healed - 45 degree joint at 24.54m, planar, rough, moderately open - 45 degree fault, at 24.84m, stepped, rough, lean clay gouge infilling, approximately 1.9cm-wide	
26	C18	- gneiss band, from 25.91 to 26.03m	
27	C19	- sub-vertical joint, at 27.28m, undulating, rough, open	
28		- approximately 80 degree to sub-vertical joint, from 27.65 to 28.10m, stepped to undulating, totally healed	
29	C20	- 45 to 75 degree microjoints, from 28.32 to 28.59m, planar, totally healed - approximately 6.4cm-thick quartz vein, at 28.47m - quartz vein/boudin, at 28.74m - approximately 75 degree joint, at 28.74m, stepped, rough, open, trace fine sand infilling - approximately 10.2cm-thick quartz vein, at 29.11m	
30	C21	- quartz vein, with biotite schist margins, at 29.50m - 30 degree joint at 29.69m, planar, slightly rough, slightly open - 45 degree joint, at 29.96m, planar, smooth, slightly open - sub-vertical joint, from 30.14 to 30.39m, undulating, rough, partly healed	
31		- 60 degree to sub-vertical joint, at 30.78m, stepped to undulating, totally healed	
32	C22	- 50 degree joint at 31.73m, planar, smooth to slightly rough - quartz vein with minor deformation, at 31.79m	
33		- 45 degree joint, at 32.55m, planar, slightly rough, moderately open - three sub-vertical microjoints, at 32.77m, totally healed - very intensely fractured, from 32.95 to 33.04m - increased deformation, from 33.04 to 34.05m	
34	C23	- approximately 7.6cm-thick gneiss band, at 33.38m - approximately 60 degree joint, at 33.62m, stepped, totally healed - gneiss bands, from 34.17 to 34.35m - randomly oriented microjoints, from 34.20 to 34.96m, planar to stepped, totally healed - gneiss bands, from 34.44 to 34.56m - gneiss bands, from 34.56 to 34.96m	
35		**TD = 35.05m**	-4.7

CLASSIFICATION: UNIT DRY WT, kN/m³ | PASSING NO. 200 SIEVE, % | WATER CONTENT, % | LIQUID LIMIT | PLASTIC LIMIT | PLASTICITY INDEX (PI)

WATER CONTENT, %: 0 | 0 | 0 | 0 | 0 | 0

SHEAR STRENGTH / UCS
□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
UCS ✳
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE — Min./m: 10 20 30 40
REC. SCR RQD
%: 20 40 60 80

NOTES:
▽ : Initial Ground Water Depth ▼ : Static Ground Water Depth
1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:
Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 30 June, 2013
TOTAL DEPTH: 35.05m
CAVED DEPTH: N/A
CORING: 114 m
WET ROTARY: 1 m
BACKFILL: Grout
LOGGER: GEckrich, CEG
DRILLER: Geotech Drilling

C:\USERS\BBINATLI\DESKTOP\04.10130058\GINT\04_1013_0058_FE13B-122313 - WITH TORVANE CORRECTION.GPJ FUGRO_S_(LAB)_IND GRP_A3_ONSHORE_REV03 12/24/2013

LOG OF BORING BH-21
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-13c

LOCATION: See Plate 2
COORDINATES: N 6006717m
E 415748m

SURFACE EL. 30.57 m

DEPTH, METERS	SYMBOL	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS	UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
0		1	WOH	**PEAT** PEAT (PT): very soft, brown, wet, fibrous, organic, with roots, amorphous, trace silt, with 15.2cm-of moss and roots at ground surface							
1		3	WOH	- some silt, less moss, at 0.91m				743			
				- with an organic content of 69%, at 1.22m							
2		4	1								
		5	1	- few large roots to 0.3cm-diameter, at 2.44m							
3		6A		- trace sand, at 2.97m	27.5		60	1280			
				SEDIMENTARY DEPOSITS							
		7		Clayey SAND (SC): loose, light gray, wet, fine gravel, trace roots, and silt - with an organic content of 84%, at 3.05m	27.2			21			
4		7	Push	Lean CLAY with fine Sand (CL): soft to firm, light gray, very moist, some silt, trace roots, trace rock fragments to 2.5cm-diameter					33	17	16
		9	Push	Lean CLAY with silt (CL): firm to stiff, light gray, wet, trace shells and few rock fragments and roots	26.5			23			
5											
6		10	Push	- very moist, with few fine gravel-size rock fragments, below 6.1m							
7		C1		**UNDIVIDED PHYLLITE (OTa)** PHYLLITE (Rx): slightly to moderately weathered, moderately hard, dark gray, intensely to very intensely foliated at 40 to 45 degrees, moderately fractured	23.9				33	17	16
8				- slightly weathered, hard, very intensely foliated at 40 to 45 degrees, moderately fractured, joints at 60 to 70 degrees, foliation and joints planar to slightly wavy, smooth to rough, tight to narrow, spotty green stain, quartz seams along foliation 0.2 to 0.6cm-thick, below 7.62m							
9		C2		- slightly to moderately weathered, intensely fractured, at 9.2m				0			
10		C3		- with biotite, pyrite, pink feldspar and garnet, from 9.51 to 9.83m				0			
11		C4		- silicic, very hard, from 10.91 to 11.04m							
		C5						0			

SHEAR STRENGTH / UCS
□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
UCS ✳
MPa (◆, ✳) 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲) 20 40 60 80 100

CORING RATE
Min./m 10 20 30 40
REC. SCR RQD
% 20 40 60 80

NOTES:
1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:
Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 01 July, 2013
TOTAL DEPTH: 30.18m
CAVED DEPTH: N/A
CORING: 74 m
WET ROTARY: 25 m
BACKFILL: Grout
LOGGER: DMarlow, CEG
DRILLER: Geotech Drilling

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LOG OF BORING BH-22
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-14a

LOCATION: See Plate 2
COORDINATES: N 6006717m
E 415748m

SURFACE EL. 30.57 m

DEPTH, METERS	SYMBOL	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS	CLASSIFICATION: UNIT DRY WT, kN/m³	CLASSIFICATION: PASSING NO. 200 SIEVE, %	CLASSIFICATION: WATER CONTENT, %	CLASSIFICATION: LIQUID LIMIT	CLASSIFICATION: PLASTIC LIMIT	CLASSIFICATION: PLASTICITY INDEX (PI)	SHEAR STRENGTH / UCS
13				- slightly to very intensely fractured, slightly weathered, fracture faces partially filled with quartz and spotty pyrite, very narrow to narrow, at 12.19m								
		C6		- biotite schist band, from 13.53 to 13.78m				0				
14				- slightly weathered to fresh, vertical and 65 to 70 degree fractures, stepped, rough, partial filling with quartz and spotty biotite, very narrow to narrow, at 13.87m								
15		C7		- quartz vein, from 14.94 to 15.18m, very hard, white - very intensely fractured, at 15.24m								
16		C8		- quartz, very hard, intensely fractured, with pyrite, biotite, and inclusions of phyllite, from 15.70 to 16.46m				0				
		C9		- very intensely fractured, at 16.46m				0				
17				- without fractures, at 14.70m		26						
18		C10		- schistose, from 17.59 to 17.62m - quartz, from 17.62 to 17.68m - slightly weathered, intensely fractured, below 17.68m - silicified, fresh, with evidence of folding, foliations near vertical, from 17.98 to 18.44m - biotite schist band, from 18.21 to 18.23m				0				
19				- with pink garnet phenocrysts 0.3cm-in diameter, from 18.44 to 18.65m - silicified, from 18.96 to 19.20m								
		C11		SCHIST (Rx): fresh, moderately hard to hard, gray and green, very intensely foliated with discontinuous seams of quartz from 0.2 to 0.3cm-thick, foliation at 40 to 45 degrees, seams of biotite/muscovite, moderately fractured, fractures along foliation and joints, planar to wavy, tight to very narrow, spotty quartz and pyrite filling, no stain - healed shear where foliation is offset, 0.2cm-thick, 30 degrees perpendicular to foliation, at 19.90m	11.1							
20								1				
21		C12		- moderately to intensely fractured, with brownish muscovite, at 21.34m				0				
22								0				
		C13		- very intensely fractured, from 22.63 to 22.92m								
23				- very intensely fractured, from 23.16 to 23.47m								

SHEAR STRENGTH / UCS: □ Penetrometer, ◇ Torvane, Remold Testing ○ △ ▽, Unconfined ▼, Triaxial ●, Miniature Vane ▲, Point Load ◆, UCS ✳
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE —— Min./m: 10 20 30 40
REC. —— SCR · · · RQD ——
%: 20 40 60 80

NOTES:

1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:

Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 01 July, 2013
TOTAL DEPTH: 30.18m
CAVED DEPTH: N/A
CORING: 74 m
WET ROTARY: 25 m
BACKFILL: Grout
LOGGER: DMarlow, CEG
DRILLER: Geotech Drilling

C:\USERS\BBINATLI\DESKTOP\04.10130058\GINT\04_1013_0058_FE13B-122313 - WITH TORVANE CORRECTION.GPJ FUGRO_S_(LAB)_IND GRP_A3_ONSHORE_REV03 12/24/2013

LOG OF BORING BH-22
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-14b

LOCATION: See Plate 2
COORDINATES: N 6006717m
E 415748m

SURFACE EL. 30.57 m

DEPTH, METERS	SYMBOL	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS
25		C14		- intensely to very intensely fractured, at 24.08m - very intensely fractured, from 24.23m 24.44m	
				- intensely fractured, at 24.69m	
26		C15		- very intensely fractured, possible shear, from 24.99 to 25.18m	
27		C16		- garnets, from 26.52 to 26.61m	
28				- possible shear, at 27.74m - massive (no foliation), fine grained, at 28.10 to 28.47m	
29		C17		PHYLLITE (Rx): fresh, hard, dark gray, intensely foliated at 40 to 45 degrees, intensely fractured, with 0.2 to 0.3cm-thick quartz seams along foliations, fractures along foliations, planar to wavy, tight to very narrow, filling with spotty pyrite and quartz	1.9
30				- very intensely fractured, at 29.87m	
				TD = 30.18m	0.4
31					
32					
33					
34					
35					

CLASSIFICATION

UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
		0			
		0			
		0			
		0			

SHEAR STRENGTH / UCS

□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
UCS ✳
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE —— Min./m: 10 20 30 40
REC. —— SCR · · · RQD ——
%: 20 40 60 80

NOTES:

1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:

Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 01 July, 2013
TOTAL DEPTH: 30.18m
CAVED DEPTH: N/A
CORING: 74 m
WET ROTARY: 25 m
BACKFILL: Grout
LOGGER: DMarlow, CEG
DRILLER: Geotech Drilling

C:\USERS\BBINATLI\DESKTOP\04.10130058\GINT\04_1013_0058_FE13B-122313 - WITH TORVANE CORRECTION.GPJ FUGRO_S_(LAB)_IND GRP_A3_ONSHORE_REV03 12/24/2013

LOG OF BORING BH-22
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-14c

LOCATION: See Plate 2
COORDINATES: N 6006600m
E 415612m

SURFACE EL. 40.36 m

DEPTH, METERS	SYMBOL	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS
0		1	17	**PEAT** PEAT (PT): very soft, grayish brown to black, moist, organic, fibrous to amorphous, non-plastic	
		2	Ref.	- little fine to medium sand, with an organic content of 74%, at 0.46m	39.7
1		C1		**UNDIVIDED PHYLLITE (OTa)** PHYLLITE (Rx): moderately to slightly weathered, hard to very hard, dark gray, moderately to intensely fractured, thinly foliated to laminated at 49 degrees, planar foliation - with oxidized surfaces, from 0.61 to 3.35m	
		C2		- 58 degree joint, at 2.13m, rough to stepped, tight, moderately oxidized	
2				- moderately fractured, at 2.59m, 40 degree joint, planar, totally healed	
3		C3		- approximately 65 degree to sub-vertical joints/microjoints, from 2.90 to 3.17m, rough to stepped, totally healed	
				- 61 degree joint, at 3.66m, slightly rough, slightly to moderately open, moderately mineralized	
4				- increased deformation, shears/microshears predominantly dipping approximately 45 degrees, from 3.96 to 4.39m, stepped, totally healed, with about 0.5cm-differential movement	
		C4		- quartz veins/boudins, from 4.57 to 4.79m, to approximately 1.3cm-wide	
5				- three prominent approximately 45 to 55 degree shears, from 5 to 5.31m, planar, totally healed, with approximately 0.8cm-differential movement	
				CHLORITE/MICA SCHIST: fresh, hard to very hard, brown to light green, moderately to slightly fractured, thinly foliated to laminated at 49 degrees, mica schist along contacts to approximately 5.1cm-wide	35.1 34.8
6		C5		PHYLLITE (Rx): moderately to slightly weathered, hard to very hard, dark gray, moderately to intensely fractured, thinly foliated to laminated at 49 degrees, planar foliation	
7				- sub-parallel joints/microjoints, at 7.35m, planar to slightly rough, totally healed	
		C6		- sub-parallel joints/microjoints, at 7.50m, planar to slightly rough, totally healed	
8				- 75 degree joint, at 6.49m, rough to stepped, moderately open to open, moderately mineralized	
				- approximately 35 degree joint, at 8.20m, planar, partly to moderately healed	
				- sub-parallel microjoints, from 8.26 to 8.44m, planar to undulating, totally healed	
				- 63 degree joint, at 8.32m, slightly rough, slightly open	
9				- 22 degree joint, at 8.75m, smooth, slightly open to tight	
				- increased deformation, from 8.93 to 9.14m	
		C7		- quartz veins/boudins, mica schist band, at 9.30m, approximately 5.1cm-wide	
				CHLORITE/MICA SCHIST: fresh, hard to very hard, brown to light green, moderately to slightly fractured, thinly foliated to laminated, with mica schist along contacts to approximately 5.1cm-wide	30.8 30.4
10				PHYLLITE (Rx): moderately to slightly weathered, hard to very hard, dark gray, moderately to intensely fractured, thinly foliated to laminated at 49 degrees, planar foliation, quartz veins/boudins, mica schist bands - approximately 70 degree to subvertical joints/microjoints, from 10.24 to 10.73m, stepped, totally healed	
		C8			
11				- 48 degree joint, at 11.40m, slightly rough to smooth, tight	

CLASSIFICATION: UNIT DRY WT, kN/m³ | PASSING NO. 200 SIEVE, % | WATER CONTENT, % (318) | LIQUID LIMIT | PLASTIC LIMIT | PLASTICITY INDEX (PI)

SHEAR STRENGTH / UCS: □ Penetrometer, ◇ Torvane, Remold Testing ○ △ ▽, Unconfined ▼, Triaxial ●, Miniature Vane ▲, Point Load ◆, UCS ✳
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE — Min./m: 10 20 30 40
REC. — SCR · · · RQD — %: 20 40 60 80

NOTES:
▽ : Initial Ground Water Depth ▼ : Static Ground Water Depth
1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:
Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 08 July, 2013
TOTAL DEPTH: 27.43m
CAVED DEPTH: N/A
CORING: 88 m
WET ROTARY: 2 m
BACKFILL: Grout
LOGGER: GEckrich, CEG
DRILLER: Geotech Drilling

C:\USERS\BBINATLI\DESKTOP\04.10130058\GINT\04_1013_0058_FE13B-122313 - WITH TORVANE CORRECTION.GPJ FUGRO_S_(LAB)_IND GRP_A3_ONSHORE_REV03 12/24/2013

LOG OF BORING BH-23
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-15a

LOCATION: See Plate 2
COORDINATES: N 6006600m
E 415612m

SURFACE EL. 40.36 m

DEPTH, METERS	SYMBOL	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS
13		C9		- 80 degree joint, at 12.10m, slightly to moderately rough, slightly open to tight	
				- sub-parallel joints/microjoints, from 12.62 to 13.99m, planar to stepped, moderately to totally healed	
14		C10			
				- 83 degree to sub-parallel joint, at 14.20m, rough to stepped, moderately open, partly mineralized - approximately 55 to 75 degree joints/microjoints, from 14.26 to 14.60m, stepped, totally healed	
15		C11		- randomly oriented microjoints, from 15.03 to 15.18m, stepped, totally healed	
				- approximately 75 degree joint, at 15.51m, moderately rough to rough, moderately open, moderately mineralized	
16		C12		- intensely fractured, from 16.00 to 16.12m, dark gray to black - intersected by 80 degree to sub-parallel microjoints, from 16.12m to 17.13m, stepped, totally healed - 55 degree joint, at 16.25m, stepped to undulating, open, partly mineralized	
17				- intersecting 45 and 25 degree joints, at 16.86m, moderately rough to stepped, moderately open	
18		C13			
19				- approximately 45 degree joint, at 18.68m, stepped, moderately open to open - 28 degree joint, at 18.84m, smooth, slightly open to tight	
20		C14			
21		C15		- mica schist band, from 21.43 to 21.52m	
22				-	
23		C16		- intensely to very intensely fractured, from 23.47 to 24.08m, 80 degree to sub-vertical joints, slightly to moderately rough, partly to moderately mineralized (quartz)	

CLASSIFICATION: UNIT DRY WT, kN/m³ (27, 26); PASSING NO. 200 SIEVE, %; WATER CONTENT, %; LIQUID LIMIT; PLASTIC LIMIT; PLASTICITY INDEX (PI)

SHEAR STRENGTH / UCS
□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
UCS ✳
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE — Min./m: 10 20 30 40
REC. SCR RQD
%: 20 40 60 80

NOTES:
▽ : Initial Ground Water Depth ▼ : Static Ground Water Depth
1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:
Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 08 July, 2013
TOTAL DEPTH: 27.43m
CAVED DEPTH: N/A
CORING: 88 m
WET ROTARY: 2 m
BACKFILL: Grout
LOGGER: GEckrich, CEG
DRILLER: Geotech Drilling

C:\USERS\BBINATLI\DESKTOP\04.10130058\GINT\04_1013_0058_FE13B-122313 - WITH TORVANE CORRECTION.GPJ FUGRO_S_(LAB)_IND GRP_A3_ONSHORE_REV03 12/24/2013

LOG OF BORING BH-23
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-15b

LOCATION: See Plate 2
COORDINATES: N 6006600m
E 415612m

SURFACE EL. 40.36 m

DEPTH, METERS	SYMBOL	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS
25		C17		- two 55 degree joints, at 24.54m, planar, totally healed	
				- 55 degree joint, at 25.21m, rough, moderately open to open	
26		C18		- approximately 60 degree joint, at 25.21m, rough, moderately to totally healed	
27				- increased deformation, from 26.67 to 27.04m	
				TD = 27.43m	12.9
28					
29					
30					
31					
32					
33					
34					
35					

CLASSIFICATION: UNIT DRY WT, kN/m³ | PASSING NO. 200 SIEVE, % | WATER CONTENT, % | LIQUID LIMIT | PLASTIC LIMIT | PLASTICITY INDEX (PI)

SHEAR STRENGTH / UCS
□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
UCS ✳
MPa (◆, ✳) 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲) 20 40 60 80 100

CORING RATE — Min./m 10 20 30 40
REC. SCR RQD
% 20 40 60 80

NOTES:

▽ : Initial Ground Water Depth ▼ : Static Ground Water Depth

1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:

Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 08 July, 2013
TOTAL DEPTH: 27.43m
CAVED DEPTH: N/A
CORING: 88 m
WET ROTARY: 2 m
BACKFILL: Grout
LOGGER: GEckrich, CEG
DRILLER: Geotech Drilling

C:\USERS\BBINATLI\DESKTOP\04.10130058\GINT\04_1013_0058_FE13B-122313 - WITH TORVANE CORRECTION.GPJ FUGRO_S_(LAB)_IND GRP_A3_ONSHORE_REV03 12/24/2013

LOG OF BORING BH-23
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-15c

LOCATION: See Plate 2
COORDINATES: N 6006484m
E 415474m

SURFACE EL. 24.29 m

DEPTH, METERS	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS
0	1	4	**PEAT** PEAT (PT): very soft, brown, wet, organic, fibrous, amorphous, trace silt	
	2	1	- with an organic content of 75%, at 0.61m	
1	3	1		
2	4	64/229mm	**SEDIMENTARY DEPOSITS** Silty Fine SAND (SM): very dense, greenish gray, moist, with weathered phyllite fragments 0.16 to 0.32cm, trace clay and roots, blowcounts affected by rock fragment content - with an organic content of 2%, at 2.21m	22.5
	5	Ref.	**UNDIVIDED PHYLLITE (OTa)** PHYLLITE (Rx): moderately weathered, moderately hard to hard, gray, very intensely foliated at 40 to 45 degrees, very intensely fractured along foliation, fractures planar, smooth to slightly rough, tight to very narrow, green filling (chlorite) along some surfaces, quartz seams 0.16 to 1.91cm-thick, slaty cleavage	21.9
3	C1			
4	C2		- no recovery, from 4.27m to 5.33m	
5	C3		- no recovery, from 5.33 to 6.71m	
6			- vertical fractures with pyrite filling, at 6.71m	
7	C4		- no recovery, from 6.86 to 7.62m	
8			- evidence of vertical shearing, healed with black filling, slight offset of foliation, from 7.62 to 7.92m - shattered zone, from 7.92 to 7.99m - evidence of folding where foliation becomes near-vertical, from 7.99 to 8.23m - evidence of vertical shearing, healed with black filling, slight offset of foliation, from 8.23 to 8.29m - no recovery, from 8.38 to 9.30m	
9	C5			
	C6		- fractured to gravel-size fragments, from 9.30 to 9.60m - with spotty chlorite and pyrite filling along fracture faces, at 9.45m - fractured to gravel-size fragments, from 9.75 to 9.83m - no recovery, from 9.91 to 10.82m	
10				
11	C7		- fractured to gravel-size fragments, at 10.97m - no recovery, from 11.43 to 11.73m	
	C8		- no recovery, from 11.73 to 12.34m	

CLASSIFICATION: UNIT DRY WT, kN/m³ | PASSING NO. 200 SIEVE, % | WATER CONTENT, % (395, 18, 0, 0, 0, 1, 0, 0) | LIQUID LIMIT | PLASTIC LIMIT | PLASTICITY INDEX (PI)

SHEAR STRENGTH / UCS
□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
UCS ✳
MPa (◆, ✳) 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲) 20 40 60 80 100

CORING RATE — Min./m 10 20 30 40
REC. SCR RQD
% 20 40 60 80

NOTES:
1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:
Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 11 July, 2013
TOTAL DEPTH: 55.40m
CAVED DEPTH: N/A
CORING: 173.65 m
WET ROTARY: 8.1 m
BACKFILL: Grout
LOGGER: DMarlow, CEG
DRILLER: Geotech Drilling

C:\USERS\BBINATLI\DESKTOP\04.10130058\GINT\04_1013_0058_FE13B-122313 - WITH TORVANE CORRECTION.GPJ FUGRO_S_(LAB)_IND GRP_A3_ONSHORE_REV03 12/24/2013

LOG OF BORING BH-24
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-16a

LOCATION: See Plate 2
COORDINATES: N 6006484m
E 415474m

SURFACE EL. 24.29 m

DEPTH, METERS	SYMBOL	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS
13		C9		- gravel-size fragments, at 12.65m - traces of gray clay gouge above schist, at 12.80m - green schist, from 12.80 to 12.95m - gravel-size fragments, from 12.95 to 13.11m - very intensely fractured, at 12.80m - gravel-size fragments, from 13.23 to 13.29m - gravel-size fragments, from 13.41 to 13.49m - green schist with quartz seams 0.64cm-thick, from 13.56 to 13.94m	
14		C10			
		C11		- slightly weathered to fresh, hard, intensely to very intensely foliated at 40 to 45 degrees, intensely to very intensely fractured, slaty cleavage, spotty chlorite and pyrite filling with quartz seams 0.16 to 0.32cm-thick along foliation, below 14.02m - no recovery, from 14.33 to 14.48m	
15				- no recovery, from 15.09 to 16m	
16		C12		- no recovery, from 16 to 16.38m	
17		C13		- shear zone, gravel-size fragments with trace to some clay gouge, from 16.55 to 16.67m - gravel-size fragments, from 16.76 to 16.86m - quartz and green schist gravel-size fragments, from 16.92 to 16.99m - thin band of green schist, from 17.07 to 17.10m - gravel-size fragments, from 17.16 to 17.22m - green schist with spotty pyrite, from 17.25 to 17.30m - no recovery, from 17.30 to 17.53m - foliated at 30 degrees, from 17.53 to 18.14m	
18		C14		- gravel-size fragments, from 17.92 to 17.98m	
		C15		- foliated at 40 to 45 degrees, at 18.14m - some vertical slickensides on 80 degree fracture, from 18.44 to 18.52m	
19		C16		- gravel-size fragments, sand, clay, from 18.71 to 18.78m, shear zone - no recovery, from 18.90 to 19.05m - fresh, hard, at 19.20m	
20		C17		- no recovery, from 19.66 to 19.81m	
		C18		- quartz vein, from 20.27 to 20.35m - no recovery, from 20.42 to 20.57m	
21		C19		- no recovery, from 21.18 to 21.34m - phyllite gravel-size fragments with sand, from 21.34 to 21.56m	
22		C20		- no recovery, from 21.72 to 22.05m	
23		C21		- fresh, hard, gray, very intensely foliated at 40 to 45 degrees, very intensely fractured, with quartz seams along foliation 0.16 to 0.64cm-thick, slaty cleavage, occasional horizontal and 40 degree perpendicular to joint foliation, foliation planar, tight to very narrow, smooth to slightly rough, spotty pyrite, below 22.25m - broken, gravel-size fragments, evidence of vertical fractures, from 22.86 to 23.16m	
		C22		- no recovery, from 23.32 to 23.62m - gravel-size fragments, from 23.62 to 23.68m - spotty quartz, chlorite, and pyrite filling along fracture faces, at 23.77m	

CLASSIFICATION

UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
30		0 0 0 0 0 0			

SHEAR STRENGTH / UCS

□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
UCS ✳
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE —— Min./m: 10 20 30 40
REC. SCR RQD
%: 20 40 60 80

NOTES:
1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:
Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 11 July, 2013
TOTAL DEPTH: 55.40m
CAVED DEPTH: N/A
CORING: 173.65 m
WET ROTARY: 8.1 m
BACKFILL: Grout
LOGGER: DMarlow, CEG
DRILLER: Geotech Drilling

C:\USERS\BBINATLI\DESKTOP\04.10130058\GINT\04_1013_0058_FE13B-122313 - WITH TORVANE CORRECTION.GPJ FUGRO_S_(LAB)_IND GRP_A3_ONSHORE_REV03 12/24/2013

LOG OF BORING BH-24
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-16b

LOCATION: See Plate 2
COORDINATES: N 6006484m
E 415474m

SURFACE EL. 24.29 m

DEPTH, METERS	SYMBOL	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS
25		C23		- no recovery, from 24.23 to 24.38m - no recovery, from 24.38 to 24.69m	
				- broken, gravel-size fragments, from 24.69 to 24.99m	
		C24		- quartz healed fracture with chlorite and pyrite, at 25.15m	
				- mica schist, from 25.39 to 25.51m	
26		C25		- no recovery, from 25.76 to 25.91m - broken rock, at 25.91m	
		C26		- trace to some garnets, from 26.75 to 26.82m	
27				- moderately to intensely fractured, at 26.97m	
		C27		- garnets, from 27.43 to 27.52m - intensely to very intensely fractured, at 27.58m	
28		C28		- phyllite gravel-size fragments, from 28.19 to 28.65m, very intensely fractured, increase in pyrite content	
				- evidence of vertical or near-vertical fractures, partially filled with pyrite and quartz, some chlorite, at 28.65m	
29		C29		- healed shear, from 29.41 to 29.47m, pyrite, black, quartz, offsets foliation	
		C30		- mica schist, from 29.81 to 29.90m	
30				- intensely fractured and broken foliation at 80 degrees, very closely spaced joints, heavy chlorite filling with spotty pyrite, at 30.39m	
31		C31		- healed vertical fracture, from 30.94 to 31.39m, healed with quartz, chlorite, and pyrite - occasional schistose banding less than 0.64cm-thick, from 31.09 to 32.00m	
				- fractures filled with chlorite, quartz, and pyrite, from 31.39 to 32.31m	
32		C32		- spotty pyrite and quartz filling, little to no chlorite filling, from 32.00 to 32.46m	
33		C33		- moderately fractured, from 32.92 to 33.53m	
				- broken fragmented phyllite, from 33.59 to 33.77m	
34		C34		- intensely to very intensely fractured along foliation planes, at 34.44m - quartz seam 0.64cm-thick, from 34.59 to 34.90m	
35					

CLASSIFICATION

UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
		0			
		0			
		0			
27		0			

SHEAR STRENGTH / UCS

□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
UCS ✳
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE —— Min./m: 10 20 30 40
REC. —— SCR · · · RQD ——
%: 20 40 60 80

NOTES:
1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:
Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 11 July, 2013
TOTAL DEPTH: 55.40m
CAVED DEPTH: N/A
CORING: 173.65 m
WET ROTARY: 8.1 m
BACKFILL: Grout
LOGGER: DMarlow, CEG
DRILLER: Geotech Drilling

C:\USERS\BBINATLI\DESKTOP\04.10130058\GINT\04_1013_0058_FE13B-122313 - WITH TORVANE CORRECTION.GPJ FUGRO_S_(LAB)_IND GRP_A3_ONSHORE_REV03 12/24/2013

LOG OF BORING BH-24
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-16c

LOCATION: See Plate 2
COORDINATES: N 6006484m
E 415474m

SURFACE EL. 24.29 m

DEPTH, METERS	SYMBOL	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS	UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
37		C35		- broken and fragmented, from 36.27 to 36.52m, chlorite and spotty pyrite filling - no recovery, from 36.42 to 36.58m				0			
38		C36		- no recovery, from 37.19 to 37.34m - quartz vein, from 37.25 to 37.31m - broken and fragmented, 37.40 to 37.95m							
39		C37		- broken and fractured, from 38.86 to 39.01m - fresh, hard, very intensely foliated at 40 to 45 degrees, intensely to very intensely fractured primarily along foliation, slaty cleavage, interbedded with seams of quartz 0.16 to 0.32cm-thick, spotty pyrite filling - mica schist, from 39.01 to 39.17m - broken, from 39.44 to 39.56m - folding, vertical foliation, from 39.62 to 40.08m				0			
40		C38		- mica schist, from 40.08 to 40.16m - no recovery, from 40.16 to 40.39m - mica schist, from 40.39 to 40.42m				0			
41		C39		- mica schist, from 41.21 to 41.27m		27					
42		C40		- no recovery, from 41.76 to 41.91m - broken and fragmented, from 41.91 to 41.99m				0			
43		C41		- broken and fragmented, from 42.82 to 44.65m - broken and fragmented, from 43.59 to 43.80m, silicic - schistose banding, from 43.89 to 45.72m				0			
46		C42		- broken and fragmented, from 45.72 to 45.96m - no recovery, from 46.18 to 46.48m							
47		C43		- intruded or hydrothermally altered, from 46.71 to 47.62m, disrupted foliation, quartz veins at random orientations - shear, at 46.71m, with black clay filling - healed shear, from 47.62 to 47.70m, clay filling				1			

CLASSIFICATION

SHEAR STRENGTH / UCS
□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
✳ UCS
MPa (◆, ✳) 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲) 20 40 60 80 100

CORING RATE —— Min./m 10 20 30 40
REC. —— SCR · · · RQD —— % 20 40 60 80

NOTES:
1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:
Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 11 July, 2013
TOTAL DEPTH: 55.40m
CAVED DEPTH: N/A
CORING: 173.65 m
WET ROTARY: 8.1 m
BACKFILL: Grout
LOGGER: DMarlow, CEG
DRILLER: Geotech Drilling

C:\USERS\BBINATLI\DESKTOP\04.10130058\GINT\04_1013_0058_FE13B-122313 - WITH TORVANE CORRECTION.GPJ FUGRO_S_(LAB)_IND GRP_A3_ONSHORE_REV03 12/24/2013

LOG OF BORING BH-24
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-16d

LOCATION: See Plate 2
COORDINATES: N 6006484m
E 415474m

SURFACE EL. 24.29 m

DEPTH, METERS	SYMBOL	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS
49		C44		- mica schist band, at 48.31m, narrow to wide, with fine developed quartz muscovite/biotite crystals - mica schist bands, at 48.69m	
50		C45		- no recovery, from 49.38 to 49.53m	
51		C46		- phyllite interbedded with green schist, below 51.00m - phyllite, from 51.05 to 51.51m - green schist, from 51.51 to 51.82m	
52				- green schist, from 51.82 to 52.27m	
53		C47		- phyllite, from 52.43 to 52.88m - no recovery, from 52.73 to 54.10m - green schist, from 52.88 to 53.80m	
54		C48		- no recovery, from 53.80 to 53.95m - phyllite, from 54.10 to 54.56m	
55		C49		- green schist, from 54.56 to 54.86m - green schist, from 54.86 to 55.24m, fresh, hard, slightly fractured	-31.1
56				NOTE: Performed acoustic televiewer and PS geophysical logging on 11 July, 2013. **TD = 55.40m**	
57					
58					
59					

CLASSIFICATION

UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
		0			
		0			
		0			
		0			

SHEAR STRENGTH / UCS

□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
UCS ✳
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE —— Min./m: 10 20 30 40
REC. SCR RQD
%: 20 40 60 80

NOTES:

1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:

Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 11 July, 2013
TOTAL DEPTH: 55.40m
CAVED DEPTH: N/A
CORING: 173.65 m
WET ROTARY: 8.1 m
BACKFILL: Grout
LOGGER: DMarlow, CEG
DRILLER: Geotech Drilling

C:\USERS\BBINATLI\DESKTOP\04.10130058\GINT\04_1013_0058_FE13B-122313 - WITH TORVANE CORRECTION.GPJ FUGRO_S_(LAB)_IND GRP_A3_ONSHORE_REV03 12/24/2013

LOG OF BORING BH-24
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

LOCATION: See Plate 2
COORDINATES: N 6006513m
E 415803m

SURFACE EL. 25.73 m

DEPTH, METERS	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS	UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
0	1	2	**PEAT** PEAT (PT): very soft, brown to reddish brown, wet, organic, non-plastic, fibrous							
	2	WOH								
1			- increase in clay content, with fine sand and an organic content of 60%, at 0.91m				717			
2			**SEDIMENTARY DEPOSITS** Sandy Lean CLAY (CL): stiff, reddish brown, wet, fine sand, few roots	23.9						
	3	WOH								
3	C1		- grades to lean clay, some subrounded to subangular gravel to 2.54m, at 2.90m	22.7		46	0	31	17	14
			UNDIVIDED PHYLLITE (OTa) PHYLLITE (Rx): slightly weathered to fresh, hard to very hard, dark gray, moderately to intensely fractured, thinly foliated to laminated at 43 degrees, planar foliation							
4			- 45 degree joint, at 3.72m, planar to stepped, rough to moderately open - sub-parallel microjoints, from 3.75 to 3.87m, stepped, totally healed - gneiss band overlying quartz vein, from 3.90 to 4.08m							
	C2		- 50 degree joint, at 4.36m, planar, slightly rough, slightly open, partly mineralized - 50 degree joint, at 4.48m, planar, slightly rough to smooth, slightly open, partly mineralized - sub-parallel microjoints, at 4.51m, stepped, totally healed - approximately 75 degree joint, at 4.57m, planar, moderately rough, approximately 1.3cm-wide, partly healed				0			
5			- approximately 40 degree joint, at 5.27m, planar, smooth, slightly open to tight - 55 degree joints, from 5.49 to 5.76m, planar to stepped, partly to totally healed							
	C3		- approximately 5.1cm-thick band of sub-parallel approximately 50 degree shears, at 5.88m, planar to undulating, totally healed, to 0.3cm-offset				0			
6			- 50 degree joint, at 6.43m, planar, slightly rough, slightly open, partly mineralized							
	C4		- approximately 65 to 70 degree intersecting joints, from 7.16 to 8.84m, planar to stepped, slightly open to tight, slightly to totally healed				0			
7										
	C5		- increase in deformation, from 7.80 to 8.29m - approximately 70 degree joint, at 7.83m, planar, totally healed - very intensely fractured, from 7.89 to 8.05m - very intensely fractured, from 8.14 to 8.58m - approximately 70 degree joint, at 8.26m, planar, totally healed		26					
8										
	C6		- sub-vertical joint, at 8.87m, planar to undulating, rough, moderately open to open, partly mineralized - approximately 50 degree joint, at 9.17m, planar, slightly rough to smooth, moderately open, partly mineralized (quartz) - 60 to 70 degree joints and microjoints, from 9.27 to 10.33m, stepped, partly totally healed, to approximately 0.6cm-wide				0			
9										
10										
	C7		- 30 degree joint, at 10.79m, planar, slightly rough, moderately open, slightly mineralized - sub-parallel joints, from 11.09 to 11.49m - approximately 55 degree joint, at 11.19m, planar to stepped, totally healed - approximately 55 degree joint, at 11.28m, planar to stepped, totally healed				0			
11										

SHEAR STRENGTH / UCS
□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
UCS ✳
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE — Min./m: 10 20 30 40
REC. SCR RQD — %: 20 40 60 80

NOTES:
▽ : Initial Ground Water Depth ▼ : Static Ground Water Depth
1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:
Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 01 July, 2013
TOTAL DEPTH: 21.34m
CAVED DEPTH: N/A
CORING: 60 m
WET ROTARY: 10 m
BACKFILL: Grout
LOGGER: GEckrich, CEG
DRILLER: Geotech Drilling

C:\USERS\BBINATL\DESKTOP\04.10130058\GINT\04_1013_0058_FE13B-122313 - WITH TORVANE CORRECTION.GPJ FUGRO_S_(LAB)_IND GRP_A3_ONSHORE_REV03 12/24/2013

LOG OF BORING BH-25
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-17a

LOCATION: See Plate 2
COORDINATES: N 6006513m
E 415803m

SURFACE EL. 25.73 m

DEPTH, METERS	SYMBOL	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS
13		C8			
14		C9		- fault zone, from 14.33 to 17.10m, randomly-oriented discontinuities, prominent fault planes approximately 70 degrees - approximately 70 degrees to sub-vertical, at 14.33m, to 5.1cm-wide, totally healed - approximately 80 degrees to sub-vertical, at 14.45m, to 5.1cm-wide, totally healed	
15		C10		- approximately 80 degrees to sub-vertical joint, at 15.24m, undulating, partly to totally healed - very intensely fractured, from 15.51 to 15.58m	
16				- approximately 65 degree shear, at 15.79m, planar to undulating, totally healed, with approximately 0.3cm-differential movement - joints/microjoints generally dipping 60 degrees, from 16.15 to 17.40m, planar to undulating, totally healed, with approximately 0.2cm-differential movement	
17		C11			
18		C12		- increased deformation, from 17.53 to 17.98m - sub-vertical joints, at 17.80m, planar to undulating, totally healed - very intensely fractured, from 18.07 to 18.20m	
19				- 30 degree joint, at 18.44m, planar, moderately rough, moderately open, partly healed - 50 degree joint, at 18.53m, planar, moderately rough, moderately open, partly healed - intersecting 35 and 70 degree joints, at 18.81m, planar, slightly rough, slightly to moderately open, slightly to partly mineralized - 55 degree to sub-vertical joints/microjoints, from 18.90 to 20.94m, planar to undulating, totally healed	
20		C13		- fault zone, from 19.78 to 20.94m, randomly-oriented discontinuities	
21				- prominent shear plane, approximately 70 degrees to sub-vertical, at 20.24m, to 1.3cm-wide, planar to undulating, partly to totally healed, with approximately 4.5cm-differential movement - prominent shear plane, approximately 85 degrees to sub-vertical, at 20.60m, to 1.3cm-wide, planar to undulating, partly to totally healed, with approximately 4.5cm-differential movement	
				- 25 degree joint, at 21.21m, planar, smooth to slickensided, slightly open **TD = 21.34m**	4.4
22					
23					

CLASSIFICATION

UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
		0			
		0			
		0			
		1			
		1			
		0			

SHEAR STRENGTH / UCS

□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
UCS ✳
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE —— Min./m: 10 20 30 40
REC. SCR RQD
%: 20 40 60 80

NOTES:

▽ : Initial Ground Water Depth ▼ : Static Ground Water Depth

1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:

Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 01 July, 2013
TOTAL DEPTH: 21.34m
CAVED DEPTH: N/A
CORING: 60 m
WET ROTARY: 10 m
BACKFILL: Grout
LOGGER: GEckrich, CEG
DRILLER: Geotech Drilling

C:\USERS\BBINATLI\DESKTOP\04.10130058\GINT\04_1013_0058_FE13B-122313 - WITH TORVANE CORRECTION.GPJ FUGRO_S_(LAB)_IND GRP_A3_ONSHORE_REV03 12/24/2013

LOG OF BORING BH-25
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-17b

LOCATION: See Plate 2
COORDINATES: N 6006339m
E 415596m

SURFACE EL. 34.78 m

DEPTH, METERS	SYMBOL	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS	UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
0		1	10	**PEAT** PEAT (PT): very soft, brown, wet, fibrous, organic, non-plastic, little to some medium to coarse sand, approximately 1.3cm-diameter root in SPT sampler							
1		2 Ref.		with an organic content of 19%, at 1.07m - tonalite cobble in HQ grab sample, shattered angular phyllite gravel to 1.3cm in silty sand matrix, at 1.22m	33.5			140			
2		C1 C2		**UNDIVIDED PHYLLITE (OTa)** PHYLLITE (Rx): slightly weathered, hard to very hard, dark gray, moderately to intensely fractured, thinly foliated to laminated at approximately 48 degrees, planar to undulating foliation - deformed/folded, from 1.34 to 2.38m - 70 degree joint, at 1.37m, rough, open, moderately mineralized - 25 degree joint, slightly rough to smooth, moderately open		26					
3		C3		- fresh, at 2.41m - approximately 60 degree to subvertical joints/microjoints, from 2.65 to 3.05m, stepped, totally healed - approximately 45 to 60 degree joints/microjoints, from 3.02 to 4.05m, planar to stepped, totally healed - 45 degree joint, at 3.17m, stepped, slightly open to tight, moderately mineralized (quartz)				0			
4		C4		- 48 degree joint, rough, slightly open to tight, moderately mineralized (quartz), at 3.60m - 48 degree joint, rough, slightly open to tight, moderately mineralized (quartz), at 3.87m - increased deformation/folding, increase in foliation dip to approximately 78 degrees, quartz boudinage, from 4.02 to 4.88m - 34 degree joint, at 4.33m, slightly rough to smooth, moderately open, trace pyrite							
5				- intersecting 26 and 35 degree joints, at 4.48m, smooth to moderately rough, slightly open - 15 degree joint, at 4.54m, rough, open - 60 degree joint, at 4.63m, stepped, moderately open, moderately mineralized (quartz) - three approximately 35 degree joints, from 4.66 to 4.79m, slightly rough to smooth, open, intersected by approximately 45 degree joints/microjoints, from 4.66 to 5.06m, totally healed to not healed, with moderate mineralization (quartz)				1			
6		C5		- approximately 85 degree joint, at 5m, rough to stepped, slightly open to tight, moderately mineralized (quartz) - three sub-vertical microjoints, at 5.06m, stepped, totally healed - slightly fractured, at 5.06m - increase in deformation/folding, plication, from 5.39 to 6m - mica schist band, at 6m, approximately 3.8cm-wide - approximately 75 degree joint, at 6.16m, stepped, totally healed, sub-parallel and perpendicular microjoints - increase in deformation, from 6.31 to 6.98m				0			
7				- increase in deformation/folding, schistosity, from 7.04 to 8.75m - two 45 degree joints, at 7.22m, slightly rough, tight, moderately healed to not healed, with moderate mineralization (quartz)							
8		C6									
9		C7		- increase in deformation, from 9.39 to 9.69m				0			
10		C8		- three approximately 50 degree joints, from 9.97 to 10.18m, stepped, totally healed to not healed, with moderate mineralization (quartz) - two approximately 50 degree microjoints, from 10.42 to 10.49m, stepped, totally healed - 30 degree joint, at 10.64m, rough to stepped, moderately open to open - increase in schistosity, trace to few garnet inclusions, at 10.79m - 35 degree joint, at 10.85m, moderately rough to rough, open, partly mineralized (quartz) - 40 degree joint, at 11.09m, slightly rough, slightly open, moderately mineralized (quartz) - 35 degree joint, at 11.40m, slightly rough to smooth, slightly to moderately open				0			
11											

SHEAR STRENGTH / UCS
□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
UCS ✳
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE —— Min./m: 10 20 30 40
REC. SCR RQD
%: 20 40 60 80

NOTES:
▽ : Initial Ground Water Depth ▼ : Static Ground Water Depth
1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:
Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 16 July, 2013
TOTAL DEPTH: 21.34m
CAVED DEPTH: N/A
CORING: 65.75 m
WET ROTARY: 4.25 m
BACKFILL: Piezometer
LOGGER: GEckrich, CEG
DRILLER: Geotech Drilling

C:\USERS\BBINATLI\DESKTOP\04.10130058\GINT\04_1013_0058_FE13B-122313 - WITH TORVANE CORRECTION.GPJ FUGRO_S_(LAB)_IND GRP_A3_ONSHORE_REV03 12/24/2013

LOG OF BORING BH-26
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-18a

LOCATION: See Plate 2
COORDINATES: N 6006339m
E 415596m

SURFACE EL. 34.78 m

DEPTH, METERS	SYMBOL	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS
		C9		- intersecting 20 and 33 degree joints, at 12.13m, smooth, slightly open to tight	
				GNEISS (Rx): fresh, very hard, white to dark gray, moderately fractured, thinly foliated to laminated at 43 degrees, few actinolite inclusions	22.5
				- two 21 degree joints, at 12.41m, slightly to moderately rough, slightly open to tight	22.1
13				PHYLLITE (Rx): slightly weathered, hard to very hard, dark gray, moderately to intensely fractured - 35 degree joint, at 13.01m, smooth, slightly open, moderately mineralized (chlorite)	
		C10		- 68 degree joint, at 13.41m, stepped, slightly open to tight, moderately mineralized (quartz)	
14				- increase in deformation, from 13.78 to 13.93m	
				- gneiss band, at 14.05m, approximately 5.1cm-wide, trace garnet inclusions - 40 degree joint, at 14.17m, slightly rough to smooth, slightly open	
15		C11		- increase in deformation, intensely weathered to decomposed, from 14.60 to 14.78m - 35 to 60 degree joints/microjoints, from 14.78 to 15.00m, planar to stepped, totally healed, approximately 1.3cm-wide	
				- gneiss band, from 15.33 to 15.48m, trace to few garnet inclusions	
16				- randomly -oriented microjoints, from 15.64 to 19.26m, moderately to totally healed, very thin - slickensided foliation plane, at 15.82m	
17		C12		- very intensely fractured, from 16.73 to 18.38m - intersecting 45 degree joints, at 55 degrees, rough to stepped, slightly open	
		C13		- approximately 75 degree to sub-vertical joint, at 17.19m, stepped, moderately to totally healed, truncated by foliation	
18		C14		- 81 degree to sub-vertical joint, at 18.17m, stepped, totally healed to not healed, with moderate mineralization (quartz) - sub-parallel microjoints, from 18.41 to 18.81m, totally healed	
19				- two sub-horizontal joints, at 19.11m, rough, tight (mechanical breaks)	
				- quartz vein with deformed margins, at 19.31m, approximately 3.8cm-wide	
20		C15		- 74 degree joint, at 20.15m, stepped, totally healed - sub-parallel joints/microjoints, from 20.11 to 21.12m, totally healed	
21					13.4
22				NOTE: Installed 5cm-diameter PVC piezometer to 20m; refer to piezometer detail log. **TD = 21.34m**	
23					

CLASSIFICATION

UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
26		0			
		0			
		0			
		0			
		0			

SHEAR STRENGTH / UCS

□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
UCS ✳
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE — Min./m: 10 20 30 40
REC. SCR RQD
%: 20 40 60 80

NOTES:

▽ : Initial Ground Water Depth ▼ : Static Ground Water Depth

1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:

Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 16 July, 2013
TOTAL DEPTH: 21.34m
CAVED DEPTH: N/A
CORING: 65.75 m
WET ROTARY: 4.25 m
BACKFILL: Piezometer
LOGGER: GEckrich, CEG
DRILLER: Geotech Drilling

C:\USERS\BBINATLI\DESKTOP\04.10130058\GINT\04_1013_0058_FE13B-122313 - WITH TORVANE CORRECTION.GPJ FUGRO_S_(LAB)_IND GRP_A3_ONSHORE_REV03 12/24/2013

LOG OF BORING BH-26

PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-18b

LOCATION: See Plate 2
COORDINATES: N 6006414m
E 415945m

SURFACE EL. 30.45 m

DEPTH, METERS	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS
0	1	1	**PEAT** PEAT (PT): very soft, brown to reddish brown, wet, organic, fibrous to amorphous, non-plastic	
	2	WOH		
1	3	WOH	- with an organic content of 61%, at 0.91m	
	4	16		
	5	Push	**SEDIMENTARY DEPOSITS** Sandy Lean CLAY (CL): firm to stiff, dark gray, wet, fine sand, trace medium to coarse sand, micaceous - with an organic content of 2%, at 1.83m	28.7
2	6	46	- trace angular to subangular gravel to 3.8cm, at 2.44m Lean CLAY (CL): stiff to hard, gray, trace to few fine to medium sand, gradational upper contact	27.9
3	7	Push	- very stiff to hard, approximately 0.6cm-diameter root in shelby tube sample, at 3.05m	
	8	62	- trace coarse sand, rootlets, at 3.66m - thin stratum of clayey sand with gravel, from 3.81 to 3.96m, fine to coarse sand, angular granodiorite gravel to approximately 7.6cm	
4	9	Push		
	10			
5			- stiff to very stiff, below 5.80m	
6	11	Push		
	12			
7	13	Push		
	14			
8	15	Push Ref.		
9	C1		**UNDIVIDED PHYLLITE (OTa)** PHYLLITE (Rx): fresh, hard to very hard, dark gray, moderately to intensely fractured, thinly foliated to laminated at 45 degrees, planar foliation, pyrite inclusions on fracture surfaces	21.0
10			- approximately 80 degree joint, at 10.03m, moderately rough to rough, slightly open, partly healed - increased deformation, quartz veins/boudins, from 10.45 to 10.82m	
	C2		- 55 degree joint, at 10.88m, slightly to moderately rough, slightly open, partly mineralized (quartz)	
11				

CLASSIFICATION

UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
		634			
		20			
18	58	18	20	12	8
			37	17	20
16 17	97	29 22			
16 16	95	24 25	33	18	15
15 15	96	29 29	35	18	17
26		0			

SHEAR STRENGTH / UCS

□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
UCS ✳
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

UCS (kPa)	Depth (m)
143.6	4.39
131.7	4.85
131.7	4.88
128.3	6.00
203.5	6.05
148.4	6.10
167.6	7.62
167.6	7.67

CORING RATE ——
Min./m: 10 20 30 40
REC. —— SCR · · · RQD ——
%: 20 40 60 80

NOTES:

▽ : Initial Ground Water Depth ▼ : Static Ground Water Depth

1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:

Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 11 July, 2013
TOTAL DEPTH: 19.81m
CAVED DEPTH: N/A
CORING: 34 m
WET ROTARY: 31 m
BACKFILL: Grout
LOGGER: GEckrich, CEG
DRILLER: Geotech Drilling

C:\USERS\BBINATLI\DESKTOP\04.10130058\GINT\04_1013_0058_FE13B-122313 - WITH TORVANE CORRECTION.GPJ FUGRO_S_(LAB)_IND GRP_A3_ONSHORE_REV03 12/24/2013

LOG OF BORING BH-27
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-19a

LOCATION: See Plate 2
COORDINATES: N 6006414m
E 415945m

SURFACE EL. 30.45 m

DEPTH, METERS	STRATUM DESCRIPTION	STRATUM ELEV, METERS
13	- increased deformation, from 12.28 to 12.50m - approximately 35 degree joint, at 12.80m, moderately open, sub-vertical joints, from 12.80 to 13.29m, stepped, totally healed	
14	- 55 degree joint, at 13.93m, slightly rough to stepped, tight - 33 degree joint, at 14.11m, slightly to moderately rough, slightly open - moderately fractured, from 14.23 to 16.31m	
15	- increased deformation, from 14.81 to 15.18m	
16	- increase in mica schist bands, at 15.39m, approximately 5.1cm wide - approximately 45 degree joint, at 15.90m, moderately rough, slightly open to tight	
17	- increase in sub-vertical microjoints, at 16.37m, stepped, moderately to totally healed - 25 degree joint, at 16.95m, slightly to moderately rough, moderately open - 45 degree joint, at 17.10m, stepped, moderately open to open	
18	- 47 degree joint, at 17.34m, moderately rough, moderately open to open - 35 degree joint, at 18.14m, slightly rough, moderately open to open, partly mineralized (chlorite) - 50 degree joint/microjoint, at 18.35m, planar to stepped, totally healed - 50 degree joint/microjoint, at 18.44m, planar to stepped, totally healed	
19		
20	- 47 degree joint, at 19.69m, slightly rough to smooth, slightly to moderately open	10.6
21	NOTE: Core pipe stuck at 18.29m and casing stuck at 13.72m bgs on 10 July 2013; attempted to recover. Core pipe and casing parted leaving 13.72m of HQ core pipe and 10 of casing in hole on 11 July 2013. Abandoned hole and pipe/casing with neat cement backfill to ground surface. **TD = 19.81m**	
22		
23		

SAMPLES: C3, C4, C5, C6, C7

UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
		0			
		0			
		0			
		0			
28					
		0			
27					

SHEAR STRENGTH / UCS
□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
UCS ✳
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE — Min./m: 10 20 30 40
REC. SCR RQD
%: 20 40 60 80

NOTES:
▽ : Initial Ground Water Depth ▼ : Static Ground Water Depth
1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:
Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 11 July, 2013
TOTAL DEPTH: 19.81m
CAVED DEPTH: N/A
CORING: 34 m
WET ROTARY: 31 m
BACKFILL: Grout
LOGGER: GEckrich, CEG
DRILLER: Geotech Drilling

C:\USERS\BBINATLI\DESKTOP\04.10130058\GINT\04_1013_0058_FE13B-122313 - WITH TORVANE CORRECTION.GPJ FUGRO_S_(LAB)_IND GRP_A3_ONSHORE_REV03 12/24/2013

LOG OF BORING BH-27
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-19b

LOCATION: See Plate 2
COORDINATES: N 6006327m
E 415842m

SURFACE EL. 38.63 m

DEPTH, METERS	SYMBOL	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS
0		1	1	**PEAT** PEAT (PT): very soft, brown, wet, organic, fibrous to amorphous, with few to little roots	
		1	1		
1		2	1	- with an organic content of 92%, at 1.13m	
		3	50/150mm	**SEDIMENTARY DEPOSITS** Clayey SAND (SC): very dense, brown to dark gray, wet, fine to coarse, with trace of fine light yellowish brown gravel	37.2
2		C1		- Silty SAND (SM), brown, wet, with cobbles, blowcounts affected by cobbles, at 1.77	36.8
				UNDIVIDED PHYLLITE (OTa) PHYLLITE (Rx): slightly weathered to fresh, hard to very hard, dark gray, slightly to very slightly fractured, thinly foliated to laminated at 56 degree - quartz veins and boudins, from 2.19 to 2.65m	
3		C2		- 57 degree joint, slightly rough, slightly open to moderately open, moderately mineralized, at 3.08m - 77 degree joints, moderately rough to rough, slightly open to tight, at 3.32m - 77 degree joints, moderately rough to rough, slightly open to tight, at 3.41m	
4		C3 C4		- very slightly fractured to unfractured, fresh, at 3.66m - randomly oriented joints and microjoints, healed, very thin, from 4.18 to 6.34m	
5					
6		C5			
7				- 25 degree joint, smooth, slight open, partly oxidized and mineralized, at 6.89m - 20 degree joint, slightly rough to smooth, slightly open to moderately open, striated, partly mineralized, at 7.09m	
8		C6		- intersecting 13 degree and 65 degree joints, slightly rough to rough, tight, at 7.68m - 22 degree joint, smooth, tight, totally mineralized, at 8.26m	
9		C7			
10				- increase in deformation, from 9.60 to 10m - 55 degree shear, slighty rough to smooth, moderately healed, with differential movement, at 10.21m	
11		C8		- foliation plane, infilled with dark gray clayey sand, intersected by 25 degree joint, stepped, moderately healed, at 10.82m - gneiss bands, from 11.25 to 11.67m - increase in deformation and plication, from 11.40 to 11.64m	

CLASSIFICATION

UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
		763			
	19		41	30	11
		0			
	27	0			
		0			
		0			
	27	0			
		0			

SHEAR STRENGTH / UCS

□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
UCS ✳
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

143.6

CORING RATE —— Min./m: 10 20 30 40
REC. —— SCR · · · RQD — %: 20 40 60 80

NOTES:

▽ : Initial Ground Water Depth ▼ : Static Ground Water Depth

1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:

Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 19 July, 2013
TOTAL DEPTH: 30.48m
CAVED DEPTH: N/A
CORING: 94 m
WET ROTARY: 6 m
BACKFILL: Piezometer
LOGGER: GEckrich, CEG
DRILLER: Geotech Drilling

C:\USERS\BBINATLI\DESKTOP\04.10130058\GINT\04_1013_0058_FE13B-122313 - WITH TORVANE CORRECTION.GPJ FUGRO_S_(LAB)_IND GRP_A3_ONSHORE_REV03 12/24/2013

LOG OF BORING BH-28
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-20a

LOCATION: See Plate 2
COORDINATES: N 6006327m
E 415842m

SURFACE EL. 38.63 m

DEPTH, METERS	SAMPLES	STRATUM DESCRIPTION	STRATUM ELEV, METERS
13	C9	- sub-vertical joint, stepped, healed, at 12.01m - gneiss band, at 12.10m - increase in schistosity and randomly oriented joints, stepped, healed, from 12.25 to 12.59m - quart vein, tabular to amorphous, with pyrite inclusions, at 12.59m - 20 degree joint, slightly rough to smooth, slightly open to tight, at 13.04m	25.5
14	C10	MICA SCHIST (Rx): hard to very hard, dark gray to light gray, fresh, moderately to intensely fractured, thinly foliated to laminated at 47 degree - sub-vertical joints, stepped, healed, at 13.99m	
15	C11	- 15 degree and 19 degree joints, rough, moderately open to open, at 14.42m - 15 degree and 19 degree joints, rough, moderately open to open, at 14.48m - 20 degree joint, rough to stepped, open, with very thin fine white infilling, at 15.18m - quartz veins, amorphous, from 15.27 to 15.42m	23.1
16		GNEISS (Rx): hard to very hard, dark gray to white, unfractured, planar to undulating foliation, with pyrite bands	22.8
17	C12	PHYLLITE (Rx): hard to very hard, dark gray to white, moderately fractured - 15 degree joint, slightly rough, slightly open to moderately open, at 16.25m - increase in deformation, with quartz veins, from 16.43 to 16.58m	21.0
18	C13	GNEISS (Rx): hard to very hard, dark gray to white, strata deformed and folded	20.6
19		PHYLLITE (Rx): hard to very hard, dark gray to white, moderately fractured - shear, stepped, healed, with differential movement, at 18.35m - quartz veins, at 19.05m - quartz veins, at 19.20m - mica schist band, at 19.23m - quartz vein, amorphous, at 19.29m	
20	C14	GNEISS (Rx): hard to very hard, dark gray to white, unfractured to slightly fractured - sub-vertical shear, stepped, healed, with differential movement, from 20.06 to 20.82m	18.6 18.3
21		PHYLLITE (Rx): hard to very hard, dark gray to white, fractured - 22 degree joint, smooth, slightly open to tight, at 20.79m - 28 degree joint, rough to stepped, slightly open to tight, at 21.18m	
22	C15	- chlorite and mica schist band, from 21.52 to 21.82m - 27 degree shear, healed, planar, with differential movement, at 21.82m - sub-vertical shears, stepped, healed, at 21.85m	
23	C16	- moderately weathered with increase in deformation, from 22.49 to 22.62m - quartz veins and boudins, plication, from 23.29 to 23.38m - 58 degree joint, rough to stepped, moderately open, at 23.77m	

CLASSIFICATION: UNIT DRY WT, kN/m³ | PASSING NO. 200 SIEVE, % | WATER CONTENT, % | LIQUID LIMIT | PLASTIC LIMIT | PLASTICITY INDEX (PI)

SHEAR STRENGTH / UCS: □ Penetrometer ▼ Unconfined; ◇ Torvane ● Triaxial; Remold Testing ▲ Miniature Vane; ○ △ ▽ ◆ Point Load; ✳ UCS
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE — Min./m: 10 20 30 40
REC. SCR RQD — %: 20 40 60 80

	UNIT DRY WT, kN/m³	WATER CONTENT, %
C10	26	0
C11		0
C13	27	
C16	27	

NOTES:
▽ : Initial Ground Water Depth ▼ : Static Ground Water Depth
1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:
Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 19 July, 2013
TOTAL DEPTH: 30.48m
CAVED DEPTH: N/A
CORING: 94 m
WET ROTARY: 6 m
BACKFILL: Piezometer
LOGGER: GEckrich, CEG
DRILLER: Geotech Drilling

C:\USERS\BBINATLI\DESKTOP\04.10130058\GINT\04_1013_0058_FE13B-122313 - WITH TORVANE CORRECTION.GPJ FUGRO_S_(LAB)_IND GRP_A3_ONSHORE_REV03 12/24/2013

LOG OF BORING BH-28
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-20b

LOCATION: See Plate 2
COORDINATES: N 6006327m
E 415842m

SURFACE EL. 38.63 m

DEPTH, METERS	STRATUM DESCRIPTION	STRATUM ELEV, METERS
25	- 58 degree joints, stepped, moderately healed to healed, from 23.85 to 24.35m - gneiss band, from 24.60 to 24.72m - 40 degree joint, healed, planar, at 25.12m - gneiss band, with strong deformation and plicated, 25.24 to 25.39m - 58 degree to sub-vertical microjoints, stepped, healed, from 25.39 to 26.18m - 29 degree joint, slightly rough to moderately rough, open, at 25.42m	
26	- randomly oriented shears and microshears, planar to stepped, healed, with differential movement, from 26.18 to 26.64m	
27	- quartz vein, amorphous, micaceous, from 27.31 to 27.55m - increase in deformation and folding, from 27.43 to 27.74m	
28	- 20 to 30 degree shears, slightly rough to moderately rough, healed to not healed, with differential movement, from 28.22 to 28.44m - gneiss band, from 28.44 to 28.56m	
29	- 56 degree to sub-vertical microjoints, planar to stepped, healed, from 29.32 to 29.72m	
30	- 35 degree joint, rough to stepped, open, at 30.45 increase in deformation, at 30.45m	8.2
31	NOTE: Installed 5cm-diameter PVC piezometer to 20m; refer to piezometer detail log. **TD = 30.48m**	
32		
33		
34		
35		

SAMPLES: C17, C18, C19, C20

CLASSIFICATION: UNIT DRY WT, kN/m³ (27); PASSING NO. 200 SIEVE, %; WATER CONTENT, %; LIQUID LIMIT; PLASTIC LIMIT; PLASTICITY INDEX (PI)

SHEAR STRENGTH / UCS: □ Penetrometer, ◇ Torvane, Remold Testing ○ △ ▽, Unconfined ▼, Triaxial ●, Miniature Vane ▲, Point Load ◆, UCS ✳
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE — Min./m: 10 20 30 40
REC. — SCR · · · RQD —
%: 20 40 60 80

NOTES:
▽ : Initial Ground Water Depth ▼ : Static Ground Water Depth
1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:
Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 19 July, 2013
TOTAL DEPTH: 30.48m
CAVED DEPTH: N/A
CORING: 94 m
WET ROTARY: 6 m
BACKFILL: Piezometer
LOGGER: GEckrich, CEG
DRILLER: Geotech Drilling

C:\USERS\BBINATLI\DESKTOP\04.10130058\GINT\04_1013_0058_FE13B-122313 - WITH TORVANE CORRECTION.GPJ FUGRO_S_(LAB)_IND GRP_A3_ONSHORE_REV03 12/24/2013

LOG OF BORING BH-28
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-20c

LOCATION: See Plate 2
COORDINATES: N 6006240m
E 415738m

SURFACE EL. 27.62 m

DEPTH, METERS	SYMBOL	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS
		1	1	**PEAT** PEAT (PT): very soft to soft, brown to light brown, moist, fibrous, organic, non plastic, with little to some roots	
		2	8	- wet, amorphous, at 0.53m	
1		3	Ref.	**SEDIMENTARY DEPOSITS** Lean CLAY (CL): firm, gray to dark gray, wet, becoming CLAYEY SAND with gravel (SC), fine to coarse, with rounded to subangular gravel, blowcounts affected by gravel content	26.7
		C1		- with an organic content of 44%, at 1.0m	26.2
		C2		**UNDIVIDED PHYLLITE (OTa)** PHYLLITE (Rx): hard to very hard, dark gray, slightly weathered to fresh, thinly foliated to laminated at 43 degrees, planar, with some schistose foliations	
2		C3		- mica schist band, from 1.92 to 2.13m - fresh, at 1.98m	
3				- gneiss band, from 2.32 to 2.52m - intensely fractured, at 2.44m	
				- sub-vertical joints and microjoints, stepped, healed to not healed, at 2.83m	
				- sub-vertical joints and microjoints, stepped, healed to not healed, at 3.12m	
				- sub-vertical joints and microjoints, stepped, healed to not healed, at 3.41m	
				- sub-vertical joints and microjoints, stepped, healed to not healed, at 3.63m	
4		C4		- increased deformation, from 3.87 to 4.11m - moderately fractured, at 3.96m	
				- 60 degree joint, smooth, slightly open to tight, with gray to dark gray lean clay infilling (<1cm-thick), at 4.30m	
				- 23 degree joint, smooth, tight, partly mineralized, at 4.60m	
5				- gneiss bands (3.8cm-thick), at 4.75m	
				- gneiss bands (3.8cm-thick), at 4.97m - gneiss bands (3.8cm-thick), at 5.03m	
		C5		- increased deformation, from 5.49 to 5.70m - quart vein with deformed and micaceous margins (<1cm-thick), at 5.55m	22.1
6				MICA SCHIST (Rx): hard to very hard, dark gray to brown, fresh, moderately fractured, thinly foliated to laminated at 51 degrees, planar, with some phyllite bands	
		C6			
7		C7		- increased deformation, from 7.39 to 7.56m	
8		C8		- 68 degree joint, stepped, slightly open to moderately open, moderately mineralized, at 8.63m - 10 to 20 degree joints, moderately rough to rough, slightly open to tight, from 8.87 to 9.27m	
9				- with very thin, light brown, fine-grained infilling, at 9.27m - 45 degree shear, planar, healed, with differential movement (5.7cm), at 9.27m - 80 degree to sub-vertical joints and microjoints, stepped, healed, from 9.57 to 10.52m	
10		C9			
11		C10		- 45 degree joint, smooth, tight, moderately mineralized, at 10.795m - increase in schistosity, from 11.34 to 11.79m	

CLASSIFICATION

UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
		287			
27		0			
		0			
27		0			
		0			
27		0			
		0			

SHEAR STRENGTH / UCS

□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
UCS ✳
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE —— Min./m: 10 20 30 40
REC. —— SCR · · · RQD ——
%: 20 40 60 80

NOTES:

▽ : Initial Ground Water Depth ▼ : Static Ground Water Depth

1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:

Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 20 July, 2013
TOTAL DEPTH: 20.73m
CAVED DEPTH: N/A
CORING: 64.5 m
WET ROTARY: 3.5 m
BACKFILL: Grout
LOGGER: GEckrich, CEG
DRILLER: Geotech Drilling

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LOG OF BORING BH-29
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-21a

LOCATION: See Plate 2
COORDINATES: N 6006240m
E 415738m

SURFACE EL. 27.62 m

DEPTH, METERS	SYMBOL	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS
13		C11		- randomly oriented microjoints, stepped, healed, from 12.50 to 12.83m - gneiss band (2.5cm-thick), at 12.89m	
14				- 50 degree to sub-vertical joint, rough to stepped, healed, at 13.44m - gneiss band, from 13.53 to 13.72m - intensely fractured, from 13.65 to 15.33m - sub-vertical microjoint, rough to stepped, moderately healed to healed, at 13.84m - 75 degree to sub-vertical microjoint, stepped, moderately healed to healed, from 14.11 to 14.30m	
15		C12		- 70 degree microjoints, rough to stepped, moderately healed to healed, from 14.84 to 15.33m - increased deformation, from 15.08 to 15.55m	
16		C13		- quartz vein, amorphous, deformed margins, micaceous inclusions, at 16.09m - gneiss bands (6.4cm-thick), at 16.31m - gneiss bands (6.4cm-thick), at 16.46m	
17				- increased deformation, from 16.80 to 17.25m - 45 degree to sub-vertical microjoints and microshears, stepped, healed, with differential movement (<1cm), from 17.00 to 17.25m	
18		C14		- increased deformation, from 17.86 to 18.20m - sub-vertical joints and microjoints, stepped, moderately healed to healed, from 18.17 to 19.02m	
19					
20		C15		- 23 degree joints, slightly rough to rough, slightly open to moderately open, at 19.38m - increased deformation, from 19.44 to 20.12m - 23 degree joints, slightly rough to rough, slightly open to moderately open, at 19.54m - very intensely fractured, from 19.87 to 19.96m - 20 to 40 degree shears, planar, healed, with differential movement (<1cm), intersected by randomly oriented microshears, stepped, healed, from 19.96 to 20.09m	
21				**TD = 20.73m**	6.9
22					
23					

CLASSIFICATION

UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
27		0			
27		0			
		0			

SHEAR STRENGTH / UCS

□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
✳ UCS
MPa (◆, ✳) 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲) 20 40 60 80 100

CORING RATE — Min./m 10 20 30 40
REC. — SCR · · · RQD —
% 20 40 60 80

NOTES:

▽ : Initial Ground Water Depth ▼ : Static Ground Water Depth

1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:

Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 20 July, 2013
TOTAL DEPTH: 20.73m
CAVED DEPTH: N/A
CORING: 64.5 m
WET ROTARY: 3.5 m
BACKFILL: Grout
LOGGER: GEckrich, CEG
DRILLER: Geotech Drilling

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LOG OF BORING BH-29
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-21b

LOCATION: See Plate 2
COORDINATES: N 6006150m
E 415921m

SURFACE EL. 35.28 m

DEPTH, METERS	STRATUM DESCRIPTION	STRATUM ELEV, METERS
0	**PEAT** PEAT (PT): very soft, brown, wet, moss at surface, fibrous to amorphous, massive and abundant very fine to fine roots	
	- amorphous, below 0.61m - with an organic content of 96%, at 0.61m	
	SEDIMENTARY DEPOSITS	33.6
	Sandy Clayey SILT (ML-CL): medium dense to very dense, bluish gray, moist, massive with a medium root fragment	33.4
	Sandy Lean CLAY (CL): very stiff to hard, bluish gray, moist, laminated, with trace of fine sand	
	GLACIAL TILL	32.8
	GLACIAL TILL: gravel and cobbles, well rounded, gneiss, granite, pebble conglomerate	32.6
	UNDIVIDED PHYLLITE (OTa) PHYLLITE (Rx): fresh, hard, gray, moderately to intensely fractured, 50 degree dip on foliations, slatey cleavage - 70 degree joint, rough, open, planar, very thin, at 3.17m - 80 degree joint, rough, open, planar, very thin, at 3.26m	
	chloritized igneous dike (<1cm-thick), at 4.39m	
	- 75 degree to 85 degree joint, rough, open, planar, very thin, from 4.63 to 4.97m	
	- 30 degree shear, healed, planar, extremely to very narrow, foliations below shear dip at about 45 degrees, compositional bands truncated, at 5.27m - pale gray quartzite (<1cm-thick), amorphoric, at 5.33m - chloritized igneous dike (<1cm-thick), at 5.36m - 40 degree joint, smooth, open, planar, very thin, crosses foliation, at 5.58m	
	- 85 degree joint, rough, open, very thin, at 5.94m - 80 degree joint, healed, planar, very thin, at 6.09m	
	- 75 degree joint, rough, open, undulating, very thin, at 7.44m	
	- muscovite on foliation joint surface, at 7.93m	
	- 45 degree shears, stepped, healed, very thin, from 8.38 to 8.74m	
	- 75 to 40 degree quartz veins, very thin, from 9.08 to 9.29m	
	- 85 to 75 degree joint, rough, moderately healed, planar, very thin, from 9.51 to 9.69m	
	- 90 degree joint, healed, planar, very thin, at 10.12m - ductile deformation of foliations, from 10.18 to 10.63m	
	- "S"-fold within foliations, at 10.54m - 70 to 90 degree fracture, rough, open, undulatory, very thin, from 10.67 to 10.94m	
	- 35 degree joint, smooth, open, planar, very thin, at 11.19m - 90 to 85 degree joint, healed, planar, very thin, from 11.30 to 11.73m - 50 degree joint, rough, open, planar, very thin, at 11.30m	

SAMPLES	BLOWS PER 300mm
1	1
2	1
3	9
4	46
C1	
C2	
C3	
C4	
C5	
C6	
C7	
C8	
C9	

CLASSIFICATION	UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
			505			
		68	14	37	17	20
			0			
			0			
			0			
		27				
			0			
			0			

SHEAR STRENGTH / UCS
□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
UCS ✳
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE — Min./m: 10 20 30 40
REC. SCR RQD
%: 20 40 60 80

NOTES:
▽ : Initial Ground Water Depth
1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:
Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 19 July, 2013
TOTAL DEPTH: 21.49m
CAVED DEPTH: N/A
CORING: 61.8 m
WET ROTARY: 8.7 m
BACKFILL: Piezometer
LOGGER: TGlidden
DRILLER: Geotech Drilling

C:\USERS\BBINATLI\DESKTOP\04.10130058\GINT\04_1013_0058_FE13B-122313 - WITH TORVANE CORRECTION.GPJ FUGRO_S_(LAB)_IND GRP_A3_ONSHORE_REV03 12/24/2013

LOG OF BORING BH-30
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-22a

LOCATION: See Plate 2
COORDINATES: N 6006150m
E 415921m

SURFACE EL. 35.28 m

DEPTH, METERS	SYMBOL	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS	CLASSIFICATION: UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)	SHEAR STRENGTH / UCS
13		C10		- 45 degree joint, rough, open, healed, planar, very thin, at 12.34m - 70 to 90 degree fracture, rough, open, partly healed, undulatory, from 12.46 to 12.55m - 60 degree joint, healed, planar, very thin, from 13.04 to 13.17m				0				
14		C11		- 65 degree joint, healed, planar, very thin, at 13.32m - 70 degree joint, rough, stepped, open, very thin, at 13.75m - 75 degree joint, rough, open, planar, very thin, at 14.11m		27						
15		C12		- 60 degree joint, healed, undulatory, very thin, at 14.44m - 70 to 90 degree fracture, rough, open, moderately healed, undulatory, very thin, from 14.57 to 14.75m - 60 degree joint, moderately healed, undulatory, very thin, at 14.87m - extremely fractured, increased chlorite, from 14.93 to 15.55m				0				
16		C13		- brittle deformation, flower structure, with 75 degree shears, healed, at 15.79m - 40 degree parallel joints, smooth, open, planar, very thin, from 15.84 to 15.91m - sub-vertical quartz veins, from 16.12 to 16.45m - 80 to 90 degree shear, healed, planar, very thin, at 16.27m - foliation with parallel pyrite infill, at 16.49m pervasively fractured, from 16.49 to 16.61m								
17		C14										
18		C15		- extremely fractured, from 17.57 to 17.86m - extremely fractured, from 17.95 to 18.20m - 90 degree joint, rough, open, planar, very thin, at 18.55m				0				
19		C16		- 50 degree joint, stepped, rough, open, very thin, at 19.20m - 85 to 90 degree joint, rough, open, undulating, very thin, from 19.20 to 19.39m				1				
20		C17				22						
21					13.8							
22				NOTE: Installed 5cm-diameter PVC piezometer to 20m; refer to piezometer detail log. **TD = 21.49m**								
23												

SHEAR STRENGTH / UCS: □ Penetrometer, ◇ Torvane, Remold Testing ○ △ ▽, Unconfined ▼, Triaxial ●, Miniature Vane ▲, Point Load ◆, UCS ✳
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE — Min./m: 10 20 30 40
REC. — SCR · · · RQD — %: 20 40 60 80

NOTES:
▽ : Initial Ground Water Depth
1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:
Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 19 July, 2013
TOTAL DEPTH: 21.49m
CAVED DEPTH: N/A
CORING: 61.8 m
WET ROTARY: 8.7 m
BACKFILL: Piezometer
LOGGER: TGlidden
DRILLER: Geotech Drilling

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LOG OF BORING BH-30
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-22b

LOCATION: See Plate 2
COORDINATES: N 6006690m
E 415177m

SURFACE EL. 5.00 m

DEPTH, METERS	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS
0	1	3	**PEAT** Peat (PT): very soft, brown, wet, fiberous, with fine to large roots	
			Organic SILT (OL) with Peat and Clay: medium dense, brown, wet, massive, fine-grained	4.5
	2	23	- with moderately weathered phyllite, from 0.58 to 0.61m	4.2
1			**SEDIMENTARY DEPOSITS** Silty SAND with gravel (SM): medium dense, brown, wet, angular to well-rounded, granitic, phyllitic, and schistose rock fragments/gravel, massive, with 12.7cm granitic cobble at bedrock contact	
	3	73/250mm	- very dense at 1.61m	
2	C1		**UNDIVIDED PHYLLITE (OTa)** PHYLLITE (Rx): hard to very hard, slightly weathered to fresh, greenish gray - parallel joints, 60 degrees, planar, open, rough, extremely narrow, chlorite and quartz on fracture/joint surface, at 1.79m, cleavage has 0.2cm-thick highly decomposed micaceous material on fracture/joint surface - joint, 80 degrees, planar, open, smooth, extremely narrow, chlorite on fracture/joint surface, at 2.13m - parallel joints, 60 degrees, planar, open, rough, extremely narrow, chlorite and quartz on fracture/joint surface - highly weathered, from 2.71 to 2.74m - no recovery, from 2.74 to 3.20m	3.0
3	C2		- no recovery, from 3.51 to 3.81m - two 65 degree sub-parallel joints, at 3.57m, planar, rough, open, extremely narrow, chlorite on surface of one joint	
4	C3		- 45 degree joint, at 3.99m, crosses foliations, healed with quartz, planar, extremely narrow - minor ductile deformation of foliations, with sub-vertical quartz veins, at 4.27m - 20 degree joint, at 4.33m, rough, planar, open, extremely narrow - 50 degree joint, at 4.57m, crosses foliation, planar, smooth, open, extremely narrow, correlates with quartz vein - arcuate-shaped fracture, 0 to 30 degrees, at 4.69m, healed, extremely narrow, folding of foliations suggestive of possible offset of about 0.5cm - 30 degree joint, at 4.79m, stepped on foliation, rough, open, extremely narrow, quartz on fracture/joint surface - 75 degree joint, at 5.15m, open, extremely narrow, undulating, rough	
5	C4			
6	C5		- fractures orthogonal to cleavage, from 5.58 to 5.76m, terminate at cleavage planes, planar to stepped, open, extremely narrow, rough - 65 degree joint, at 5.76m, stepped, rough, open, extremely narrow, chlorite, quartz, and pyrite on fracture/joint surface - intensely fractured (pulverized), from 5.85 to 5.91m, hard to moderately hard - 40 degree joint, at 5.85m, crosses foliation, open, extremely narrow, smooth, planar, chlorite on fracture/joint surface - 75 to 90 degree joint, at 6.10m, undulating, open, extremely narrow - parallel joints cross foliations, 50 degrees, at 6.49m, planar, smooth, open, extremely narrow, chlorite on fracture/joint surface - parallel joints cross foliations, 50 degrees, at 6.55m, planar, smooth, open, extremely narrow, chlorite on fracture/joint surface - fracture zone, from 6.71m to 7.13m	
7	C6			
8	C7		- 65 degree joint, at 7.59m, healed, planar, extremely narrow - quartz pegmatite with associated ductile deformation of foliation, from 7.77 to 8.11m, approximately 2.5 to 5cm-thick compositional band of muscovite-rich material, chlorite and possibly epidote body in quartz pegmatite	
9	C8		- 45 degree parallel joints, cross foliations, from 8.53 to 8.78m, planar to stepped, open, extremely narrow, clean to chlorite and quartz mineralization, rough - 50 degree joint, at 8.90m, crosses foliation, open, extremely narrow, rough, quartz on fracture/joint surface, planar - 65 degree joint, at 9.05m, crosses foliations, open, rough, extremely narrow, stepped, quartz on fracture/joint surface - 25 degree joint, at 9.20m, rough, stepped, open, extremely narrow - 40 degree joint, at 9.36m, crosses foliation, planar to stepped, rough, open, extremely narrow - pyrite on cleavage fracture/joint surfaces common, below 9.39m - approximately 2.54cm-thick moderately hard interval, at 9.60m - 55 degree joint, at 9.60m, crosses foliations, planar, open, extremely narrow, rough, chlorite on fracture/joint surface	
10	C9			
11	C10			
	C11		- arcuate-shaped fracture, 40 to 90 degrees, at 11.65m, rough, undulating, open, extremely narrow, quartz and chlorite on fracture/joint surface	

CLASSIFICATION

UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
		0			
		0			
		0			
		0			
		0			
27		0			

SHEAR STRENGTH / UCS

□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
UCS ✳
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE —— Min./m: 10 20 30 40
REC. —— SCR · · · RQD —— %: 20 40 60 80

NOTES:
1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:
Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 16 July, 2013
TOTAL DEPTH: 20.33m
CAVED DEPTH: N/A
CORING: 60.1 m
WET ROTARY: 6.6 m
BACKFILL: Grout
LOGGER: TGlidden
DRILLER: Geotech Drilling

C:\USERS\BBINATLI\DESKTOP\04.10130058\GINT\04_1013_0058_FE13B-122313 - WITH TORVANE CORRECTION.GPJ FUGRO_S_(LAB)_IND GRP_A3_ONSHORE_REV03 12/24/2013

LOG OF BORING BH-31
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-31a

LOCATION: See Plate 2
COORDINATES: N 6006690m
E 415177m

SURFACE EL. 5.00 m

DEPTH, METERS	SYMBOL	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS
13		C12		- 85 to 90 degree joint, at 12.04m, totally healed, very narrow, planar, quartz and pyrite infill	
14		C13		- 55 degree joint, at 13.01m, crosses foliation, planar, smooth, open, extremely narrow, quartz on fracture/joint surface - 55 degree joint, at 13.11m, crosses foliations, planar to undulating, smooth, open, extremely narrow, quartz on fracture/joint surface - 55 degree joint, at 13.23m, crosses foliations, planar to undulating, smooth, open, extremely narrow, quartz on fracture/joint surface - extremely narrow quartz veins, from 13.26 to 13.32m, dipping 55 degrees, cross foliations with no visible offset - ductile deformation of foliations, at 13.93m - 70 degree joint, at 13.99m, planar, smooth to rough, open, extremely narrow, quartz and chlorite on fracture/joint surface - approximately 5.08-thick pegmatite quartz dike, at 14.33m	
15		C14			
16		C15			
17					
18		C16			
19		C17			
20				**TD = 20.33m**	-15.3
21					
22					
23					

CLASSIFICATION: UNIT DRY WT, kN/m³ | PASSING NO. 200 SIEVE, % | WATER CONTENT, % | LIQUID LIMIT | PLASTIC LIMIT | PLASTICITY INDEX (PI)

SHEAR STRENGTH / UCS
□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
UCS ✳
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE — Min./m: 10 20 30 40
REC. — SCR · · · RQD —
%: 20 40 60 80

WATER CONTENT, %: 0 | 0 | 0 | 0

NOTES:

1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:

Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 16 July, 2013
TOTAL DEPTH: 20.33m
CAVED DEPTH: N/A
CORING: 60.1 m
WET ROTARY: 6.6 m
BACKFILL: Grout
LOGGER: TGlidden
DRILLER: Geotech Drilling

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LOG OF BORING BH-31
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-31b

LOCATION: See Plate 2
COORDINATES: N 6006253m
E 414629m

MUDLINE EL.: -4.83 m

DEPTH, METERS	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS	UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
0			**SEAFLOOR SEDIMENTS** Silty fine SAND (SM): loose, dark gray, slight organic odor, with shell fragments, micaceous			13				
1	1	5								
2	2	9								
3	3	9				12				
4	4	4	- very loose, with clay pockets and few wood fragments, at 3.51m							
5	5	6	- with clay pockets, few shell fragments, micaceous, few wood fragments, at 4.48m			48				
6	6	7	Sandy SILT (ML): loose, very dark gray, with clay and few shell fragments, micaceous	-10.3						
7	7	6				79				
7	8	Push	Lean CLAY with Sand (CL): soft to firm, dark gray, micaceous, silty	-11.8						
8	9	6			12 13		40 40	47	26	21
9										
10	10	Push	- with sand pockets, at 9.51m							
11	11	6			13		40	39	17	22

SHEAR STRENGTH / UCS
□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
UCS ✳
MPa (◆, ✳) 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲) 20 40 60 80 100

CORING RATE —— Min./m 10 20 30 40
REC. —— SCR • • • RQD —— % 20 40 60 80

NOTES:
1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:

DATE COMPLETED: 29 June, 2013
TOTAL DEPTH: 61.39m
CAVED DEPTH: N/A
CORING: 49.1 m
WET ROTARY: 152.3 m
BACKFILL: Grout
LOGGER: Fluke/Wade
DRILLER: Seacore

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LOG OF BORING BH-32
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-32a

LOCATION: See Plate 2
COORDINATES: N 6006253m
E 414629m

MUDLINE EL.: -4.83 m

DEPTH, METERS	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS
13	12	Push		
	13	8	- very soft, at 13.40m	
14				
15				
16	14	Push	- no recovery, with Shelby tube at 15.51m	
	15	7	SILT (ML): loose, greenish black, wet, with fine sand	-21.3
17				
18				
19	16	Push	Lean CLAY (CL): soft to firm, greenish black, wet, with fine sand and mica	-23.3
	17	6		
20				
21				
22	18	Push		
	19	9		
23				

CLASSIFICATION

UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
13		39			
13		40			
	86				
14		35	43	18	25
		38			

SHEAR STRENGTH / UCS

□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
UCS ✳
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE —— Min./m 10 20 30 40
REC. —— SCR · · · RQD ——
% 20 40 60 80

NOTES:

1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:

DATE COMPLETED: 29 June, 2013
TOTAL DEPTH: 61.39m
CAVED DEPTH: N/A
CORING: 49.1 m
WET ROTARY: 152.3 m
BACKFILL: Grout
LOGGER: Fluke/Wade
DRILLER: Seacore

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LOG OF BORING BH-32
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-32b

LOCATION: See Plate 2
COORDINATES: N 6006253m
E 414629m

MUDLINE EL.: -4.83 m

DEPTH, METERS	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS	UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
25	20	Push								
	21	11	- soft, at 25.40m		13		36			
26										
27										
	22	Push					37			
28										
	23	10	Lean CLAY (CL): soft, greenish black, with fine sand and mica	-33.2						
29										
30										
			Fat CLAY (CH): very soft to soft, greenish black, with fine mica	-35.3						
31	24	Push								
	25	9	- few organic pockets, at 31.79m		12		48	59	20	39
32										
33										
	26	Push								
34							48			
	27	10								
35			- with fine mica, at 34.99m							

SHEAR STRENGTH / UCS
□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
✳ UCS
MPa (◆, ✳) 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲) 20 40 60 80 100

CORING RATE —— Min./m 10 20 30 40
REC. —— SCR • • • RQD —— %
20 40 60 80

NOTES:
1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:

DATE COMPLETED: 29 June, 2013
TOTAL DEPTH: 61.39m
CAVED DEPTH: N/A
CORING: 49.1 m
WET ROTARY: 152.3 m
BACKFILL: Grout
LOGGER: Fluke/Wade
DRILLER: Seacore

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LOG OF BORING BH-32
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-32c

LOCATION: See Plate 2
COORDINATES: N 6006253m
E 414629m

MUDLINE EL.: -4.83 m

DEPTH, METERS	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS	UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
37	28	Push			11		53	54	27	27
	29	10	- few organic pockets, at 31.79m		11		53			
38										
39										
40	30	Push	- with sand pockets and shell fragments below 39.50m				64			
	31	11								
41										
42			- with fine mica, sand pockets, and shell fragments, at 42.49m							
43	32	Push								
	33	14	- stiff, blocky, below 43.40m		13		41			
44			- with 3cm subangular rock fragments, at 43.80m							
			- driller noted increased stiffness during drilling, below 44.50m							
45										
	34	Push	- with sand pockets and angular gravel-size fragments, at 45.51m							
46			**GLACIAL TILL** Lean CLAY with gravel (CL): firm, dark greenish gray, moist, 1 to 3cm angular phyllite and granitic gravel-size fragments	-50.8						
	35 C1	Ref.	- with fractured weathered rock fragments, sampler bouncing, at 46.39m - phyllite cobble from 46.48 to 46.60m				72	26	42	20	22
47			- granitic cobble, from 47.12 to 47.34m							

SHEAR STRENGTH / UCS: □ Penetrometer, ◇ Torvane, Remold Testing ○ △ ▽, Unconfined ▼, Triaxial ●, Miniature Vane ▲, Point Load ◆, UCS ✳
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100
215.5 191.5

CORING RATE — Min./m: 10 20 30 40
REC. SCR RQD — %: 20 40 60 80

NOTES:
1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:

DATE COMPLETED: 29 June, 2013
TOTAL DEPTH: 61.39m
CAVED DEPTH: N/A
CORING: 49.1 m
WET ROTARY: 152.3 m
BACKFILL: Grout
LOGGER: Fluke/Wade
DRILLER: Seacore

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LOG OF BORING BH-32
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-32d

LOCATION: See Plate 2
COORDINATES: N 6006253m
E 414629m

MUDLINE EL.: -4.83 m

DEPTH, METERS	STRATUM DESCRIPTION	STRATUM ELEV, METERS
	Lean CLAY (CL): stiff to very stiff, dark greenish gray, moist, with hard clay pod inclusions	-53.3
49	- trace gravel, from 48.95 to 50.54m	
50		
51		
	UNDIVIDED PHYLLITE (OTa) GNEISS (Rx): fresh, very hard, grayish blue to light greenish gray, fine grained, 40 degree foliations, with quartz, trace mafic minerals, and chlorite	-56.5
52	- 55 degree fractures, dip opposite of and cross-cut foliation planes, with several incipient fractures, at 52.49m	
53		
54	- intensely fractured, from 53.55 to 54.41m, fractures dip 60 degrees and intersect foliation planes, few fractures along foliation planes	
55	- intensely to very intensely fractured, from 54.41 to 55.35m	
56	- intensely fractured, from 55.35 to 55.60m - sub-vertical incipient fractures, from 55.60 to 56.05m	
57	- medium bluish gray, below 26.24m	
58	- moderately fractured, below 58.49m	
59	- reddish brown layer of gneiss from 59.44 to 59.62m, very thin healed fractures and quartz fill fractures along abrupt contact	

SAMPLES: C2, C3, C4, C5, C6, C7, C8, C9, C10

CLASSIFICATION

UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
		26			
		0			
		0			
		28			
		26			
		0			

SHEAR STRENGTH / UCS

□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
UCS ✳
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

□ 186.7

CORING RATE — Min./m: 10 20 30 40
REC. — SCR · · · RQD —
%: 20 40 60 80

NOTES:
1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:

DATE COMPLETED: 29 June, 2013
TOTAL DEPTH: 61.39m
CAVED DEPTH: N/A
CORING: 49.1 m
WET ROTARY: 152.3 m
BACKFILL: Grout
LOGGER: Fluke/Wade
DRILLER: Seacore

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LOG OF BORING BH-32
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-32e

LOCATION: See Plate 2
COORDINATES: N 6006253m
E 414629m

MUDLINE EL.: -4.83 m

DEPTH, METERS	SYMBOL	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS
61		C11			
		C12		- Core barrel jammed at 61.39m **TD = 61.39m**	-66.2
62					
63					
64					
65					
66					
67					
68					
69					
70					
71					

CLASSIFICATION: UNIT DRY WT, kN/m³ | PASSING NO. 200 SIEVE, % | WATER CONTENT, % | LIQUID LIMIT | PLASTIC LIMIT | PLASTICITY INDEX (PI)

SHEAR STRENGTH / UCS
□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
✳ UCS
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE — Min./m: 10 20 30 40
REC. — SCR · · · RQD —
%: 20 40 60 80

NOTES:
1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:

DATE COMPLETED: 29 June, 2013
TOTAL DEPTH: 61.39m
CAVED DEPTH: N/A
CORING: 49.1 m
WET ROTARY: 152.3 m
BACKFILL: Grout
LOGGER: Fluke/Wade
DRILLER: Seacore

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LOG OF BORING BH-32
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-32f

LOCATION: See Plate 2
COORDINATES: N 6005800m
E 414121m

MUDLINE EL.: -5.79 m

DEPTH, METERS	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS
0	1	3	**SEAFLOOR SEDIMENTS** Sandy SILT (ML): very loose, greenish black, wet	
	2	1		
1	3	WOH	SILT (ML): very loose, greenish black, wet, with fine sand	-6.8
	4	WOR		
2	5	WOR	- no recovery, at 2.01m	
	6	WOH		
3	7	Push	- no recovery, at 2.99m Silty Fine SAND (SM): very loose, greenish black, wet	-8.8
4	8	WOR		
	9	WOR	- no recovery with SPT, at 4.45m	
6	10	WOR	Sandy Lean CLAY (CL): very soft, greenish black, wet	-12.1
8	11	Push	SILT with sand (ML): very loose, greenish black, wet, with fine mica and organics	-13.5
9	12	WOH		
10			Lean CLAY (CL): soft to firm, greenish black, wet, with fine mica and organics	-15.8
11	13	Push		

DEPTH, METERS	UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
0		59				
		59				
1		49				
3						
4		13				
6		56		42	18	24
8		81	38			
10		36		41	18	23

SHEAR STRENGTH / UCS
□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
UCS ✳
MPa (◆, ✳) 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲) 20 40 60 80 100

CORING RATE
Min./m 10 20 30 40
REC. SCR RQD
% 20 40 60 80

NOTES:
1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:

DATE COMPLETED: 02 July, 2013
TOTAL DEPTH: 71.51m
CAVED DEPTH: N/A
CORING: 29.5 m
WET ROTARY: 205.1 m
BACKFILL: Grout
LOGGER: Fluke/Wade
DRILLER: Seacore

C:\USERS\BBINATLI\DESKTOP\04.10130058\GINT\04_1013_0058_FE13B-122313 - WITH TORVANE CORRECTION.GPJ FUGRO_S_(LAB)_IND GRP_A3_ONSHORE_REV03 12/24/2013

LOG OF BORING BH-33
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-33a

LOCATION: See Plate 2
COORDINATES: N 6005800m
E 414121m

MUDLINE EL.: -5.79 m

DEPTH, METERS	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS	UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
13	14	WOR					37			
14	15	Push	Lean CLAY (CL) with Sand: soft to firm, greenish black	-19.8	14	85	36	33	23	10
15	16	WOH	- with an organic content of 3.24%, at 15.0m							
16			SILT (ML): very loose, greenish black, wet, with fine sand	-22.1						
17	17	Push				88				
18	18	7	Lean CLAY (CL): soft, greenish black, wet, with fine mica, wood fragments, and organic pockets	-23.8			37	43	26	17
19										
20	19	Push								
21	20	7	- with fine mica, at 21m		13		40	48	18	30
22										
23	21	Push			12		44 43	41	23	18
	22									

SHEAR STRENGTH / UCS
□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
UCS ✳
MPa (◆, ✳) 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲) 20 40 60 80 100

CORING RATE
Min./m 10 20 30 40
REC. SCR RQD
% 20 40 60 80

NOTES:
1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:

DATE COMPLETED: 02 July, 2013
TOTAL DEPTH: 71.51m
CAVED DEPTH: N/A
CORING: 29.5 m
WET ROTARY: 205.1 m
BACKFILL: Grout
LOGGER: Fluke/Wade
DRILLER: Seacore

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LOG OF BORING BH-33
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-33b

LOCATION: See Plate 2
COORDINATES: N 6005800m
E 414121m

MUDLINE EL.: -5.79 m

DEPTH, METERS	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS	UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
25		6								
26	23	Push								
27	24	6	- firm, at 26.90m		12		45	46	28	18
28										
29	25	Push	- with sand pockets and few shell fragments, blocky texture, below 28.99m							
30	26	10	- stiff, at 29.90m		12		46			
31										
32	27	Push								
33	28	8	- firm, at 32.89m				50			
34										
35	29	Push	- stiff, with sand pockets, few organic pockets, few shell fragments, blocky texture, at 34.99m		11		54			
	30									

SHEAR STRENGTH / UCS
□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
UCS ✳
MPa (◆, ✳) 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲) 20 40 60 80 100

CORING RATE —— Min./m 10 20 30 40
REC. —— SCR • • • RQD —— %
20 40 60 80

NOTES:
1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:

DATE COMPLETED: 02 July, 2013
TOTAL DEPTH: 71.51m
CAVED DEPTH: N/A
CORING: 29.5 m
WET ROTARY: 205.1 m
BACKFILL: Grout
LOGGER: Fluke/Wade
DRILLER: Seacore

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LOG OF BORING BH-33
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-33c

LOCATION: See Plate 2
COORDINATES: N 6005800m
E 414121m

MUDLINE EL.: -5.79 m

DEPTH, METERS	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS
	31	11		
37				
38	31	Push	- very soft, at 38.00m Lean CLAY (CL)/Fat CLAY (CH): soft, greenish black, moist	-43.8
39	32	11		
40				
41	33	Push	- casing sank during sampling, at 41m	
42				
43	34		- sampled slough or disturbed material at 42.49m, clean out borehole to 43.50m to resample - trace wood fibers and shell fragments, below 42.49m	
44	35	Push		
45	36	7		
46	37	Push	- Fat CLAY (CH), limited recovery, extruded sample, placed in bulk bag, at 45.99m	
47	38	13		

CLASSIFICATION

UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
		53			
11		51			
		59			
12		48	49	26	23
		53			

SHEAR STRENGTH / UCS

□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
UCS ✳
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE —— Min./m: 10 20 30 40
REC. —— SCR · · · RQD ——
%: 20 40 60 80

NOTES:

1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:

DATE COMPLETED: 02 July, 2013
TOTAL DEPTH: 71.51m
CAVED DEPTH: N/A
CORING: 29.5 m
WET ROTARY: 205.1 m
BACKFILL: Grout
LOGGER: Fluke/Wade
DRILLER: Seacore

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LOG OF BORING BH-33
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-33d

LOCATION: See Plate 2
COORDINATES: N 6005800m
E 414121m

MUDLINE EL.: -5.79 m

DEPTH, METERS	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS	UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
49	39	Push	Fat CLAY (CH): soft to firm, greenish black, with few sand pockets, blocky texture, with few shell fragments	-54.8						
			- very soft, at 49.70m		10		62			
50	40	WOR	- sampler sank under weight of rods to 49.99m to 50.69m, drill out to next sample interval							
51	41	Push	- sample disturbed, placed in bulk bag, at 50.99m				29			
52	42	Push	- stiff, sample disturbed, at 51.91m							
53			- stiff, at 52.80m				30			
54										
55	43	Push	- no recovery at 54.50m; fat clay smear on outside of sampler tube, similar to material sampled above							
				-61.3			28			
56	44	39	Lean CLAY (CL): very stiff, dark gray, with silt pockets, trace shell fragments, and fine mica							
57	45	Push	- no recovery at 56.21m, resampled interval using core catcher							
58	47	24	- very stiff, dark olive gray, at 57.49m							
59	48	Push								

SHEAR STRENGTH / UCS
□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
UCS ✳
MPa (◆, ✳) 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲) 20 40 60 80 100

CORING RATE — Min./m 10 20 30 40
REC. — SCR · · · RQD —
% 20 40 60 80

129.3
148.6

NOTES:
1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:

DATE COMPLETED: 02 July, 2013
TOTAL DEPTH: 71.51m
CAVED DEPTH: N/A
CORING: 29.5 m
WET ROTARY: 205.1 m
BACKFILL: Grout
LOGGER: Fluke/Wade
DRILLER: Seacore

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LOG OF BORING BH-33
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-33e

LOCATION: See Plate 2
COORDINATES: N 6005800m
E 414121m

MUDLINE EL.: -5.79 m

DEPTH, METERS	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS
61	49	25	- firm, at 60.40m - with many shell fragments, rounded gravel in shoe to 4cm in diameter, at 30.02m	
62			- harder drilling, possible cobbles/boulder at 61.60m	
63	C1		**GLACIAL TILL** Clayey GRAVEL (GC): hard, very dark greenish gray, wet, subrounded to rounded gravel and cobble clasts	-68.3
64	C2		- gneissic boulder, from 63.89 to 64.19m	
65	50	53	- clean out borehole, from 65.01 to 65.50m	
66	C3		- rounded cobbles, at 65.50m - phyllite boulder, from 65.90 to 84.43m - with scattered shell fragments, 65.50 to 66.51m	
67	C4		- phyllite boulder, from 67.00 to 67.21m	
68			Lean CLAY (CL): hard, dark greenish gray, moist	-73.3
69	C5		- phyllite boulder, from 68.31 to 68.40m - medium grained sand lens, from 68.49 to 68.61m	
70	C6		**UNDIVIDED PHYLLITE (OTa)**	-76.1
71	C7		PHYLLITE (Rx): fresh, hard to very hard, black, 40 degree foliations, moderately fractured, with quartz healed fractures, with some pyrite and chlorite infilling on fracture surfaces	
			TD = 71.51m	-77.3

CLASSIFICATION

UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
16		27 28			

LOCATION: See Plate 2
COORDINATES: N 6005361m
E 413597m

MUDLINE EL.: -6.88 m

DEPTH, METERS	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS
0	1	WOR	**SEAFLOOR SEDIMENTS** Silty SAND (SM): very loose, dark greenish gray	
1	2	WOR		
	3	WOR		
	4	WOR		
2	5	WOR		
	6	WOR	- hydrogen sulfide odor, from 2.5 to 4.5m	
3	7	WOH	- moderate gray, at 3m	
	8	2	- trace silt, below 34.00m	
4	9	2		
	10	2		
5	11	2		
	12	2		
6				
7	13	3	Sandy SILT (ML): very loose, greenish black	-13.9
	14	Push		
8				
9				
10	15	Push	Lean CLAY (CL) to SILT (ML): very soft, greenish black, with silt pockets and organics	-16.9
11	16	WOH	- with shell fragments, below 11m	

CLASSIFICATION

DEPTH, METERS	UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
1		39				
2		34				
3		75				
4		48				
5		72				
6		89				
7		54				
8	14		34 35	34	26	8
9						
10	9		36 35	34	24	10
11						

SHEAR STRENGTH / UCS

□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
UCS ✳
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE —— Min./m: 10 20 30 40
REC. —— SCR • • • RQD ——
%: 20 40 60 80

NOTES:

1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:

DATE COMPLETED: 18 July, 2013
TOTAL DEPTH: 50.00m
CAVED DEPTH: N/A
CORING: 29.54 m
WET ROTARY: 134.5 m
BACKFILL: Grout
LOGGER: Marlow/Fluke
DRILLER: Seacore

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LOG OF BORING BH-34
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-34a

LOCATION: See Plate 2
COORDINATES: N 6005361m
E 413597m

MUDLINE EL.: -6.88 m

DEPTH, METERS	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS	UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
13	17	Push								
14	18	5	- soft to firm below 13.8m - with a few shell fragments, at 14m		14	83	35	29	23	6
15										
16	19	Push	Lean CLAY (CL): soft to firm, dark gray, wet, massive, with some fine sand	-22.9						
17	20	3				37 36	42	20	22	
18										
19	21	Push	- with shell fragments, coarse sand, at 19m							
20	22	4				42	48	18	30	
21										
22	23	Push								
23	24	5	- soft, 22.90m		13 12	41 43				

SHEAR STRENGTH / UCS
□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
✳ UCS
MPa (◆, ✳) 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲) 20 40 60 80 100

CORING RATE —— Min./m 10 20 30 40
REC. —— SCR • • • RQD ——
% 20 40 60 80

NOTES:
1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:

DATE COMPLETED: 18 July, 2013
TOTAL DEPTH: 50.00m
CAVED DEPTH: N/A
CORING: 29.54 m
WET ROTARY: 134.5 m
BACKFILL: Grout
LOGGER: Marlow/Fluke
DRILLER: Seacore

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LOG OF BORING BH-34
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-34b

LOCATION: See Plate 2
COORDINATES: N 6005361m
E 413597m

MUDLINE EL.: -6.88 m

DEPTH, METERS	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS	UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
25	25	Push	- gray, moist, at 25m							
26	26	WOH	- very soft, at 26m		11	99	52	48	26	22
27										
28	27	Push	- trace silt and shell fragments, at 28m							
29	28	7			11		52			
30										
31	29	Push	Fat CLAY (CH): soft to firm, gray, moist, with silt, trace shell fragments	-37.9						
32	30	WOH			12 11		47 47	62	21	41
33										
34	31	Push	- slickensided, with blocky structure and faint horizontal bedding, with sand and silt partings and pockets, at 34.6m		11 11		49 51	52	27	25
35	32	7								

SHEAR STRENGTH / UCS: □ Penetrometer, ◇ Torvane, Remold Testing ○ △ ▽, Unconfined ▼, Triaxial ●, Miniature Vane ▲, Point Load ◆, UCS ✳
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE — Min./m: 10 20 30 40
REC. — SCR · · · RQD —
%: 20 40 60 80

NOTES:
1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:

DATE COMPLETED: 18 July, 2013
TOTAL DEPTH: 50.00m
CAVED DEPTH: N/A
CORING: 29.54 m
WET ROTARY: 134.5 m
BACKFILL: Grout
LOGGER: Marlow/Fluke
DRILLER: Seacore

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LOG OF BORING BH-34
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-34c

LOCATION: See Plate 2
COORDINATES: N 6005361m
E 413597m

MUDLINE EL.: -6.88 m

DEPTH, METERS	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS
37	33	Push	- some dark gray mottling, trace shell fragments, at 37m	
38	34	7	- firm, at 37.90m	
39				
40	35	Push	Silty Fine SAND (SM): very dark gray	-46.9
			GLACIAL TILL? Clayey SAND (SC) with gravel: with granite, gneiss, and phyllite gravel and cobbles in a matrix of clayey sand/sandy clay	-47.4
41	C1			
42	C2			
43			- hard to very hard, dark gray, with phyllite, very thinly bedded quartz, with fine to coarse, very dense, clayey sand, at 42.9m	
44	C3		**UNDIVIDED PHYLLITE (OTa)** PHYLLITE (Rx): slightly weathered, hard, dark greenish gray, chlorite rich, 40 degree foliation, quartz seams, discontinuous, intensely fractured, wavey, rough, with pyrite infilling - 0.6cm-thick 60 degree shear, with clay and quartz infill, narrow to open, at 44.4m - intensely fractured, from 44.2 to 44.4m	-50.5
	C4			
45			- 20 to 30 degree shear, with slickensides, at 44.7m - 20 to 30 degree shear, with slickensides, at 44.9m - with trace garnets, at 45m - unfractured, 45.30 to 45.7m	
46	C5		- partially filled fractures, with quartz and spotty pyrite and chlorite, at 45.70m QUARTZITE (Rx): fresh, very hard, light gray to grayish white, planar, smooth to slightly rough, tight to very narrow, 70 to 80 degree joints, with chlorite staining and spotty pyrite	-53.1
47	C6		- 10 to 20 degree fractures, very narrow to narrow, with chlorite staining and spotty pyrite filling, at 47m	
	C7		- 10 to 20 degree fractures, slightly rough, narrow, with spotty chlorite and pyrite filling, at 47.50m - broken, from 47.9 to 48.1m	

CLASSIFICATION

UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
11 11		50 50	76	21	55
23		NP	NP	NP	
		1			
		0			

SHEAR STRENGTH / UCS

□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
UCS ✳
MPa (◆, ✳) 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲) 20 40 60 80 100

CORING RATE —— Min./m 10 20 30 40
REC. —— SCR • • • RQD —— %
20 40 60 80

NOTES:
1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:

DATE COMPLETED: 18 July, 2013
TOTAL DEPTH: 50.00m
CAVED DEPTH: N/A
CORING: 29.54 m
WET ROTARY: 134.5 m
BACKFILL: Grout
LOGGER: Marlow/Fluke
DRILLER: Seacore

C:\USERS\BBINATLI\DESKTOP\04.10130058\GINT\04_1013_0058_FE13B-122313 - WITH TORVANE CORRECTION.GPJ FUGRO_S_(LAB)_IND GRP_A3_ONSHORE_REV03 12/24/2013

LOG OF BORING BH-34
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-34d

LOCATION: See Plate 2
COORDINATES: N 6005361m
E 413597m

MUDLINE EL.: -6.88 m

DEPTH, METERS	STRATUM DESCRIPTION	STRATUM ELEV, METERS
49	- 70 to 80 degree fractures, smooth, very narrow, at 48m	
	- extremely fractured, near vertical, very narrow, tight, with phyllite seams, from 48.5 to 49m	
	- vertical broken very intense 30 to 40 degree fractures, with spotty chlorite and pyrite partial filling and folding, from 49.40 to 49.50m - fractures, healed, from 49.5 to 49.75m	
50	**TD = 50.00m**	-56.9
51		
52		
53		
54		
55		
56		
57		
58		
59		

SYMBOL: C8, C9, C10

SAMPLES

BLOWS PER 300mm

CLASSIFICATION
- UNIT DRY WT, kN/m³
- PASSING NO. 200 SIEVE, %
- WATER CONTENT, %
- LIQUID LIMIT
- PLASTIC LIMIT
- PLASTICITY INDEX (PI)

SHEAR STRENGTH / UCS
- □ Penetrometer, Unconfined ▼
- ◇ Torvane, Triaxial ●
- Remold Testing ○ △ ▽, Miniature Vane ▲
- Point Load ◆
- UCS ✳
- MPa (◆, ✳): 50 100 150 200 250
- kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

0

CORING RATE — Min./m: 10 20 30 40

REC. — SCR · · · RQD — %: 20 40 60 80

NOTES:
1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:

DATE COMPLETED: 18 July, 2013
TOTAL DEPTH: 50.00m
CAVED DEPTH: N/A
CORING: 29.54 m
WET ROTARY: 134.5 m
BACKFILL: Grout
LOGGER: Marlow/Fluke
DRILLER: Seacore

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LOG OF BORING BH-34
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-34e

LOCATION: See Plate 2
COORDINATES: N 6004966m
E 413115m

MUDLINE EL.: -10.06 m

DEPTH, METERS	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS	UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
0	1	WOR	**SEAFLOOR SEDIMENTS** SILT (ML): very loose, very dark greenish gray, wet, with fine sand, hard organic odor			88				
	2	WOR								
1	3	WOR								
	4	WOH								
2	5	WOH								
	6	WOH	- trace organics below 2.5m							
3	7	1								
	8	WOH								
4	9	WOR	Fat CLAY (CH): very soft, very dark greenish gray, moist to wet, with fine sand, trace organics	-14.1						
	10	WOR								
5	11	Push						52	19	33
					11	47				
6	12	WOH	- soft, at 5.9m			46				
						49				
7										
8	13	Push								
			Lean CLAY (CL): very soft, dark gray, moist to wet	-18.6						
9	14	WOR			12	44	39	25	14	
10										
11	15	Push						45	17	28
					12	41				

SHEAR STRENGTH / UCS
□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
✳ UCS
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE —— Min./m 10 20 30 40
REC. —— SCR • • • RQD —— %
20 40 60 80

NOTES:
1- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
2- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:

DATE COMPLETED: 13 July, 2013
TOTAL DEPTH: 109.90m
CAVED DEPTH: N/A
CORING: N/A m
WET ROTARY: 360.56 m
BACKFILL: Grout
LOGGER: Fluke/Wade
DRILLER: Seacore

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LOG OF BORING BH-35
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-35a

LOCATION: See Plate 2
COORDINATES: N 6004966m
E 413115m

MUDLINE EL.: -10.06 m

DEPTH, METERS	SYMBOL	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS	UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
13		16	WOR					39 41			
14		17	Push	- very dark greenish gray, moist to wet, with fine sand, at 14m		12		50	45	23	22
15		18	5								
16											
17		19	Push	- greenish black, moist, with fine sand and mica, at 17m		13 13		41 40			
18		20	7								
19											
20		21	Push	soft to firm below 20m		12		43 43	41	27	14
21		22	5								
22											
23		23	Push			13		40			

SHEAR STRENGTH / UCS
□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
✳ UCS
MPa (◆, ✳) 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲) 20 40 60 80 100

CORING RATE
Min./m 10 20 30 40
REC. SCR RQD
% 20 40 60 80

NOTES:
1- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
2- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:

DATE COMPLETED: 13 July, 2013
TOTAL DEPTH: 109.90m
CAVED DEPTH: N/A
CORING: N/A m
WET ROTARY: 360.56 m
BACKFILL: Grout
LOGGER: Fluke/Wade
DRILLER: Seacore

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LOG OF BORING BH-35
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-35b

LOCATION: See Plate 2
COORDINATES: N 6004966m
E 413115m

MUDLINE EL.: -10.06 m

DEPTH, METERS	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS	UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
25	24	3								
26	25	Push			13		40	43	19	24
27	26	7			13		40			
28			- with organic pockets, at 28m							
29	27	Push								
30	28	7			13		39	37	27	10
31			- with trace of shell fragments, below 31.4m							
32	29	Push	- blocky structure, below 32m							
33	30	9			13		39			
34			- dark gray mottling, at 33m							
35	31	Push								
	32		- with 1 to 2cm-thick silt seams, at 36m							

SHEAR STRENGTH / UCS
□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
✳ UCS
MPa (◆, ✳) 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲) 20 40 60 80 100

CORING RATE
Min./m 10 20 30 40
REC. SCR RQD
% 20 40 60 80

NOTES:
1- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
2- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:

DATE COMPLETED: 13 July, 2013
TOTAL DEPTH: 109.90m
CAVED DEPTH: N/A
CORING: N/A m
WET ROTARY: 360.56 m
BACKFILL: Grout
LOGGER: Fluke/Wade
DRILLER: Seacore

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LOG OF BORING BH-35
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-35c

LOCATION: See Plate 2
COORDINATES: N 6004966m
E 413115m

MUDLINE EL.: -10.06 m

DEPTH, METERS	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS	UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
37		20					38			
38	33	Push			12		44			
39	34	12	- very soft at 38.9m							
40										
41	35	Push			13		40			
42	36	14	- with few organic pockets, at 42.2m							
43										
44		Push	- no recovery, clay with fine sand on tube, at 44m							
45	37	Push	- sample disturbed on recovery, at 45m				38			
46	38	14	- with a few sand pockets, at 46.2m		53		37			
47										

SHEAR STRENGTH / UCS
□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
UCS ✳
MPa (◆, ✳) 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲) 20 40 60 80 100

CORING RATE —— Min./m 10 20 30 40
REC. —— SCR • • • RQD —— %
20 40 60 80

NOTES:
1- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
2- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:

DATE COMPLETED: 13 July, 2013
TOTAL DEPTH: 109.90m
CAVED DEPTH: N/A
CORING: N/A m
WET ROTARY: 360.56 m
BACKFILL: Grout
LOGGER: Fluke/Wade
DRILLER: Seacore

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LOG OF BORING BH-35
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-35d

LOCATION: See Plate 2
COORDINATES: N 6004966m
E 413115m

MUDLINE EL.: -10.06 m

DEPTH, METERS	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS	UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
49	39	Push			12		45			
50	40	12								
51	41	Push	- no recovery, clay on end of tube, at 51m							
52	42	10	- with mica and organic fibers, at 52m				36			
53			- firmer drilling, below 53m							
54	43	Push	- 5cm recovered, placed sample in bag, at 54m							
55	44	Push								
56	45	19	- stiff, at 56m		13		37			
57										
58	46	Push								
59	47	14	- attempted to Geobor between 59 and 60m, poor recovery, continue with drag bit from 60.5 to 62m - stiff, at 59m				34			

SHEAR STRENGTH / UCS
□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
✳ UCS
MPa (◆, ✳) 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲) 20 40 60 80 100

CORING RATE — Min./m 10 20 30 40
REC. — SCR · · · RQD — %
20 40 60 80

NOTES:
1- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
2- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:

DATE COMPLETED: 13 July, 2013
TOTAL DEPTH: 109.90m
CAVED DEPTH: N/A
CORING: N/A m
WET ROTARY: 360.56 m
BACKFILL: Grout
LOGGER: Fluke/Wade
DRILLER: Seacore

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LOG OF BORING BH-35
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-35e

LOCATION: See Plate 2
COORDINATES: N 6004966m
E 413115m

MUDLINE EL.: -10.06 m

DEPTH, METERS	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS	UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
61										
62	48	Push	- no recovery, at 62m							
63	49	12	- trace shell fragments below 63m				38			
64										
65										
66	50	Push	- with sand and silt pockets, at 66m							
67	51	17	- stiff to very stiff at 66.9m		13 13		35 37	37	23	14
68										
69										
70	52	Push	- stiff, below 70m - with silt pockets, at 70m				13			
71	53	16	SPT sampling not performed below 71m; boring depth exceeded project planned depth and rod supply							

SHEAR STRENGTH / UCS
□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
✳ UCS
MPa (◆, ✳) 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲) 20 40 60 80 100

CORING RATE —— Min./m 10 20 30 40
REC. —— SCR • • • RQD —— %
20 40 60 80

NOTES:
1- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
2- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:

DATE COMPLETED: 13 July, 2013
TOTAL DEPTH: 109.90m
CAVED DEPTH: N/A
CORING: N/A m
WET ROTARY: 360.56 m
BACKFILL: Grout
LOGGER: Fluke/Wade
DRILLER: Seacore

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LOG OF BORING BH-35
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-35f

LOCATION: See Plate 2
COORDINATES: N 6004966m
E 413115m

MUDLINE EL.: -10.06 m

DEPTH, METERS	SYMBOL	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS	UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
73											
74		54	Push			13		39			
75											
76											
77											
78		55	Push	Fat CLAY (CH): stiff to very stiff, moderate gray	-88.6			42	64	20	44
79											
80											
81								49			
82						12		42			
83		56	Push								

SHEAR STRENGTH / UCS
□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
UCS ✳
MPa (◆, ✳) 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲) 20 40 60 80 100

CORING RATE —— Min./m 10 20 30 40
REC. —— SCR • • • RQD —— % 20 40 60 80

NOTES:
1- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
2- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:

DATE COMPLETED: 13 July, 2013
TOTAL DEPTH: 109.90m
CAVED DEPTH: N/A
CORING: N/A m
WET ROTARY: 360.56 m
BACKFILL: Grout
LOGGER: Fluke/Wade
DRILLER: Seacore

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LOG OF BORING BH-35
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-35g

LOCATION: See Plate 2
COORDINATES: N 6004966m
E 413115m

MUDLINE EL.: -10.06 m

DEPTH, METERS	SYMBOL	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS	CLASSIFICATION: UNIT DRY WT, kN/m³	CLASSIFICATION: PASSING NO. 200 SIEVE, %	CLASSIFICATION: WATER CONTENT, %	CLASSIFICATION: LIQUID LIMIT	CLASSIFICATION: PLASTIC LIMIT	CLASSIFICATION: PLASTICITY INDEX (PI)	SHEAR STRENGTH / UCS	CORING RATE Min./m / REC. SCR RQD %
85													
86													
87		57	Push										
88													
89													
90													
91		58	Push	- soft, gray, moist, below 91m		11		52					
92													
93													
94													
95													

SHEAR STRENGTH / UCS: □ Penetrometer, ◇ Torvane, Remold Testing ○ △ ▽, Unconfined ▼, Triaxial ●, Miniature Vane ▲, Point Load ◆, UCS ✳
MPa (◆, ✳) 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲) 20 40 60 80 100

CORING RATE Min./m 10 20 30 40
REC. SCR RQD
% 20 40 60 80

NOTES:

1- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
2- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:

DATE COMPLETED: 13 July, 2013
TOTAL DEPTH: 109.90m
CAVED DEPTH: N/A
CORING: N/A m
WET ROTARY: 360.56 m
BACKFILL: Grout
LOGGER: Fluke/Wade
DRILLER: Seacore

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LOG OF BORING BH-35
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-35h

LOCATION: See Plate 2
COORDINATES: N 6004966m
E 413115m

MUDLINE EL.: -10.06 m

DEPTH, METERS	SYMBOL	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS
97		59	Push	- mottled with dark gray, at 97m, stiff, below 97m	
98				- stiff, below 97m	
99					
100					
101					
102					
103		60	Push	- very stiff at 103.8m	
104					
105					
106					
107					

CLASSIFICATION: UNIT DRY WT, kN/m³ | PASSING NO. 200 SIEVE, % | WATER CONTENT, % | LIQUID LIMIT | PLASTIC LIMIT | PLASTICITY INDEX (PI)

WATER CONTENT, %: 48 (97m); 10 (103m); 59 (103m)

SHEAR STRENGTH / UCS
□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
✳ UCS
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

◇ (97m); ◇ (103m); ● (103m)

CORING RATE —— Min./m 10 20 30 40
REC. —— SCR · · · RQD —— %
20 40 60 80

NOTES:
1- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
2- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:

DATE COMPLETED: 13 July, 2013
TOTAL DEPTH: 109.90m
CAVED DEPTH: N/A
CORING: N/A m
WET ROTARY: 360.56 m
BACKFILL: Grout
LOGGER: Fluke/Wade
DRILLER: Seacore

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LOG OF BORING BH-35
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-35i

LOCATION: See Plate 2
COORDINATES: N 6004966m
E 413115m

MUDLINE EL.: -10.06 m

STRATUM DESCRIPTION

- very stiff at 109.8m

TD = 109.90m

DEPTH, METERS	STRATUM ELEV, METERS
109	120.0

SAMPLES: 61
BLOWS PER 300mm: Push

CLASSIFICATION

UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
15		30			

SHEAR STRENGTH / UCS

□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
UCS ✳
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE — Min./m: 10 20 30 40
REC. SCR RQD
%: 20 40 60 80

NOTES:

1- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
2- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:

DATE COMPLETED: 13 July, 2013
TOTAL DEPTH: 109.90m
CAVED DEPTH: N/A
CORING: N/A m
WET ROTARY: 360.56 m
BACKFILL: Grout
LOGGER: Fluke/Wade
DRILLER: Seacore

C:\USERS\BBINATLI\DESKTOP\04.10130058\GINT\04_1013_0058_FE13B-122313 - WITH TORVANE CORRECTION.GPJ FUGRO_S_(LAB)_IND GRP_A3_ONSHORE_REV03 12/24/2013

LOG OF BORING BH-35

PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-35j

LOCATION: See Plate 2
COORDINATES: N 6004612m
E 413413m

MUDLINE EL.: -10.13 m

DEPTH, METERS	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS	UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
0	1	WOR	**SEAFLOOR SEDIMENTS** Sandy SILT (ML): very loose, greenish black, with clay pockets							
	2	WOR	Sandy Lean CLAY (CL): very soft, greenish black	-10.6						
1	3	Push	- with organic pockets, at 3.28m		12		47			
2	4	WOH	- with hydrogen sulfide odor, from 2 to 4m				44 52			
3	5	Push								
4	6	WOR								
5	7	Push			11		45 50			
6	8	WOR								
7	9	Push	- soft, below 5.50m		12		48 42	43	18	25
8	10	Push	- with organic pockets, below 7m							
9	11	5	Sandy Lean CLAY (CL): soft to firm, gray, wet	-19.1	13		42 41	39	25	14
10	12	Push								
11										

SHEAR STRENGTH / UCS
□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
UCS ✳
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE — Min./m: 10 20 30 40
REC. SCR RQD — %: 20 40 60 80

NOTES:
1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:

DATE COMPLETED: 02 August, 2013
TOTAL DEPTH: 109.90m
CAVED DEPTH: N/A
CORING: N/A m
WET ROTARY: 360.56 m
BACKFILL: Grout
LOGGER: Fluke/Marlow/Fisher
DRILLER: Seacore

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LOG OF BORING BH-36
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-36a

LOCATION: See Plate 2
COORDINATES: N 6004612m
E 413413m

MUDLINE EL.: -10.13 m

DEPTH, METERS	SYMBOL	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS	UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
13		13	WOH	Sandy Lean CLAY (CL): soft, gray, wet	-22.1	12		38 42	49	18	31
14								42			
15		14	Push								
16		15	3			12		43 45	48	19	29
17		16	Push						45	17	28
18		17	4			12		43	41	22	19
19		18	Push	- dark gray to black, wet, with trace of shell fragments, at 20.5m							
21		19	4	Lean CLAY (CL): soft to firm, dark gray, with trace to some fine sand and mica	-31.5	13	89	41	46	20	26
22											
23		20	Push					40			

SHEAR STRENGTH / UCS
□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
UCS ✳
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE —— Min./m 10 20 30 40
REC. —— SCR • • • RQD ——
% 20 40 60 80

NOTES:
1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:

DATE COMPLETED: 02 August, 2013
TOTAL DEPTH: 109.90m
CAVED DEPTH: N/A
CORING: N/A m
WET ROTARY: 360.56 m
BACKFILL: Grout
LOGGER: Fluke/Marlow/Fisher
DRILLER: Seacore

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LOG OF BORING BH-36
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-36b

LOCATION: See Plate 2
COORDINATES: N 6004612m
E 413413m

MUDLINE EL.: -10.13 m

DEPTH, METERS	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS	UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
25	21	6					43			
26										
27	22	Push				91				
	23	WOH	- very soft, at 27.5m							
28										
29										
30	24	Push								
			- firm, at 30.4m - blocky texture, weak horizontal layering, with trace organics, at 30.5m		13		38	46	19	27
31	25	6								
32										
33	26	Push								
						92	39			
34	27	7	- micaceous, with seams of clay and fine sand, at 33.5m							
35										
	28	Push	- with seams and pockets of clay, shells, and shell fragments, below 35.5m							

SHEAR STRENGTH / UCS
□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
✳ UCS
MPa (◆, ✳) 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲) 20 40 60 80 100

CORING RATE —— Min./m 10 20 30 40
REC. —— SCR • • • RQD —— %
20 40 60 80

NOTES:
1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:

DATE COMPLETED: 02 August, 2013
TOTAL DEPTH: 109.90m
CAVED DEPTH: N/A
CORING: N/A m
WET ROTARY: 360.56 m
BACKFILL: Grout
LOGGER: Fluke/Marlow/Fisher
DRILLER: Seacore

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LOG OF BORING BH-36
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-36c

LOCATION: See Plate 2
COORDINATES: N 6004612m
E 413413m

MUDLINE EL.: -10.13 m

DEPTH, METERS	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS	UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
37	29	8			13		38			
38										
39	30	Push			13		37	36	24	12
			- stiff, at 39.40m		13		36			
40	31	9								
41										
42	32	Push								
	33	9					38			
43										
44			Fat CLAY (CH): stiff, dark gray, micaceous, with organics, with silt layers	-54.1						
45	34	Push			13	92	37	51	19	32
	35	10								
46										
47	36	Push								

SHEAR STRENGTH / UCS
□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
UCS ✳
MPa (◆, ✳) 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲) 20 40 60 80 100

CORING RATE
Min./m 10 20 30 40
REC. SCR RQD
% 20 40 60 80

NOTES:
1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:

DATE COMPLETED: 02 August, 2013
TOTAL DEPTH: 109.90m
CAVED DEPTH: N/A
CORING: N/A m
WET ROTARY: 360.56 m
BACKFILL: Grout
LOGGER: Fluke/Marlow/Fisher
DRILLER: Seacore

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LOG OF BORING BH-36
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-36d

LOCATION: See Plate 2
COORDINATES: N 6004612m
E 413413m

MUDLINE EL.: -10.13 m

DEPTH, METERS	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS	UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
49	37	10	- with an organic content of 4.02%, at 48.40m				39			
50										
51	38	Push								
			- with an organic content of 3.60%, at 51.40m				36			
52	39	12								
53										
54	40	Push			14		35			
	41	15								
55										
56										
57	42	Push								
	43	10					37			
58										
59										
	44	Push								

SHEAR STRENGTH / UCS
□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
✳ UCS
MPa (◆, ✳) 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲) 20 40 60 80 100

CORING RATE —— Min./m 10 20 30 40
REC. —— SCR • • • RQD —— % 20 40 60 80

NOTES:
1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:

DATE COMPLETED: 02 August, 2013
TOTAL DEPTH: 109.90m
CAVED DEPTH: N/A
CORING: N/A m
WET ROTARY: 360.56 m
BACKFILL: Grout
LOGGER: Fluke/Marlow/Fisher
DRILLER: Seacore

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LOG OF BORING BH-36
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-36e

LOCATION: See Plate 2
COORDINATES: N 6004612m
E 413413m

MUDLINE EL.: -10.13 m

DEPTH, METERS	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS	UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
					13		36	50	19	31
61	45	12	Lean to Fat CLAY (CL to CH): stiff to very stiff, gray, moist, with some silt, trace organics, shell fragments, and fine sand	-70.6						
							36	48	28	20
62			SPT sampling not performed below 61m; boring depth exceeded project planned depth and rod supply							
63										
64	46	Push			14		35			
65										
66										
67										
68	47	Push	- with trace shell fragments, below 67.5m Fat CLAY (CH): stiff, gray	-78.1			32	54	20	34
69										
70	51	Push								
71	52	Push			13		35			
			- very dark gray and black, 71.82 to 83m							

SHEAR STRENGTH / UCS: □ Penetrometer, ◇ Torvane, Remold Testing ○ △ ▽, Unconfined ▼, Triaxial ●, Miniature Vane ▲, Point Load ◆, UCS ✳
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100
148.6

CORING RATE —— Min./m 10 20 30 40
REC. —— SCR • • • RQD —— %
20 40 60 80

NOTES:
1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:

DATE COMPLETED: 02 August, 2013
TOTAL DEPTH: 109.90m
CAVED DEPTH: N/A
CORING: N/A m
WET ROTARY: 360.56 m
BACKFILL: Grout
LOGGER: Fluke/Marlow/Fisher
DRILLER: Seacore

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LOG OF BORING BH-36
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-36f

LOCATION: See Plate 2
COORDINATES: N 6004612m
E 413413m

MUDLINE EL.: -10.13 m

DEPTH, METERS	SYMBOL	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS	UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
73				- very stiff, at 71.9m							
74											
75		53	Push	- firm at 75.5m		13		35			
76				- with organic root casts and small mica furrows, at 76.5m							
77		50	Push								
78											
79		54	Push					37	51	20	31
80											
81											
82											
83		55	Push	- very dark gray, below 83m		12		40			
				- very stiff, at 83.9m							

SHEAR STRENGTH / UCS
□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
✳ UCS
MPa (◆, ✳) 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲) 20 40 60 80 100

CORING RATE —— Min./m 10 20 30 40
REC. —— SCR • • • RQD —— %
20 40 60 80

124.5

NOTES:
1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:

DATE COMPLETED: 02 August, 2013
TOTAL DEPTH: 109.90m
CAVED DEPTH: N/A
CORING: N/A m
WET ROTARY: 360.56 m
BACKFILL: Grout
LOGGER: Fluke/Marlow/Fisher
DRILLER: Seacore

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LOG OF BORING BH-36
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-36g

LOCATION: See Plate 2
COORDINATES: N 6004612m
E 413413m

MUDLINE EL.: -10.13 m

STRATUM DESCRIPTION

- very stiff, very dark gray to grayish black, at 92m

DEPTH, METERS	SAMPLES	BLOWS PER 300mm	STRATUM ELEV, METERS	UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
85									
86									
87	56	Push							
88									
89									
90									
91	57	Push							
92	58	Push				40	61	22	39
93									
94									
95									

CLASSIFICATION

SHEAR STRENGTH / UCS

□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
✳ UCS
MPa (◆, ✳) 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲) 20 40 60 80 100

CORING RATE —— Min./m 10 20 30 40
REC. —— SCR • • • RQD —— %
20 40 60 80

NOTES:

1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:

DATE COMPLETED: 02 August, 2013
TOTAL DEPTH: 109.90m
CAVED DEPTH: N/A
CORING: N/A m
WET ROTARY: 360.56 m
BACKFILL: Grout
LOGGER: Fluke/Marlow/Fisher
DRILLER: Seacore

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LOG OF BORING BH-36
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-36h

LOCATION: See Plate 2
COORDINATES: N 6004612m
E 413413m

MUDLINE EL.: -10.13 m

DEPTH, METERS	SYMBOL	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS	UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)	SHEAR STRENGTH / UCS	CORING RATE Min./m / REC. SCR RQD %
97		59	Push	- very stiff, below 96m		12		42				138.9	
98				- very dark gray to black, micaceous, with organic pockets, below 98m									
99				- dark gray, at 71m									
100		60	Push					43					
101													
102													
103													
104		61	Push	- micaceous, with organic pockets, at 104m		12		44				162.8	
105													
106													
107													

SHEAR STRENGTH / UCS: □ Penetrometer, ◇ Torvane, Remold Testing ○ △ ▽, Unconfined ▼, Triaxial ●, Miniature Vane ▲, Point Load ◆, UCS ✳
MPa (◆, ✳) 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲) 20 40 60 80 100

CORING RATE Min./m 10 20 30 40
REC. SCR RQD
% 20 40 60 80

NOTES:
1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:

DATE COMPLETED: 02 August, 2013
TOTAL DEPTH: 109.90m
CAVED DEPTH: N/A
CORING: N/A m
WET ROTARY: 360.56 m
BACKFILL: Grout
LOGGER: Fluke/Marlow/Fisher
DRILLER: Seacore

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LOG OF BORING BH-36
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-36i

LOCATION: See Plate 2
COORDINATES: N 6004612m
E 413413m

MUDLINE EL.: -10.13 m

DEPTH, METERS	SYMBOL	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS
109		62	Push	- with light gray pockets and seams, and a few shell fragments, below 109m	
				TD = 109.90m	120.0

CLASSIFICATION

UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
12		46			

SHEAR STRENGTH / UCS

□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ○ △ ▽ ▲ Miniature Vane
◆ Point Load
✳ UCS
MPa (◆, ✳) 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲) 20 40 60 80 100

CORING RATE — Min./m 10 20 30 40
REC. — SCR · · · RQD —
% 20 40 60 80

NOTES:

1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:

DATE COMPLETED: 02 August, 2013
TOTAL DEPTH: 109.90m
CAVED DEPTH: N/A
CORING: N/A m
WET ROTARY: 360.56 m
BACKFILL: Grout
LOGGER: Fluke/Marlow/Fisher
DRILLER: Seacore

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LOG OF BORING BH-36
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-36j

LOCATION: See Plate 2
COORDINATES: N 6005292m
E 412787m

MUDLINE EL.: -10.01 m

DEPTH, METERS	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS	UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
0	1	Push	**SEAFLOOR SEDIMENTS** Lean CLAY (CL): very soft to soft, olive gray, micaceous, with organics							
1	2	WOR								
2	3	Push			11		47 50			
3	4	WOH	- increased silt content, at 3m					44	18	26
			- with fine sub-rounded gravel, at 3.4m							
4	5	Push								
5	6	WOH	- soft to firm, with increased stiffness, at 4.9m - with fibrous organic debris, at 5.35m				47 45			
6	7	Push								
7	8	WOH	- grades to Clayey SILT with trace scattered shell fragments, at 6.9m - olive black, slightly micaceous, sticky, with organic inclusions, at 7m		11		49			
9	9	Push	- with scattered fine shell fragments, at 9.5m							
10	10	WOR	- with faint light gray silty laminations, at 10m		12		45	45	18	27
11										

SHEAR STRENGTH / UCS
□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
✳ UCS
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE —— Min./m 10 20 30 40
REC. —— SCR · · · RQD —— %
20 40 60 80

NOTES:
1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:

DATE COMPLETED: 01 August, 2013
TOTAL DEPTH: 77.45m
CAVED DEPTH: N/A
CORING: 14.9 m
WET ROTARY: 239.2 m
BACKFILL: Grout
LOGGER: Prentice/Fluke/Fisher
DRILLER: Seacore

C:\USERS\BBINATLI\DESKTOP\04.10130058\GINT\04_1013_0058_FE13B-122313 - WITH TORVANE CORRECTION.GPJ FUGRO_S_(LAB)_IND GRP_A3_ONSHORE_REV03 12/24/2013

LOG OF BORING BH-37
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-37a

LOCATION: See Plate 2
COORDINATES: N 6005292m
E 412787m

MUDLINE EL.: -10.01 m

DEPTH, METERS	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS	UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
	11	Push	- medium gray, slightly micaceous, at 12m							
13	12	WOH	- with silt, at 12.9m - interbedded with fat clay lenses and organic pockets, at 13m		12		41	36	25	11
15	13	Push	- medium gray, at 15m							
16	14	4	- slightly micaceous, at 15.8m - faintly laminated, with light gray seams, below 16m		12 12		42 43	48	20	28
21	17	Push			13		40	37	24	13
22	18	5								

SHEAR STRENGTH / UCS: □ Penetrometer, ◇ Torvane, Remold Testing ○ △ ▽, Unconfined ▼, Triaxial ●, Miniature Vane ▲, Point Load ◆, UCS ✳
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE —— Min./m: 10 20 30 40
REC. —— SCR • • • RQD —— %: 20 40 60 80

NOTES:
1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:

DATE COMPLETED: 01 August, 2013
TOTAL DEPTH: 77.45m
CAVED DEPTH: N/A
CORING: 14.9 m
WET ROTARY: 239.2 m
BACKFILL: Grout
LOGGER: Prentice/Fluke/Fisher
DRILLER: Seacore

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LOG OF BORING BH-37
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-37b

LOCATION: See Plate 2
COORDINATES: N 6005292m
E 412787m

MUDLINE EL.: -10.01 m

DEPTH, METERS	SYMBOL	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS	UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
		19 Push									
				Fat CLAY (CH): firm, with clay pockets and light gray silty laminations	-34.5						
25		20	10			13 13		40 41	51	19	32
26											
27		21 Push									
				Lean CLAY (CL) to SILT (ML): stiff, gray	-37.5	13		39 41	39	25	14
28		22	10								
29											
30		23		- with many clay parts and seams, at 30m							
		Push									
				Fat CLAY (CH): soft to firm, dark gray, micaceous, with silt partings and seams, and organic pockets	-40.5						
31		24	3			13		38	53	21	32
32											
33		25 Push									
34		26	12			13		37			
35											

SHEAR STRENGTH / UCS
□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
✳ UCS
MPa (◆, ✳) 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲) 20 40 60 80 100

CORING RATE —— Min./m 10 20 30 40
REC. —— SCR • • • RQD —— %
20 40 60 80

NOTES:
1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:

DATE COMPLETED: 01 August, 2013
TOTAL DEPTH: 77.45m
CAVED DEPTH: N/A
CORING: 14.9 m
WET ROTARY: 239.2 m
BACKFILL: Grout
LOGGER: Prentice/Fluke/Fisher
DRILLER: Seacore

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LOG OF BORING BH-37
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-37c

LOCATION: See Plate 2
COORDINATES: N 6005292m
E 412787m

MUDLINE EL.: -10.01 m

DEPTH, METERS	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS	UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
37	27	Push	- lean clay, at 36.9m		13		37	35	21	14
38	28	12								
39	29	Push								
40	30	9	- firm to stiff, below 39.90m		14		12			
41										
42	31	Push								
43	32	9					36			
44										
45	33	Push	- stiff, below 45m							
			Lean CLAY (CL): stiff, gray	-55.5	13		37	49	18	31
46	34	8								
47										

SHEAR STRENGTH / UCS
□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
✳ UCS
MPa (◆, ✳) 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲) 20 40 60 80 100

CORING RATE —— Min./m 10 20 30 40
REC. —— SCR • • • RQD —— %
20 40 60 80

NOTES:
1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:

DATE COMPLETED: 01 August, 2013
TOTAL DEPTH: 77.45m
CAVED DEPTH: N/A
CORING: 14.9 m
WET ROTARY: 239.2 m
BACKFILL: Grout
LOGGER: Prentice/Fluke/Fisher
DRILLER: Seacore

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LOG OF BORING BH-37
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-37d

LOCATION: See Plate 2
COORDINATES: N 6005292m
E 412787m

MUDLINE EL.: -10.01 m

DEPTH, METERS	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS	UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
49	35 Push		- with light gray seams, at 48m				38			
50	36	10	- blocky, at 49m, stiff below 49m							
51	37 Push									
52	38	11			12		41			
53										
54	39 Push									
55	40	14	- with light gray silt pockets, at 55m		12		42	41	24	17
56			SPT sampling not performed below 55m; boring depth exceeded project planned depth and rod supply							
57	41 Push									
58			- light gray, with organic debris (3cm length), at 57.8m		12 12		47 47			
59										

SHEAR STRENGTH / UCS
□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
✳ UCS
MPa (◆, ✳) 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲) 20 40 60 80 100

CORING RATE —— Min./m 10 20 30 40
REC. —— SCR • • • RQD —— % 20 40 60 80

NOTES:
1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:

DATE COMPLETED: 01 August, 2013
TOTAL DEPTH: 77.45m
CAVED DEPTH: N/A
CORING: 14.9 m
WET ROTARY: 239.2 m
BACKFILL: Grout
LOGGER: Prentice/Fluke/Fisher
DRILLER: Seacore

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LOG OF BORING BH-37
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-37e

LOCATION: See Plate 2
COORDINATES: N 6005292m
E 412787m

MUDLINE EL.: -10.01 m

DEPTH, METERS	SYMBOL	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS	UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
61		50	Push					49			
62											
63											
64		51	Push								
65				Fat CLAY (CH): firm, dark gray, micaceous, with organic and silt pockets	-74.5	13		37	52	22	30
66											
67											
68		52	Push								
69								33			
70											
71											

CLASSIFICATION

SHEAR STRENGTH / UCS
□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
✳ UCS
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE —— Min./m: 10 20 30 40
REC. —— SCR • • • RQD —— %: 20 40 60 80

NOTES:

1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:

DATE COMPLETED: 01 August, 2013
TOTAL DEPTH: 77.45m
CAVED DEPTH: N/A
CORING: 14.9 m
WET ROTARY: 239.2 m
BACKFILL: Grout
LOGGER: Prentice/Fluke/Fisher
DRILLER: Seacore

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LOG OF BORING BH-37
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-37f

LOCATION: See Plate 2
COORDINATES: N 6005292m
E 412787m

MUDLINE EL.: -10.01 m

DEPTH, METERS	SYMBOL	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS
		53	Push	Sandy CLAY (CL): soft to firm, gray, fine to coarse, with shell fragments and few rock fragments	-82.0
				PHYLLITE (Rx): moderately weathered, hard, intensely fractured	-82.7
73		C1		- dark green to black, at 73.5m - with white bands, below 73.65m	
74		C2			
75		C3		- no recovery, from 74.75 to 75.5m	
76		C4		- very hard, slightly fractured, below 75.6m	
77		C5			
				TD = 77.45m	-87.5
78					
79					
80					
81					
82					
83					

CLASSIFICATION

UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
16		23			
		0			
		0			
		0			

SHEAR STRENGTH / UCS

□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
UCS ✳
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE —— Min./m: 10 20 30 40
REC. —— SCR · · · RQD ——
%: 20 40 60 80

NOTES:

1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:

DATE COMPLETED: 01 August, 2013
TOTAL DEPTH: 77.45m
CAVED DEPTH: N/A
CORING: 14.9 m
WET ROTARY: 239.2 m
BACKFILL: Grout
LOGGER: Prentice/Fluke/Fisher
DRILLER: Seacore

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LOG OF BORING BH-37
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-37g

LOCATION: See Plate 2
COORDINATES: N 6007090m
E 415333m

MUDLINE EL.: -2.50 m

DEPTH, METERS	SYMBOL	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS
0				**SEAFLOOR SEDIMENTS** Sandy SILT (ML): very loose, gray brown, wet, with scattered fine shell fragments and organics	
1		1	WOR		
		2	Push		
		3	12/ref.	- with shell hash in bottom of sampler, at 1.71m - SPT sampler bouncing at 2.m, drilled out to 2.m tried to resample; refusal, switch to Geobor S coring	-4.4
2		C1		PHYLLITE (Rx): fresh, hard, thinly bedded, striated, greenish brown, with fine undulatory quartzose banding and boudinage structures, unfractured, breaks along 37 to 40 degrees bedding/foliation, with very fine micaceous sheen along bedding planes	
		C2			
3					
4		C3		- dark gray, very hard, with few quartzose laminations, below 3.63m - with very think quartz infilled 55 degrees fracture, at 3.81m	
5		C4		- with thin 64 degrees quartz infilled healed fracture, at 4.21m	
6				- with near vertical quartz-filled healed fracture from 0.1 to 0.2cm in width, from 6 to 6.92m	
7		C5			
8				- with increasing quartzose foliations, from 7.50 to 8.2m - 0.5cm-wide quartz banding, at 7.74m	
9		C6		- very hard, foliated, dark gray, with fine quartz wavy foliation, unfractured, at 8.41m - with high angle-healed quartz-filled very thin fractures from 70 to 90 degrees, at 8.5m - with very thin quartz infilled fracture, at 8.69m	
10		C7		- with trace pyrite in fracture fill, at 9.14m - with garnet nodules to 4cm in diameter, below 9.81m - with 3cm-thick quartz band, at 9.81m - highly fractured with 3cm-thick clay infill, at 10.21m - with thin quartz-filled fractures, at 10.3m - with thin quartz-filled fractures, at 10.39m - with thin quartz-filled fractures, at 10.55m - with thin quartz-filled fractures, at 10.58m	
11		C8		- highly fractured with silt infill 3cm-thick, at 11m - highly fractured with silt infill 8cm-thick, at 11.09m - with thin quartz-filled fractures, at 11.13m - fractured zones slightly weathered, overall fractured zones dip about 45 degrees - with thin quartz-filled fractures, at 11.22m - with quartz banding 1 to 3cm-thick, from 11.49 to 11.64m - with thin quartz infilled fractures, at 11.89m	

CLASSIFICATION

UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
		46	38	28	10
13		39			
15		31			
		0			
		0			
		0			
		0			
27		0			
		1			
27					

SHEAR STRENGTH / UCS

□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
UCS ✳
MPa (◆, ✳) 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲) 20 40 60 80 100

CORING RATE —— Min./m 10 20 30 40
REC. —— SCR · · · RQD —— % 20 40 60 80

NOTES:

1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:

Within the existing seafloor sediments overlying bedrock, the borehole was advanced using a rotary drill technique. Rock coring was conducted using the Geobor-S wireline, triple-barrel coring system. This coring system produces a high quality, 102mm (4-in) core with a hole diameter of 146mm (5.75-in). The core run interval is typically be 1m (3 ft), but was determined based on the material characteristics during drilling operations.

DATE COMPLETED: 24 June, 2013
TOTAL DEPTH: 30.51m
CAVED DEPTH: N/A
CORING: 93.5 m
WET ROTARY: 6.6 m
BACKFILL: Grout
LOGGER: Prentice/Fluke/Wade
DRILLER: Seacore

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LOG OF BORING BH-38
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-38a

LOCATION: See Plate 2
COORDINATES: N 6007090m
E 415333m

MUDLINE EL.: -2.50 m

DEPTH, METERS	STRATUM DESCRIPTION
13	- with thin quartz infilled fractures, at 11.95m - with thin quartz infilled fractures, at 12.59m - highly fractured, from 12.65 to 12.71m - with high angle very thin fractures 70 to 85 degrees, from 12.71 to 12.89m - with high angle very thin fractures, healed, 70 to 85 degrees, at 13.01m - with thin quartz infilled fractures, at 13.01m - with thin quartz infilled fractures, at 13.26m - with thin quartz infilled fractures, at 13.29m - highly fractured with silt infill 2cm-thick at 13.41m, possible shear, 45 degrees dip perpendicular to bedding/foliation; offset on either side of fracture zone is greater than diameter of core
14	- with thin quartz infilled fractures, at 13.5m - with thin quartz infilled fractures, at 13.75m - with thin quartz infilled fractures, at 13.9m - with thin quartz infilled fractures, at 14.14m - foliated, dark gray, with fine quartz laminations, slightly fractured, with garnet crystals to 0.2cm, bedding dips approximately 55 degrees, with very thin healed fractures 70 to 80 degrees, at 14.02m - with thin infilled fractures, at 14.39m
15	- with thin infilled fractures, at 14.6m - with thin infilled fractures, at 14.75m - with thin infilled fractures, at 14.81m - with thin infilled fractures, at 15.12m - - with thin infilled fractures, at 15.3m - fracture zone from 15.30 to 15.9m with high angle, filled fractures
16	- with thin quartz infilled fractures, at 16.12m - with thin quartz infilled fractures, at 16.31m - with quartz banding 1 to 4cm-thick, garnet-rich, from 16.31 to 17.04m
17	- slightly fractured, at 17.19m - with thin quartz infilled fractures, at 17.31m - with thin quartz infilled fractures, at 17.34m - with thin quartz infilled fractures, at 17.59m - with thin quartz infilled fractures, at 17.65m
18	- with thin quartz infilled fractures, at 17.98m - quartz banding 3 to 5cm-thick, at 18.29m
19	- with thin quartz infilled fractures along bedding, at 18.75m - high angle thin fractures 70 to 85 degrees, at 18.84m
20	- high angle thin fractures 70 to 85 degrees, at 18.93m - with thin quartz infilled fractures along bedding, at 19.11m - with thin quartz infilled fractures along bedding, at 19.26m - with thin quartz infilled fractures along bedding, at 19.42m - dark greenish black below 19.8m
21	- with 30 degrees quartz and micaceous foliations below 20.57m -
22	- moderately close to wide fracture spacing, subvertical quartz vein, 21.82 to 22.05m
23	

SAMPLES: C9, C10, C11, C12, C13, C14, C15, C16

CLASSIFICATION: UNIT DRY WT, kN/m³ | PASSING NO. 200 SIEVE, % | WATER CONTENT, % | LIQUID LIMIT | PLASTIC LIMIT | PLASTICITY INDEX (PI)

WATER CONTENT, %: 0 | 0 | 0 | 0 | 0 | 0

SHEAR STRENGTH / UCS
□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
UCS ✳
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE — Min./m: 10 20 30 40
REC. — SCR · · RQD —
%: 20 40 60 80

NOTES:
1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:
Within the existing seafloor sediments overlying bedrock, the borehole was advanced using a rotary drill technique. Rock coring was conducted using the Geobor-S wireline, triple-barrel coring system. This coring system produces a high quality, 102mm (4-in) core with a hole diameter of 146mm (5.75-in). The core run interval is typically be 1m (3 ft), but was determined based on the material characteristics during drilling operations.

DATE COMPLETED: 24 June, 2013
TOTAL DEPTH: 30.51m
CAVED DEPTH: N/A
CORING: 93.5 m
WET ROTARY: 6.6 m
BACKFILL: Grout
LOGGER: Prentice/Fluke/Wade
DRILLER: Seacore

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LOG OF BORING BH-38
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-38b

LOCATION: See Plate 2
COORDINATES: N 6007090m
E 415333m

MUDLINE EL.: -2.50 m

DEPTH, METERS	SYMBOL	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS
25		C17		- 0.2cm offset of foliations along incipient fracture at 24.81.4 to 24.9m	
26		C18		- several incipient subvertical fractures, below 25.45m - close to moderate fracture/joint spacing from 25.54 to 26.64m, dips 30 degrees along foliation fabric, very closely spaced foliations at 26.49m	
27		C19		- ductile deformation in foliations along about 3cm-thick quartz vein at 26.79m	
28		C20		- offset foliations at 27.34m	
29		C21		- quartz veins 2 to 3cm, at 28.41m - quartz banding 1 to 4cm, from 28.41 to 30.14m - very thin quartz infilled fractures along bedding, at 28.8m - very thin quartz infilled fractures along bedding, at 28.96m - bedding 70 degrees, at 28.99m	
30		C22		- dark gray with very thinly laminated quartz below 30.14m	
				TD = 30.51m	-33.0
31					
32					
33					
34					
35					

CLASSIFICATION: UNIT DRY WT, kN/m³ | PASSING NO. 200 SIEVE, % | WATER CONTENT, % | LIQUID LIMIT | PLASTIC LIMIT | PLASTICITY INDEX (PI)

WATER CONTENT, %: 0 | 0 | 0 | 0

SHEAR STRENGTH / UCS
□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
UCS ✳
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE — Min./m: 10 20 30 40
REC. — SCR · · · RQD —
%: 20 40 60 80

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NOTES:

1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:

Within the existing seafloor sediments overlying bedrock, the borehole was advanced using a rotary drill technique. Rock coring was conducted using the Geobor-S wireline, triple-barrel coring system. This coring system produces a high quality, 102mm (4-in) core with a hole diameter of 146mm (5.75-in). The core run interval is typically be 1m (3 ft), but was determined based on the material characteristics during drilling operations.

DATE COMPLETED: 24 June, 2013
TOTAL DEPTH: 30.51m
CAVED DEPTH: N/A
CORING: 93.5 m
WET ROTARY: 6.6 m
BACKFILL: Grout
LOGGER: Prentice/Fluke/Wade
DRILLER: Seacore

LOG OF BORING BH-38
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-38c

LOCATION: See Plate 2
COORDINATES: N 6007311m
E 415200m

MUDLINE EL.: -6.60 m

DEPTH, METERS	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS
			UNDIVIDED PHYLLITE (OTa) FRACTURED SHALE (Rx): highly weathered, weak to moderately hard, dark gray, subangular fragments to diameter of SPT sampler with silt and clay at top, brownish yellow with reddish brown staining	
1	1	48	PHYLLITE (Rx): moderately hard, dark gray, thinly laminated with quartz, moderately weathered bedding dips 50 degrees, thin fractures with yellowish brown coating and reddish brown staining, typically along bedding/foliations, some high angle fractures from 75 to 80 degrees - highly fractured to 0.79m, few rounded pebbles and cobbles at top - quartz banding, 2 to 5cm-thick, at 0.94m	-7.1
2	C1		- quartz banding, 2 to 5cm-thick, at 1.8m - quartz banding, 2 to 5cm-thick, from 1.89 to 2.01m	
3	C2		- moderately weak and friable, from 2.29 to 2.9m - fracture approximately 1cm-wide with sandy clay infill at 2.41m	
4	C3		- very slightly weathered, from 2.90 to 4.6m - healed pyrite-filled fractures, very thin to thin, parallel to bedding and high angle, 70 degrees to sub-vertical, with greenish gray coating, quartz banding 1 to 2 cm-thick, at 3.2m	
5	C4		- fresh, hard, thinly bedded and laminated with very thin quartz, slightly fractured bedding dips 50 degrees below 4.6m	
6	C5			
7	C6		- fractures along bedding, some pyrite infill, 2 to 5cm spacing, from 6.40 to 7.04m - fracture zone with silt and sand infill 1 to 2cm-thick. from 6.49 to 6.89m, with spotty pyrite infill	
8	C7			
9	C8			
10	C9		- 50 degree dipping foliations, augen quartz veins and specular pyrite at 1m, 50 degrees, wavy, 0.1cm quartz and pyrite infilling	
11	C10		- quartz augen veins and specular pyrite, joints 50 degrees, wavy, clean, at 10.7m - joint 50 degrees, wavy, clean, at 10.94m - joint 50 degrees, wavy, 0.1cm pyrite infilling, at 11.16m - 3cm-thick quartz vein dipping 50 degrees, at 11.58m, specular pyrite	

CLASSIFICATION

UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
		0			
		0			
		0			
26		0			
		0			
26					
		0			
		0			

SHEAR STRENGTH / UCS

□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
UCS ✳
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE —— Min./m: 10 20 30 40
REC. —— SCR · · · RQD ——
%: 20 40 60 80

NOTES:
1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:
Within the existing seafloor sediments overlying bedrock, the borehole was advanced using a rotary drill technique. Rock coring was conducted using the Geobor-S wireline, triple-barrel coring system. This coring system produces a high quality, 102mm (4-in) core with a hole diameter of 146mm (5.75-in). The core run interval is typically be 1m (3 ft), but was determined based on the material characteristics during drilling operations.

DATE COMPLETED: 27 June, 2013
TOTAL DEPTH: 29.99m
CAVED DEPTH: N/A
CORING: 95.3 m
WET ROTARY: 3.1 m
BACKFILL: Grout
LOGGER: Fluke/Wade
DRILLER: Seacore

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LOG OF BORING BH-39
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-39a

LOCATION: See Plate 2
COORDINATES: N 6007311m
E 415200m

MUDLINE EL.: -6.60 m

DEPTH, METERS	SYMBOL	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS
13		C11		- trace 0.2 to 0.3cm pyrite crystals below 12.01m - slickensides on fracture surface, at 12.04m - silty infilled fractures from 12.68 to 12.8m - vertical fracture from 12.80 to 13.29m, with less than 0.1cm quartz infilling - with quartz augen banding and specular pyrite at 12.98m	
14		C12		- specular pyrite and trace 0.1cm pyrite seams in quartz veins/healed fractures, at 14.63m	
15				- intensely fractured, from 15.18 to 15.3m - fracture 70 degrees, healed, with 0.2cm-thick quartz infill, at 15.54m	
16		C13		- 4cm quartz vein, at 15.88m - specular pyrite, 50 degree foliations and 70 degree healed fractures wide to very wide spacing, below 16.15m	
17				- fracture 70 degrees, healed, greater than 0.1cm quartz infill, at 16.92m	
18		C14			
19		C15		- few 70 degree dipping fractures, healed, with quartz, below 18.68m	
20				- intensely fractured, foliations dip 50 degrees, from 19.39 to 19.66m - thin sandy silt infill, at 19.51m - very intensely fractured from, 19.63 to 20.42m	
21		C16		- moderately fractured, from 20.42 to 23.01m	
22		C17			
23		C18		- very intensely fractured zone 3cm-thick at 22.95m - patchy thin pyrite crystals coating fractures, from 23.16 to 23.26m	
		C19			

CLASSIFICATION

UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
		0			
		0			
		0			
		0			
		0			

SHEAR STRENGTH / UCS

□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
UCS ✳
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE — Min./m: 10 20 30 40
REC. — SCR • • • RQD —
%: 20 40 60 80

NOTES:

1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:

Within the existing seafloor sediments overlying bedrock, the borehole was advanced using a rotary drill technique. Rock coring was conducted using the Geobor-S wireline, triple-barrel coring system. This coring system produces a high quality, 102mm (4-in) core with a hole diameter of 146mm (5.75-in). The core run interval is typically be 1m (3 ft), but was determined based on the material characteristics during drilling operations.

DATE COMPLETED: 27 June, 2013
TOTAL DEPTH: 29.99m
CAVED DEPTH: N/A
CORING: 95.3 m
WET ROTARY: 3.1 m
BACKFILL: Grout
LOGGER: Fluke/Wade
DRILLER: Seacore

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LOG OF BORING BH-39
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-39b

LOCATION: See Plate 2
COORDINATES: N 6007311m
E 415200m

MUDLINE EL.: -6.60 m

DEPTH, METERS	SYMBOL	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS
25		C20		- fracture zone associated with high angle fracture, from24.69 to 24.84m	
				- intensely to moderately fractured, evenly spaced below about 25.21m	
26				- very intensely fractured, from 25.79 to 25.91m	
		C21		- high angle fractures with greenish gray silt fill and pyrite coating fracture surfaces, at 26.21m	
27					
28		C22		- intensely fractured, from 28.38 to 28.59m	
				- slightly fractured below 28.59m	
29					
30		C23		**TD = 29.99m**	-36.6
31					
32					
33					
34					
35					

CLASSIFICATION

UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
		0			
		0			
		0			
		0			

SHEAR STRENGTH / UCS

□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
UCS ✳
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE —
Min./m: 10 20 30 40
REC. SCR RQD
%: 20 40 60 80

NOTES:

1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:

Within the existing seafloor sediments overlying bedrock, the borehole was advanced using a rotary drill technique. Rock coring was conducted using the Geobor-S wireline, triple-barrel coring system. This coring system produces a high quality, 102mm (4-in) core with a hole diameter of 146mm (5.75-in). The core run interval is typically be 1m (3 ft), but was determined based on the material characteristics during drilling operations.

DATE COMPLETED: 27 June, 2013
TOTAL DEPTH: 29.99m
CAVED DEPTH: N/A
CORING: 95.3 m
WET ROTARY: 3.1 m
BACKFILL: Grout
LOGGER: Fluke/Wade
DRILLER: Seacore

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LOG OF BORING BH-39
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE A-39c

SOIL TYPES

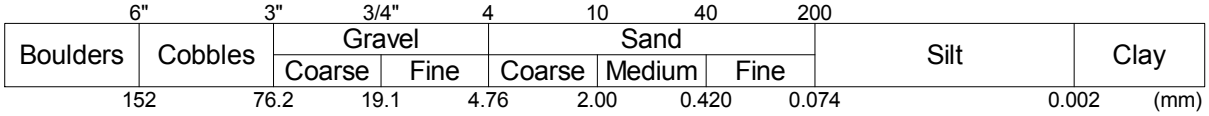
Sand
Silt
Fat Clay
Gravel
Silty Sand
Sandy Silt
Sandy Fat Clay
Silty Clay with sand
Clayey Sand
Silty Clay
Gravelly Fat Clay
Sandy Clayey Silt
Clayey Gravel
Lean Clay
Sandy Lean Clay
Peat

SAMPLER TYPES

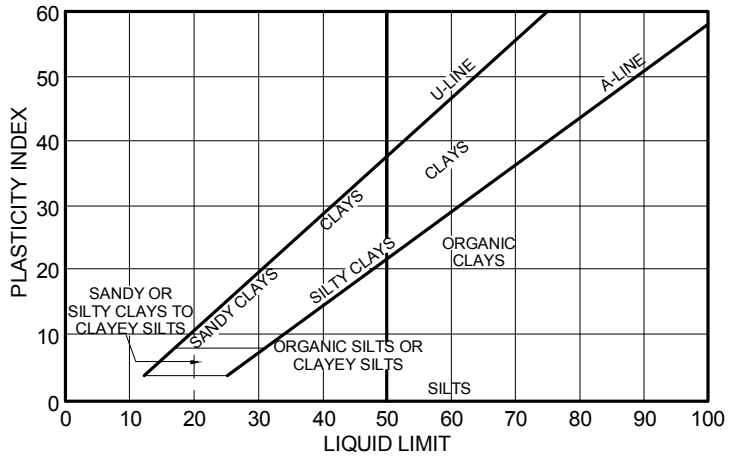
Rock Core
Core Length or No Recovery
SPT
Soil Core
TWT Shelby Tube

SOIL GRAIN SIZE

U.S. Standard Sieve



PLASTICITY CHART



SOIL STRUCTURE

Slickensided	Having planes of weakness that appear slick and glossy.
Fissured	Containing shrinkage or relief cracks, often filled with fine sand or silt; usually more or less vertical.
Pocket	Inclusion of material of different texture that is smaller than the diameter of the sample.
Parting	Inclusion less than 1/8 inch thick extending through the sample.
Seam	Inclusion 1/8 inch to 3 inches thick extending through the sample.
Layer	Inclusion greater than 3 inches thick extending through the sample.
Laminated	Soil sample composed of alternating partings or seams of different soil type.
Interlayered	Soil sample composed of alternating layers of different soil type.
Intermixed	Soil sample composed of pockets of different soil type and layered or laminated structure is not evident.
Calcareous	Having appreciable quantities of carbonate.
Carbonate	Having more than 50% carbonate content.

TERMS AND SYMBOLS USED ON BORING LOGS

SOIL CLASSIFICATION (1 of 2)

PLATE A-40a

STANDARD PENETRATION TEST (SPT)

A 50-mm-OD, 1-3/8-ID split spoon sampler is driven 0.45m into undisturbed soil with a 64 kg hammer free falling 0.76m. After the sampler is seated 150mm into undisturbed soil, the number of blows required to drive the sampler the last 300mm is the Standard Penetration Resistance or "N" value, which is recorded as blows per 300mm as described below.

SPLIT-BARREL SAMPLER DRIVING RECORD

Blows Per Foot	Description
25	25 blows drove sampler 300 mm, after initial 150 mm of seating.
50/180mm	50 blows drove sampler 180 mm, after initial 150 mm of seating.
Ref/75mm	50 blows drove sampler 75 mm during initial 150 mm seating interval.

NOTE: To avoid damage to sampling tools, driving is limited to 50 blows during or after seating interval.

DENSITY OF GRANULAR SOILS

Descriptive Term	*Relative Density, %	**Blows Per 300 mm (SPT)
Very Loose	< 15	0 to 4
Loose	15 to 35	5 to 10
Medium Dense	35 to 65	11 to 30
Dense	65 to 85	31 to 50
Very Dense	> 85	> 50

*Estimated from sampler driving record.

**Requires correction for depth, groundwater level, and grain size.

STRENGTH OF COHESIVE SOILS

Term	Undrained Shear Strength, kPa	Blows Per 300 mm (SPT) (approximate)
Very Soft	< 12.5	0 to 2
Soft	12.5 to 25.0	2 to 4
Firm	25.0 to 50.0	4 to 8
Stiff	50.0 to 100	8 to 16
Very Stiff	100 to 200	16 to 32
Hard	> 200	> 32

SHEAR STRENGTH TEST METHOD

U - Unconfined Q = Unconsolidated - Undrained Triaxial RV = Residual Miniature Vane

P = Pocket Penetrometer T = Torvane V = Miniature Vane F = Field Vane

Information on each boring log is a compilation of subsurface conditions and soil or rock classifications obtained from the field as well as from laboratory testing of samples. Strata have been interpreted by commonly accepted procedures. The stratum lines on the logs may be transitional and approximate in nature. Water level measurements refer only to those observed at the time and places indicated, and can vary with time, geologic condition, or construction activity.

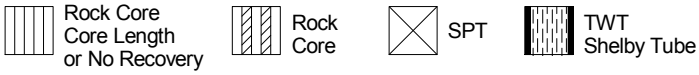
TERMS AND SYMBOLS USED ON BORING LOGS

SOIL CLASSIFICATION (2 of 2)

CLASSIFICATION TERMS / ROCK TYPES

Schist:	Medium grade metamorphic rock containing $\geq$ 50% lamellar minerals (mica, talc, etc.).
Sandstone:	A sedimentary rock composed primarily of sand grains.
Residual Soil:	All rock material is decomposed to soil, with no remaining structure or fabric.
Mudstone:	A fine-grained sedimentary rock whose original constituents were clays or muds.
Quartzite:	A metaphoric rock which was originally sandstone.
Argillite:	A fine-grained sedimentary rock composed predominantly of indurated clay particles.
Arenite:	A sedimentary rock that consists os sand-sized particles about 2-mm in size irrespective of composition.
Phyllite:	A type of foliated metamorphic rock primarily composed of quartz, sericite mica, and chlorite.
Gneiss:	A type of metamorphic rock composed of layers of sheet like planar structure.

SAMPLER TYPES



ROCK LEGEND

PERCENT RECOVERY AND RQD

Percent Recovery is the ratio of the total length of core recovered to the total length of the core run, expressed as a percentage.

Rock Quality Designation (RQD) is the ratio of the total length of core segments longer than 10-cm to the total length of the core run, expressed as a percentage. Machine breaks are ignored in the calculation of total length of segments greater than 10-cm long. RQD will always be equal to or less than Percent Recovery. For 5-cm-diameter cores, the following table gives qualitative descriptors; for a given rock, RQD increases substantially for larger core diameters. See Plate F for graphical representation.

RQD	Rock Mass Quality
90-100	Excellent
75-90	Good
50-75	Fair
25-50	Poor
0-25	Very Poor

TERMS AND SYMBOLS USED ON BORING LOGS

ROCK CLASSIFICATION (1 of 3)

PLATE A-41a

STRENGTH OF ROCK SCALE [from Brown (1981)]

Description	Symbol	Field Identifications	RANGE OF UNIAXIAL COMPRESSIVE STRENGTH (kPa)	(psi)
Extremely Weak	(R0)	Indented by thumbnail	250-1,000	35-140
Very Weak	(R1)	Crumbles under firm blow with point of geological hammer. Can be peeled with a pocket knife.	1,000-5,000	140-700
Weak	(R2)	Can be peeled with a pocket knife with difficulty, indentations made by firm blow with point of geological hammer.	5,000-25,000	700-3,500
Medium Strong	(R3)	Cannot be scraped or peeled with a pocket knife, can be fractured with single firm blow of geological hammer.	25,000-50,000	3,500-7,000
Strong	(R4)	Specimen requires more than one blow of the geological hammer to fracture it.	50,000-100,000	7,000-14,000
Very Strong	(R5)	Specimen requires many blows of geological hammer to fracture it.	100,000-250,000	14,000-35,000
Extremely Strong	(R6)	Specimen can only be chipped with geological hammer	>250,000	>35,000

DEGREE OF ROCK WEATHERING SCALE [from Brown (1981)]

Term	Description
Fresh	No visible sign of rock material weathering; perhaps some slight discoloration on major discontinuity surfaces.
Slightly Weathered	Discoloration indicates weathering of rock material and discontinuity surfaces. All the rock material may be discolored by weathering.
Moderately Weathered	Less than half the rock material is decomposed or disintegrated to a soil. Fresh or discolored rock is present either as a continuous framework or as near continuous remnants of the original material.
Highly Weathered	More than half of the rock material is discomposed or disintegrated to a soil. Fresh or discolored rock is present either as a continuous framework or as near continuous remnants of the original material.
Completely Weathered	All rock material is decomposed and/or disintegrated to soil. The original mass structure is still largely intact.
Residual Soil	All rock material is converted to soil. The mass structure and material fabric are destroyed. There is a large change in volume, but the soil has not been significantly transported.

FRACTURE DENSITY

Based on the spacing of all natural fractures in an exposure or core recovery lengths in boreholes; excludes mechanical breaks, shears, and shear zones; however, shear-disturbed zones (fractures outside the shear) are included. Descriptors for fracture density apply to all rock exposures such as tunnel walls, dozer trenches, outcrops, or foundation cut slopes and inverts, as well as boreholes. Descriptive criteria presented below are based on boreholes cores where lengths are measured along the core axis; for other exposures the criteria is distance measured between fractures (size of blocks).

Unfracturerd – No fractures.
Very slightly fractured – Core recovered mostly in lengths greater than 1m (3 ft.)
Slightly to very slightly fractured – *
Slightly fractured – Core recovered mostly in lengths from 300 to 1000mm (1 to 3 ft.) with few scattered lengths less than 300mm (1 ft.) or greater than 1000mm (3 ft.)
Moderately to slightly fractured – *
Moderately fractured – Core recovered mostly in 100 to 300mm (0.3 to 1.0 ft.) lengths with most lengths about 200mm (0.6 ft.)
Intensely to moderately fractured – *
Intensely fractured – Lengths average from 30 to 100mm (0.1 to 0.3 ft.) with scattered fragmented intervals. Core recovered mostly in lengths less than 100mm (0.3 ft.)
Very Intensely to Intensely fractured – *
Very Intensely fractured – Core recovered mostly as chips and fragments with a few scattered short core lengths.

* Combination of fracture densities (eg. *Very Intensely Fractured to Intensely Fractured* or *Moderately to Slightly Fractured*) are used where equal distribution of both fracture density characteristics are present over a significant interval or exposure, or where characteristics are "in between" the descriptor definitions.

TERMS AND SYMBOLS USED ON BORING LOGS
ROCK CLASSIFICATION (2 of 3)

PLATE A-41b

TERMS USED ON ROCK LOGS

Term	Descriptions
Bedding	Planes dividing sedimentary rocks of the same or different characteristics.
Blocky	Easily broken up into blocks or cubes.
Calcareous	Containing between 12 to 50 percent calcium carbonate.
Carbonate	Containing greater than 50 percent calcium carbonate.
Cementation	The process of precipitation of a binding material from ground water around grains or minerals in rock.
Chert	An impure, very fine grained siliceous rock frequently associated with limestone. Agate, flint, and jasper are varieties of chert.
Clastic	A rock or sediment composed principally of fragments derived from pre-existing rock.
Conglomerate	A rock composed predominantly of cemented gravel-size, rounded rock fragments. The Cement paste is usually calcareous or siliceous.
Cross Bedding	The arrangement of laminations of strata oblique or inclined to the main planes of stratification.
Dip	The angle and direction at which a plane is inclined from horizontal.
Discontinuity	A break or gap in the rock.
Fault	A natural break along which there has been appreciable shearing displacement of the two sides along the plane of the break.
Ferrous	Rock contains iron-rich minerals either in-situ or accumulating along discontinuity planes.
Filled	The full width of the discontinuity is occupied with soil or rock that does not provide significant tensile strength.
Fissile	Splits easily along closely spaced, parallel planes.
Fissured	Containing shrinkage of relief cracks, often filled with fine sand or silt; usually more or less vertical.
Fossiliferous	Containing evidence or organic remains.
Fracture	A natural, mechanical break in a rock along which no appreciable displacements Have occurred parallel to the plane of the break.
Friable	Easily crumbled.
Gouge	A layer or seam of soft material usually found in a shear zone.
Healed	A discontinuity that is cemented without a visible, foreign cementing agent or secondary mineralization. The healing process gives both tensile strength and reduced permeability to the feature.
Indurated	Applies to rocks hardened not only be heat but also by pressure and cementation.
Interbedded	Sample composed of alternating layers.
Joint	A natural, mechanical break in a rock along which no appreciable displacements have occurred parallel to the plane of the break. Joints are found in groups that have significant lateral extent and characteristic geometric relationships.
Laminate	Sample composed of alternating partings or seams.
Layer	Inclusion greater than 76 mm thick extending through sample.
Lined	Where surfaces of a void or discontinuity are partially or totally coated with secondary mineralization.
Nodule	A small, more or less rounded mass of material or mineral aggregate differing from and generally harder than the surrounding matrix.
Parting	Inclusion less than 3 mm thick extending through the sample.
Pocket	Inclusion of material of different texture that is smaller than the diameter of the sample.
Porous	Containing small voids less than 0.25 mm in diameter.
Seam	Inclusion 3 mm to 76 mm thick extending through the sample.
Sedimentary Rock	A layer rock resulting from (1) consolidation of sediments, (2) precipitation from solution, or (3) consolidation of the remains of plants or animals.
Shear Zone	A zone of measurable thickness in rock along which displacements have occurred.
Siliceous	Containing abundant quartz or pertaining to silica as a cementing agent.
Slickensided	Having planes of weakness that appear slick and glossy. The degree of slickensideness depends upon the spacing of slickensides and the ease of breaking along these planes.
Strike	The compass direction of a line formed by the intersection of an incline plane (such as a Bedding plane or joint) with a horizontal plane.
Vuggy	Contains voids (vugs) greater than 0.25 mm , which do not extend through the entire core Diameter.
Wavy Bedding	Bedding that is marked by layers which are not parallel and have a sinusoidal profile.
Waxy	Sample having a smooth lustrous texture.
Weathering	The group of processes by which rocks are exposed to the weather, change in character, decay, and finally crumble into soil. These processes include the chemical action of air and rain water and of plants and bacteria, and the mechanical action of changes in temperature.

TERMS AND SYMBOLS USED ON BORING LOGS
ROCK CLASSIFICATION (3 of 3)

PLATE A-41c

$$\text{Total Core Recovery, [\%]} = \frac{\text{Recovery}}{\text{Core Run}} = \frac{R}{CR}$$

$$\text{RQD, [\%]} = \frac{\text{Sum of Cores > 10 cm}}{\text{Core Run}} = \frac{C}{CR}$$

$$\text{Solid Core Recovery, [\%]} = \frac{\text{Sum of Solid Cores}}{\text{Core Run}} = \frac{SC}{CR}$$

$$\text{Fracture Index, [Fractures/Unit Length]} = \frac{\text{Number of Fractures in Core}}{\text{Core Run}} = \frac{NF}{CR}$$

NOTES

Total Core Recovery (TCR) is used to quantify the percentage of core recovered. A TCR of less than 100% means that some material, generally the weakest, has been lost.

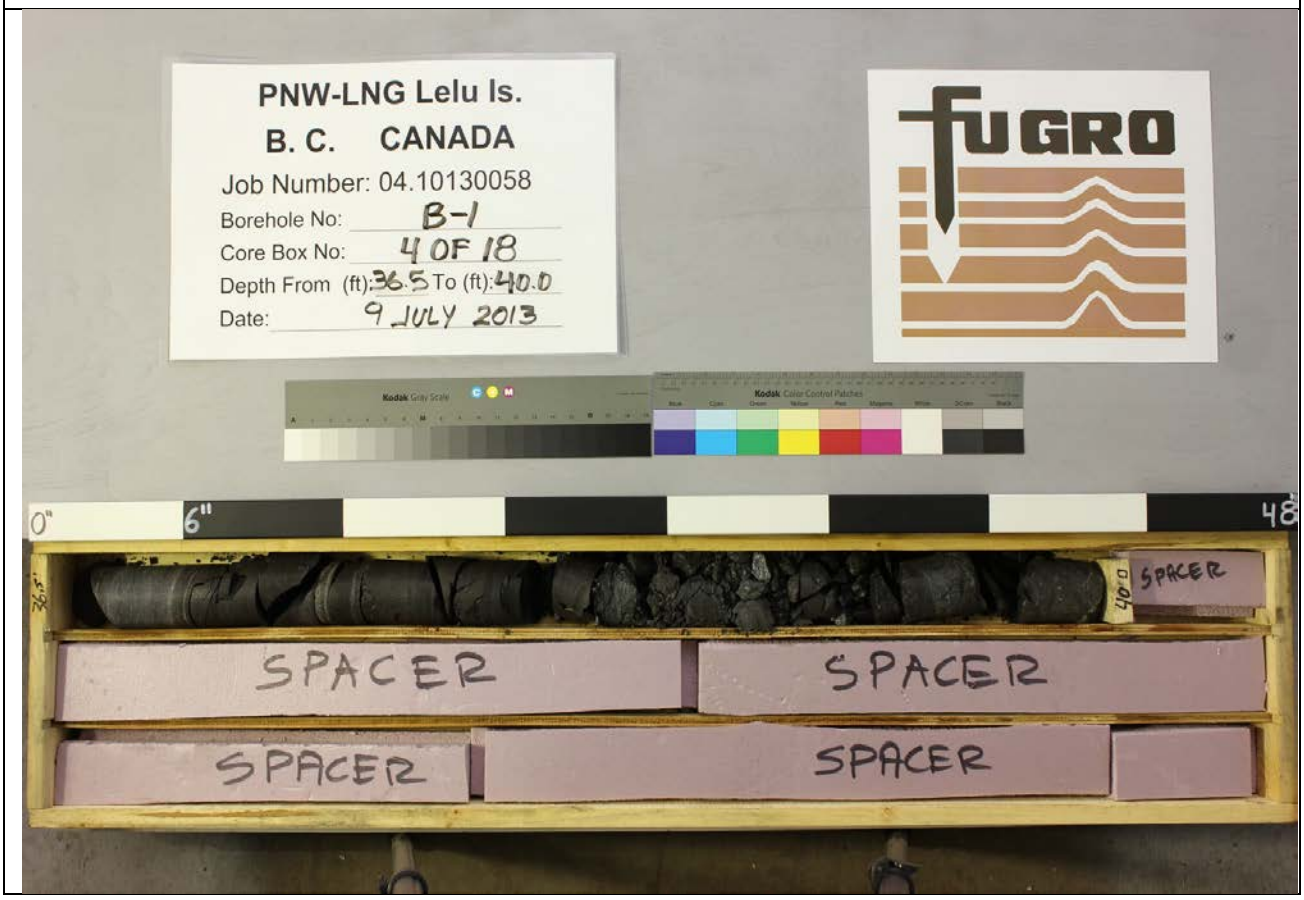
Rock Quality Designation (RQD) is used to rate the quality of the rock formation in situ. Only core fragments greater than 10 cm are included in the sum. Fractures and/or deterioration caused by drilling should be ignored.

ROCK CORE RECOVERY AND FRACTURE INDICES
MOF, DOCKS, & FERRY LANDING REPORT
AUSTRALIA PACIFIC LNG PROJECT
CURTIS ISLAND, QUEENSLAND, AUSTRALIA

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-1
Core Box No: 1 OF 18
Depth From (ft): 2.7 To (ft): 13.3
Date: 8-9 JULY 2013
FUGRO
0"
6"
48"
13.3 SPACER

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-1
Core Box No: 2 OF 18
Depth From (ft): 13.3 To (ft): 25.0
Date: 8-9 JULY 2013
FUGRO
0"
6"
48"
14.6'
19.6'
25.0

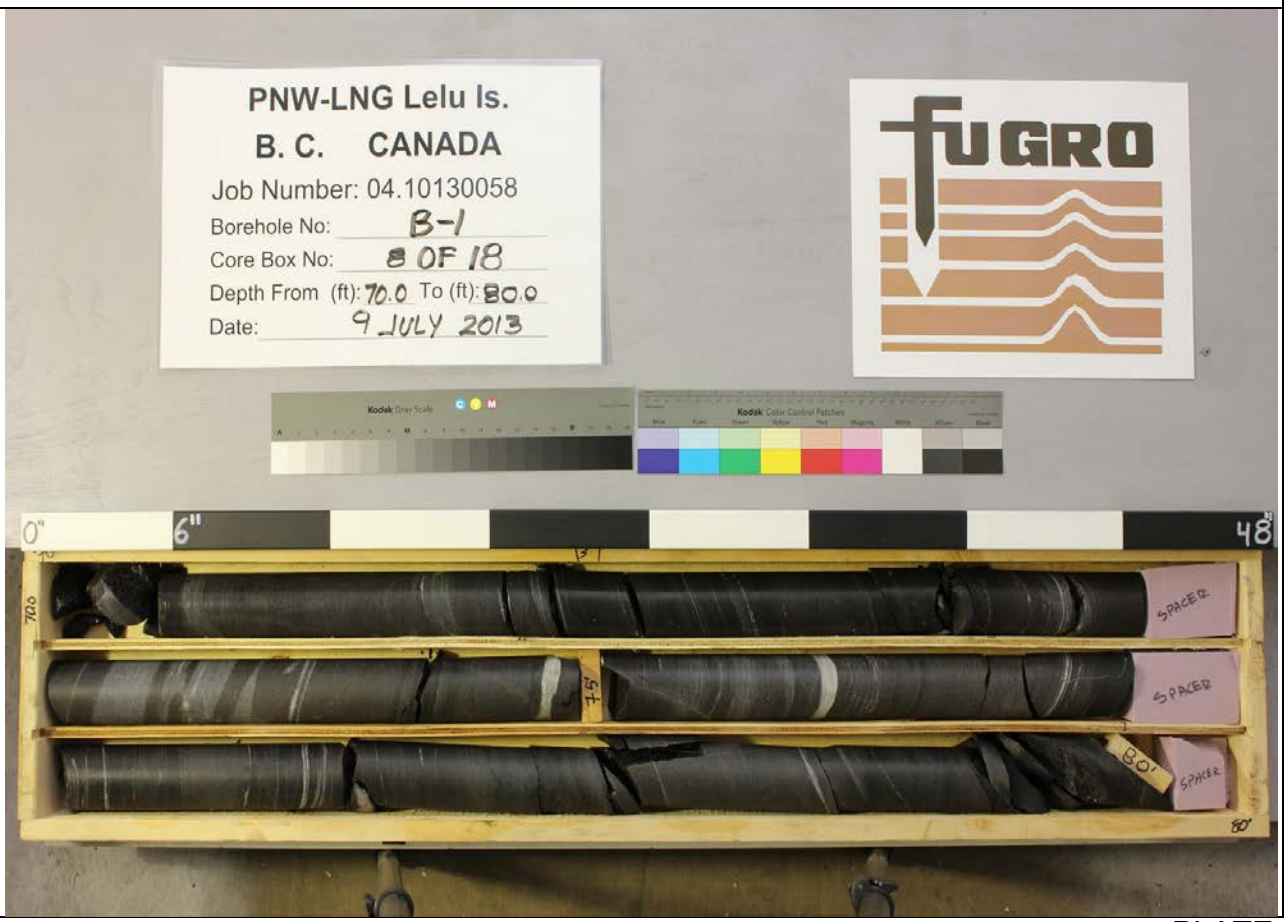
PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-1
Core Box No: 3 OF 18
Depth From (ft): 25.0 To (ft): 36.5
Date: 9 JULY 2013
FUGRO
0"
6"
48"
25.0
40'
35'
36.5'


PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-1
Core Box No: 4 OF 18
Depth From (ft): 36.5 To (ft): 40.0
Date: 9 JULY 2013
FUGRO
0"
6"
48"
36.5'
40.0'
SPACER
SPACER
SPACER
SPACER
SPACER

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-1
Core Box No: 5 OF 18
Depth From (ft): 40.0 To (ft): 51.0
Date: 9 JULY 2013
FUGRO
0"
6"
48"
46'
48'
51'

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-1
Core Box No: 6 OF 18
Depth From (ft): 51.0 To (ft): 60.0
Date: 9 JULY 2013
FUGRO
0"
6"
48"
51'
53'
55'
60'
SPACER

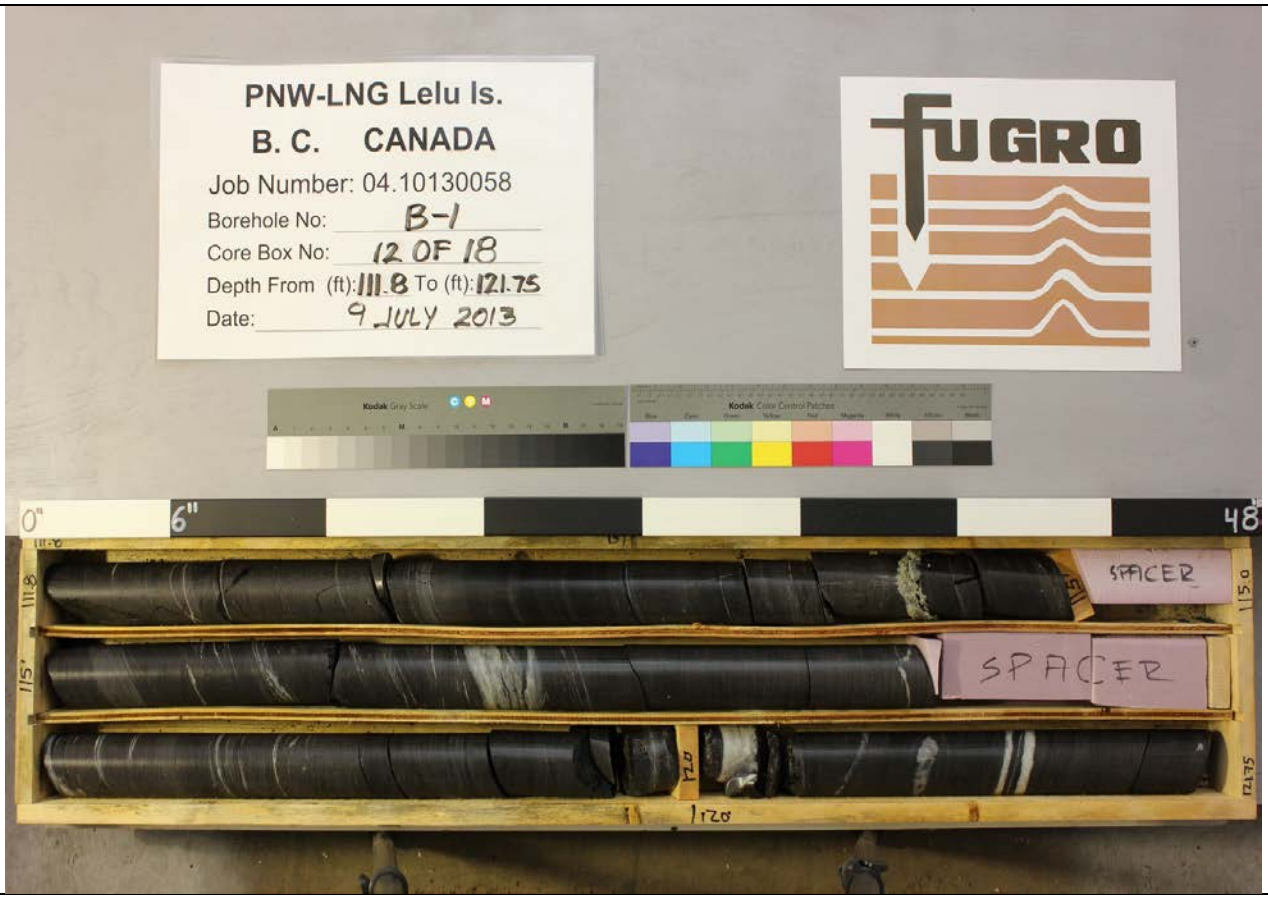
PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-1
Core Box No: 7 OF 18
Depth From (ft): 60.0 To (ft): 70.0
Date: 9 JULY 2013
FUGRO
0"
6"
48"
60.0
65
SPACER
70'
SPACER
70.0

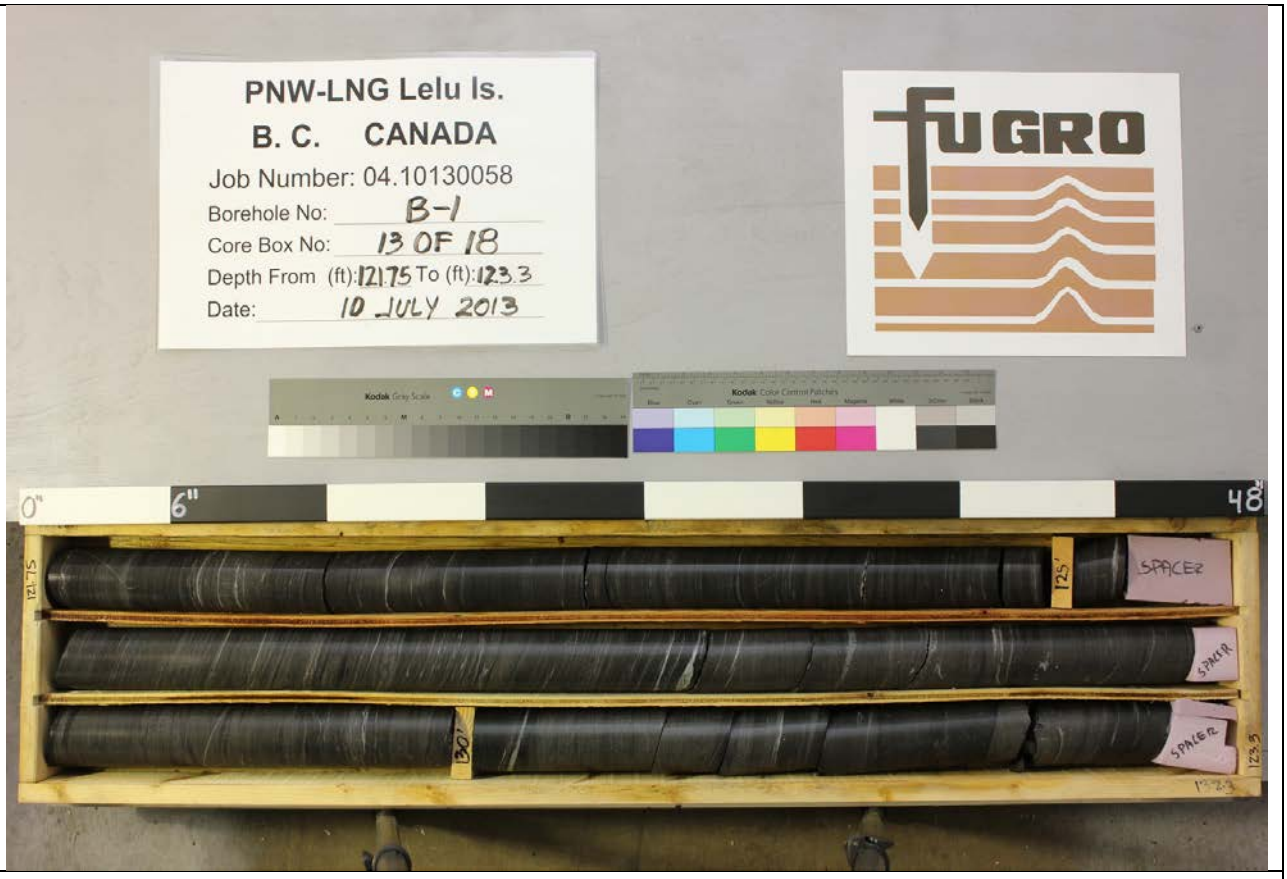

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-1
Core Box No: 8 OF 18
Depth From (ft): 70.0 To (ft): 80.0
Date: 9 JULY 2013
FUGRO
0"
6"
48"
70.0
75
SPACER
SPACER
80'
SPACER
80'

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-1
Core Box No: 9 OF 18
Depth From (ft): 80.0 To (ft): 90.0
Date: 9 JULY 2013
FUGRO
0"
6"
48"
80.0
85'
90'
SPACER
SPACER
SPACER
90'0

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-1
Core Box No: 10 OF 18
Depth From (ft): 90.0 To (ft): 101.3
Date: 9 JULY 2013
FUGRO
0"
6"
48"
90.0
95'
100'
SPACER
101.3

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-1
Core Box No: 11 OF 18
Depth From (ft): 101.3 To (ft): 111.8
Date: 9 JULY 2013
FUGRO
0"
6"
48"
SPACER
SPACER


PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-1
Core Box No: 12 OF 18
Depth From (ft): 111.8 To (ft): 121.75
Date: 9 JULY 2013
FUGRO
0"
6"
48"
SPACER
SPACER


PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-1
Core Box No: 13 OF 18
Depth From (ft): 121.75 To (ft): 123.3
Date: 10 JULY 2013
FUGRO
0"
6"
48
121.75
125'
SPACER
SPACER
SPACER
130'
123.3

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-1
Core Box No: 14 OF 18
Depth From (ft): 132.3 To (ft): 143.0
Date: 10 JULY 2013
FUGRO
0"
6"
48
132.3
135'
140'
143.0

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-1
Core Box No: 15 OF 18
Depth From (ft): 143.0 To (ft): 153.5
Date: 10 JULY 2013
FUGRO
0"
6"
48"
143.0
145
150
150.0
153.5
SPACER
SPACER

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-1
Core Box No: 16 OF 18
Depth From (ft): 153.5 To (ft): 165.0
Date: 10 JULY 2013
FUGRO
0"
6"
48"
153.5
155
160
165.0

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-1
Core Box No: 17 OF 18
Depth From (ft): 165.0 To (ft): 176.0
Date: 10 JULY 2013
FUGRO
0"
6"
48"
165.0
170.0
176.0

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-1
Core Box No: 18 OF 18
Depth From (ft): 176.0 To (ft): 180.0
Date: 10 JULY 2013
FUGRO
0"
6"
48"
176.0
179.0
SPACER
180.0
EOH
SPACER
SPACER
SPACER

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-2
Core Box No: 1 OF 12
Depth From (ft): 7.0 To (ft): 23.2
Date: 18 AUGUST 2013
FUGRO
0"
6"
60"
SPACER
SPACER
SPACER

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-2
Core Box No: 2 OF 12
Depth From (ft): 23.2 To (ft): 38.5
Date: 18 AUGUST 2013
FUGRO
0"
6"
60"
SPACER

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-2
Core Box No: 3 OF 12
Depth From (ft): 38.5 To (ft): 54.0
Date: 18 AUGUST 2013
FUGRO
0"
6"
60"
B-2
41'
46'
51'

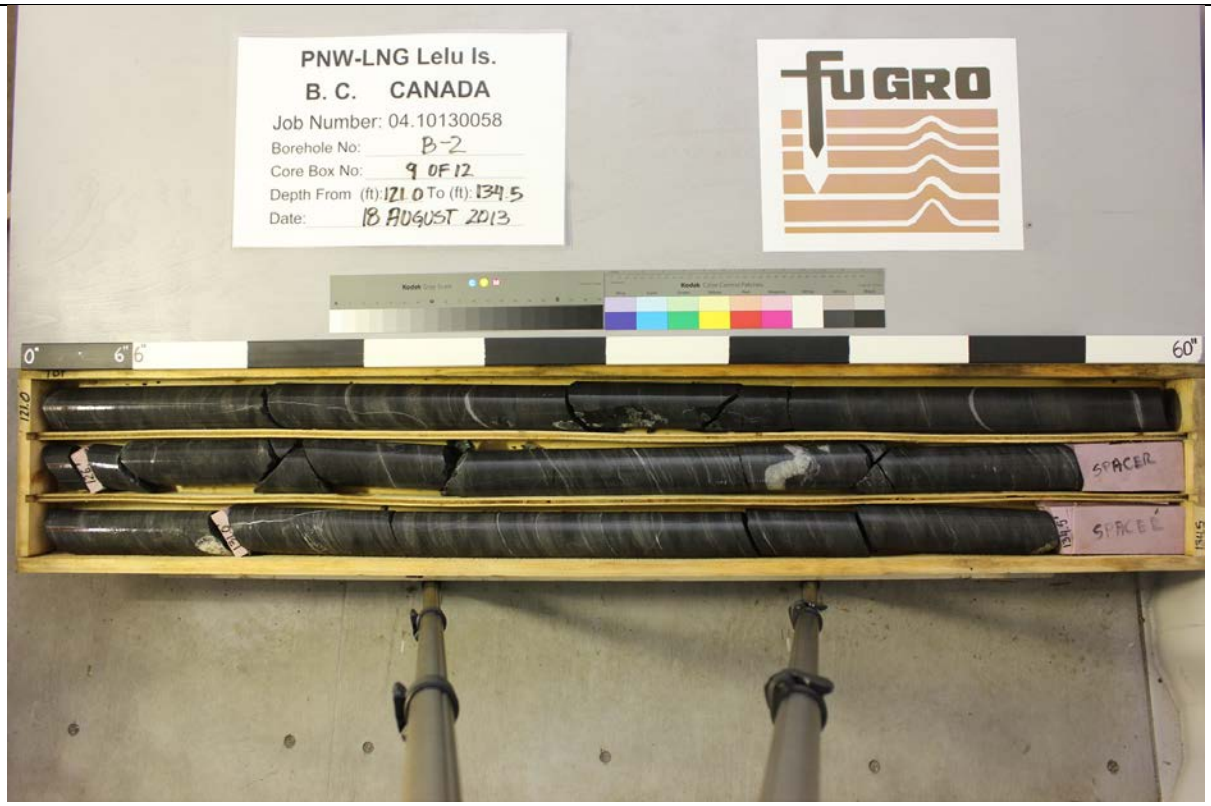
PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-2
Core Box No: 4 OF 12
Depth From (ft): 54.0 To (ft): 68.0
Date: 18 AUGUST 2013
FUGRO
0"
6"
60"
B-2
56'
61'

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-2
Core Box No: 5 OF 12
Depth From (ft): 68.0 To (ft): 82.0
Date: 18 AUGUST 2013
FUGRO
0"
6"
60"
SPACER
SPACER
SPACER

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-2
Core Box No: 6 OF 12
Depth From (ft): 82.0 To (ft): 95.0
Date: 18 AUGUST 2013
FUGRO
0"
6"
60"
B-2
SPACER
SPACER

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-2
Core Box No: 7 OF 12
Depth From (ft): 95.0 To (ft): 108.8
Date: 18 AUGUST 2013
FUGRO
0"
6"
60"
B-2
SPACER

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-2
Core Box No: 8 OF 12
Depth From (ft): 108.8 To (ft): 121.0
Date: 18 AUGUST 2013
FUGRO
0"
6"
60"
SPACER
SPACER
SPACER


PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-2
Core Box No: 9 OF 12
Depth From (ft): 121.0 To (ft): 134.5
Date: 18 AUGUST 2013
FUGRO
0"
6"
60"
121.0
134.5
SPACER
SPACER

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-2
Core Box No: 10 OF 12
Depth From (ft): 134.5 To (ft): 148.5
Date: 18 AUGUST 2013
FUGRO
0"
6"
60"
134.5

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-2
Core Box No: 11 OF 12
Depth From (ft): 148.5 To (ft): 162.5
Date: 19 AUGUST 2013
FUGRO
0"
6"
60"
151.0'
156.0'
161.0'

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-2
Core Box No: 12 OF 12
Depth From (ft): 162.5 To (ft): 166.0 E.O.H
Date: 19 AUGUST 2013
FUGRO
0"
6"
60"
166'
EOH

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-3
Core Box No: 1 OF 17
Depth From (ft): 3.1 To (ft): 14.2
Date: 14 JULY 2013
FUGRO
0"
6"
48"

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-3
Core Box No: 2 OF 17
Depth From (ft): 14.2 To (ft): 24.7
Date: 14 JULY 2013
FUGRO
0"
6"
48"

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-3
Core Box No: 3 OF 17
Depth From (ft): 24.7 To (ft): 35.6
Date: 14 JULY 2013
FUGRO
0"
6"
48"
24.7
28.4
32.0
35.6
27.5
32.5

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-3
Core Box No: 4 OF 17
Depth From (ft): 35.6 To (ft): 46.3
Date: 14 JULY 2013
FUGRO
0"
6"
48"
35.6
39.3
42.8
46.3
37.5
42.5

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-3
Core Box No: 5 OF 17
Depth From (ft): 46.3 To (ft): 56.6
Date: 14 JULY 2013
FUGRO
0"
6"
48"

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-3
Core Box No: 6 OF 17
Depth From (ft): 56.6 To (ft): 67.5
Date: 15 JULY 2013
FUGRO
0"
6"
48"

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-3
Core Box No: 7 OF 17
Depth From (ft): 67.5 To (ft): 77.5
Date: 15 JULY 2013
FUGRO
0"
6"
48"

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-3
Core Box No: 8 OF 17
Depth From (ft): 77.5 To (ft): 87.9
Date: 15 JULY 2013
FUGRO
0"
6"
48"

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-3
Core Box No: 9 OF 17
Depth From (ft): 87.9 To (ft): 97.8
Date: 15 JULY 2013
FUGRO
0"
6"
48"
88
89
90
91
91.4
92
92.5
93
94
95
96
97
97.8

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-3
Core Box No: 10 OF 17
Depth From (ft): 97.8 To (ft): 108.3
Date: 15 JULY 2013
FUGRO
0"
6"
48"
98
99
100
101
102
102.5
103
104
105
106
107
107.5
108

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-3
Core Box No: 11 OF 17
Depth From (ft): 108.3 To (ft): 118.0
Date: 15 JULY 2013
FUGRO
0"
6"
48"

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-3
Core Box No: 12 OF 17
Depth From (ft): 118.0 To (ft): 128.7
Date: 15 JULY 2013
FUGRO
0"
6"
48"

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-3
Core Box No: 13 OF 17
Depth From (ft): 128.7 To (ft): 139.7
Date: 15 JULY 2013
FUGRO

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-3
Core Box No: 14 OF 17
Depth From (ft): 139.7 To (ft): 150.5
Date: 15 JULY 2013
FUGRO

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-3
Core Box No: 15 OF 17
Depth From (ft): 150.5 To (ft): 161.5
Date: 15 JULY 2013
FUGRO
0"
6"
48"

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-3
Core Box No: 16 OF 17
Depth From (ft): 161.5 To (ft): 171.8
Date: 16 JULY 2013
FUGRO
0"
6"
48"

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-3
Core Box No: 17 OF 17
Depth From (ft): 171.8 To (ft): 180.7 E.O.B.
Date: 16 JULY 2013
FUGRO
0"
6"
48"

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-4
Core Box No: 1 OF 6
Depth From (ft): 2.7 To (ft): 19.3
Date: 20 JULY 2013
FUGRO
0"
6"
48"

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-4
Core Box No: 2 OF 6
Depth From (ft): 193 To (ft): 30.0
Date: 20 JULY 2013
FUGRO
0"
6"
48"

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-4
Core Box No: 3 OF 6
Depth From (ft): 30.0 To (ft): 40.8
Date: 20 JULY 2013
FUGRO
0"
6"
48"

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-4
Core Box No: 4 OF 6
Depth From (ft): 40.8 To (ft): 51.0
Date: 20 AND 21 JULY 2013
FUGRO
0"
6"
48

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-4
Core Box No: 5 OF 6
Depth From (ft): 51.0 To (ft): 62.0
Date: 21 JULY 2013
FUGRO
0"
6"
48

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-4
Core Box No: 6 OF 6
Depth From (ft): 62.0 To (ft): 67.0
Date: 21 JULY 2013
FUGRO
0"
6"
48"
67+0

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-5A
Core Box No: 1 OF 6
Depth From (ft): 1.5 To (ft): 13.6
Date: 22 JULY 2013
FUGRO
0"
6"
60"
SPACER
SPACER
SPACER
BOTTOM

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-5A
Core Box No: 2 OF 6
Depth From (ft): 13.6 To (ft): 26.9
Date: 22 JULY 2013
FUGRO
0"
6"
60"
SPACER
SPACER
BOTTOM

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-5A
Core Box No: 3 OF 6
Depth From (ft): 26.9 To (ft): 38.1
Date: 22 JULY 2013
FUGRO
0"
6"
60"
SPACER
SPACER
SPACER
BOTTOM

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-5A
Core Box No: 4 OF 6
Depth From (ft): 38.1 To (ft): 49.2
Date: 22 JULY 2013
FUGRO
0"
6"
60"
SPACER
SPACER
BOTTOM

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-5A
Core Box No: 5 OF 6
Depth From (ft): 42.9 To (ft): 60.0
Date: 22 JULY 2013
FUGRO
0"
6"
48"
BOTTOM

Not Available

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-6
Core Box No: 2 OF 5
Depth From (ft): 15.8 To (ft): 28.7
Date: 26 JULY 2013
FUGRO
0"
6"
60"

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-6
Core Box No: 3 OF 5
Depth From (ft): 28.7 To (ft): 42.7
Date: 26 JULY 2013
FUGRO
0"
6"
60"

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-6
Core Box No: 4 OF 5
Depth From (ft): 42.7 To (ft): 56.6
Date: 26 JULY 2013
FUGRO
0"
6"
60"

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-6
Core Box No: 5 OF 5
Depth From (ft): 56.6 To (ft): 68.5 EOB
Date: 26 JULY 2013
FUGRO
0"
6"
60"
SPACER

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-7
Core Box No: 1 OF 5
Depth From (ft): 0.0 To (ft): 19.1
Date: 24 AND 25 JULY 2013
FUGRO
0"
6"
60"

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-7
Core Box No: 1A
Depth From (ft): 0.0 To (ft): 8.5
Date: 24 JULY 2013
FUGRO
6"

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-7
Core Box No: 2 OF 5
Depth From (ft): 19.1 To (ft): 34.1
Date: 25 JULY 2013
FUGRO
0"
6"
60"

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-7
Core Box No: 3 OF 5
Depth From (ft): 34.1 To (ft): 47.9
Date: 25 JULY 2013
FUGRO
0"
6"
60"

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-7
Core Box No: 4 OF 5
Depth From (ft): 47.9 To (ft): 62.3
Date: 25 JULY 2013
FUGRO
0"
6"
60"

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-7
Core Box No: 5 OF 5
Depth From (ft): 62.3 To (ft): 67.5 E.O.B.
Date: 25 JULY 2013
FUGRO
0"
6"
60"
SPACER
OZONE DEPLETION
SPACER

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-8
Core Box No: 1 OF 5
Depth From (ft): 0.0 To (ft): 15.0
Date: 22 JULY 2013
FUGRO
0"
6"
60"

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-8
Core Box No: 2 OF 5
Depth From (ft): 15.0 To (ft): 29.0
Date: 22 JULY 2013
FUGRO
0"
6"
60"

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-8
Core Box No: 3 OF 5
Depth From (ft): 29.0 To (ft): 44.0
Date: 22 JULY 2013
FUGRO
0"
6"
60"

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-8
Core Box No: 4 OF 5
Depth From (ft): 44.0 To (ft): 58.5
Date: 23 JULY 2013
FUGRO
0"
6"
60"

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-8
Core Box No: 5 OF 5
Depth From (ft): 58.5 To (ft): 68.7 E.O.B
Date: 23 JULY 2013
FUGRO
0"
6"
60"
SPACER

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-9
Core Box No: 1 OF 7
Depth From (ft): 2.50 To (ft): 17.5
Date: 28 JUNE 2013
FUGRO
0"
6"
60"
4.0
14.5
15.0

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-9
Core Box No: 2 OF 7
Depth From (ft): 17.5 To (ft): 32.5
Date: 28 JUNE 2013
FUGRO
0"
6"
60"
20.0
25.0
30.0
BOTTOM

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-9
Core Box No: 3 OF 7
Depth From (ft): 32.5 To (ft): 46.3
Date: 28 JUNE 2013
FUGRO
0"
6"
60"
40.0
45.0
SPACER
BOTTOM

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-9
Core Box No: 4 OF 7
Depth From (ft): 46.3 To (ft): 60.0
Date: 28 JUNE 2013
FUGRO
0"
6"
60"
TOP
BOTTOM

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-9
Core Box No: 5 OF 7
Depth From (ft): 60.0 To (ft): 74.5
Date: 28 JUNE 2013
FUGRO
0"
6"
60"
BOTTOM

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-9
Core Box No: 6 OF 7
Depth From (ft): 74.5 To (ft): 88.2
Date: 28 JUNE 2013
FUGRO
0"
6"
60"
TOP
BOTTOM

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-9
Core Box No: 7 OF 7
Depth From (ft): 88.2 To (ft): 100.0
Date: 28 JUNE 2013
FUGRO
0"
6"
60"
TOP
SPACER
SPACER
BOTTOM

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-12
Core Box No: 1 OF 6
Depth From (ft): 24.5 To (ft): 46.3
Date: 22 JUNE - 23 JUNE 2013
FUGRO
0"
6"
60"

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-12
Core Box No: 2 OF 6
Depth From (ft): 46.3 To (ft): 60.3
Date: 23 JUNE 2013
FUGRO
0"
6"
60"

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-12
Core Box No: 3 OF 6
Depth From (ft): 60.3 To (ft): 74.0
Date: 23 JUNE 2013
FUGRO
0"
6"
60"

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-12
Core Box No: 4 OF 6
Depth From (ft): 74.0 To (ft): 89.0
Date: 23 JUNE 2013
FUGRO
0"
6"
60"

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-12
Core Box No: 5 OF 6
Depth From (ft): 89.0 To (ft): 104.0
Date: 25 JUNE 2013
FUGRO
0"
6"
60"
TOP
BOTTOM

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-12
Core Box No: 6 OF 6
Depth From (ft): 104.0 To (ft): 114.0
Date: 25 JUNE 2013
FUGRO
0"
6"
60"
TOP
BOTTOM

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-13
Core Box No: 1 OF 7
Depth From (ft): 6.85 To (ft): 22.0
Date: 18 JUNE 2013
FUGRO
0"
6"
60"

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-13
Core Box No: 2 OF 7
Depth From (ft): 22.0 To (ft): 37.0
Date: 18 JUNE 2013
FUGRO
0"
6"
60"

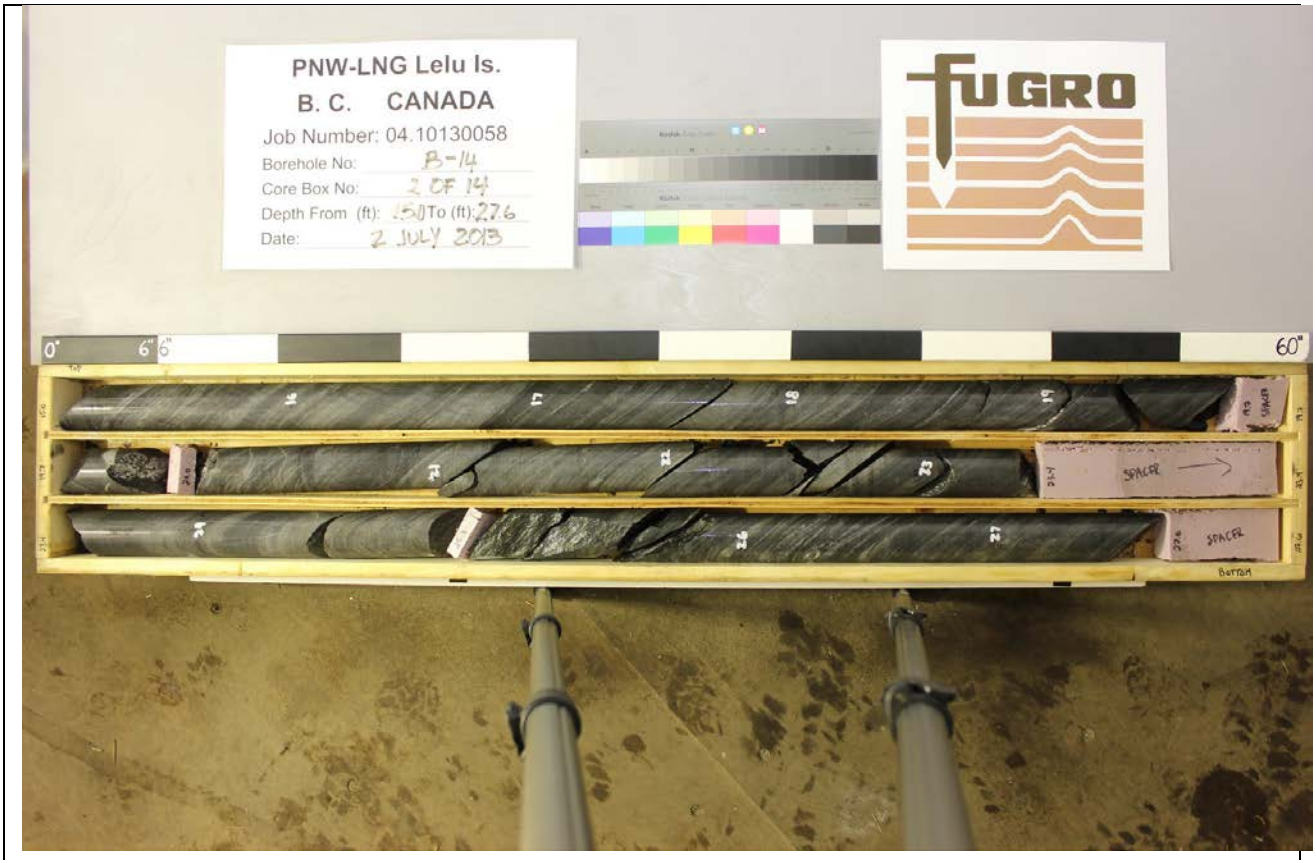
PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-13
Core Box No: 3 OF 7
Depth From (ft): 37.0 To (ft): 51.20
Date: 18 JUNE 2013
FUGRO
0"
6"
60"

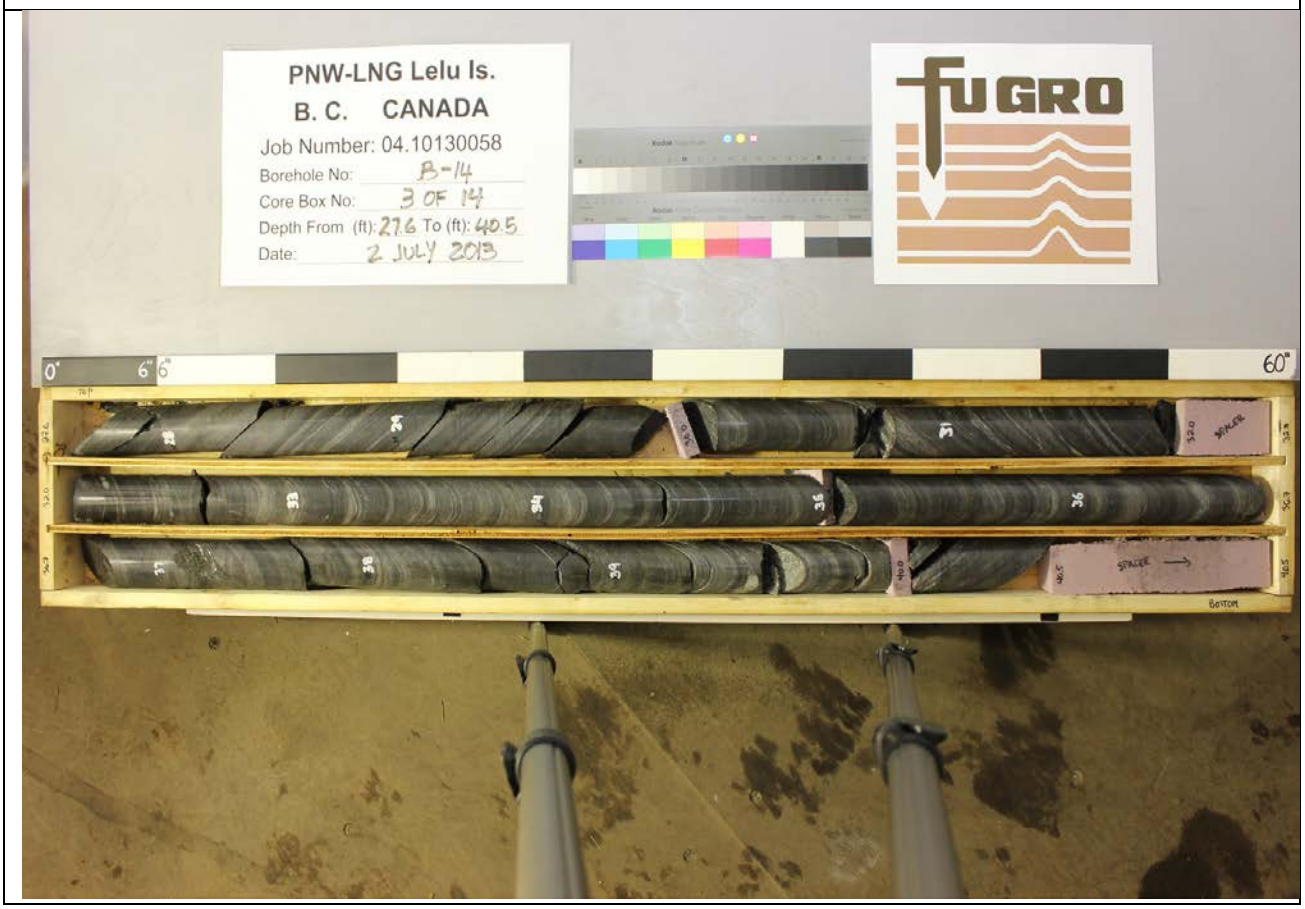
PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-13
Core Box No: 4 OF 7
Depth From (ft): 51.20 To (ft): 64.6
Date: 18 JUNE 2013
FUGRO
0"
6"
60"

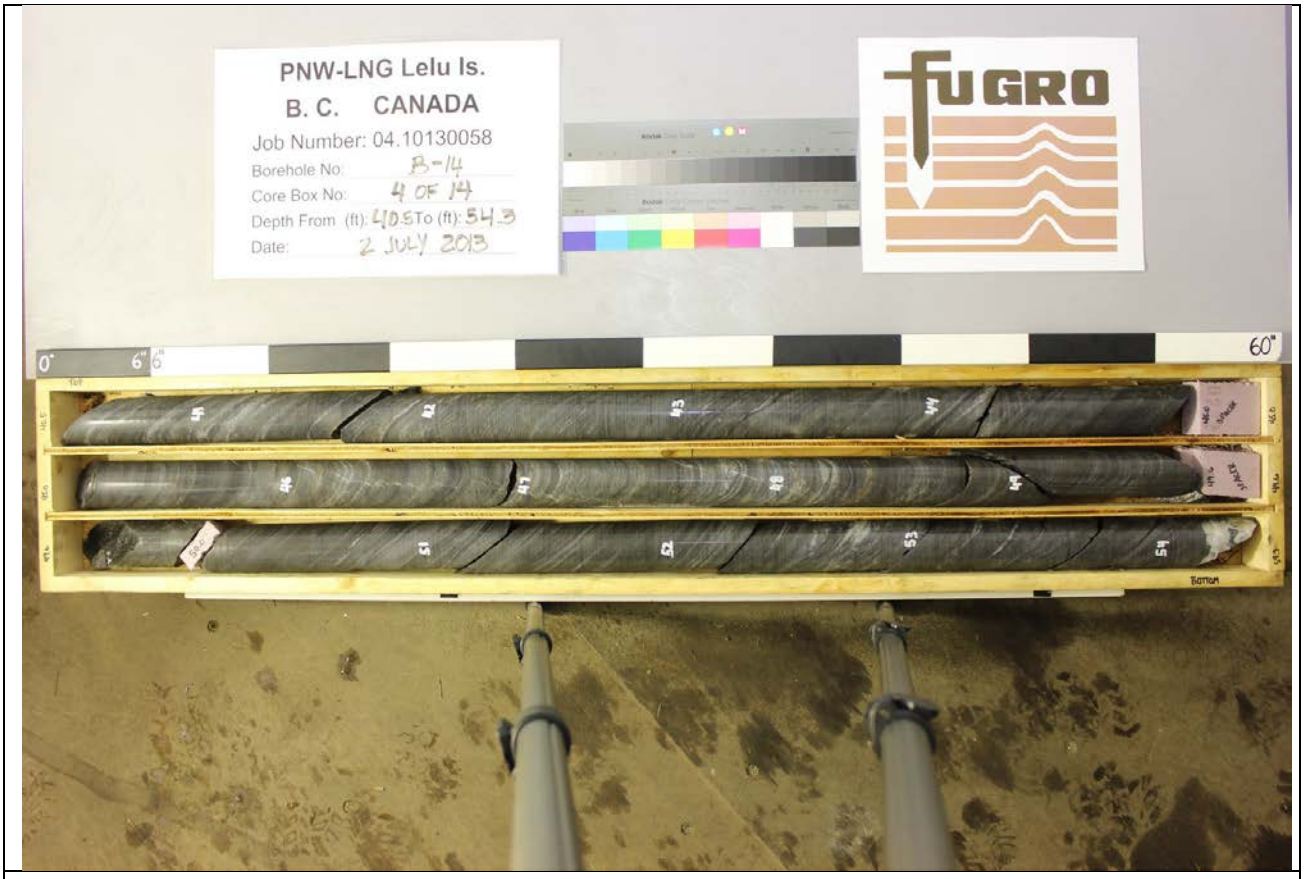
PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-13
Core Box No: 5 OF 7
Depth From (ft): 61.6 To (ft): 78.7
Date: 18 JUNE 2013
FUGRO
0"
6"
60"

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-13
Core Box No: 6 OF 7
Depth From (ft): 78.7 To (ft): 92.75
Date: 18 JUNE 2013
FUGRO
0"
6"
60"

Not Available


PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-14
Core Box No: 2 OF 14
Depth From (ft): 15.1 To (ft): 27.6
Date: 2 JULY 2013
FUGRO
0"
6"
60"
SPACER
SPACER
SPACER
BOTTOM

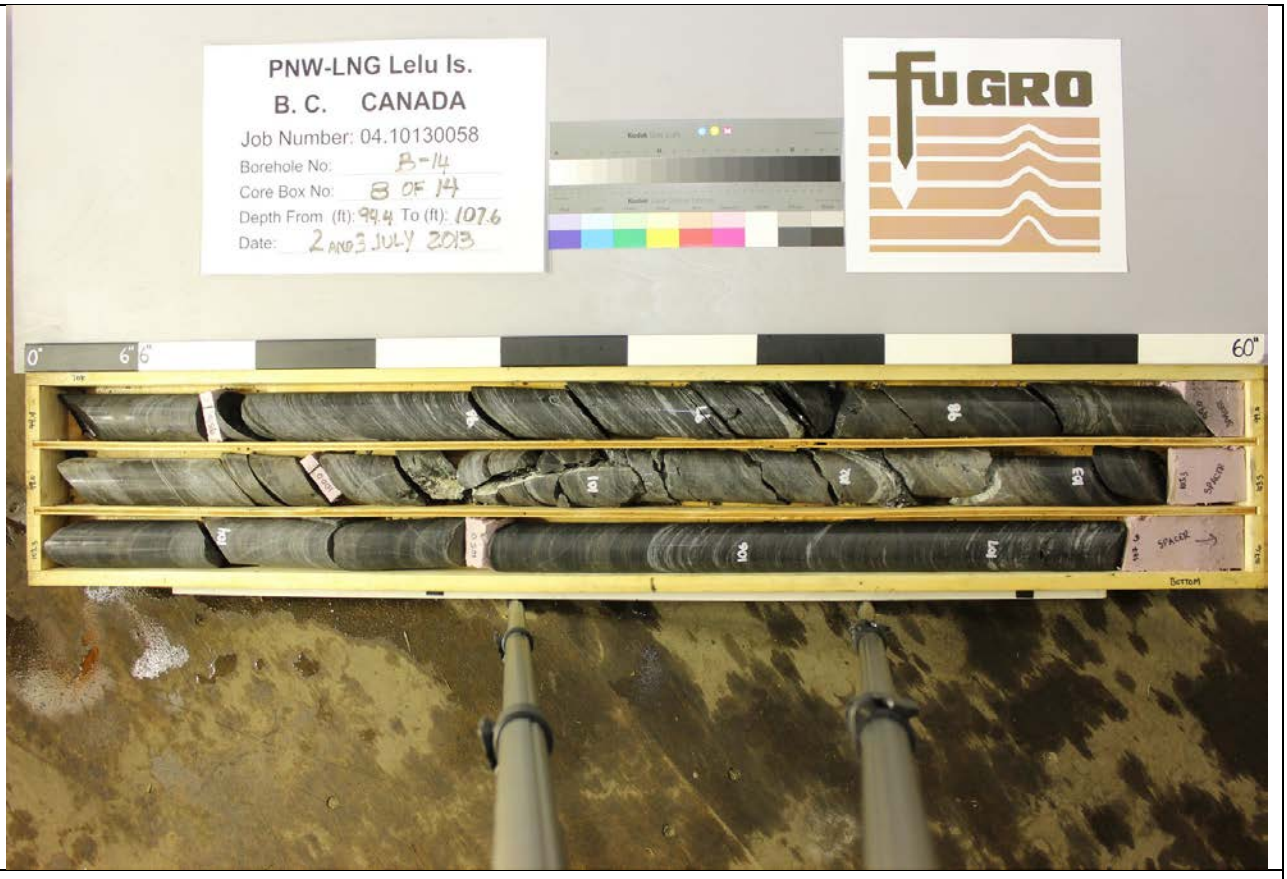

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-14
Core Box No: 3 OF 14
Depth From (ft): 27.6 To (ft): 40.5
Date: 2 JULY 2013
FUGRO
0"
6"
60"
SPACER
SPACER
BOTTOM

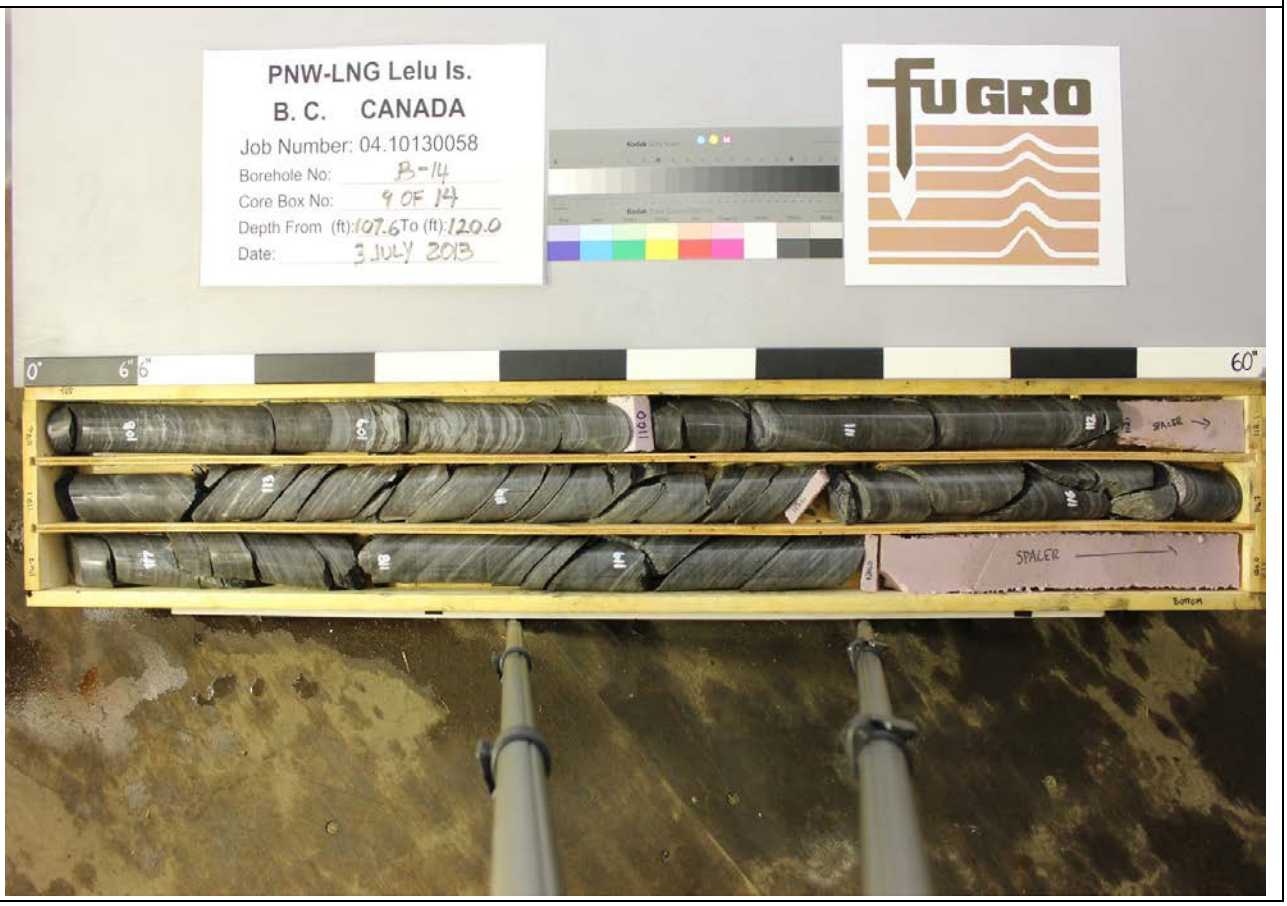

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-14
Core Box No: 4 OF 14
Depth From (ft): 40.5 To (ft): 54.3
Date: 2 JULY 2013
FUGRO
0"
6"
60"

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-14
Core Box No: 5 OF 14
Depth From (ft): 54.3 To (ft): 68.0
Date: 2 JULY 2013
FUGRO
0"
6"
60"

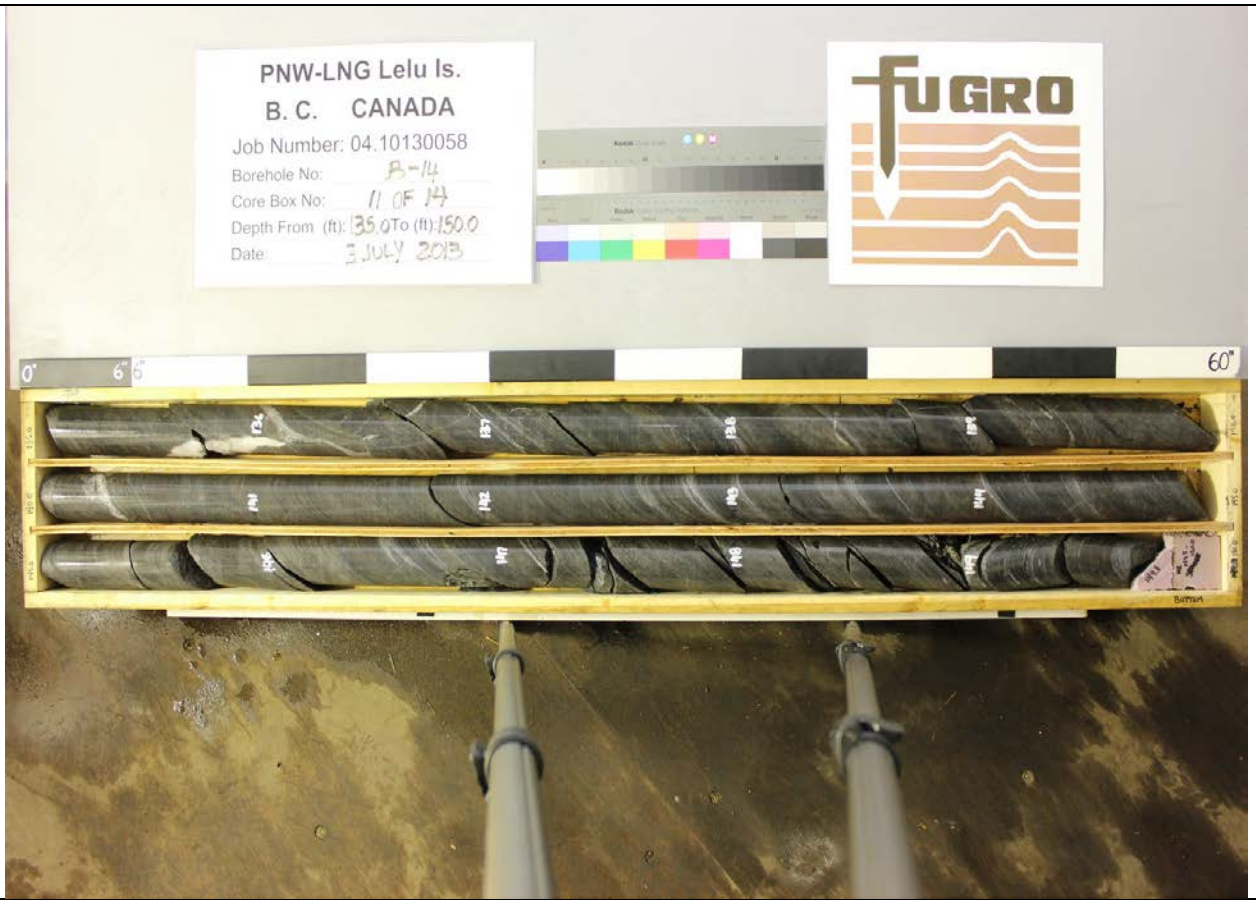
PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-14
Core Box No: 6 OF 14
Depth From (ft): 68.0 To (ft): 82.25
Date: 2 JULY 2013
FUGRO
0"
6"
60"
Bottom

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-14
Core Box No: 7 OF 14
Depth From (ft): 82.25 To (ft): 94.4
Date: 2 JULY 2013
FUGRO
0"
6"
60"
SPACER
SPACER
SPACER
Bottom

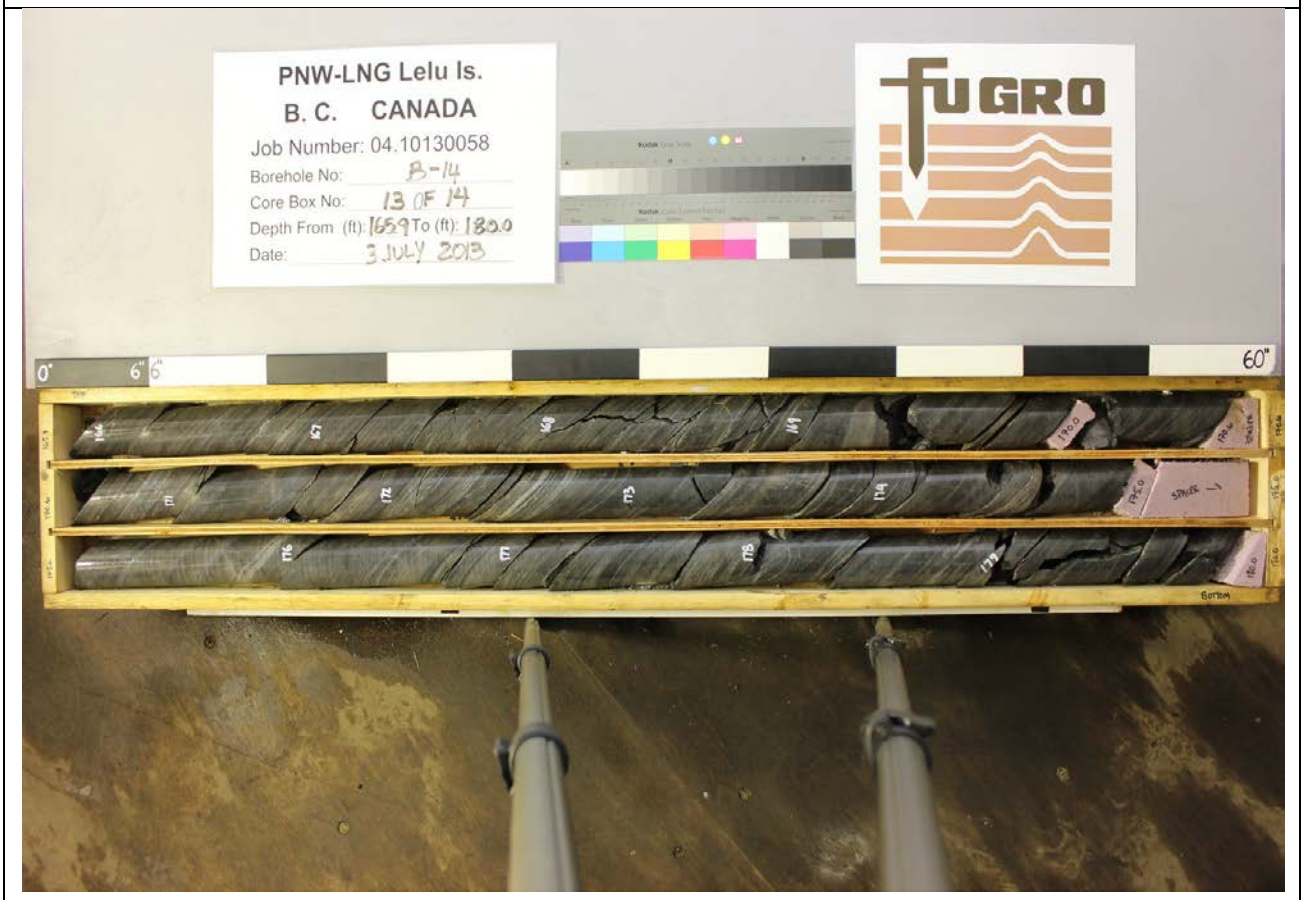

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-14
Core Box No: 8 OF 14
Depth From (ft): 99.4 To (ft): 107.6
Date: 2 AND 3 JULY 2013
FUGRO
0"
6"
60"
SPACER
BOTTOM


PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-14
Core Box No: 9 OF 14
Depth From (ft): 107.6 To (ft): 120.0
Date: 3 JULY 2013
FUGRO
0"
6"
60"
SPACER
SPACER
BOTTOM

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-14
Core Box No: 10 OF 14
Depth From (ft): 120 To (ft): 135.0
Date: 3 JULY 2013
FUGRO
0"
6"
60"


PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-14
Core Box No: 11 OF 14
Depth From (ft): 135.0 To (ft): 150.0
Date: 3 JULY 2013
FUGRO
0"
6"
60"

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-14
Core Box No: 12 OF 14
Depth From (ft): 150.0 To (ft): 165.9
Date: 3 JULY 2013
FUGRO
0"
6"
60"
Bottom


PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-14
Core Box No: 13 OF 14
Depth From (ft): 165.9 To (ft): 180.0
Date: 3 JULY 2013
FUGRO
0"
6"
60"
Bottom

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-14
Core Box No: 14 OF 14
Depth From (ft): 180.0 To (ft): 195.0
Date: 3 JULY 2013
FUGRO
0"
6"
60"
SPACER
BOTTOM

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-15
Core Box No: 1 OF 7
Depth From (ft): 18.6 To (ft): 33.2
Date: 23 JUNE 2013
FUGRO
0"
6"
60"
TOP
SPACER
SPACER
BOTTOM

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-14
Core Box No: 14 OF 14
Depth From (ft): 180.0 To (ft): 195.0
Date: 3 JULY 2013
FUGRO
0"
6"
60"
SPACER
BOTTOM

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-15
Core Box No: 1 OF 7
Depth From (ft): 18.6 To (ft): 33.2
Date: 23 JUNE 2013
FUGRO
0"
6"
60"
TOP
SPACER
SPACER
BOTTOM

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-15
Core Box No: 2 OF 7
Depth From (ft): 33.2 To (ft): 48.0
Date: 23 JUNE 2013
FUGRO
0"
6"
60"
TOP
BOTTOM
NR 42.5-43.0
NR 47.5-48.0

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-15
Core Box No: 3 OF 7
Depth From (ft): 48.0 To (ft): 63.0
Date: 24 JUNE 2013
FUGRO
0"
6"
60"
TOP
BOTTOM

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-15
Core Box No: 4 OF 7
Depth From (ft): 63.0 To (ft): 78.0
Date: 24 JUNE 2013
FUGRO
0"
6"
60"

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-15
Core Box No: 5 OF 7
Depth From (ft): 78.0 To (ft): 92.80
Date: 24 JUNE 2013
FUGRO
0"
6"
60"

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-15
Core Box No: 6 OF 7
Depth From (ft): 92.8 To (ft): 106.5
Date: 24 JUNE 2013
FUGRO
0"
6"
60"
TOP
BOTTOM

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-15
Core Box No: 7 OF 7
Depth From (ft): 106.5 To (ft): 118.0 E.O.B.
Date: 24 JUNE 2013
FUGRO
0"
6"
60"
SPACER
118.0
EOB
BOTTOM

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-16
Core Box No: 1 OF 5
Depth From (ft): 42.0 To (ft): 56.8
Date: 26 JUNE - 27 JUNE - 2013
FUGRO
0'
6"
60"
TOP
42.0
NR
45.5 TO 47.0FT
52.0
BOTTOM

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-16
Core Box No: 2 OF 5
Depth From (ft): 56.8 To (ft): 72.75
Date: 27 JUNE - 2013
FUGRO
0'
6"
60"
TOP
57.0
62.0
SPACER
72.0
BOTTOM

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-16
Core Box No: 3 OF 5
Depth From (ft): 72.75 To (ft): 87.0
Date: 27 JUNE - 2013
FUGRO
0"
6"
60"
TOP
SPACER
BOTTOM

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-16
Core Box No: 4 OF 5
Depth From (ft): 87.0 To (ft): 101.85
Date: 27 JUNE - 2013
FUGRO
0"
6"
60"
TOP
BOTTOM

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-16
Core Box No: 5 OF 5
Depth From (ft): 101.85 To (ft): 107.0
Date: 27 JUNE - 2013
FUGRO
SPACER

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-17
Core Box No: 1 OF 7
Depth From (ft): 10.0 To (ft): 22.0
Date: 20 JUNE 2013
FUGRO
SPACER

PNW-LNG Lelu Island.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-17
Core Box No: 2 OF 7
Depth From(ft): 22.00 To (ft) 36.25
Date: 20 JUNE 2013 – 21 JUNE 2013
FUGRO
0"
6"
60"

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-17
Core Box No: 3 OF 7
Depth From (ft): 36.25 To (ft): 50.5
Date: 21 JUNE 2013
FUGRO
0"
6"
60"

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-17
Core Box No: 4 OF 7
Depth From (ft): 50.5 To (ft): 64.6
Date: 21 JUNE 2013
FUGRO
0"
6"
60"

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-17
Core Box No: 5 OF 7
Depth From (ft): 64.6 To (ft): 81.5
Date: 21 JUNE 2013
FUGRO
0"
6"
60"

PNW-LNG Lelu Island.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-17
Core Box No: 6 OF 7
Depth From(ft): 81.50 To (ft) 96.50
Date: 21 JUNE 2013 - 22 JUNE 2013
FUGRO
0"
6"
60"
BOTTOM

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-17
Core Box No: 7 OF 7
Depth From (ft): 96.50 To (ft): 102.0
Date: 21 JUNE 2013
FUGRO
0"
6"
60"
BOTTOM

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-18
Core Box No: 1 OF 10
Depth From (ft): 2.76 To (ft): 15.0
Date: 23 JUNE 2013
FUGRO
SPACER
SPACER

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-18
Core Box No: 2 OF 10
Depth From (ft): 15.0 To (ft): 29.6
Date: 23 JUNE 2013
FUGRO
SPACER

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-18
Core Box No: 3 OF 10
Depth From (ft): 29.6 To (ft): 44.0
Date: 25 JUNE 2013
FUGRO
0"
6"
60"
SPACER
BOTTOM

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-18
Core Box No: 4 OF 10
Depth From (ft): 44.0 To (ft): 57.7
Date: 25 JUNE 2013
FUGRO
0"
6"
60"
BOTTOM

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-18
Core Box No: 5 OF 10
Depth From (ft): 57.7 To (ft): 69.0
Date: 25 JUNE 2013
FUGRO
0"
6"
60"
SPACER
BOTTOM

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-18
Core Box No: 6 OF 10
Depth From (ft): 69.0 To (ft): 84.0
Date: 25 JUNE 2013
FUGRO
0"
6"
60"
BOTTOM

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-18
Core Box No: 7 OF 10
Depth From (ft): 84.0 To (ft): 95.25
Date: 25 JUNE 2013
FUGRO
0"
6"
60"

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-18
Core Box No: 8 OF 10
Depth From (ft): 95.25 To (ft): 108.5
Date: 25 JUNE 2013
FUGRO
0"
6"
60"

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-18
Core Box No: 9 OF 10
Depth From (ft): 108.5 To (ft): 121.7
Date: 25 JUNE 2013
FUGRO
0"
6"
60"

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-18
Core Box No: 10 OF 10
Depth From (ft): 121.7 To (ft): 124.0 E.O.B.
Date: 25 JUNE 2013
FUGRO
0"
6"
60"
SPACER

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-19
Core Box No: 1 OF 9
Depth From (ft): 3.0 To (ft): 16.2
Date: 27 JUNE 2013
FUGRO
0"
6"
60"
SPACER

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-19
Core Box No: 2 OF 9
Depth From (ft): 16.2 To (ft): 28.2
Date: 27 JUNE 2013
FUGRO
0"
6"
60"
SPACER
SPACER

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-19
Core Box No: 3 OF 9
Depth From (ft): 28.2 To (ft): 38.7
Date: 27 JUNE 2013
FUGRO
0"
6"
60"
SPACER
SPACER
Bottom

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-19
Core Box No: 4 OF 9
Depth From (ft): 38.7 To (ft): 52.5
Date: 27 JUNE 2013
FUGRO
0"
6"
60"
SPACER
SPACER
Bottom

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-19
Core Box No: 5 OF 9
Depth From (ft): 52.5 To (ft): 65.7
Date: 27 JUNE 2013
FUGRO
SPACER

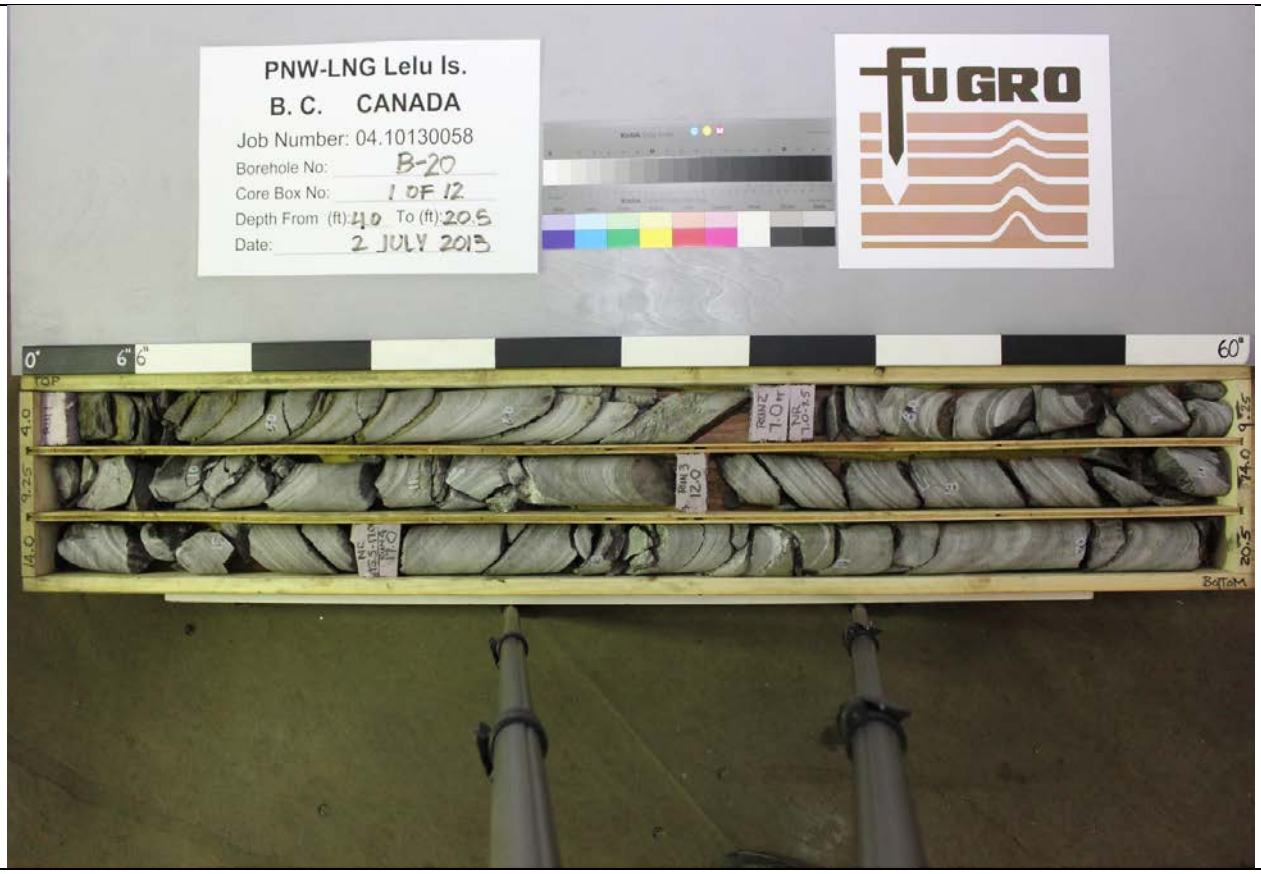
PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-19
Core Box No: 6 OF 9
Depth From (ft): 65.7 To (ft): 79.7
Date: 27 JUNE 2013
FUGRO

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-19
Core Box No: 7 OF 9
Depth From (ft): 79.7 To (ft): 94.1
Date: 27 JUNE 2013
FUGRO
0"
6"
60"

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-19
Core Box No: 8 OF 9
Depth From (ft): 94.1 To (ft): 107.3
Date: 28 JUNE 2013
FUGRO
0"
6"
60"
SPACER

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-19
Core Box No: 9 OF 9
Depth From (ft): 107.3 To (ft): 118.1
Date: 29 JUNE 2013
FUGRO
0"
6"
60"
SPACER
SPACER
SPACER
BOTTOM

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-19A
Core Box No: 1 OF 1
Depth From (ft): 2.0 To (ft): 12.0
Date: 26 JUNE-2013
FUGRO
0"
6"
60"
SPACER
SPACER
SPACER
BOTTOM

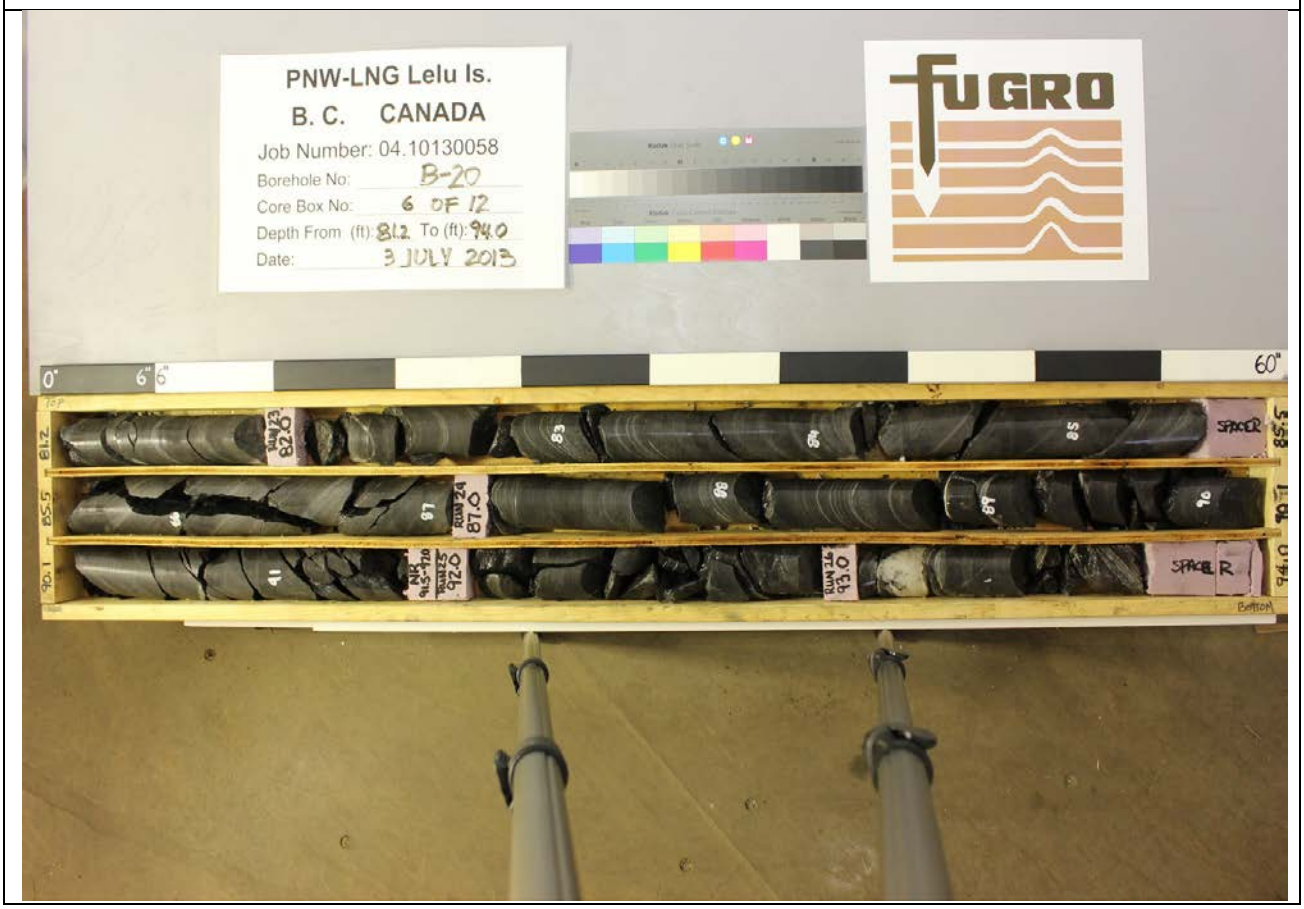

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-20
Core Box No: 1 OF 12
Depth From (ft): 4.0 To (ft): 20.5
Date: 2 JULY 2013
FUGRO
0"
6"
60"
TOP
BOTTOM

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-20
Core Box No: 2 OF 12
Depth From (ft): 20.5 To (ft): 34.0
Date: 2 JULY 2013
FUGRO
0"
6"
60"
TOP
BOTTOM

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-20
Core Box No: 3 OF 12
Depth From (ft): 34.0 To (ft): 49.0
Date: 2 JULY 2013
FUGRO
0"
6"
60"
TOP
BOTTOM

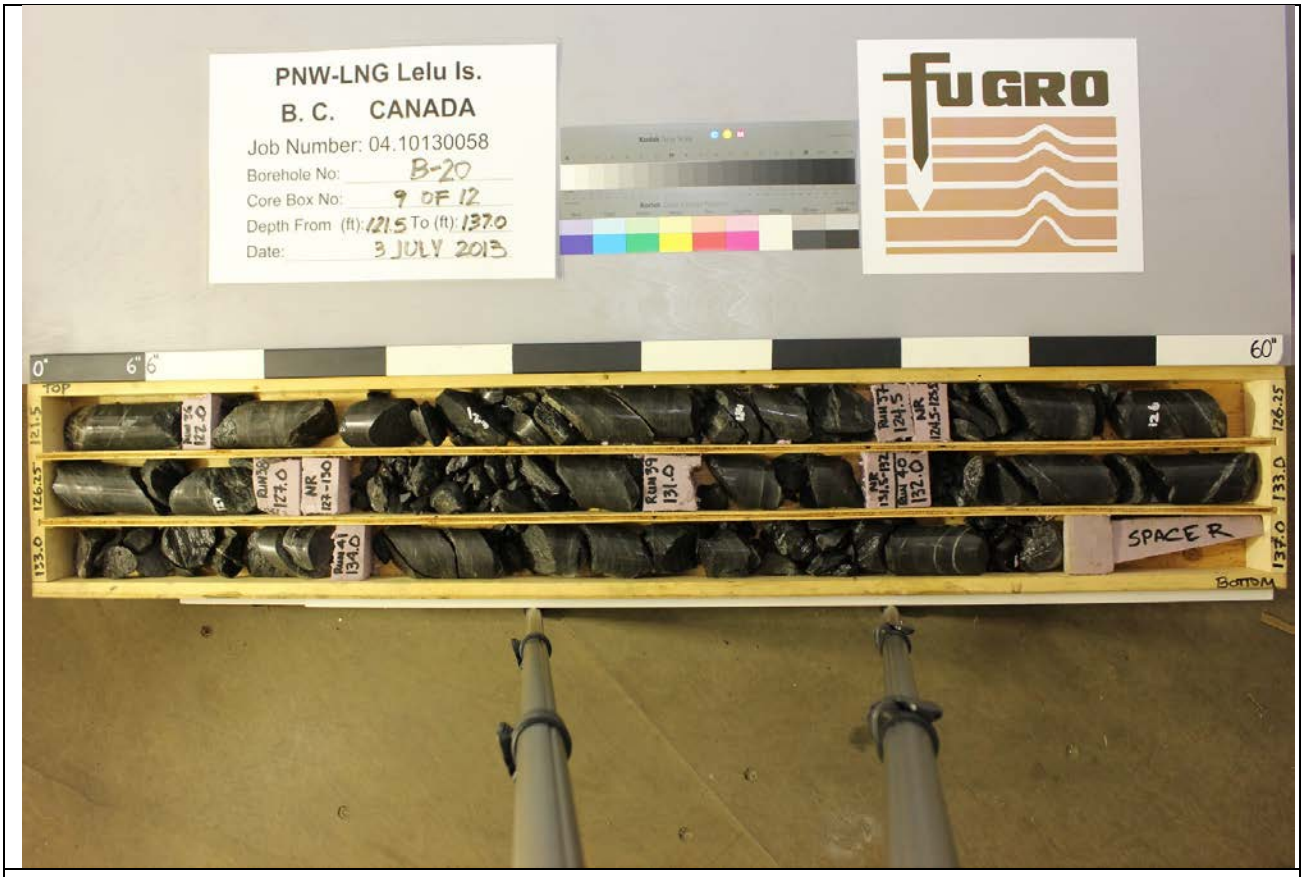
PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-20
Core Box No: 4 OF 12
Depth From (ft): 49.0 To (ft): 63.8
Date: 2 JULY 2013
FUGRO
0"
6"
60"
TOP
BOTTOM

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-20
Core Box No: 5 OF 12
Depth From (ft): 63.8 To (ft): 81.2
Date: 2 AND 3 JULY 2013
FUGRO
0"
6"
60"
TOP
BOTTOM


PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-20
Core Box No: 6 OF 12
Depth From (ft): 81.2 To (ft): 94.0
Date: 3 JULY 2013
FUGRO
0"
6"
60"
TOP
SPACER
SPACER
BOTTOM

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-20
Core Box No: 7 OF 12
Depth From (ft): 94.0 To (ft): 107.0
Date: 3 JULY 2013
FUGRO
0"
6"
60"
TOP
SPACER
SPACER
BOTTOM

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-20
Core Box No: 8 OF 12
Depth From (ft): 107.0 To (ft): 121.5
Date: 3 JULY 2013
FUGRO
0"
6"
60"
TOP
SPACER
BOTTOM


PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-20
Core Box No: 9 OF 12
Depth From (ft): 121.5 To (ft): 137.0
Date: 3 JULY 2013
FUGRO
SPACER
Bottom

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-20
Core Box No: 10 OF 12
Depth From (ft): 137.0 To (ft): 167.0
Date: 3 JULY 2013
FUGRO
Bottom

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-20
Core Box No: 11 OF 12
Depth From (ft): 167.0 To (ft): 187.0
Date: 4 JULY 2013
FUGRO
0"
6"
60"
Bottom

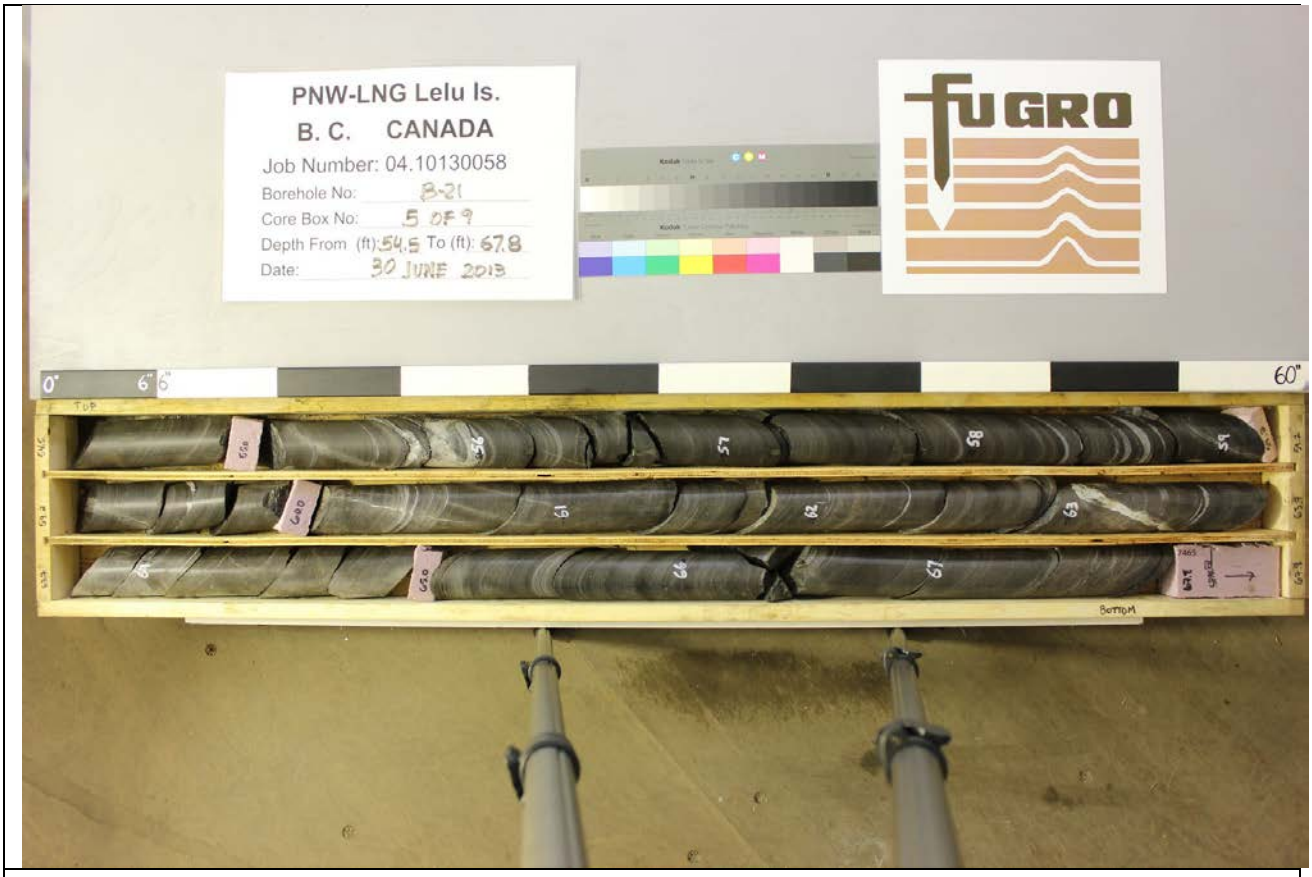
PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-20
Core Box No: 12 OF 12
Depth From (ft): 187.0 To (ft): 195.0 EOB
Date: 4 JULY 2013
FUGRO
0"
6"
60"
Bottom

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-21
Core Box No: 1 OF 9
Depth From (ft): 0.0 To (ft): 14.7
Date: 29 JUNE 2013
FUGRO
0"
6"
60"

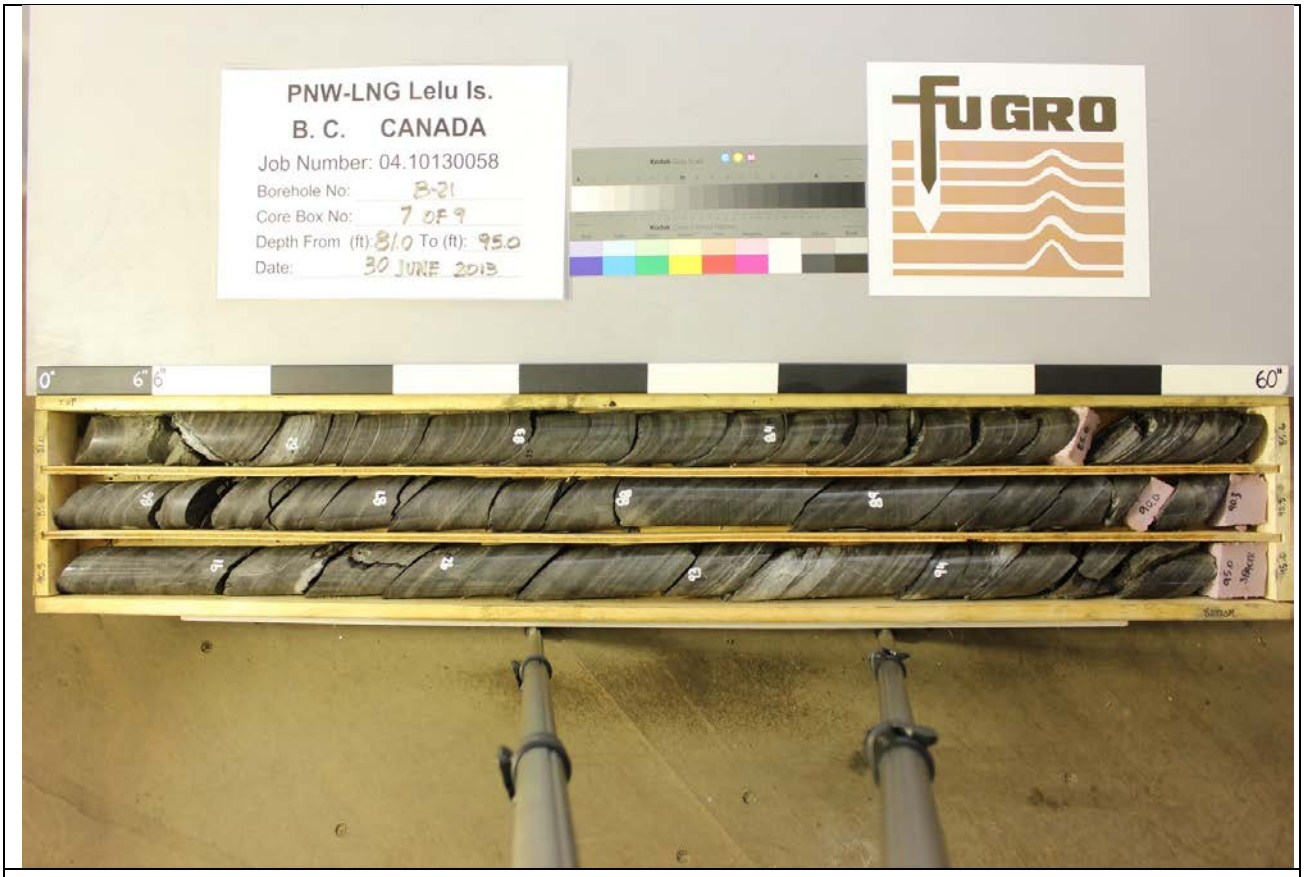
PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-21
Core Box No: 2 OF 9
Depth From (ft): 14.7 To (ft): 28.0
Date: 29 JUNE 2013
FUGRO
0"
6"
60"

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-21
Core Box No: 3 OF 9
Depth From (ft): 28.0 To (ft): 40.6
Date: 29 JUNE 2013
FUGRO
0"
6"
60"

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-21
Core Box No: 4 OF 9
Depth From (ft): 40.6 To (ft): 54.5
Date: 29 JUNE 2013
FUGRO
0"
6"
60"

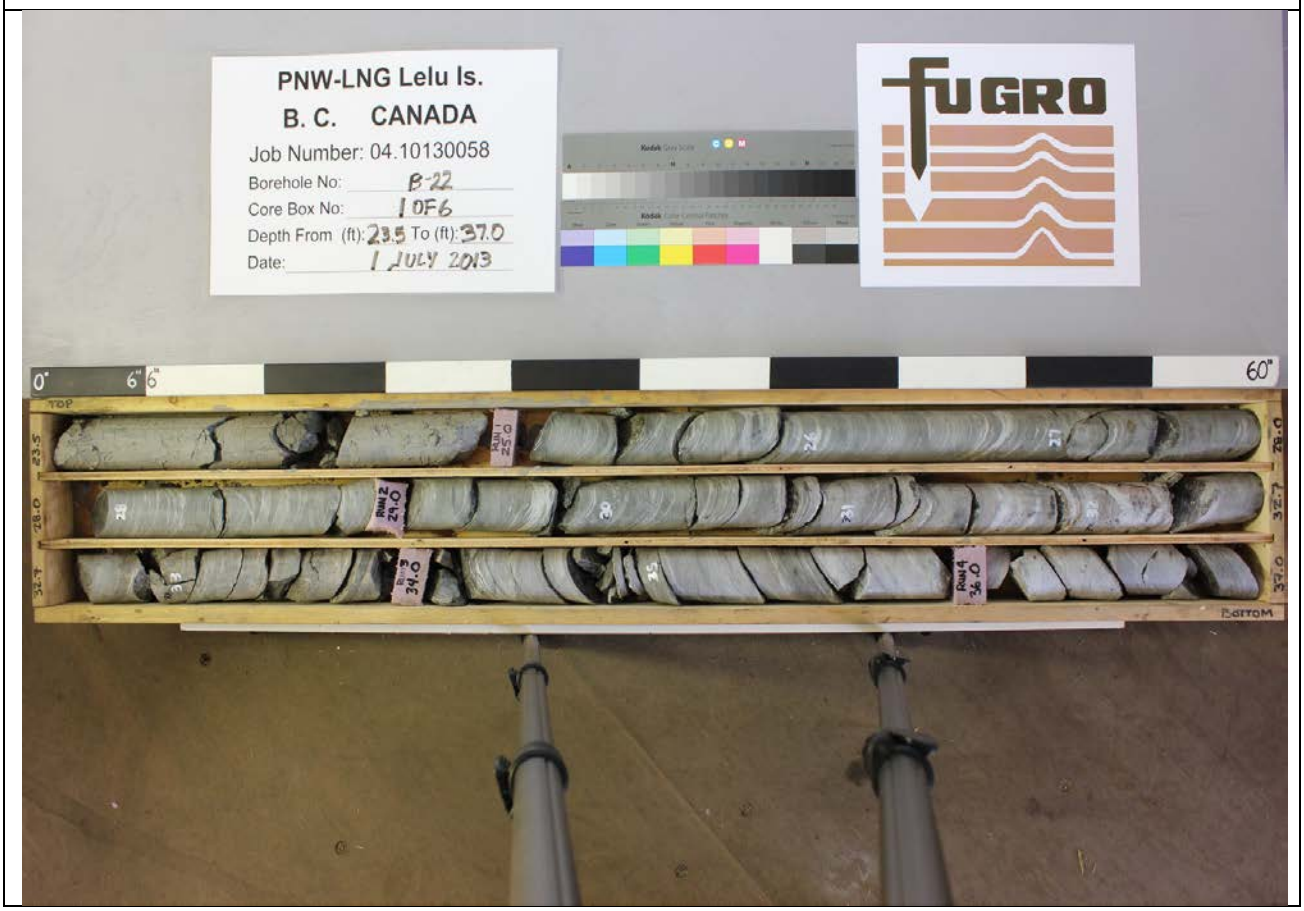

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-21
Core Box No: 5 OF 9
Depth From (ft): 54.5 To (ft): 67.8
Date: 30 JUNE 2013
FUGRO
0"
6"
60"
BOTTOM

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-21
Core Box No: 6 OF 9
Depth From (ft): 67.8 To (ft): 81.0
Date: 30 JUNE 2013
FUGRO
0"
6"
60"
SPACER
BOTTOM


PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-21
Core Box No: 7 OF 9
Depth From (ft): 81.0 To (ft): 95.0
Date: 30 JUNE 2019
FUGRO
0"
6"
60"

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-21
Core Box No: 8 OF 9
Depth From (ft): 95.0 To (ft): 110.0
Date: 30 JUNE 2019
FUGRO
0"
6"
60"

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-21
Core Box No: 9 OF 9
Depth From (ft): 110.0 To (ft): 115.0 EOB
Date: 30 JUNE 2013
FUGRO
0"
6"
6"
60"
TOP
BOTTOM

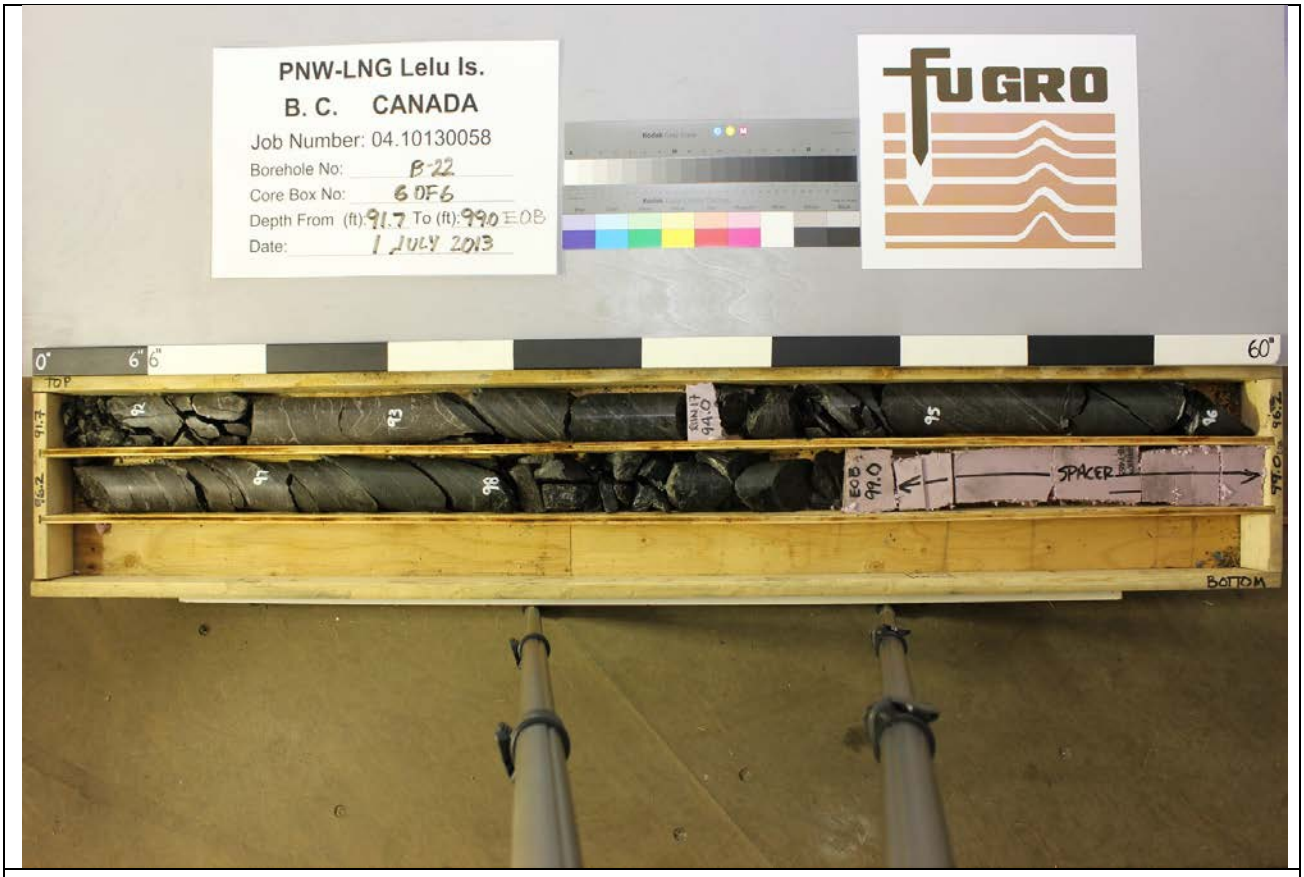

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-22
Core Box No: 1 OF 6
Depth From (ft): 23.5 To (ft): 37.0
Date: 1 JULY 2013
FUGRO
0"
6"
6"
60"
TOP
BOTTOM

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-22
Core Box No: 2 OF 6
Depth From (ft): 37.0 To (ft): 50.7
Date: 1 JULY 2013
FUGRO
0"
6"
60"
Run 5 37.0
Run 6 44.0
Run 7 49.0
Bottom

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-22
Core Box No: 3 OF 6
Depth From (ft): 50.7 To (ft): 64.0
Date: 1 JULY 2013
FUGRO
0"
6"
60"
Run 8 51.5
Run 9 54.0
Run 10 59.0
SINKER
BOTTOM

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-22
Core Box No: 4 OF 6
Depth From (ft): 64.0 To (ft): 77.3
Date: 1 JULY 2013
FUGRO
0"
6"
60"
TOP
BOTTOM
SPACER

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-22
Core Box No: 5 OF 6
Depth From (ft): 77.3 To (ft): 91.7
Date: 1 JULY 2013
FUGRO
0"
6"
60"
TOP
BOTTOM


PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-22
Core Box No: 6 OF 6
Depth From (ft): 91.7 To (ft): 99.0 EOB
Date: 1 JULY 2013
FUGRO
0"
6"
60"
TOP
BOTTOM
SPACER
EOB 99.0

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-24
Core Box No: 1 OF 14
Depth From (ft): 8.0 To (ft): 32.25
Date: 8 JULY 2013
FUGRO
0"
6"
48"
TOP
BOTTOM

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-22
Core Box No: 6 OF 6
Depth From (ft): 91.7 To (ft): 99.0 EOB
Date: 1 JULY 2013
FUGRO
0"
6"
60"
TOP
SPACER
EOB 99.0
BOTTOM

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-24
Core Box No: 1 OF 14
Depth From (ft): 8.0 To (ft): 32.25
Date: 8 JULY 2013
FUGRO
0"
6"
48"
BOTTOM

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-24
Core Box No: 2 OF 14
Depth From (ft): 32.25 To (ft): 49.0
Date: 8 July 2013
FUGRO
0"
6"
48
SPACER
BOTTOM

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-24
Core Box No: 3 OF 14
Depth From (ft): 49.0 To (ft): 65.0
Date: 8 July 2013
FUGRO
0"
6"
48

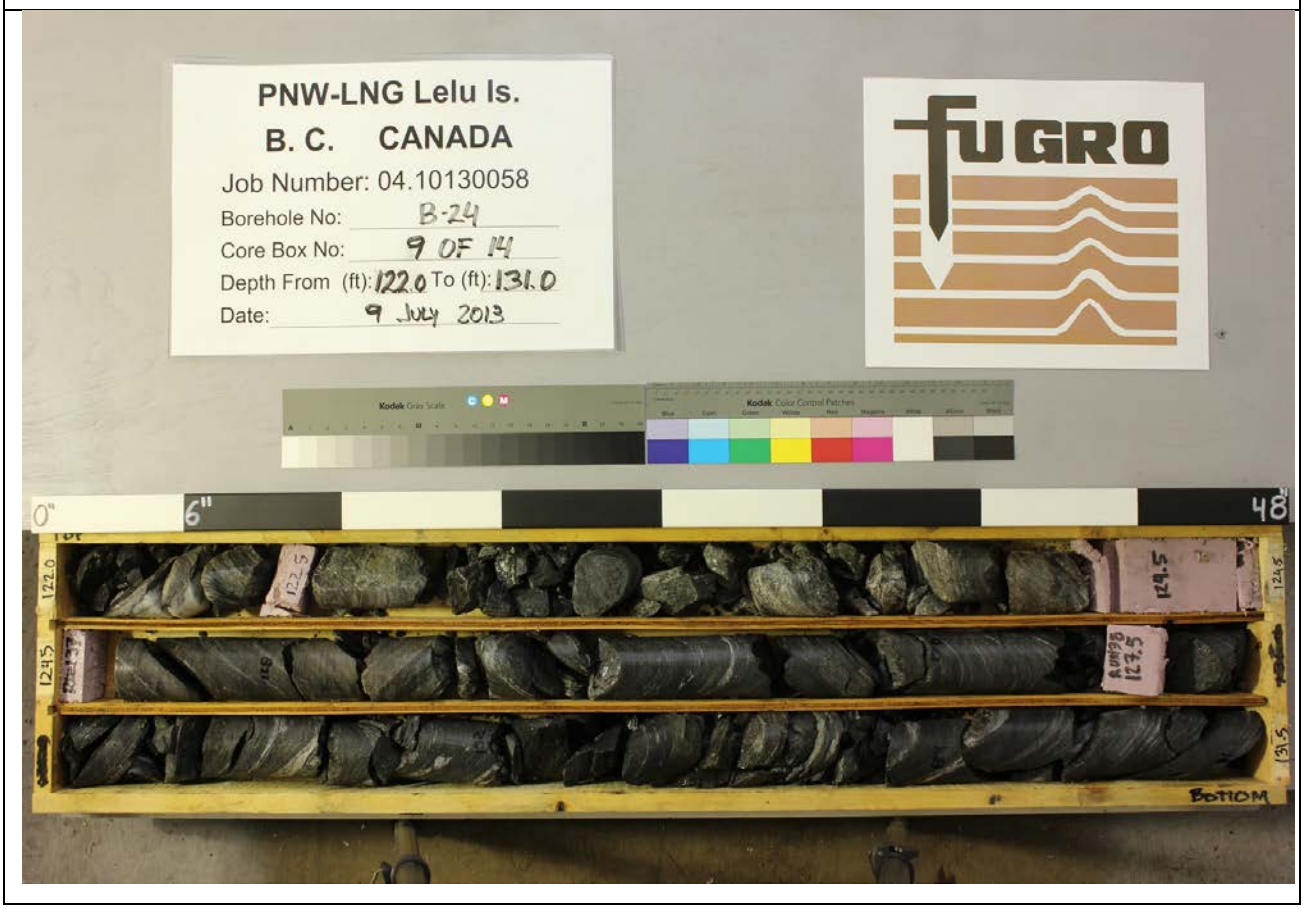
PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-24
Core Box No: 4 OF 14
Depth From (ft): 65.0 To (ft): 78.5
Date: July 2013
FUGRO
0"
6"
48"
BOTTOM

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-24
Core Box No: 5 OF 14
Depth From (ft): 78.5 To (ft): 90.0
Date: 9 July 2013
FUGRO
0"
6"
48"
SPACER
Bottom

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-24
Core Box No: 6 OF 14
Depth From (ft): 90.0 To (ft): 100.0
Date: 9 July 2013
FUGRO
0"
6"
48"
BOTTOM

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-24
Core Box No: 7 OF 14
Depth From (ft): 100.0 To (ft): 110.0
Date: 9 July 2013
FUGRO
0"
6"
48"
SPACER
SPACER
BOTTOM

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-24
Core Box No: 8 OF 14
Depth From (ft): 110.0 To (ft): 122.0
Date: 9 July 2013
FUGRO
0"
6"
48"
BOTTOM


PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-24
Core Box No: 9 OF 14
Depth From (ft): 122.0 To (ft): 131.0
Date: 9 July 2013
FUGRO
0"
6"
48"
BOTTOM

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-24
Core Box No: 10 OF 14
Depth From (ft): 131.5 To (ft): 141.8
Date: 9 July 2013
FUGRO
0"
6"
48"
BOTTOM

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-24
Core Box No: 11 OF 14
Depth From (ft): 141.8 To (ft): 152.5
Date: 9 July 2013
FUGRO
0"
6"
48"
BOTTOM

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-24
Core Box No: 12 OF 14
Depth From (ft): 152.5 To (ft): 163.5
Date: 9 July 2013
FUGRO
0"
6"
48
BOTTOM

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-24
Core Box No: 13 OF 14
Depth From (ft): 163.5 To (ft): 174.5
Date: 9 July 2013
FUGRO
0"
6"
48
BOTTOM

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-24
Core Box No: 14 OF 14
Depth From (ft): 174.5 To (ft): 177.0 E.O.B
Date: 9 July 2013
FUGRO
0"
6"
48"
SPACER

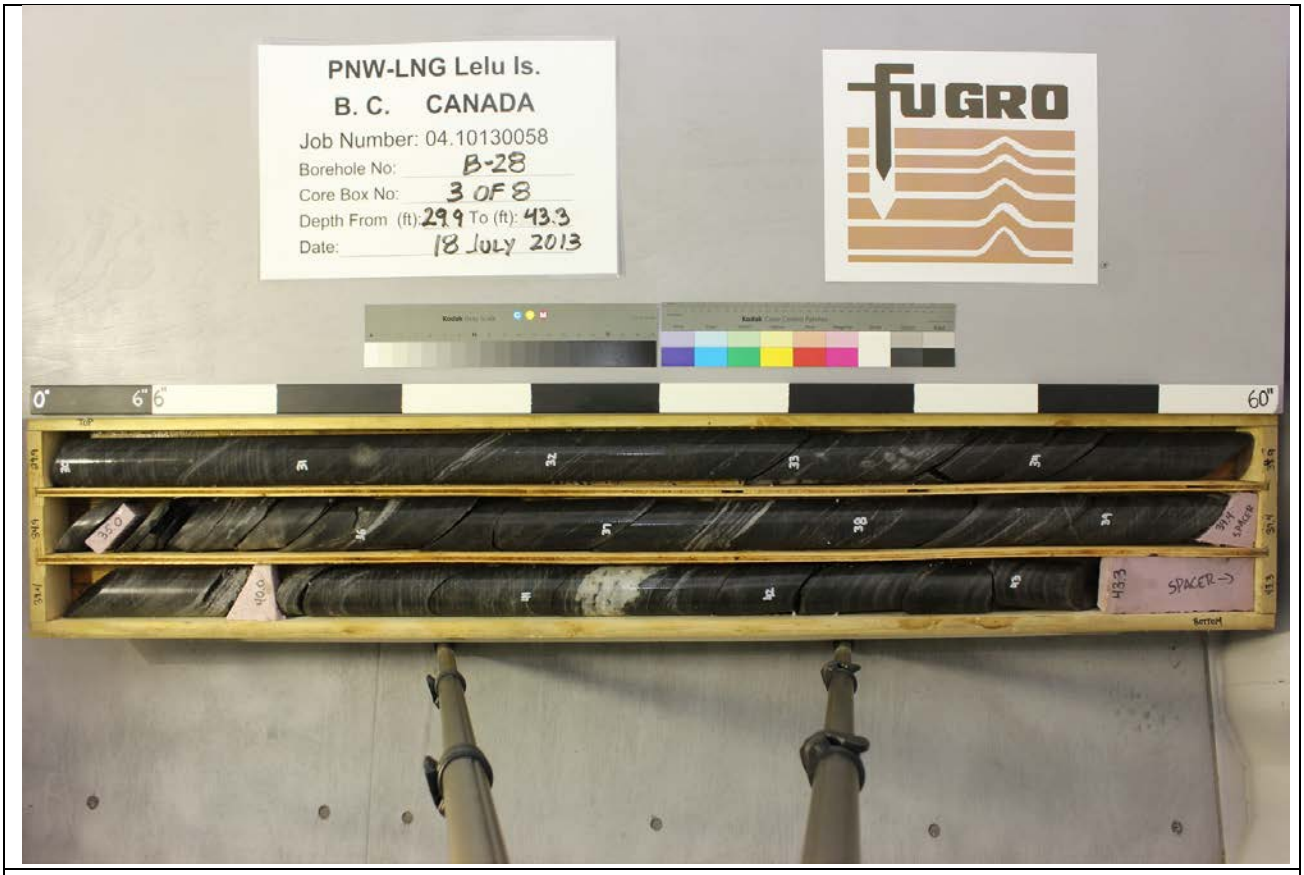
PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-27
Core Box No: 1 OF 3
Depth From (ft): 30.0 To (ft): 45.0
Date: 10 JULY 2013
FUGRO
0"
6"
60"
SPACER
BOTTOM

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-27
Core Box No: 2 OF 3
Depth From (ft): 45.0 To (ft): 57.3
Date: 10 JULY 2013
FUGRO
0"
6"
60"
SPACER
SPACER

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-27
Core Box No: 3 OF 3
Depth From (ft): 57.3 To (ft): 65.0 E.O.B.
Date: 10 JULY 2013
FUGRO
0"
6"
60"
SPACER

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-28
Core Box No: 1 OF 8
Depth From (ft): 6.0 To (ft): 19.0
Date: 17 AND 18 JULY 2013
fuGRO
0"
6"
60"
SPACER
SPACER

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-28
Core Box No: 2 OF 8
Depth From (ft): 19.0 To (ft): 29.9
Date: 18 JULY 2013
fuGRO
0"
6"
60"
SPACER
SPACER
SPACER
SPACER


PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-28
Core Box No: 3 OF 8
Depth From (ft): 299 To (ft): 433
Date: 18 JULY 2013
FUGRO
0"
6"
60"
SPACER ->
BOTTOM

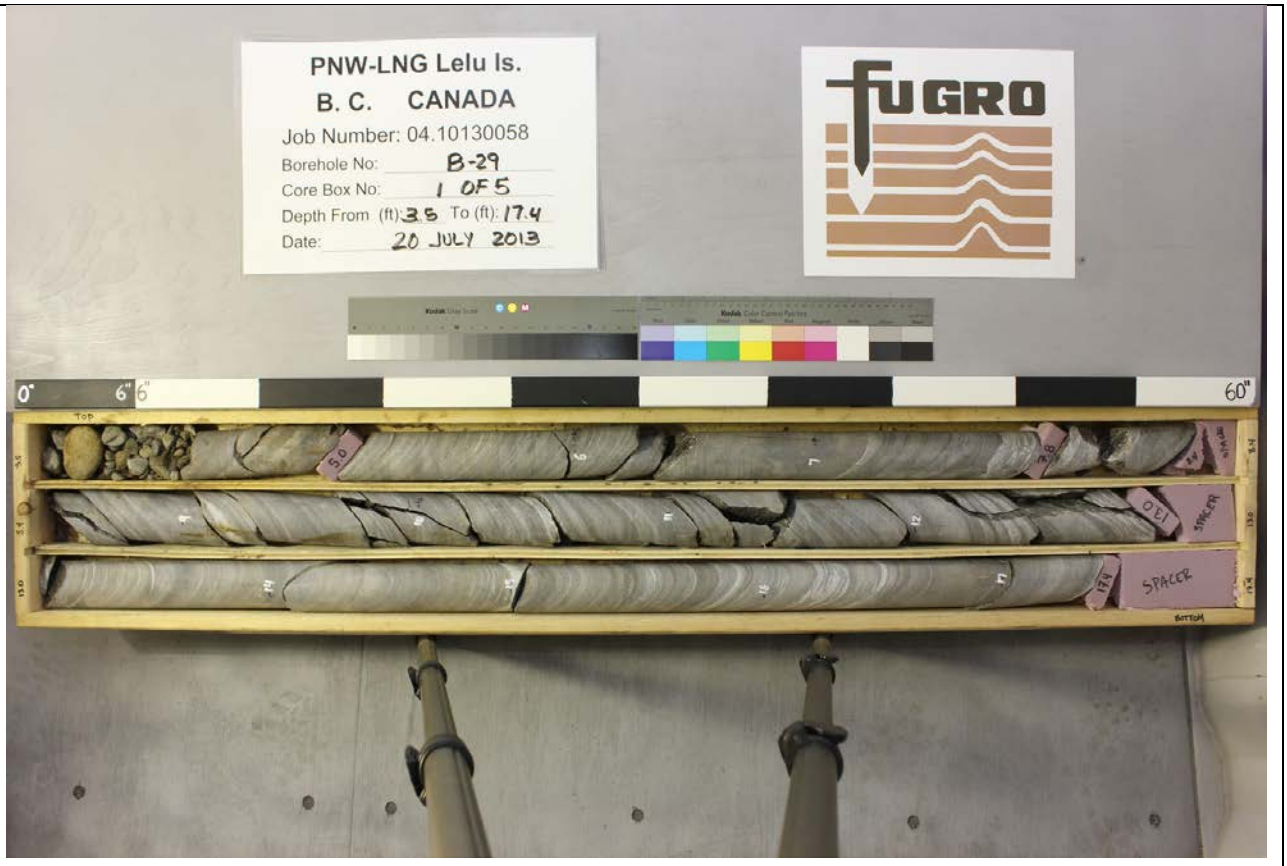
PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-28
Core Box No: 4 OF 8
Depth From (ft): 433 To (ft): 539
Date: 18 JULY 2013
FUGRO
0"
6"
48"
SPACER
BOTTOM

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-28
Core Box No: 5 OF 8
Depth From (ft): 53.9 To (ft): 64.3
Date: 18 JULY 2013
FUGRO
0"
6"
48"
SPACER
BOTTOM

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-28
Core Box No: 6 OF 8
Depth From (ft): 64.3 To (ft): 73.0
Date: 18 JULY 2013
FUGRO
0"
6"
48"
SPACER
SPACER
SPACER
BOTTOM

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-28
Core Box No: 7 OF 8
Depth From (ft): 73.0 To (ft): 87.1
Date: 18 JULY 2013
FUGRO
0"
6"
60"

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-28
Core Box No: 8 OF 8
Depth From (ft): 87.1 To (ft): 100.0 E.O.B
Date: 18 JULY 2013
FUGRO
0"
6"
60"
SPACER
SPACER
SPACER
SPACER


PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-29
Core Box No: 1 OF 5
Depth From (ft): 3.5 To (ft): 17.4
Date: 20 JULY 2013
FUGRO
0"
6"
60"
SPACER
SPACER

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-29
Core Box No: 2 OF 5
Depth From (ft): 17.4 To (ft): 31.0
Date: 20 JULY 2013
FUGRO
0"
6"
60"
SPACER

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-29
Core Box No: 3 OF 5
Depth From (ft): 31.0 To (ft): 44.8
Date: 20 JULY 2013
FUGRO
0"
6"
60"
32.8
38.0
43.0
BOTTOM

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-29
Core Box No: 4 OF 5
Depth From (ft): 44.8 To (ft): 57.8
Date: 20 JULY 2013
FUGRO
0"
6"
60"
48.0
53.0
SPACER
BOTTOM

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-29
Core Box No: 5 OF 5
Depth From (ft): 57.8 To (ft): 68.0 E.O.B.
Date: 20 JULY 2013
FUGRO
0"
6"
60"
SPACER
SPACER
BOTTOM

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-30
Core Box No: 1 OF 5
Depth From (ft): 8.7 To (ft): 22.0
Date: 17 JULY 2013
FUGRO
0"
6"
48"

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-30
Core Box No: 2 OF 5
Depth From (ft): 22.0 To (ft): 32.0
Date: 17 JULY 2013
FUGRO
0"
6"
48"

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-30
Core Box No: 3 OF 5
Depth From (ft): 32.0 To (ft): 42.6
Date: 17 JULY 2013
FUGRO
0"
6"
48"

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-30
Core Box No: 4 OF 5
Depth From (ft): 42.6 To (ft): 54.1
Date: 17 JULY 2013
FUGRO
0"
6"
48

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-30
Core Box No: 5 OF 5
Depth From (ft): 54.1 To (ft): 70.5 E.O.B.
Date: 18 JULY 2013
FUGRO
0"
6"
48

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-31B
Core Box No: 1 OF 6
Depth From (ft): 6.6 To (ft): 19.5
Date: 15 JULY 2013
FUGRO
0"
6"
48"

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-31B
Core Box No: 2 OF 6
Depth From (ft): 19.5 To (ft): 31.0
Date: 15 AND 16 JULY 2013
FUGRO
0"
6"
48"

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-31B
Core Box No: 3 OF 6
Depth From (ft): 31.0 To (ft): 41.9
Date: 16 JULY 2013
FUGRO

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-31B
Core Box No: 4 OF 6
Depth From (ft): 41.9 To (ft): 52.8
Date: 16 JULY 2013
FUGRO

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-31B
Core Box No: 5 OF 6
Depth From (ft): 52.8 To (ft): 63.7
Date: 16 JULY 2013
FUGRO
0"
6"
48"

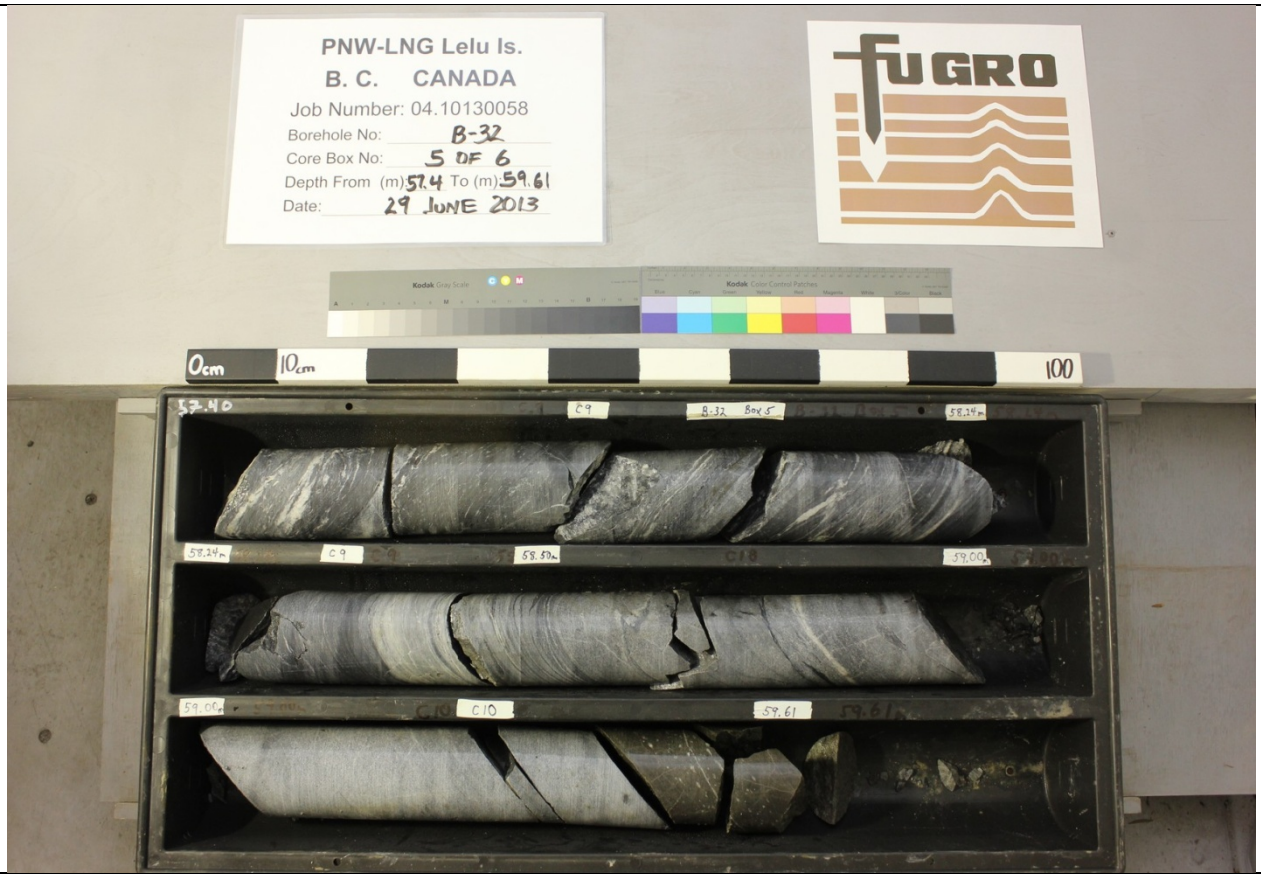
PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-31B
Core Box No: 6 OF 6
Depth From (ft): 63.7 To (ft): 66.7 E.O.B
Date: 16 JULY 2013
FUGRO
0"
6"
48"

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-32
Core Box No: 1 OF 6
Depth From (m): 46.5 To (m): 49.35
Date: 28 JUNE 2013
FUGRO
0cm
10cm
100
46.5
C-1
47.45
C-1
48.0
C-2
C-2
48.95
C-3
49.35

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-32
Core Box No: 2 OF 6
Depth From (m): 49.35 To (m): 52.35
Date: 28 AND 29 JUNE 2013
FUGRO
0cm
10cm
100
49.35
C-3
50.35
50.35
50.55
C-4
51.30
51.30
C-4
51.95
C-5
52.35

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-32
Core Box No: 3 OF 6
Depth From (m): 52.35 To (m): 54.85
Date: 29 JUNE 2013
FUGRO
0cm
10cm
100
52.35
C-5
53.25
53.25
53.55
C-6
54.02
54.02
C-6
54.85

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-32
Core Box No: 4 OF 6
Depth From (m): 54.85 To (m): 57.4
Date: 29 JUNE 2013
FUGRO
0cm
10cm
100
54.85
C-6
55.05
C-7
55.55
55.55
C-7
56.43
56.55
C-8
57.40


PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-32
Core Box No: 5 OF 6
Depth From (m): 57.4 To (m): 59.61
Date: 29 JUNE 2013
FUGRO
0cm
10cm
100
57.40
C9
B-32 Box 5
58.24m
58.50m
59.00m
59.61
C10

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-32
Core Box No: 6 OF 6
Depth From (m): 59.61 To (m): 61.4 E.O.B.
Date: 29 JUNE 2013
FUGRO
0cm
10cm
100
59.61m
C10
60.00
C11
60.25m
B-32 BOX 6
C12
61.15m
61.40m
E.O.B.

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-33
Core Box No: 1 OF 3
Depth From (m): 63.0 To (m): 66.5
Date: 2 JULY 2013
FUGRO
0cm
10cm
100
63.0
C-1
64.0
64.0
C-2
65.0
65.0 65.5
C-3
66.5

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-33
Core Box No: 2 OF 3
Depth From (m): 66.5 To (m): 69.5
Date: 2 JULY 2013
FUGRO
0cm
10cm
100
66.5
C-3
67.0
C-4
67.5
67.5
C-4
68.5
68.5
C-5
69.5

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-33
Core Box No: 3 OF 3
Depth From (m): 69.5 To (m): 71.5 EOB
Date: 2 July 2013
FUGRO
0cm
10cm
100
69.5
C-5
70.0
C-6
70.5
70.5
C-7
71.5

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-34A
Core Box No: 1 OF 3
Depth From (m): 41.0 To (m): 44.7
Date: 18 July 2013
FUGRO
0cm
10cm
100
41.0m
C1
B-34A BOX 1
41.60m
42.20m
C2
42.60m
42.88m
C2
43.70m
43.7m
C3
44.2m
C4
44.7m

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-34A
Core Box No: 2 OF 3
Depth From (m): 44.7 To (m): 47.0
Date: 18 July 2013
FUGRO
0cm
10cm
100
44.7M
C4
45.34M
45.34M
C4
45.7M
C5
46.2M
45.7
46.2M
C5
47.0M

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-34A
Core Box No: 3 OF 3
Depth From (m): 47.0 To (m): 50.0 EOB
Date: 18 July 2013
FUGRO
0cm
10cm
100
TOP 47.0M
C6
47.5M
C7
48.0M
47.5
48.0M
C7
48.5M
C8
49.0m
48.5
49.0M
C9
49.5m
C10
NR
50.0M
49.5
NR
49.75-50.0

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-38
Core Box No: 1 OF 11
Depth From (m): 2.0 To (m): 4.8
Date: 22 JUNE 2013
FUGRO
0cm
10cm
100
2.0
C1
2.4
C-2
4.0
C-3
4.8

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-38
Core Box No: 2 OF 11
Depth From (m): 4.8 To (m): 7.5
Date: 22 JUNE 2013
FUGRO
0cm
10cm
100
4.8
C-3
5.4
C-4
6.9
C-5
7.5m

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-38
Core Box No: 3 OF 11
Depth From (m): 7.5 To (m): 10.3
Date: 22 JUNE 2013
FUGRO
0cm
10cm
100
C5
C6
C6
C7

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-38
Core Box No: 4 OF 11
Depth From (m): 10.3 To (m): 12.7
Date: 22 JUNE 2013
FUGRO
0cm
10cm
100
C7
Box 4
C7
C8
C8

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-38
Core Box No: 5 OF 11
Depth From (m): 12.7 To (m): 15.33
Date: 22 JUNE 2013
FUGRO
0cm
10cm
100
BOX 5
C8
C9
C10

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-38
Core Box No: 6 OF 11
Depth From (m): 15.33 To (m): 18.03
Date: 22 JUNE 2013
FUGRO
0cm
10cm
100
BOX 6
C10
C11
C12

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-38
Core Box No: 7 OF 11
Depth From (m): 18.03 To (m): 20.20
Date: 22 JUNE 2013
FUGRO
0cm
10cm
100
C-12
B-38 Box 7
C-13
C-13

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-38
Core Box No: 8 OF 11
Depth From (m): 20.20 To (m): 23.07
Date: 22 JUNE 2013
FUGRO
0cm
10cm
100
C-14
C-14

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-38
Core Box No: 9 OF 11
Depth From (m): 23.07 To (m): 25.90
Date: 22 JUNE 2013
FUGRO
0cm
10cm
100

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-38
Core Box No: 10 OF 11
Depth From (m): 25.90 To (m): 28.40
Date: 22 JUNE 2013
FUGRO
0cm
10cm
100

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-38
Core Box No: 11 OF 11
Depth From (m): 28.4 To (m): 30.5 E.O.B.
Date: 22 AND 24 JUNE 2013
FUGRO
0cm
10cm
100
C 2.1
C 2.2
E.O.B.

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-39
Core Box No: 1 OF 12
Depth From (m): 0.5 To (m): 2.85
Date: 25 - 27 JUNE 2013
FUGRO
0cm
10cm
100
C1
C2

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-39
Core Box No: 2 OF 12
Depth From (m): 2.85 To (m): 5.47
Date: 25 - 27 JUNE 2013
FUGRO
0cm
10cm
100

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-39
Core Box No: 3 OF 12
Depth From (m): 5.47 To (m): 7.84
Date: 25 - 27 JUNE 2013
FUGRO
0cm
10cm
100

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-39
Core Box No: 4 OF 12
Depth From (m): 7.84 To (m): 10.1
Date: 25 - 27 JUNE 2013
FUGRO
0cm
10cm
100
C6
C7
C-8
C-9

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-39
Core Box No: 5 OF 12
Depth From (m): 10.1 To (m): 12.68
Date: 25 - 27 JUNE 2013
FUGRO
0cm
10cm
100
BOX 5
C-9
C-10

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-39
Core Box No: 6 OF 12
Depth From (m): 12.68 To (m): 15.18
Date: 25 - 27 JUNE 2013
FUGRO
0cm
10cm
100
BOX 6

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-39
Core Box No: 7 OF 12
Depth From (m): 15.18 To (m): 17.58
Date: 25 - 27 JUNE 2013
FUGRO
0cm
10cm
100
BOX 7

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-39
Core Box No: 8 OF 12
Depth From (m): 17.58 To (m): 20.08
Date: 25 - 27 JUNE 2013
FUGRO
0cm
10cm
100
BOX 8

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-39
Core Box No: 9 OF 12
Depth From (m): 20.08 To (m): 22.65
Date: 25 - 27 JUNE 2013
FUGRO
0cm
10cm
100

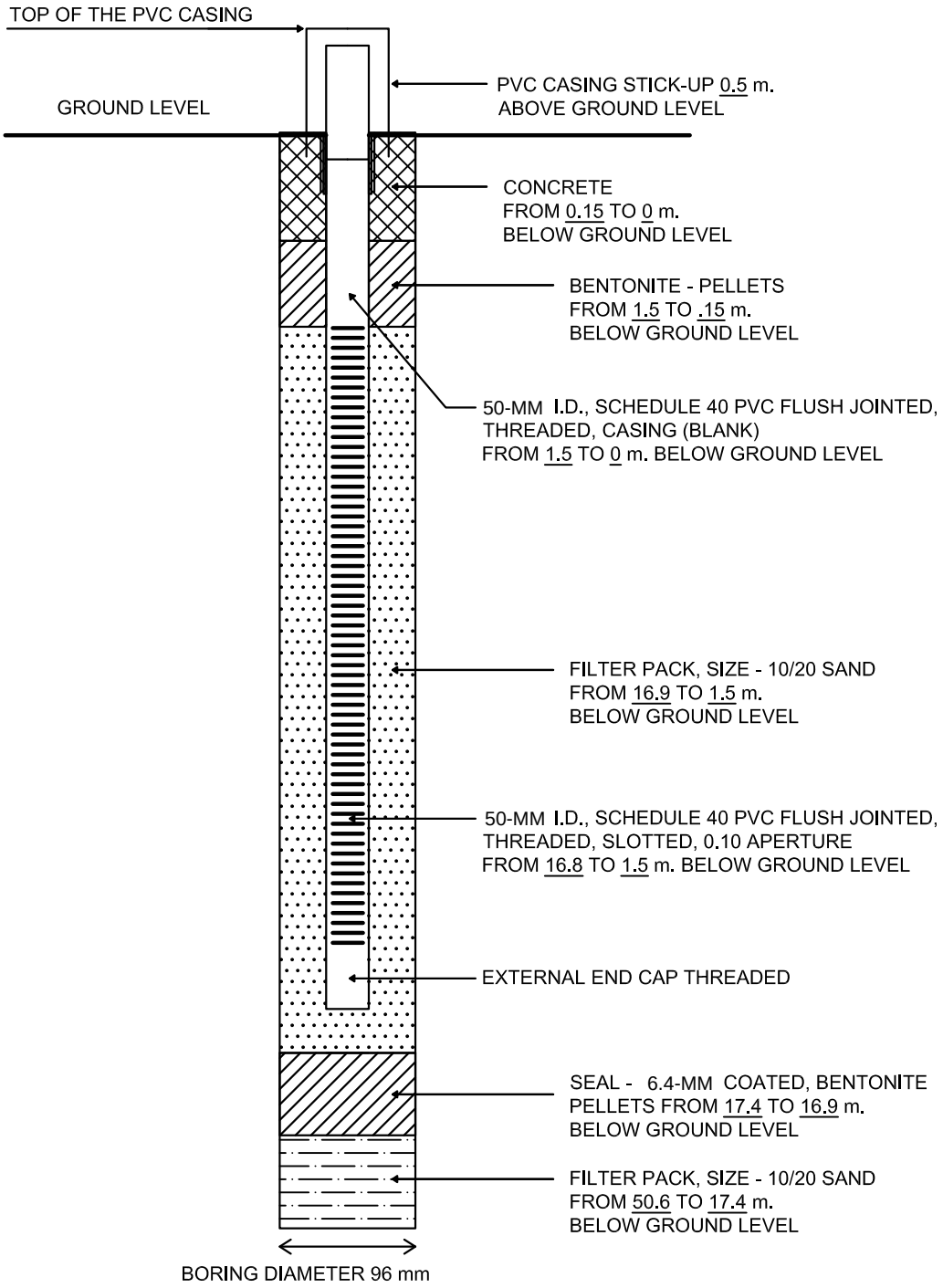
PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-39
Core Box No: 10 OF 12
Depth From (m): 22.65 To (m): 25.20
Date: 25 - 27 JUNE 2013
FUGRO
0cm
10cm
100

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-39
Core Box No: 11 OF 12
Depth From (m): 25.2 To (m): 27.87
Date: 25 - 27 JUNE 2013
FUGRO
0cm
10cm
100

PNW-LNG Lelu Is.
B. C. CANADA
Job Number: 04.10130058
Borehole No: B-39
Core Box No: 12 OF 12
Depth From (m) 27.87 To (m): 30.0 E.O.B.
Date: 25-27 JUNE 2013
FUGRO
0cm
10cm
100
C 22
28.58
29.50
C 22
29.65
C 23
30.00
E.O.B.

PACIFIC NORTHWEST LNG PROJECT

DRILLER:	MoreCore					PROJECT:	Pacific Northwest LNG Project
DRILL RIG:		COORDINATES		ELEVATIONS (Meters. MSL)		LOCATION:	Lelu Island
METHOD:	Mud Rotary	NORTHING:	6007508	GROUND SURFACE EL:	3.81	MW ID:	
INSPECTOR:	Prentice	EASTING:	416259	PVC CASING (TOP) EL:		DATE COMPLETED:	8/19/2013



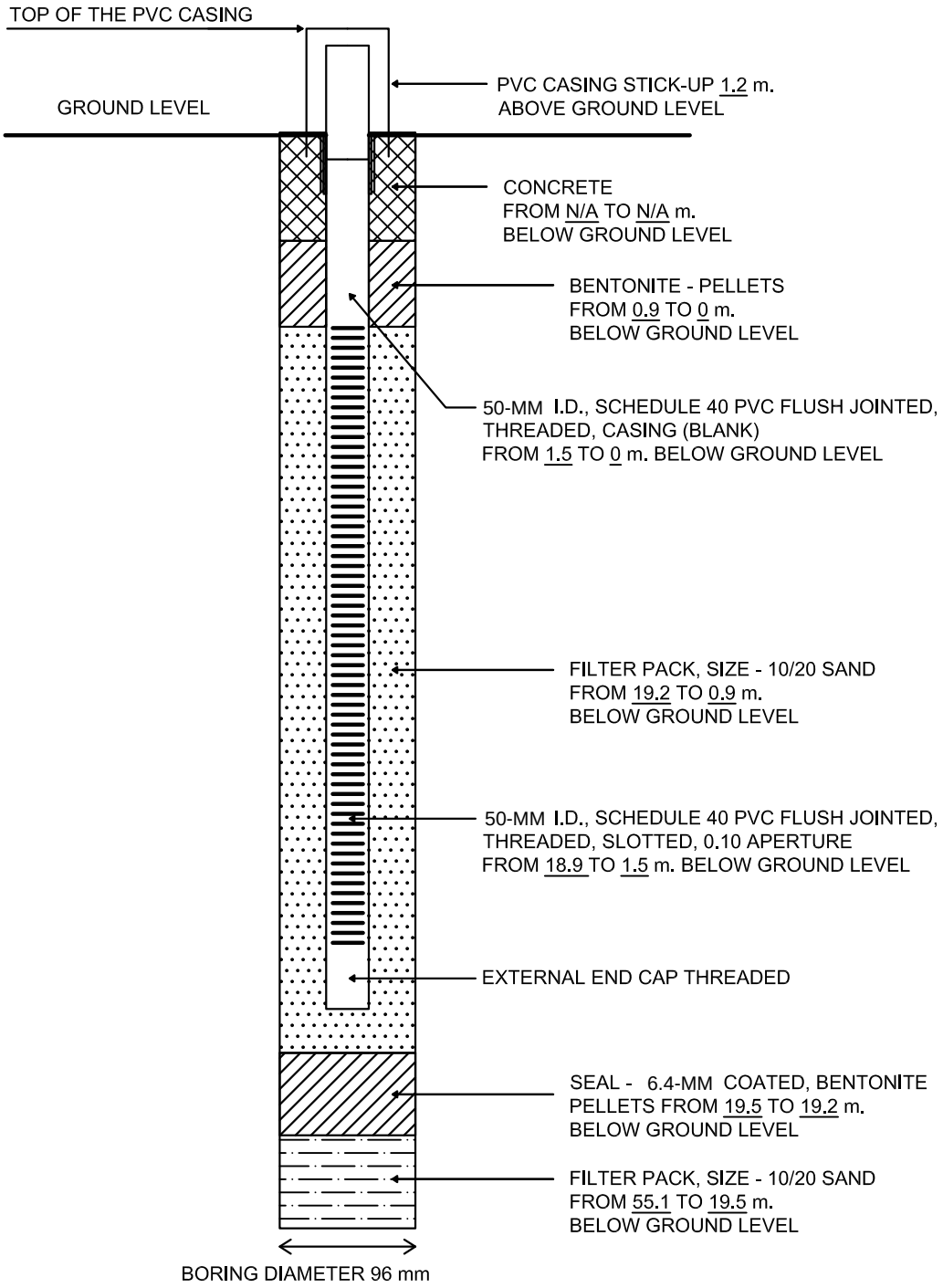
PIEZOMETER BH-2

PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA
(NOT TO SCALE)

PLATE A-170

PACIFIC NORTHWEST LNG PROJECT

DRILLER:	Geotech Drilling					PROJECT:	Pacific Northwest LNG Project
DRILL RIG:		COORDINATES		ELEVATIONS (Meters. MSL)		LOCATION:	Lelu Island
METHOD:	Mud Rotary	NORTHING:	6007346	GROUND SURFACE EL:	5	MW ID:	
INSPECTOR:	G. Lidden	EASTING:	416066	PVC CASING (TOP) EL:		DATE COMPLETED:	7/14/2013



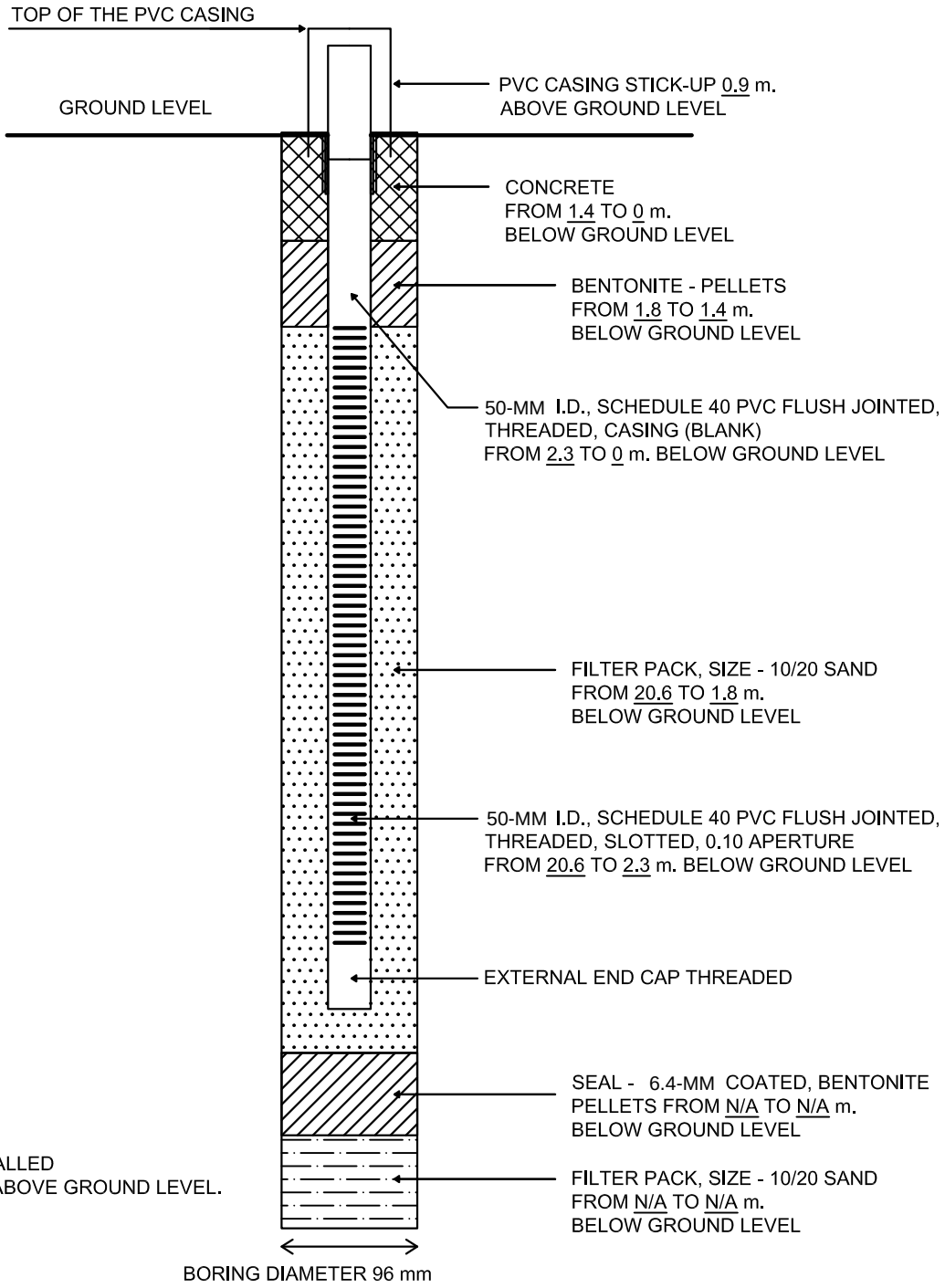
PIEZOMETER BH-3

PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA
(NOT TO SCALE)

PLATE A-171

PACIFIC NORTHWEST LNG PROJECT

DRILLER:	Geotech Drilling					PROJECT:	Pacific Northwest LNG Project
DRILL RIG:		COORDINATES		ELEVATIONS (Meters. MSL)		LOCATION:	Lelu Island
METHOD:	Mud Rotary	NORTHING:	6006971	GROUND SURFACE EL:	2.22	MW ID:	
INSPECTOR:	G. Eckrich	EASTING:	415453	PVC CASING (TOP) EL:		DATE COMPLETED:	7/25/2013



NOTE:
1. STEEL CASING INSTALLED
FROM 2.7 TO 0.5 m. ABOVE GROUND LEVEL.

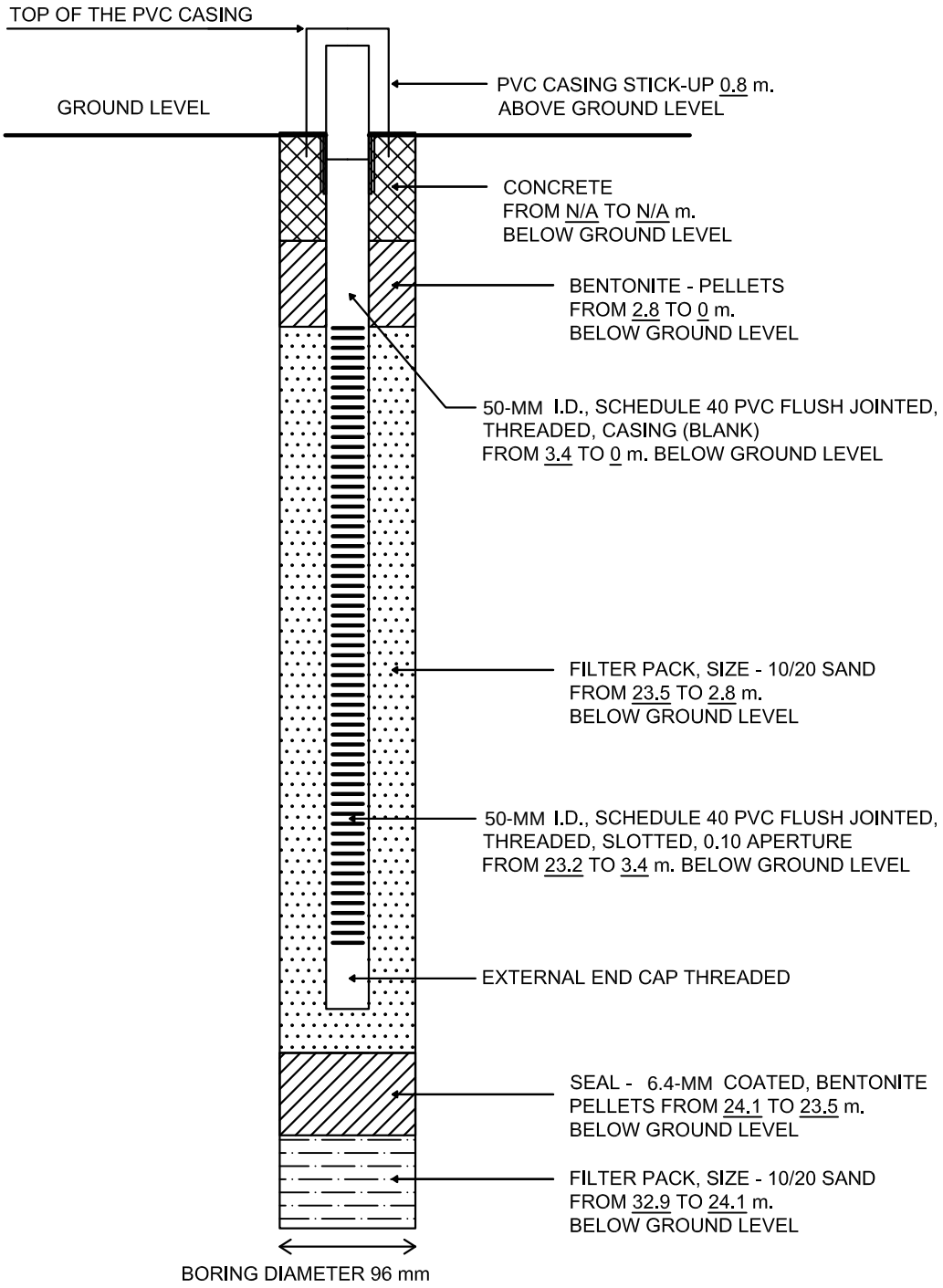
PIEZOMETER BH-7

PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA
(NOT TO SCALE)

PLATE A-172

PACIFIC NORTHWEST LNG PROJECT

DRILLER:	Geotech Drilling					PROJECT:	Pacific Northwest LNG Project
DRILL RIG:		COORDINATES		ELEVATIONS (Meters. MSL)		LOCATION:	Lelu Island
METHOD:	Mud Rotary	NORTHING:	6006797	GROUND SURFACE EL:	27.48	MW ID:	
INSPECTOR:	G. Eckrich	EASTING:	415643	PVC CASING (TOP) EL:	28.29	DATE COMPLETED:	7/15/2013



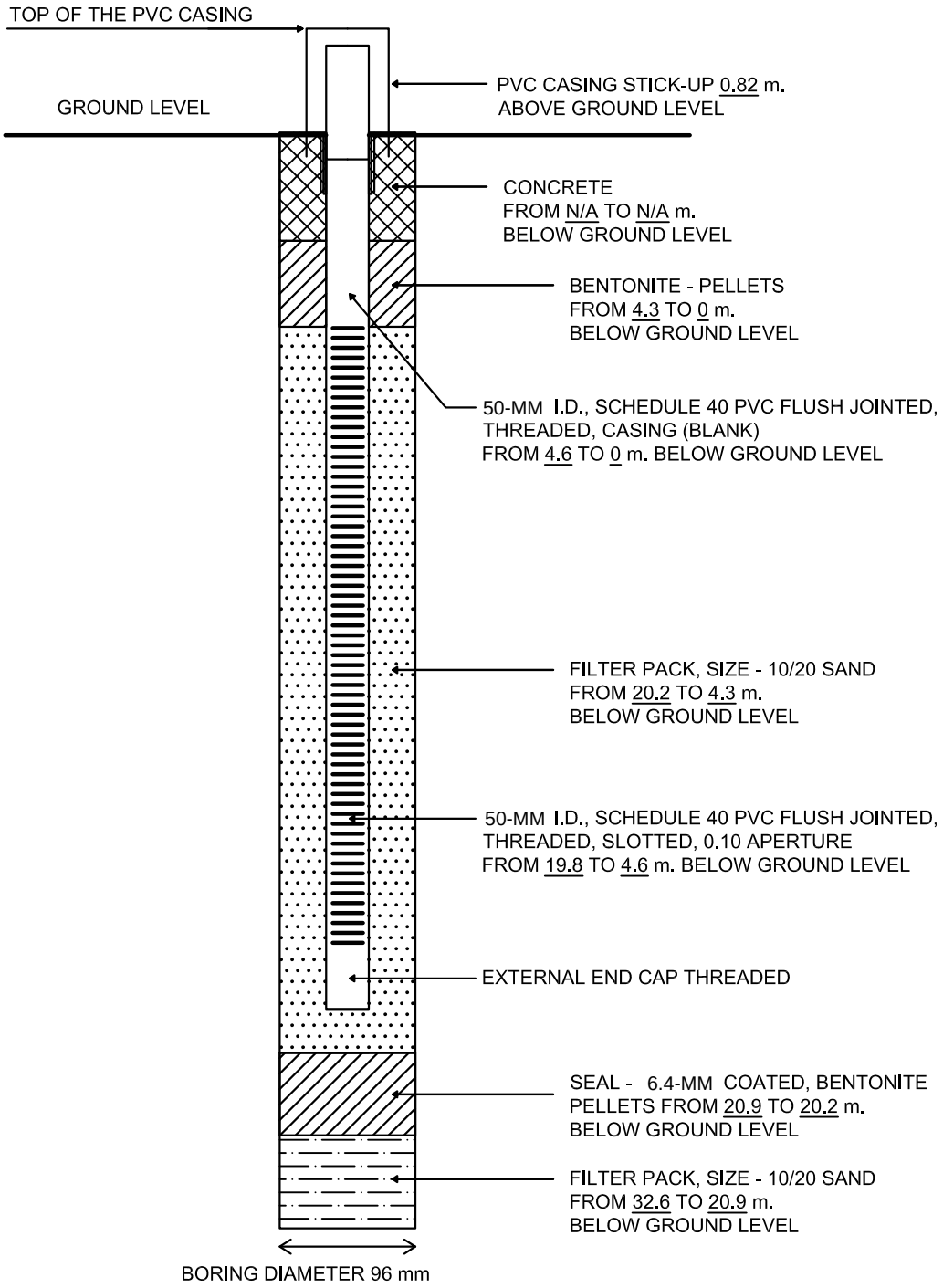
PIEZOMETER BH-11

PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA
(NOT TO SCALE)

PLATE A-173

PACIFIC NORTHWEST LNG PROJECT

DRILLER:	Geotech Drilling					PROJECT:	Pacific Northwest LNG Project
DRILL RIG:		COORDINATES		ELEVATIONS (Meters. MSL)		LOCATION:	Lelu Island
METHOD:	Mud Rotary	NORTHING:	6006739	GROUND SURFACE EL:	27.01	MW ID:	
INSPECTOR:	Marlon	EASTING:	415573	PVC CASING (TOP) EL:		DATE COMPLETED:	6/27/2013



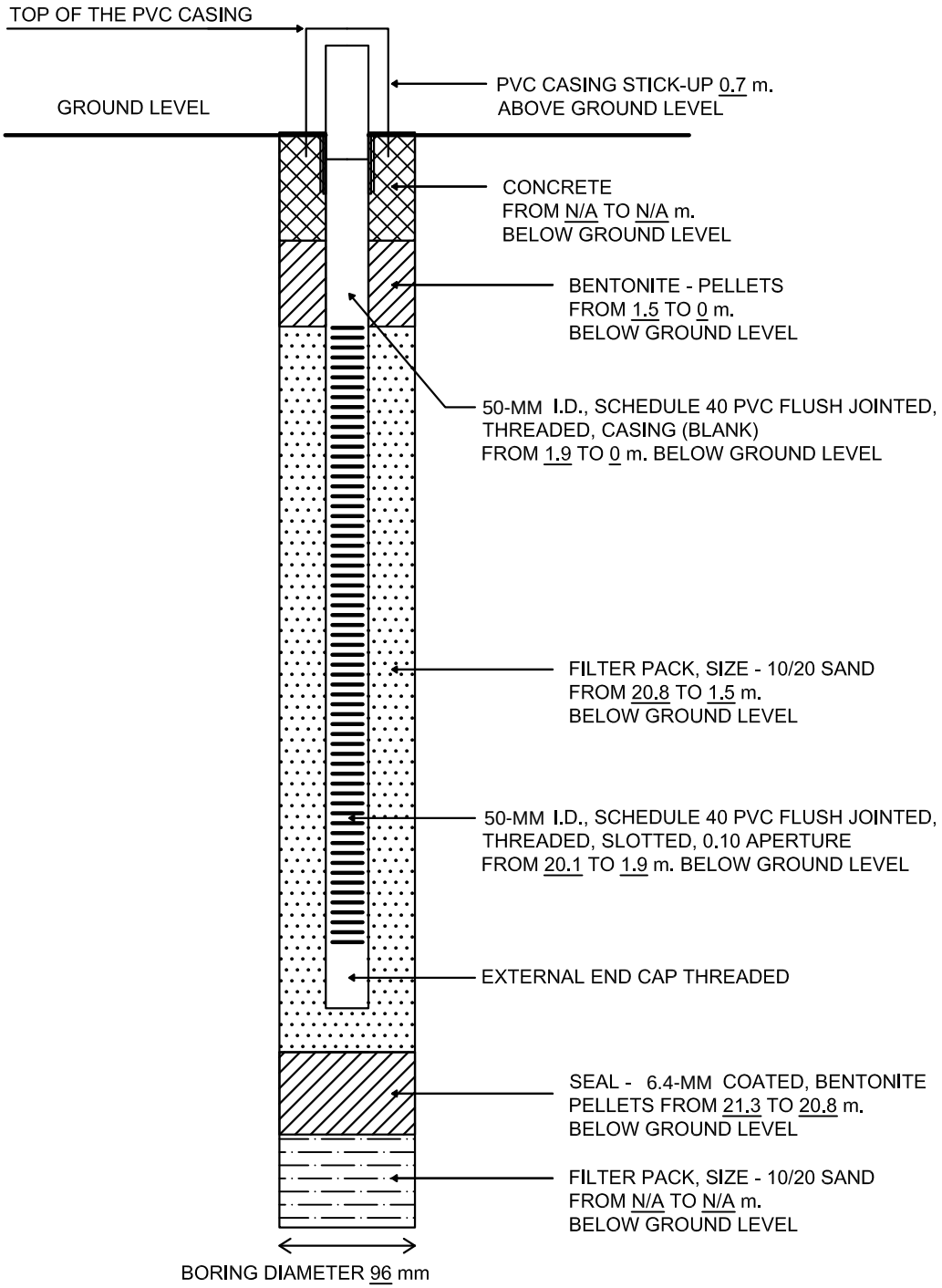
PIEZOMETER BH-16

PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA
(NOT TO SCALE)

PLATE A-174

PACIFIC NORTHWEST LNG PROJECT

DRILLER:	Geotech Drilling					PROJECT:	Pacific Northwest LNG Project
DRILL RIG:		COORDINATES		ELEVATIONS (Meters. MSL)		LOCATION:	Lelu Island
METHOD:	Mud Rotary	NORTHING:	6006339	GROUND SURFACE EL:	34.78	MW ID:	
INSPECTOR:	G. Eckrich	EASTING:	415596	PVC CASING (TOP) EL:		DATE COMPLETED:	7/16/2013

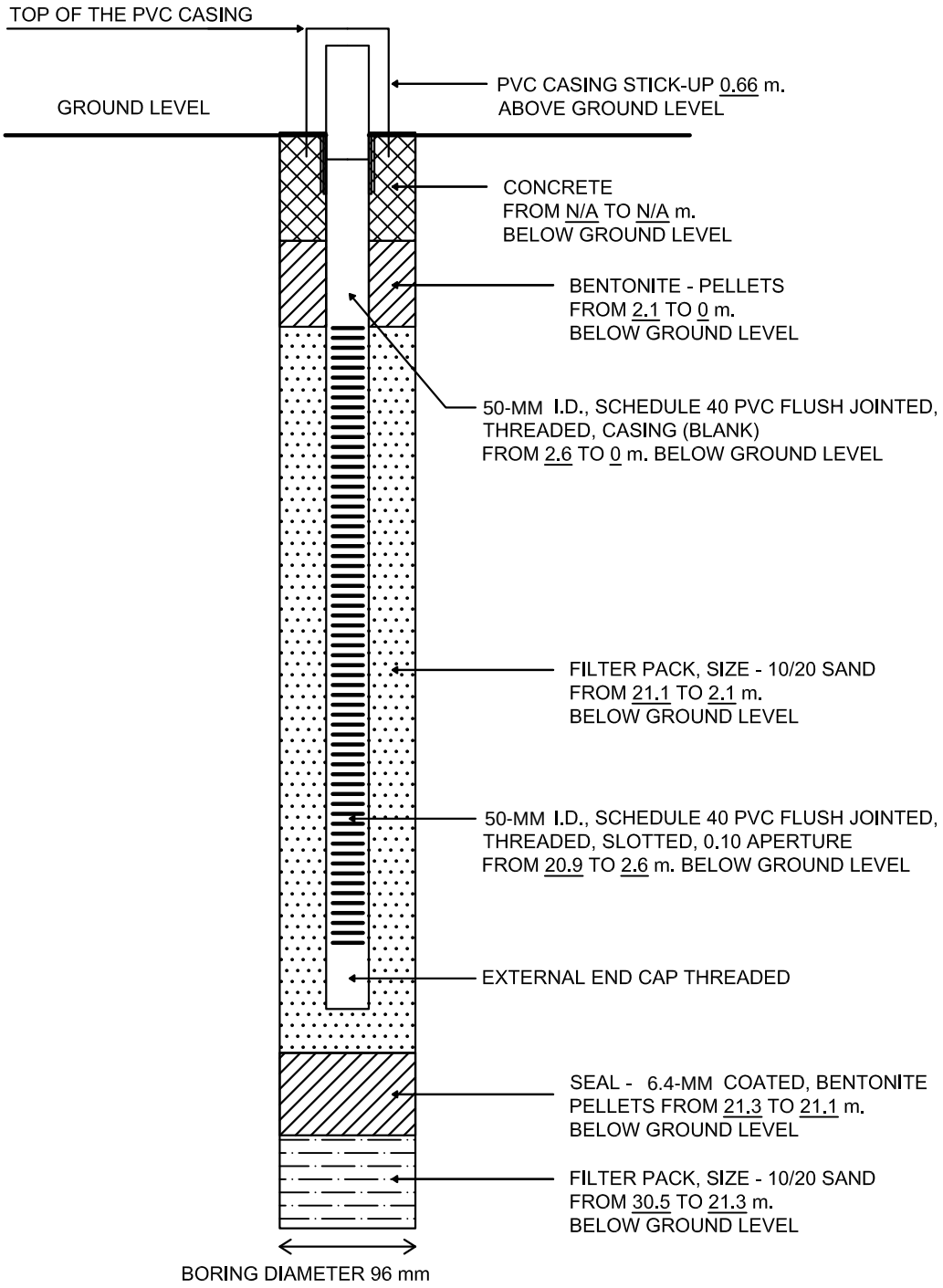


PIEZOMETER BH-26

PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA
(NOT TO SCALE)

PLATE A-175

PACIFIC NORTHWEST LNG PROJECT						
DRILLER: Geotech Drilling					PROJECT:	Pacific Northwest LNG Project
DRILL RIG:	COORDINATES		ELEVATIONS (Meters. MSL)		LOCATION:	Lelu Island
METHOD: Mud Rotary	NORTHING:	6006327	GROUND SURFACE EL:	38.63	MW ID:	
INSPECTOR: G Eckrich	EASTING:	415842	PVC CASING (TOP) EL:		DATE COMPLETED:	6/18/2013



PIEZOMETER BH-28

PACIFIC NORTHWEST LNG PROJECT

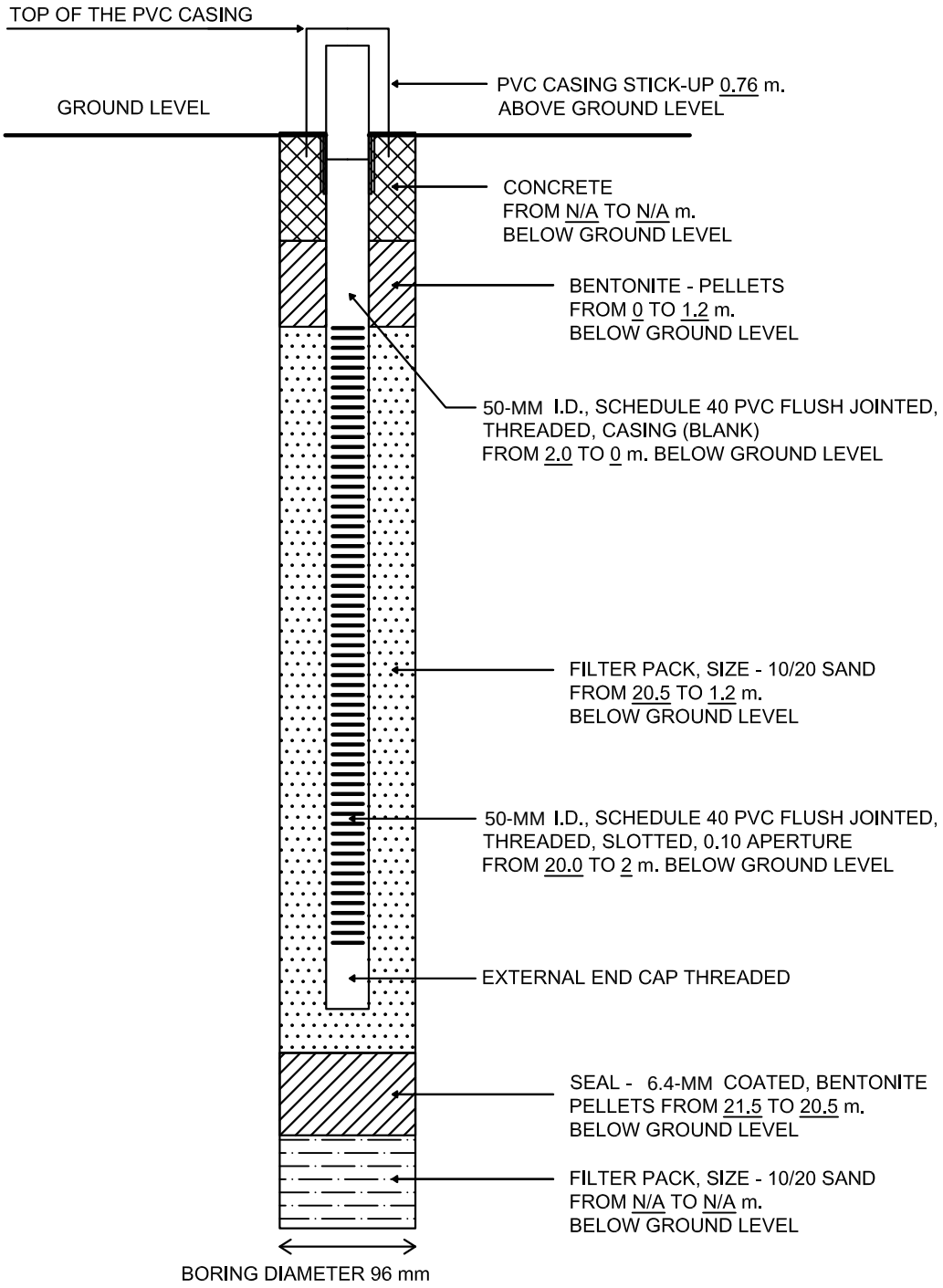
LELU ISLAND, BRITISH COLUMBIA, CANADA

(NOT TO SCALE)

PLATE A-176

PACIFIC NORTHWEST LNG PROJECT

DRILLER:	Geotech Drilling					PROJECT:	Pacific Northwest LNG Project
DRILL RIG:		COORDINATES		ELEVATIONS (Meters. MSL)		LOCATION:	Lelu Island
METHOD:	Mud Rotary	NORTHING:	6006150	GROUND SURFACE EL:	35.28	MW ID:	
INSPECTOR:	Tim Glidden	EASTING:	415921	PVC CASING (TOP) EL:	36	DATE COMPLETED:	7/19/2013



PIEZOMETER BH-30

PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA
(NOT TO SCALE)

PLATE A-177

APPENDIX B

Acoustic Televiewer Logging

APPENDIX B – ACOUSTIC TELEVIEWER LOGGING

B.1 General

As part of the pre FEED level geotechnical study for the proposed Pacific Northwest LNG Project, Acoustic Televiewer Logging data was acquired to measure the in-situ orientation of geologic discontinuities (strike and dip of bedding planes, fractures, shears, etc.) within the bedrock materials.

B.2 Methodology

Acoustic Televiewer Logging is a technique that records high-resolution images of the bedrock from inside the borings. Generally, these images provide a better indication of the bedrock structure than the cores retrieved from the borings, as the cores can be damaged or broken during the drilling process. The logging equipment generates 360 degree images of the borehole wall by transmitting ultrasound pulses from a rotating sensor and recording the amplitude and travel time of the reflected signals from the interface between drilling mud or fluid and the surrounding formation. Variations in the amplitude of the reflected signals can provide an indication of changes in texture of the borehole wall, and variations in the travel time can be associated with changes in the borehole diameter.

Acoustic Televiewer data was acquired in a total of six onshore borings (BH-01, BH-03, BH-10, BH-14, BH-20 and BH24). The data was acquired with an ALT ABI-40 acoustic televiewer probe, a Mount Sopris 200 m single conducted winch and Matrix logging console, and the ALT Logger Suite software. The equipment was also mobilized to nearshore boring BH-35, but upon completion of drilling, no bedrock was encountered and therefore the test was abandoned.

The logging probe was deployed by rigging the wireline cable through a sheave suspended from derrick of the drill rig. The probe was lowered into the boring until the cablehead of the probe was at the ground surface and zero depth was referenced on the logging system. The probe was then lowered to the base of the boreholes and data recorded whilst raising the probe at approximately 3 m/min within the open-hole portions of the boreholes. Prior to withdrawing the probe from the drill string, the zero depth mark was reoccupied to ensure the depth measurements were within tolerance. In order to correct the depth of the wireline measurements, offsets from the cablehead to the probe measurement points (from manufacturer specifications) were applied using post-processing software.

B.3 Data Analysis

Analysis of the Acoustic Televiewer data was carried out using the ALT WellCAD package and the following processing sequence was applied:

- Orientating the amplitude and travel time images of the borehole wall using the recorded tilt and azimuth of the probe and applying a geomagnetic declination correction;
- Filtering the amplitude and travel time images of the borehole wall to correct for any decentralization of the probe within the borehole; and
- Computing the average and maximum borehole caliper (diameter) using the travel time images.

The processed Acoustic Televiewer logs have been presented on the accompanying Plates B1 through B6 for borings BH-01, BH-03, BH-10, BH-14, BH-20 and BH24, respectively.

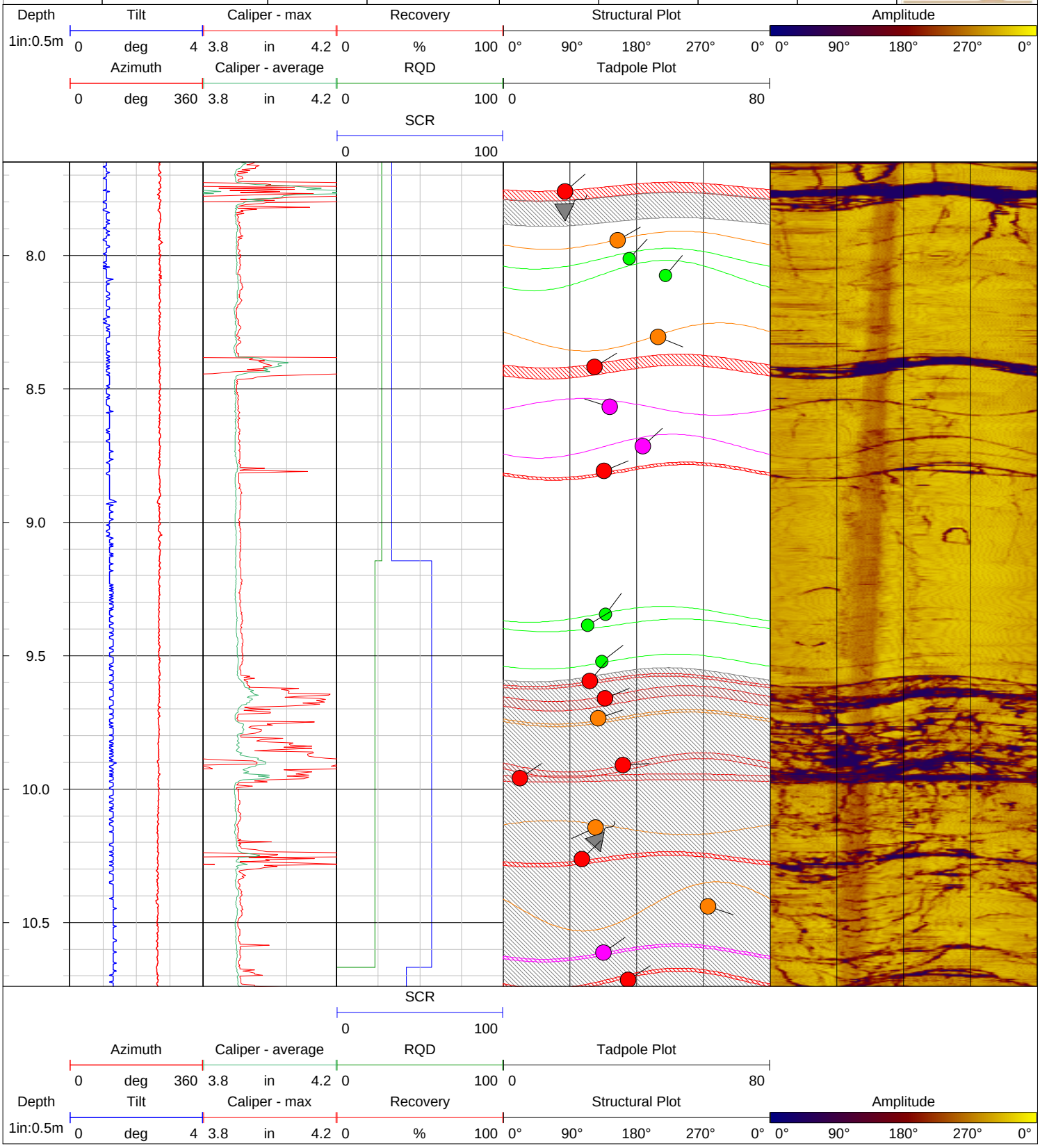
Each of the processed Acoustic Televiewer logs presents five data tracks (vertical columns) of data. The first data track contains the tilt and azimuth of the probe within the boring. Inclination of the borings is generally less than 4 degrees at all the test locations. The second and third data tracks present the computed borehole caliper data and the recovery, rock quality designation and solid core recovery data from the retrieved samples.

The fourth data track presents the structural log, which has been annotated by assessing variations in the amplitude images (fifth data track) and other log data. The schema adopted for structural log, and pertinent characteristics of each classification are summarized as follows:

- Major open joints / fractures (red) – features displaying both significant variations in amplitude and localized increases in the computed borehole caliper.
- Minor open joints / fractures (purple) – features displaying a significant variation in amplitude, but no apparent variation in computed borehole caliper.
- Partially open joints / fractures (orange) – features displaying variations in amplitude and / or computed borehole caliper, but not throughout the entire 360 degrees of the image. These features would include structures that are not continuous across the core.
- Bedding / banding / foliation (green) – features that display minor variations in amplitude.
- Undifferentiated zones (grey) – regions within the data where no individual features can be identified within the amplitude and / or computed borehole caliper images, suggesting that the core has been disintegrated or shattered.

To assist with the visualization and subsequent analysis based on the Acoustic Televiewer data, the structural log data has also been presented on rose plots on the accompanying Plates B7 through B12 for borings BH-01, BH-03, BH-10, BH-14, BH-20 and BH24, respectively. For each boring, a total of three plots, showing all structures, bedding structures and joint / fracture-related structures have been presented (Plates B7.1, B7.2 and B7.3, respectively, and so forth).

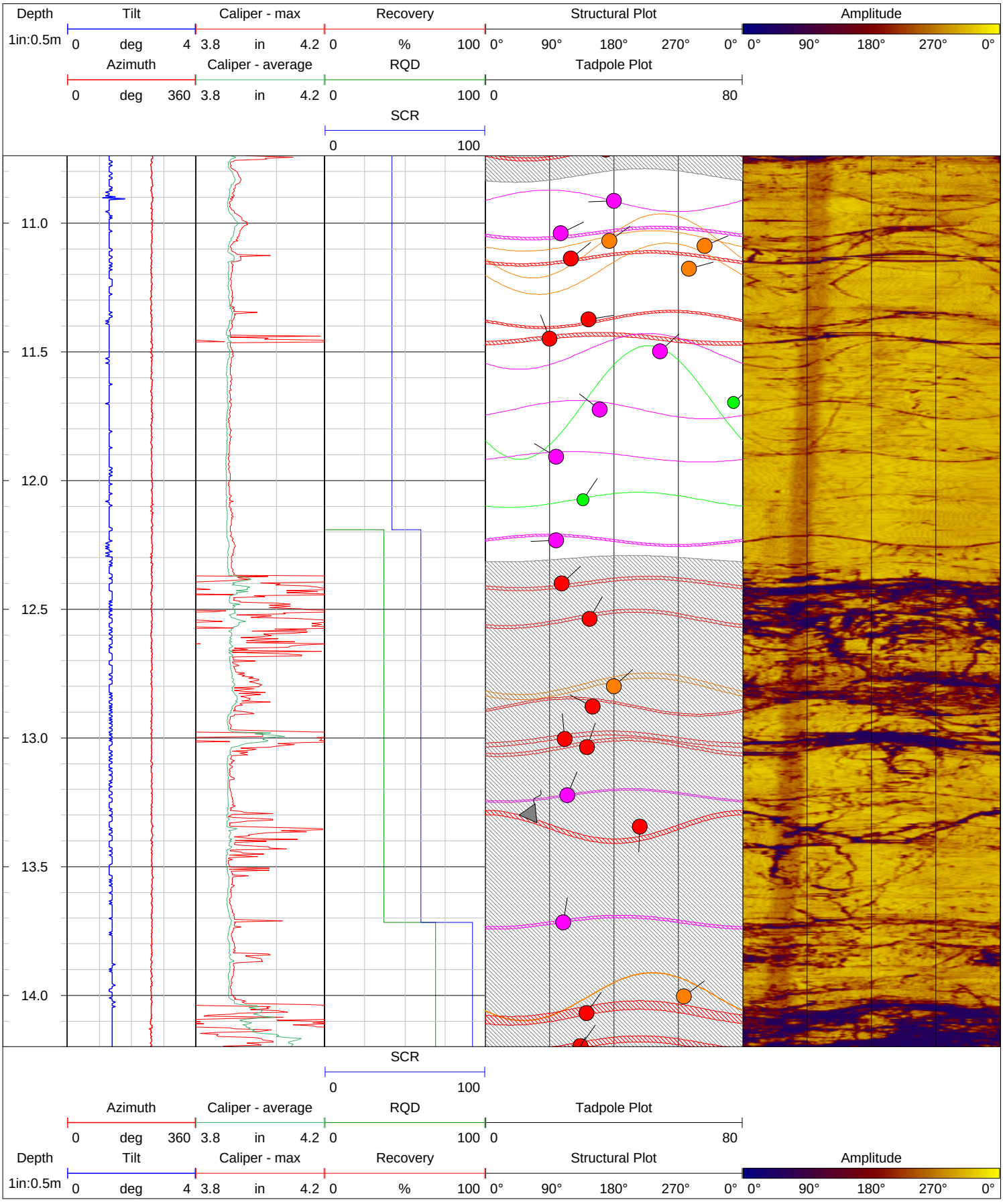
Project:	04.10135058	Boring:	BH01	Depth:	54.86 m	Log Depth:	53.69m
Date:	7/10/2013	Run:	One / Up	Elevation:	17.98 m	Operator:	DV



ACOUSTIC TELEVIEWER LOG - BORING BH01

PACIFIC NORTHWEST LNG PROJECT

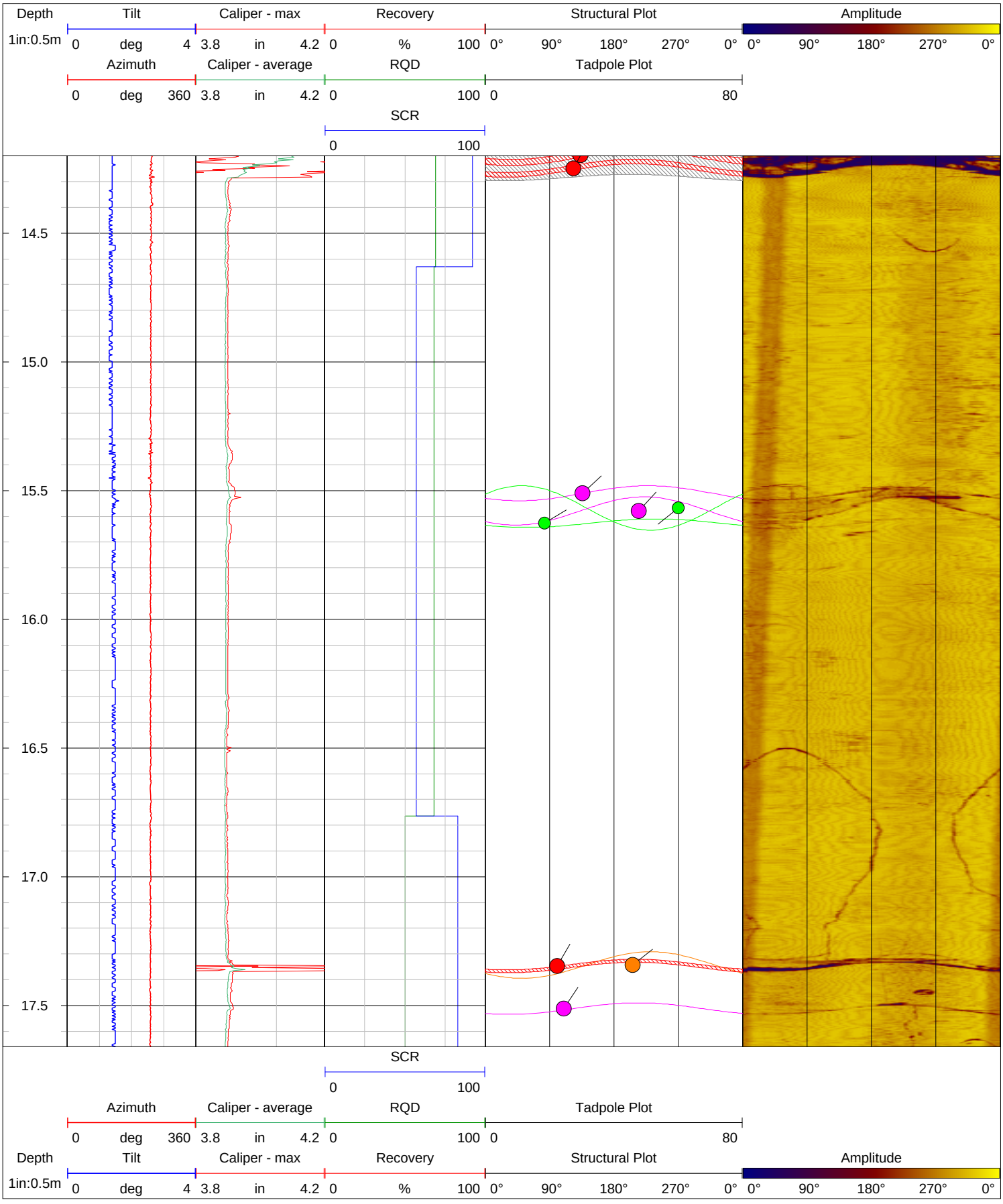
LELU ISLAND, BRITISH COLUMBIA, CANADA



ACOUSTIC TELEVIEWER LOG - BORING BH01

PACIFIC NORTHWEST LNG PROJECT

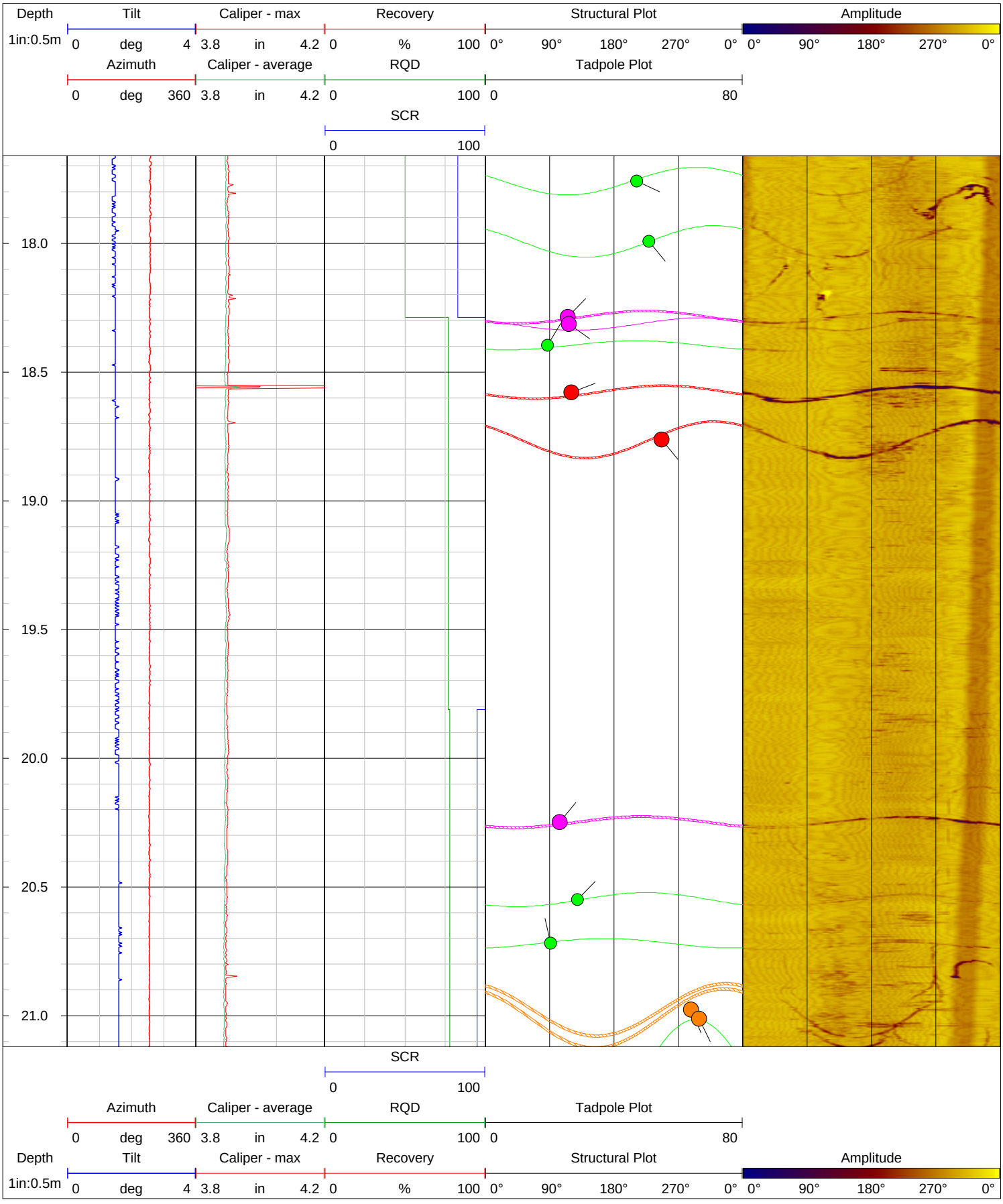
LELU ISLAND, BRITISH COLUMBIA, CANADA



ACOUSTIC TELEVIEWER LOG - BORING BH01

PACIFIC NORTHWEST LNG PROJECT

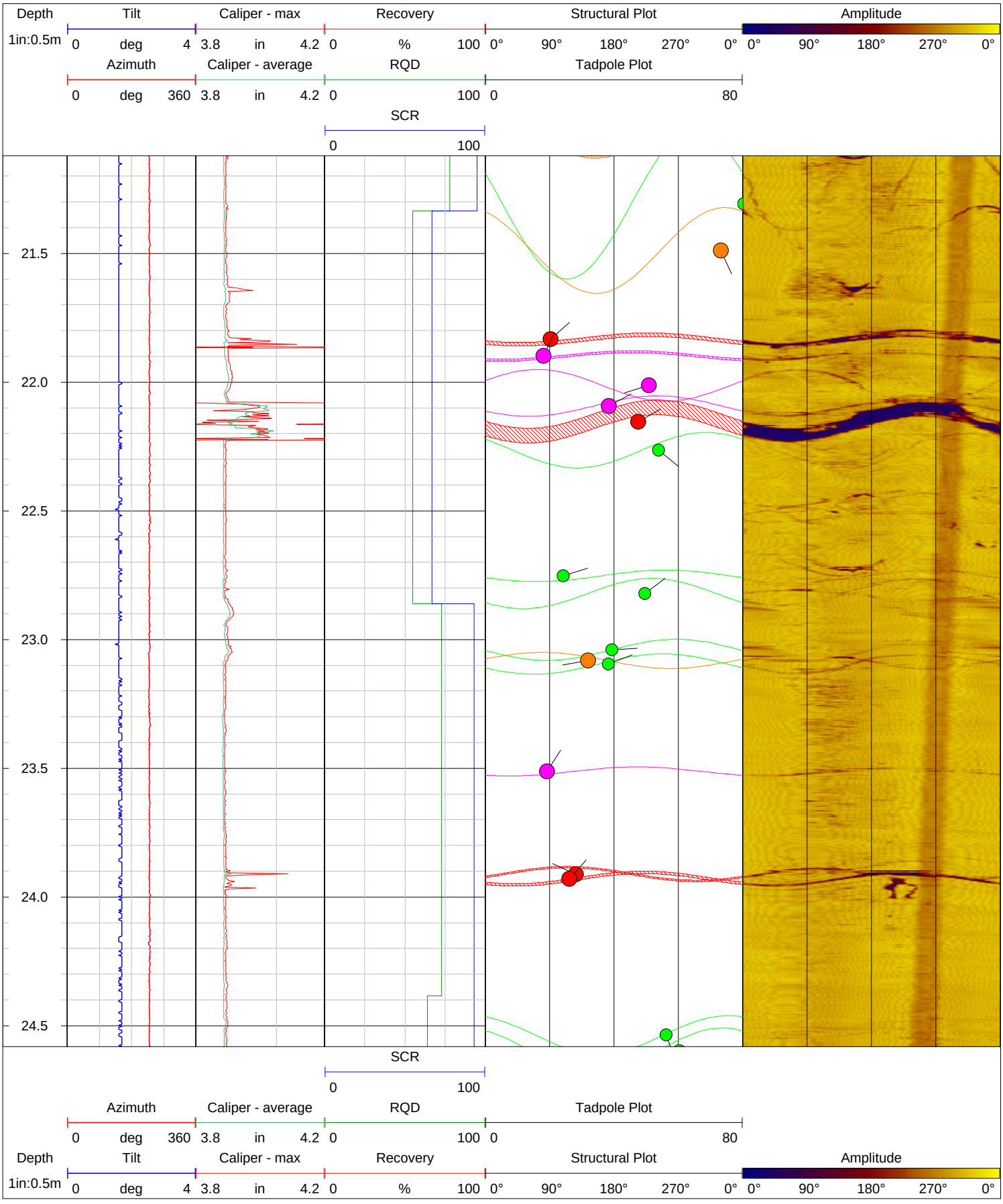
LELU ISLAND, BRITISH COLUMBIA, CANADA



ACOUSTIC TELEVIEWER LOG - BORING BH01

PACIFIC NORTHWEST LNG PROJECT

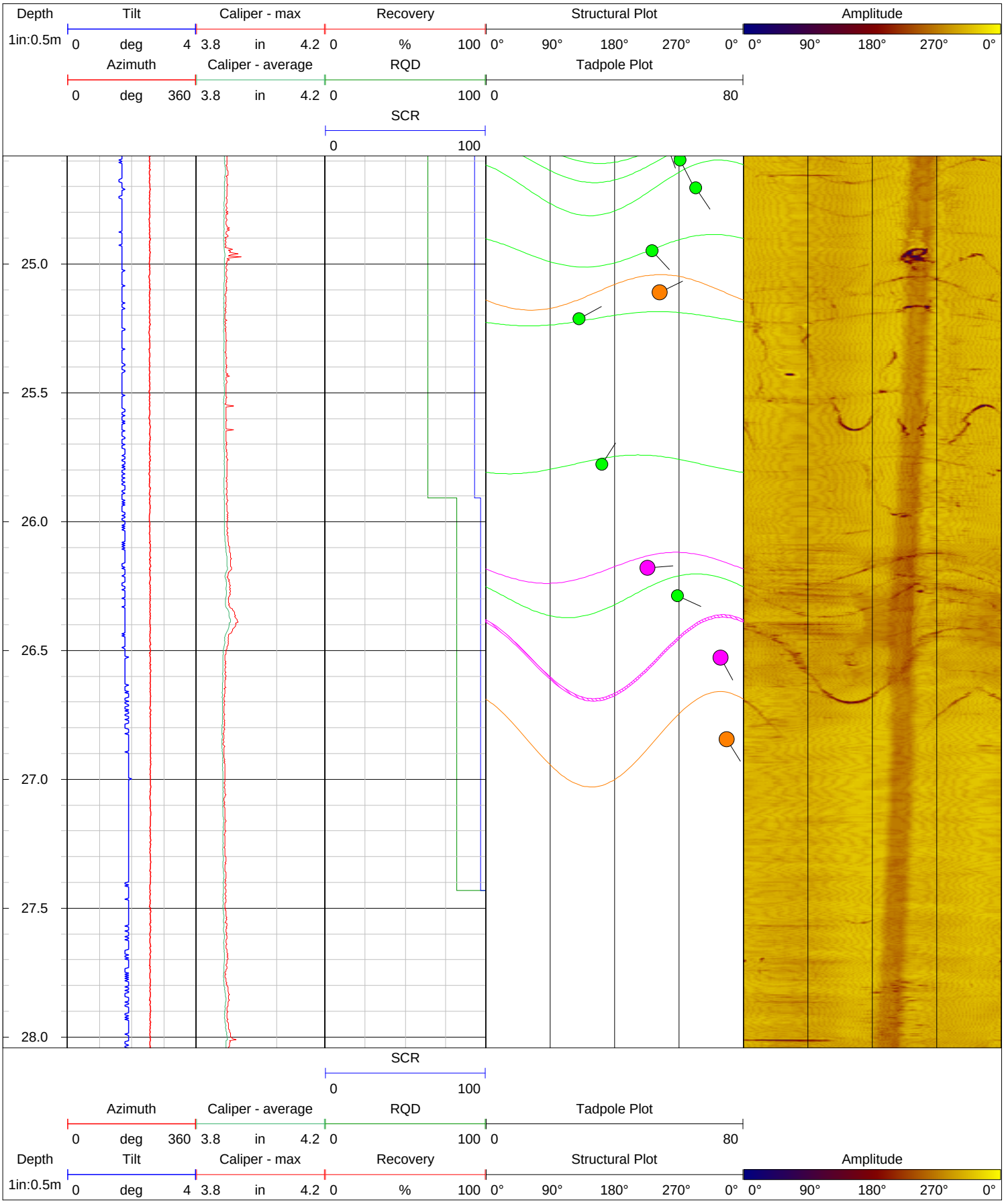
LELU ISLAND, BRITISH COLUMBIA, CANADA



ACOUSTIC TELEVIEWER LOG - BORING BH01

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

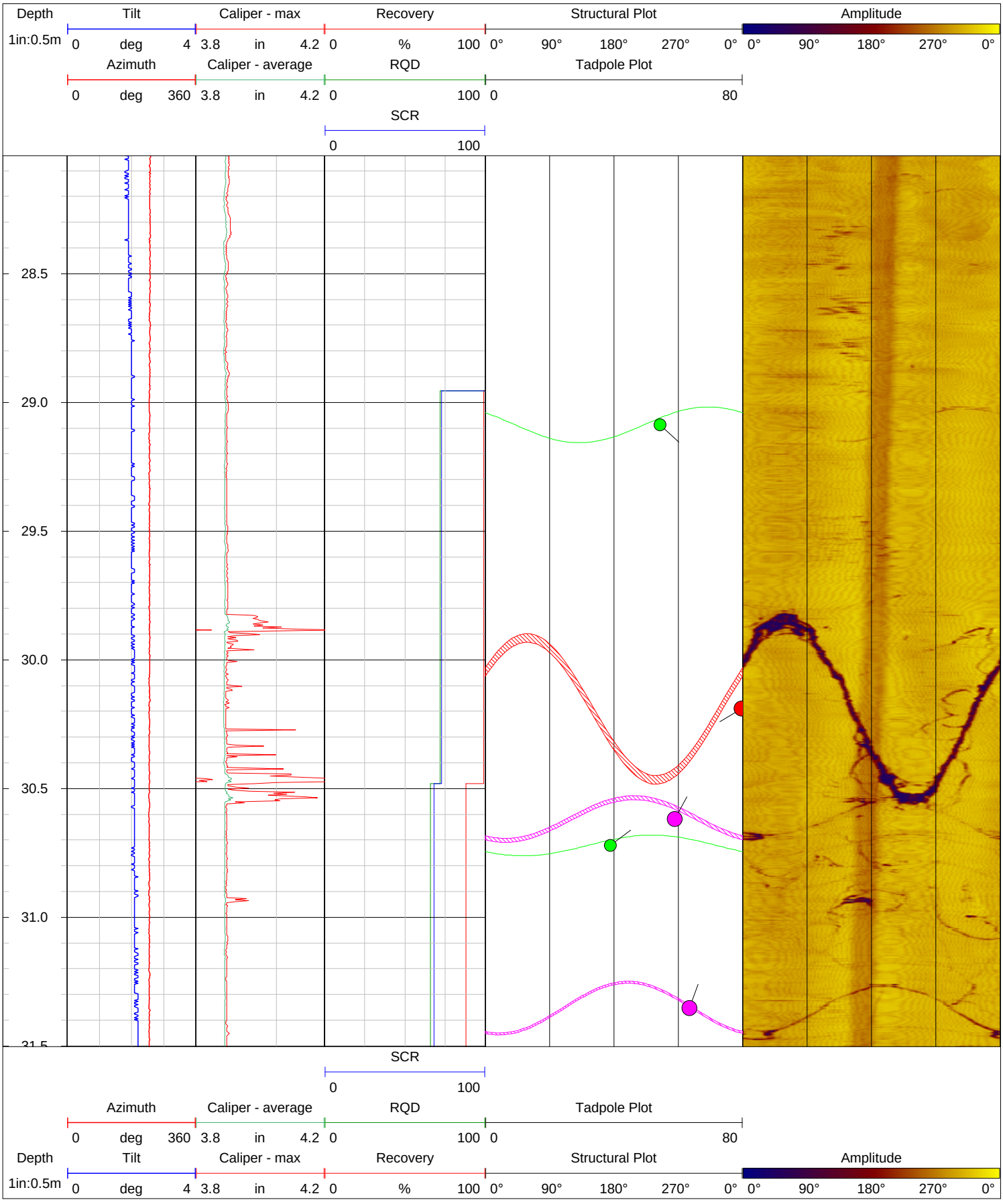


ACOUSTIC TELEVIEWER LOG - BORING BH01

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

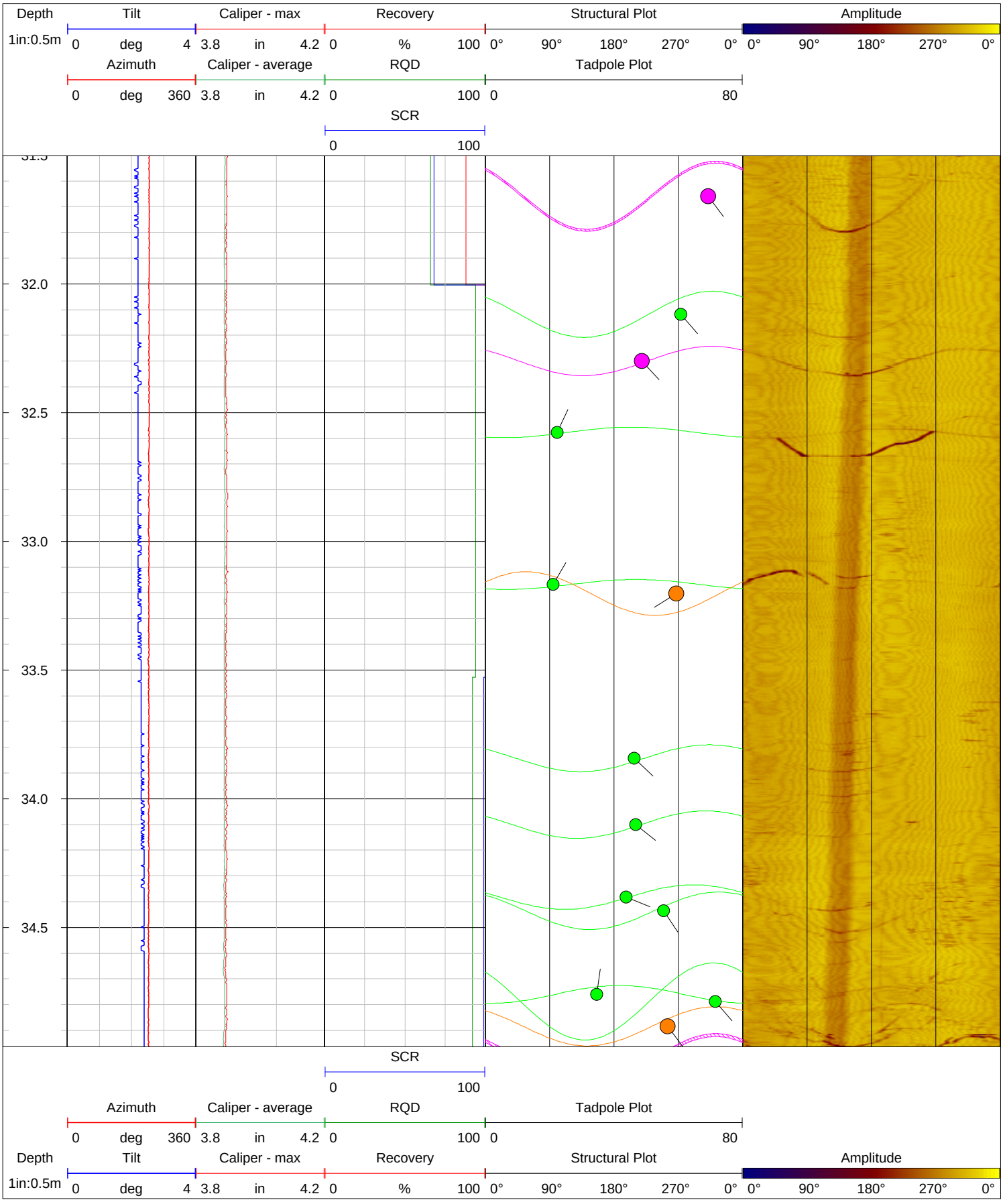
PLATE B1.6



ACOUSTIC TELEVIEWER LOG - BORING BH01

PACIFIC NORTHWEST LNG PROJECT

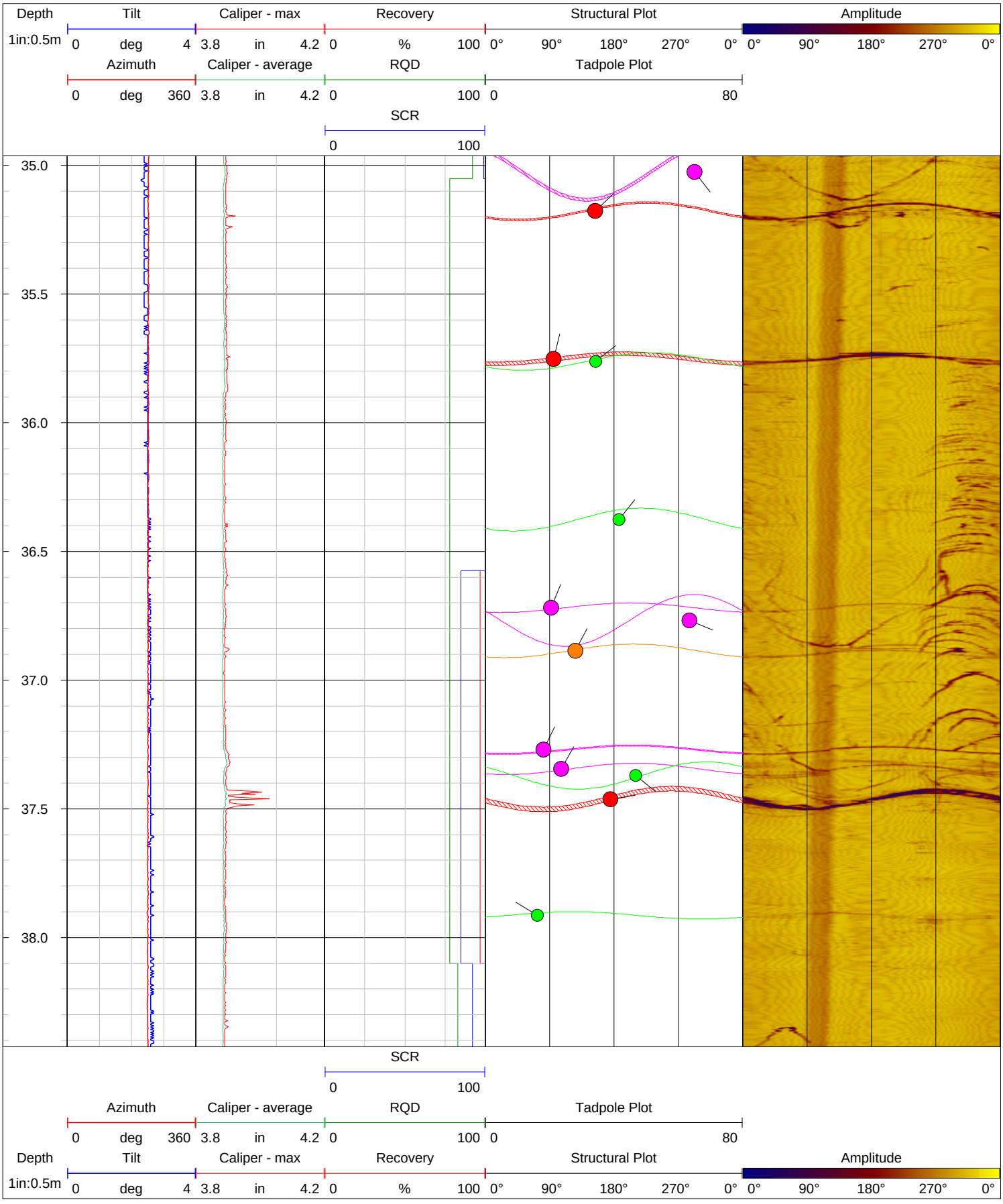
LELU ISLAND, BRITISH COLUMBIA, CANADA



ACOUSTIC TELEVIEWER LOG - BORING BH01

PACIFIC NORTHWEST LNG PROJECT

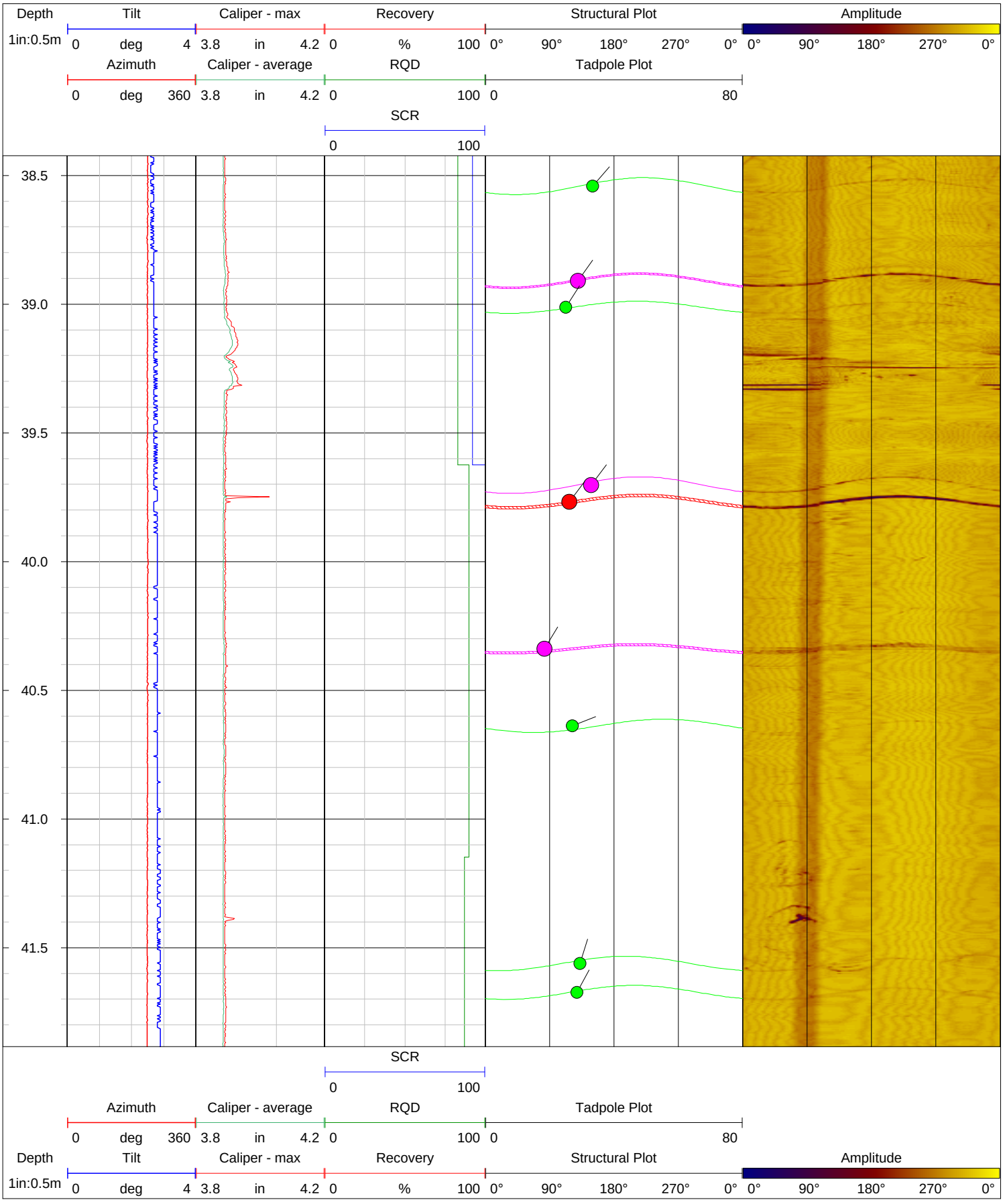
LELU ISLAND, BRITISH COLUMBIA, CANADA



ACOUSTIC TELEVIEWER LOG - BORING BH01

PACIFIC NORTHWEST LNG PROJECT

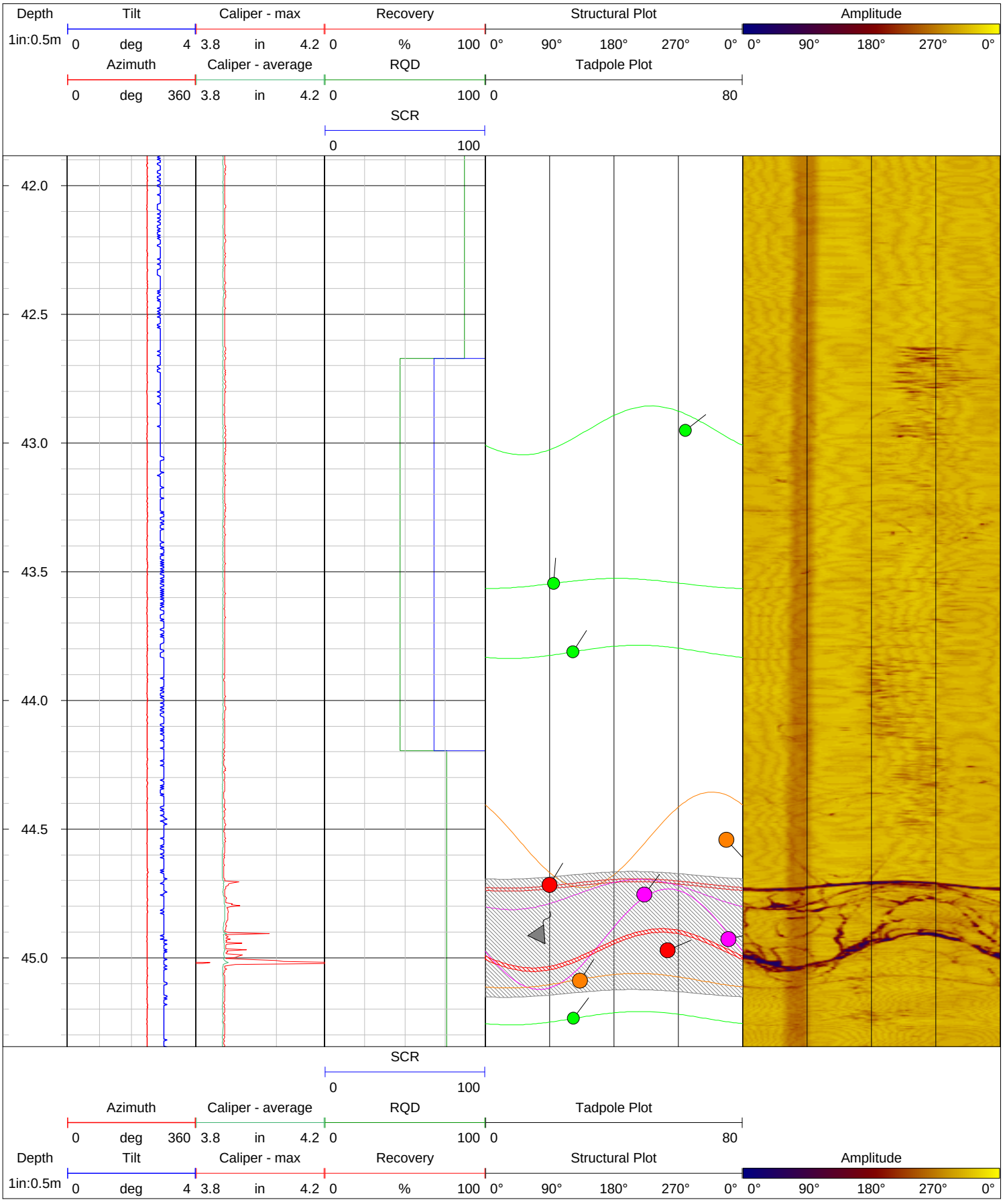
LELU ISLAND, BRITISH COLUMBIA, CANADA



ACOUSTIC TELEVIEWER LOG - BORING BH01

PACIFIC NORTHWEST LNG PROJECT

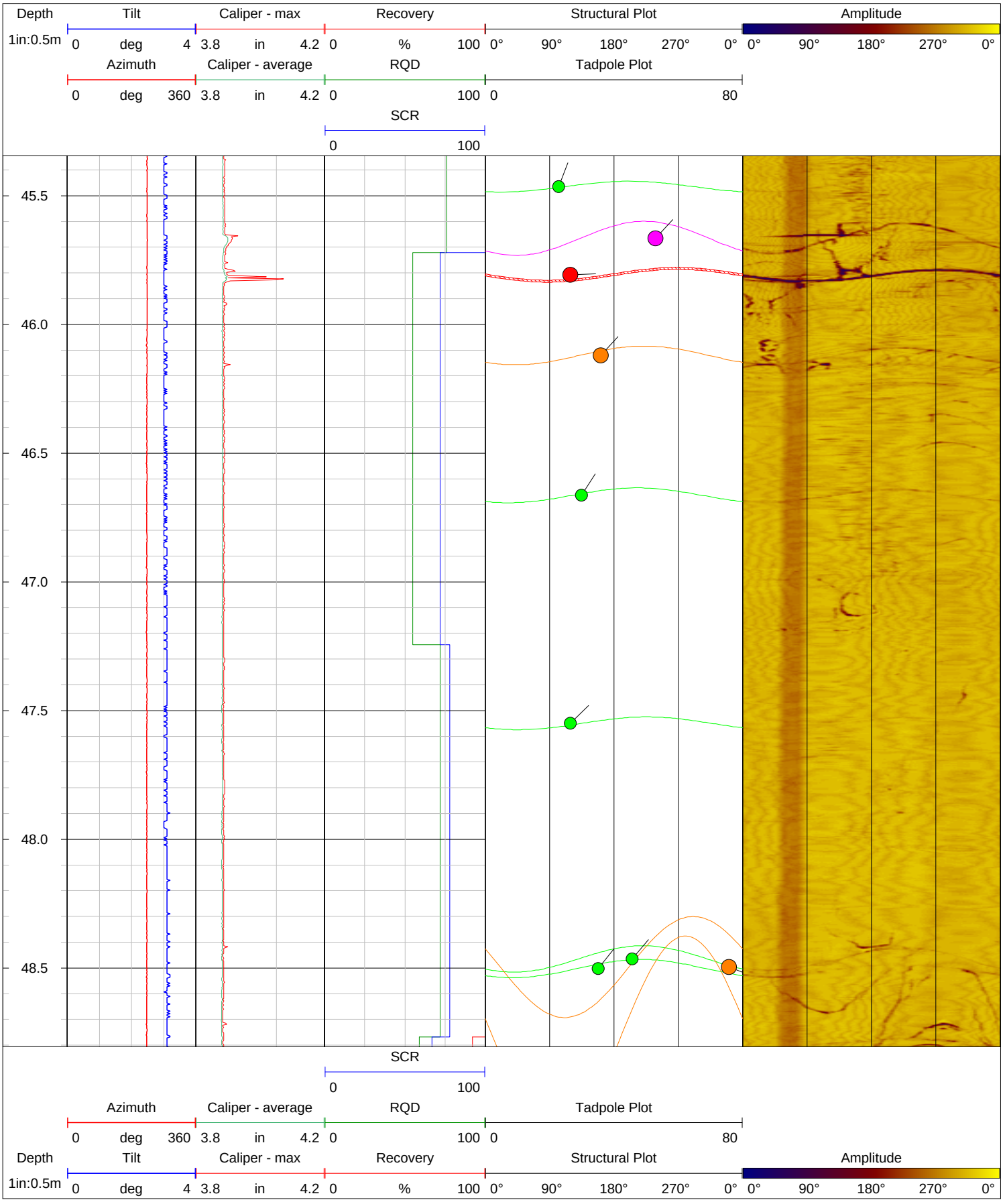
LELU ISLAND, BRITISH COLUMBIA, CANADA



ACOUSTIC TELEVIEWER LOG - BORING BH01

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

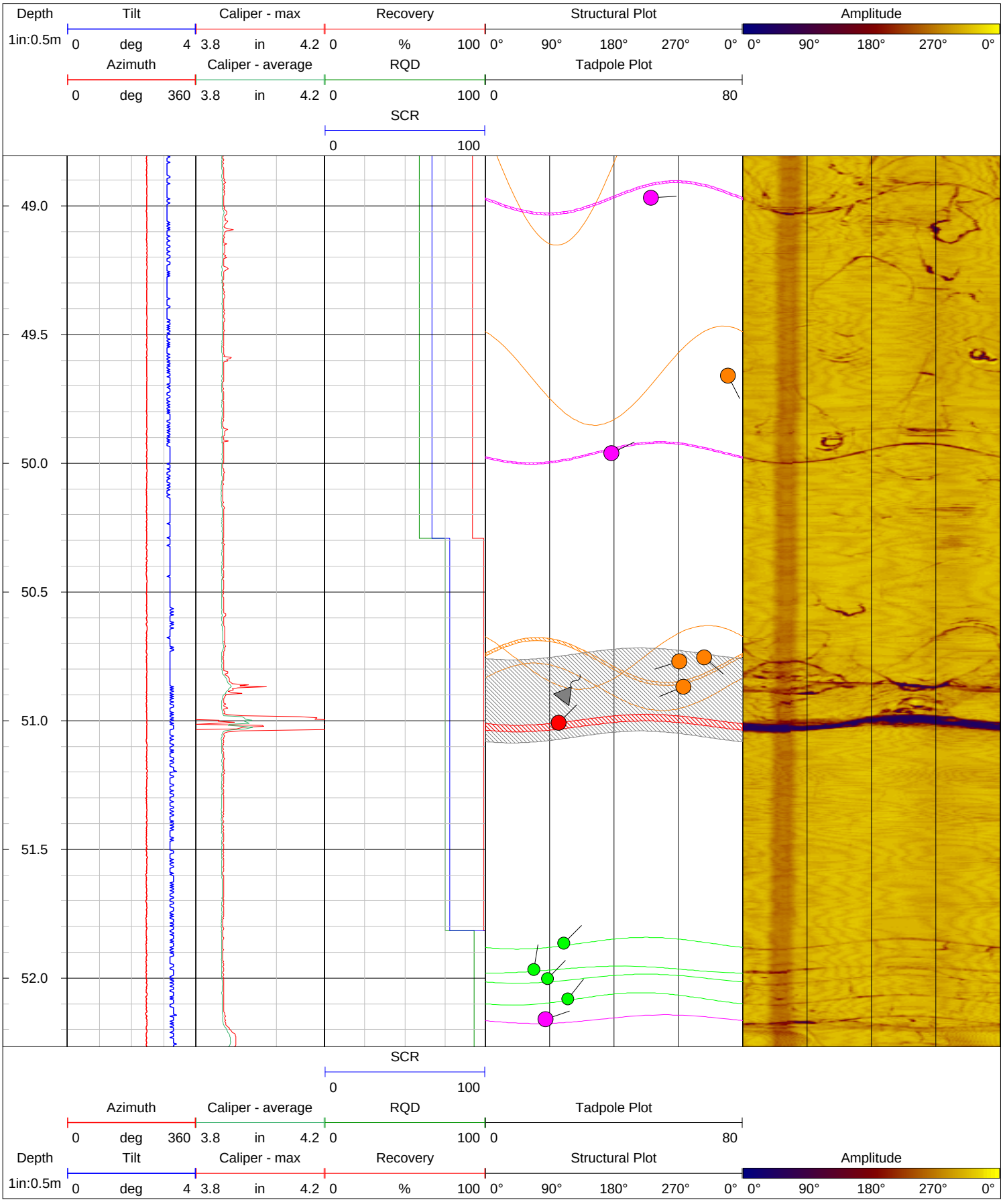


ACOUSTIC TELEVIEWER LOG - BORING BH01

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

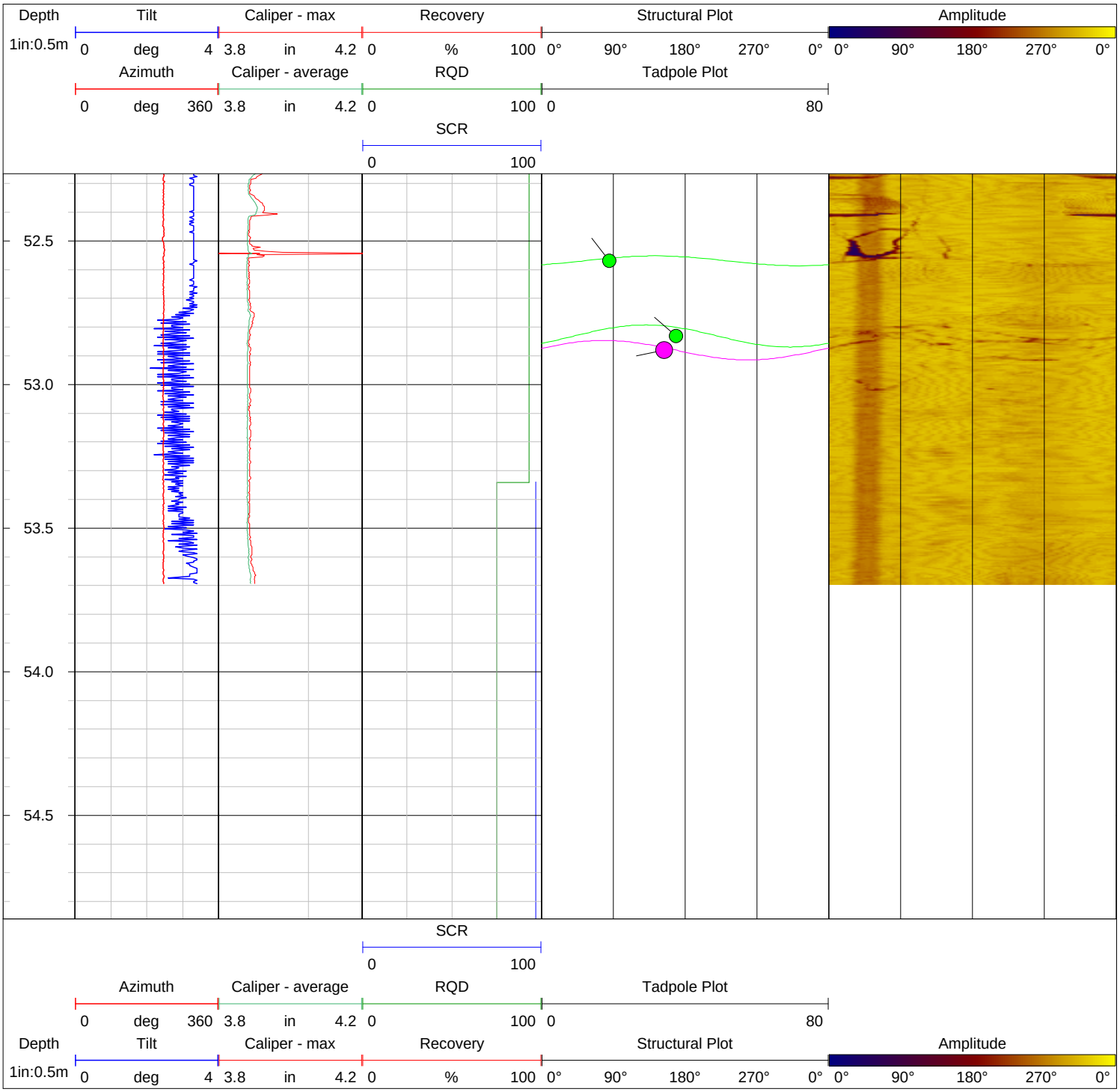
PLATE B1.12



ACOUSTIC TELEVIEWER LOG - BORING BH01

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

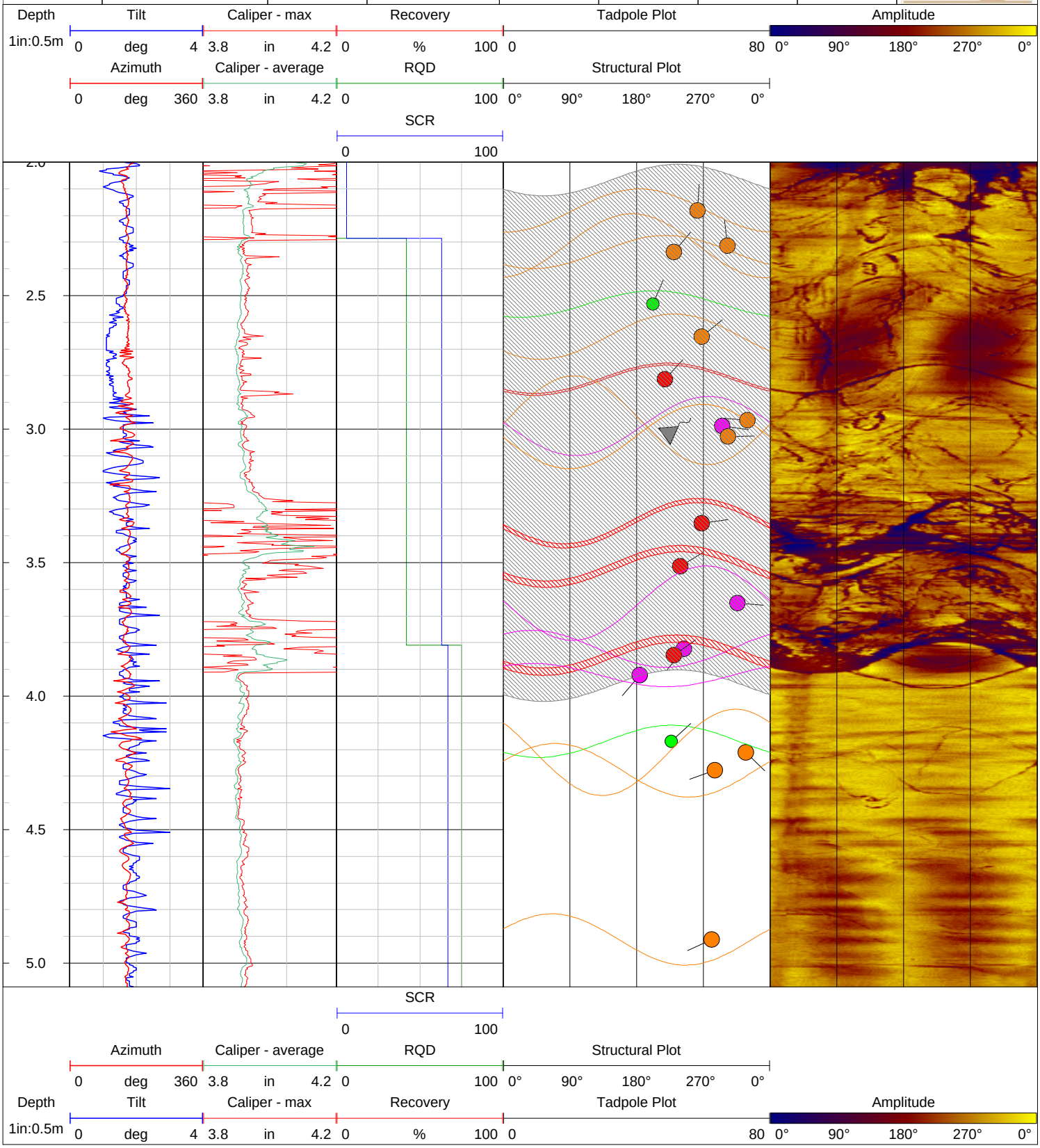


ACOUSTIC TELEVIEWER LOG - BORING BH01

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

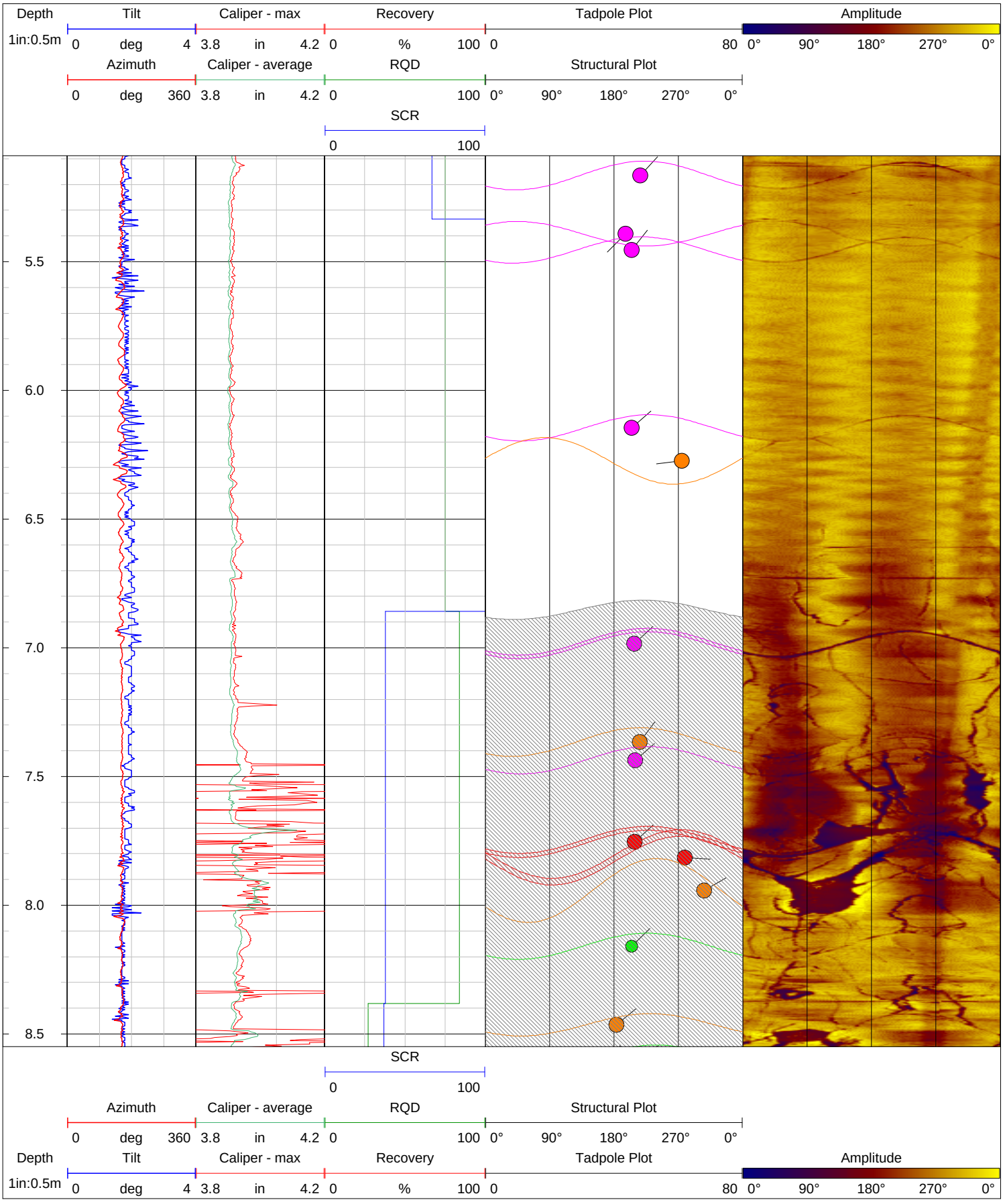
Project:	04.10130058	Boring:	BH03	Depth:	55.08 m	Log Depth:	54.11 m
Date:	July 14, 2013	Run:	One / Up	Elevation:	5.00 m	Operator:	DV



ACOUSTIC TELEVIEWER LOG - BORING BH03

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

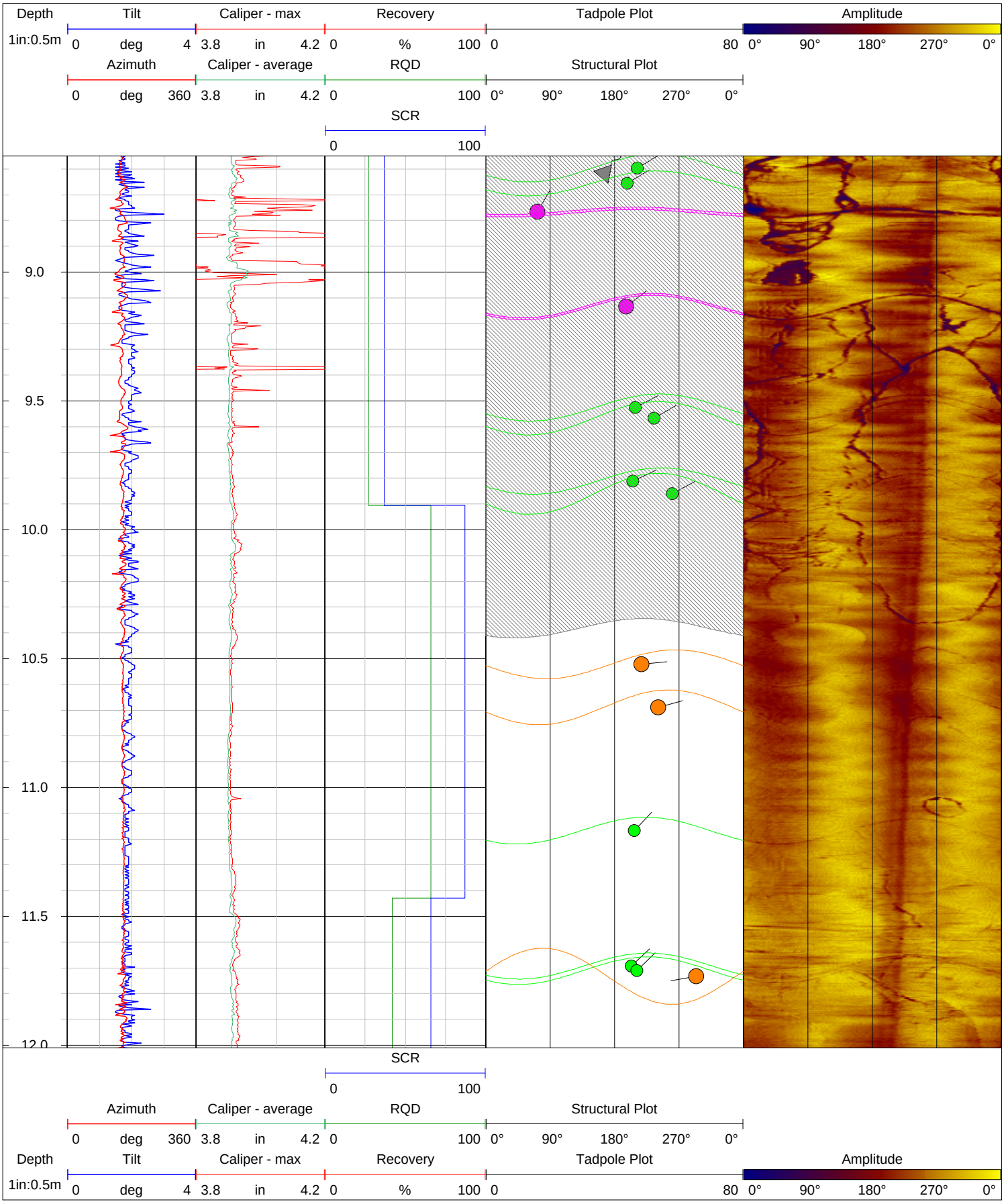


ACOUSTIC TELEVIEWER LOG - BORING BH03

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

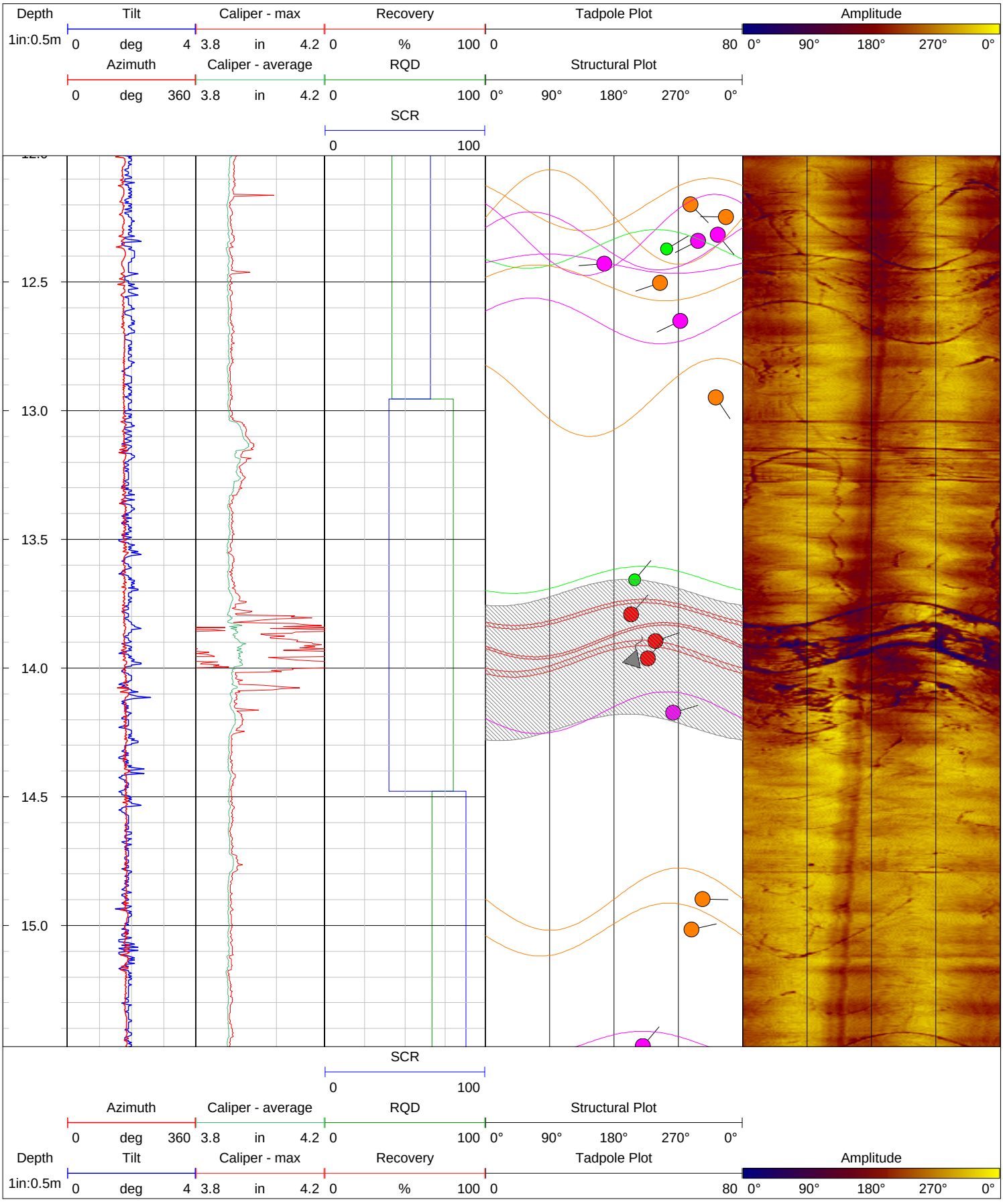
PLATE B2.2



ACOUSTIC TELEVIEWER LOG - BORING BH03

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

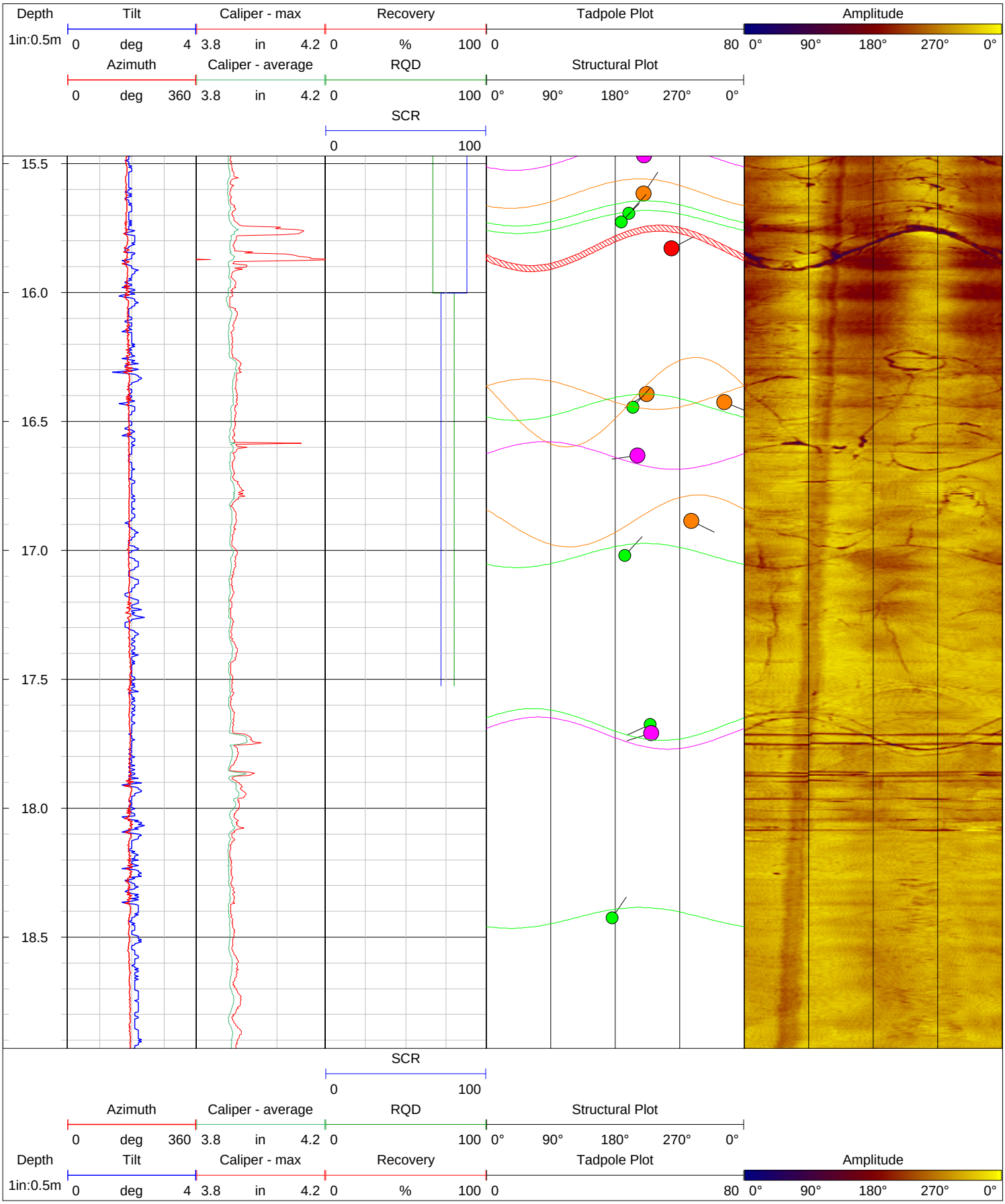


ACOUSTIC TELEVIEWER LOG - BORING BH03

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE B2.4

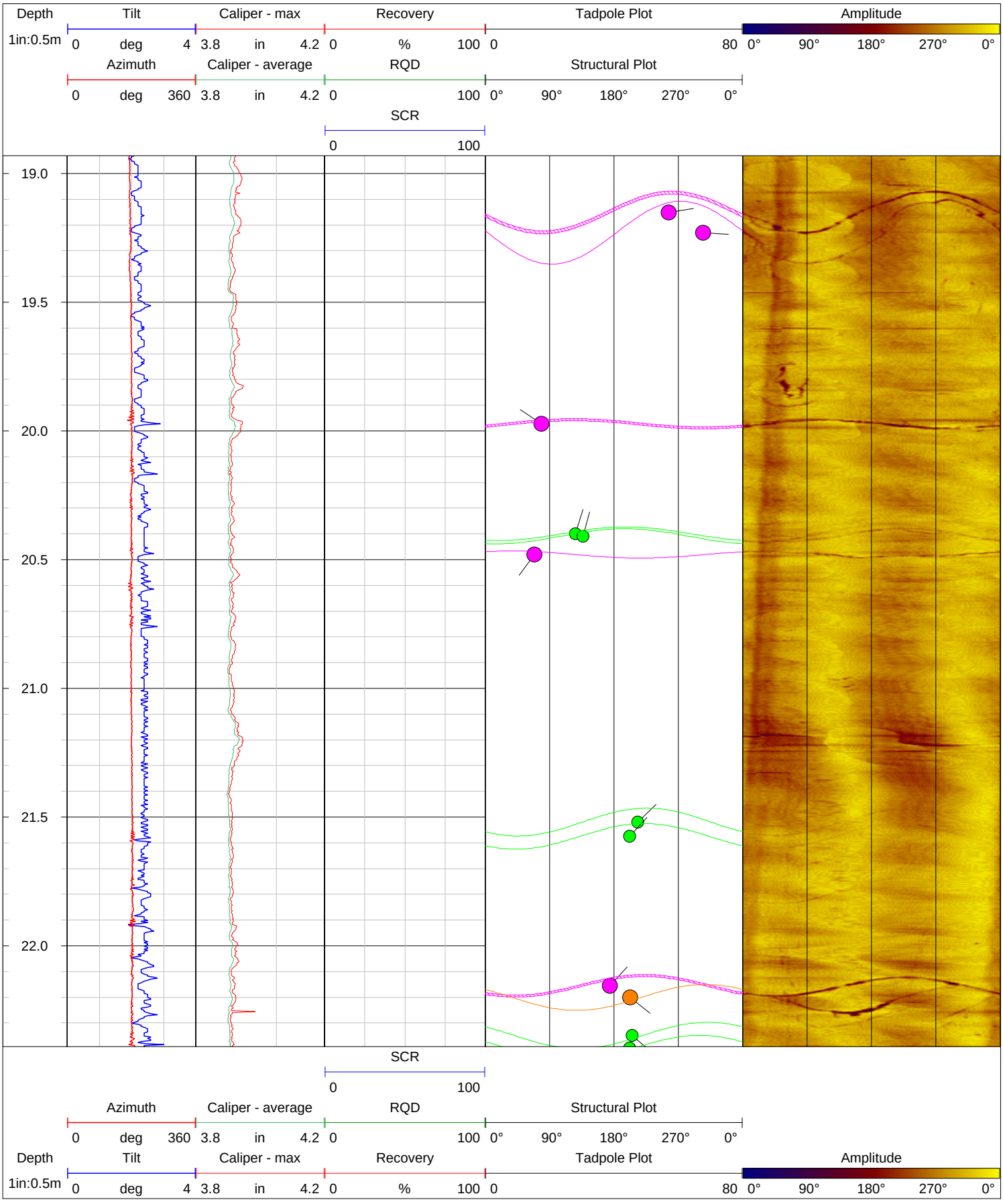


ACOUSTIC TELEVIEWER LOG - BORING BH03

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE B2.5

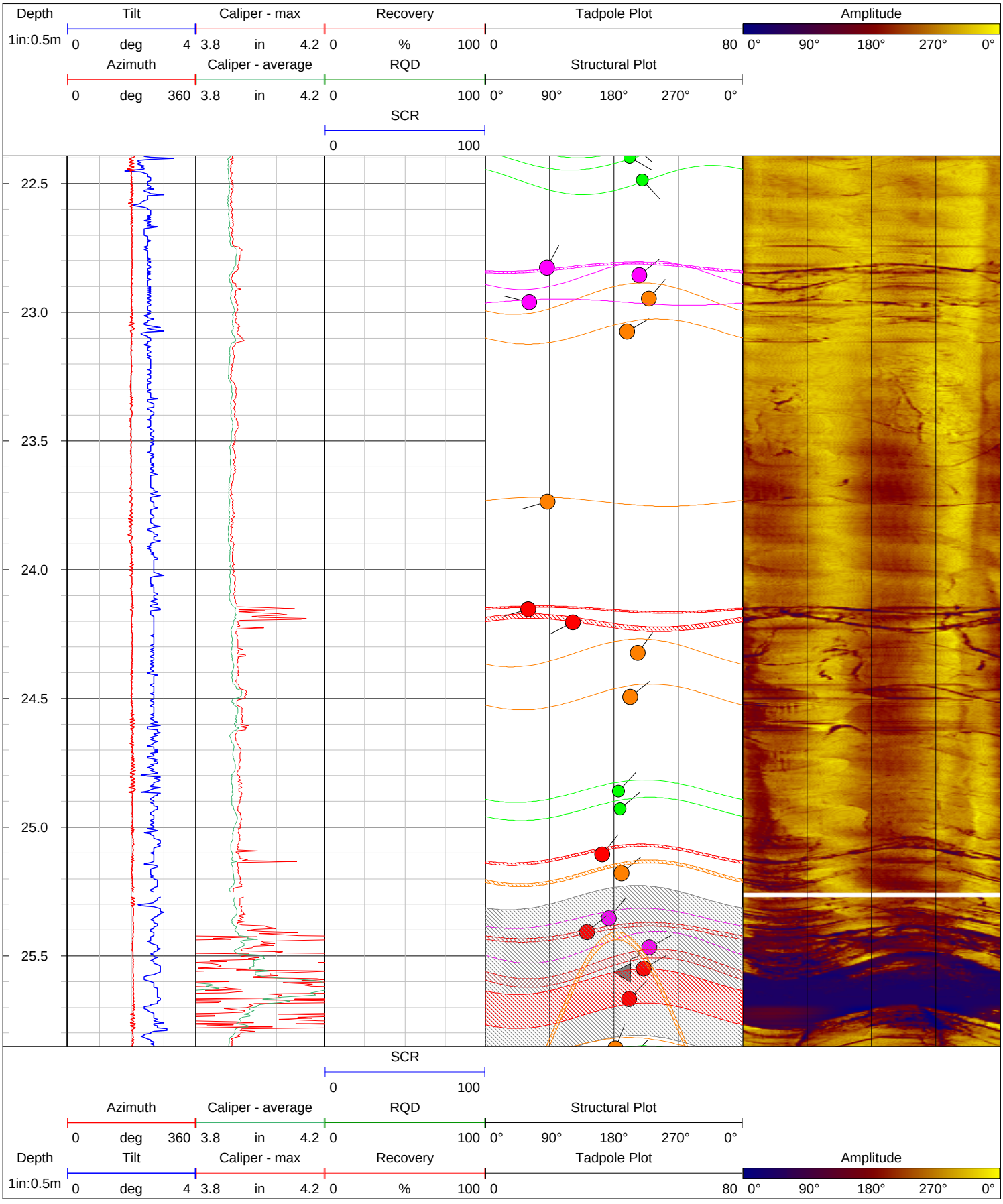


ACOUSTIC TELEVIEWER LOG - BORING BH03

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE B2.6

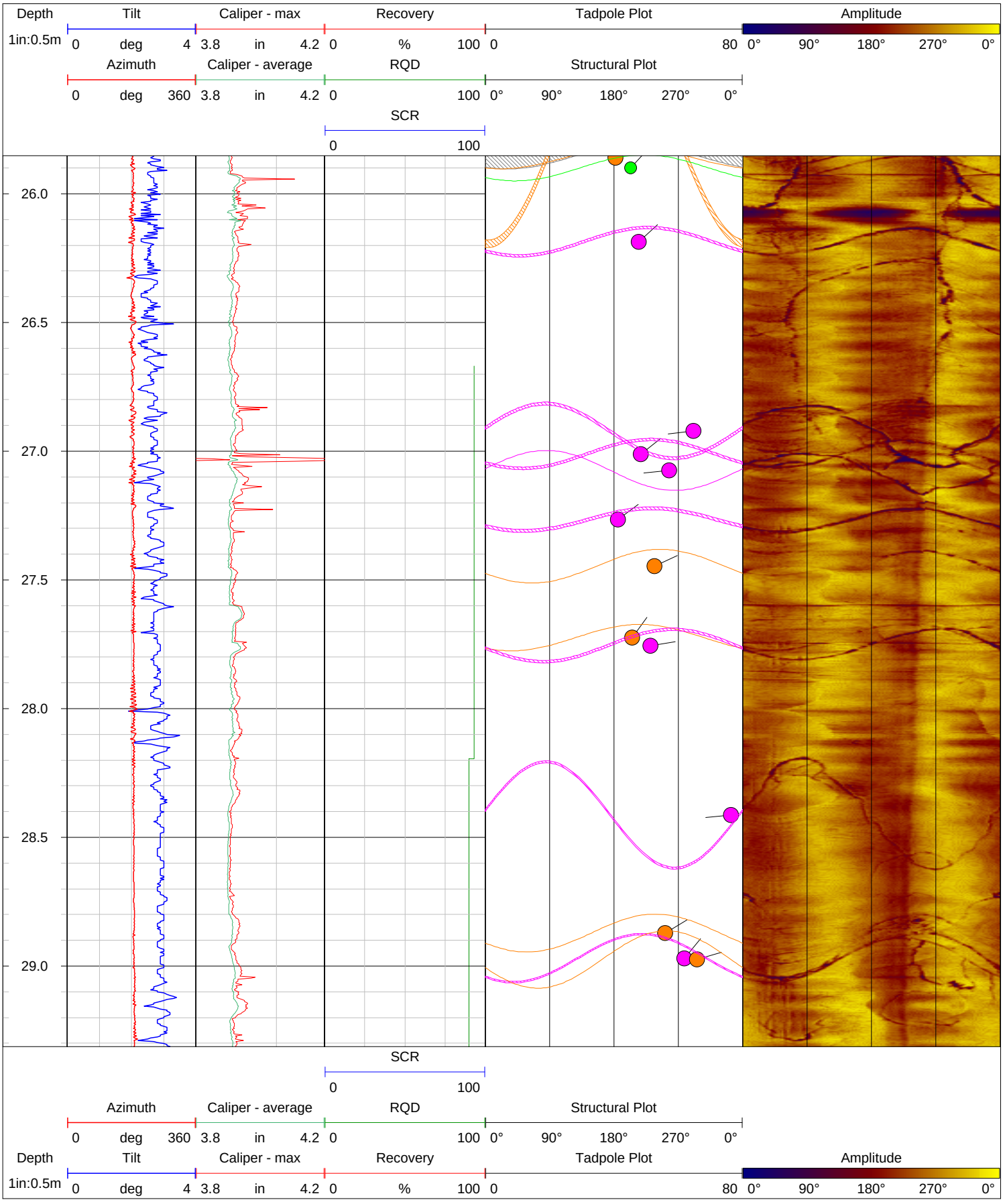


ACOUSTIC TELEVIEWER LOG - BORING BH03

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

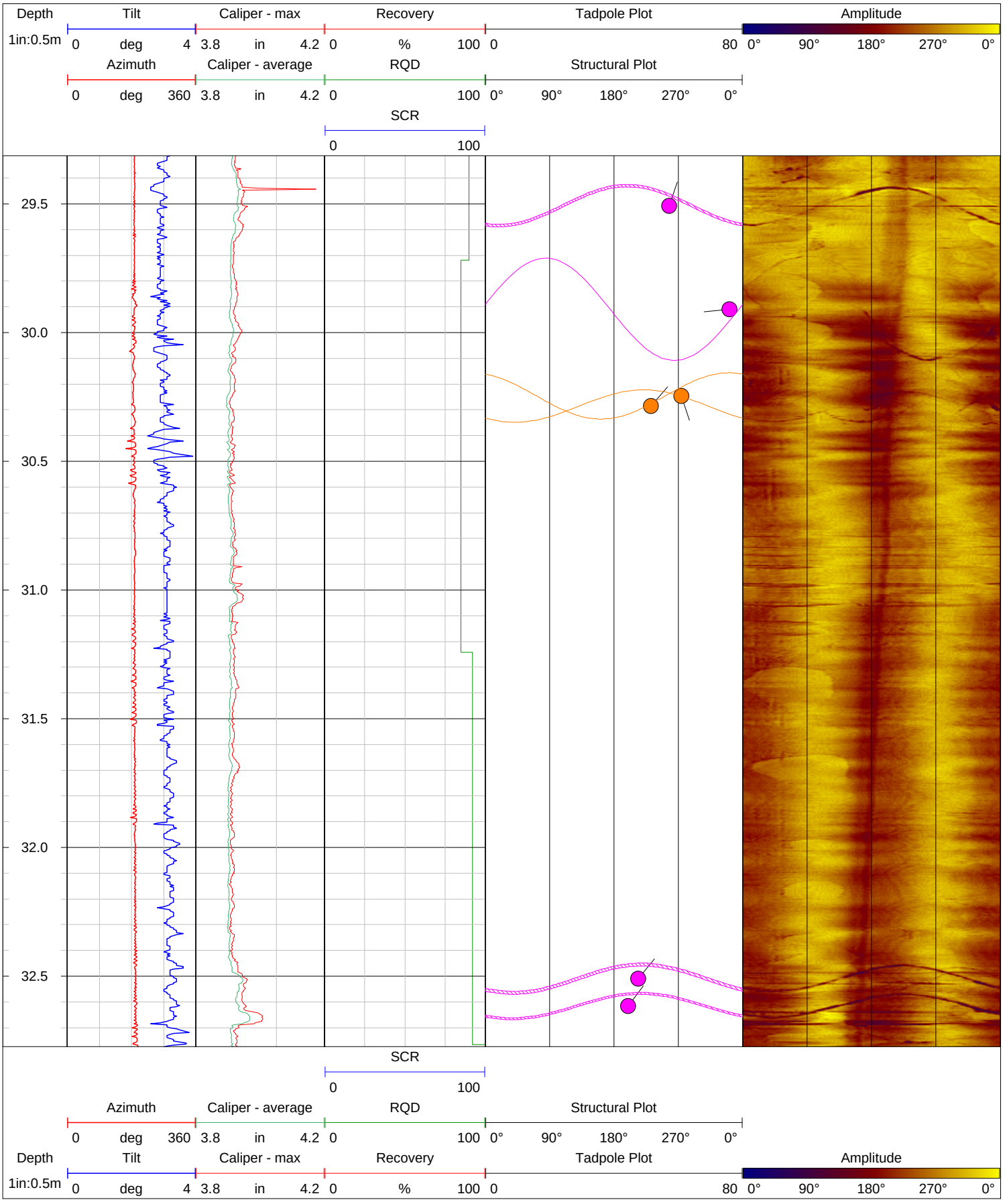
PLATE B2.7



ACOUSTIC TELEVIEWER LOG - BORING BH03

PACIFIC NORTHWEST LNG PROJECT

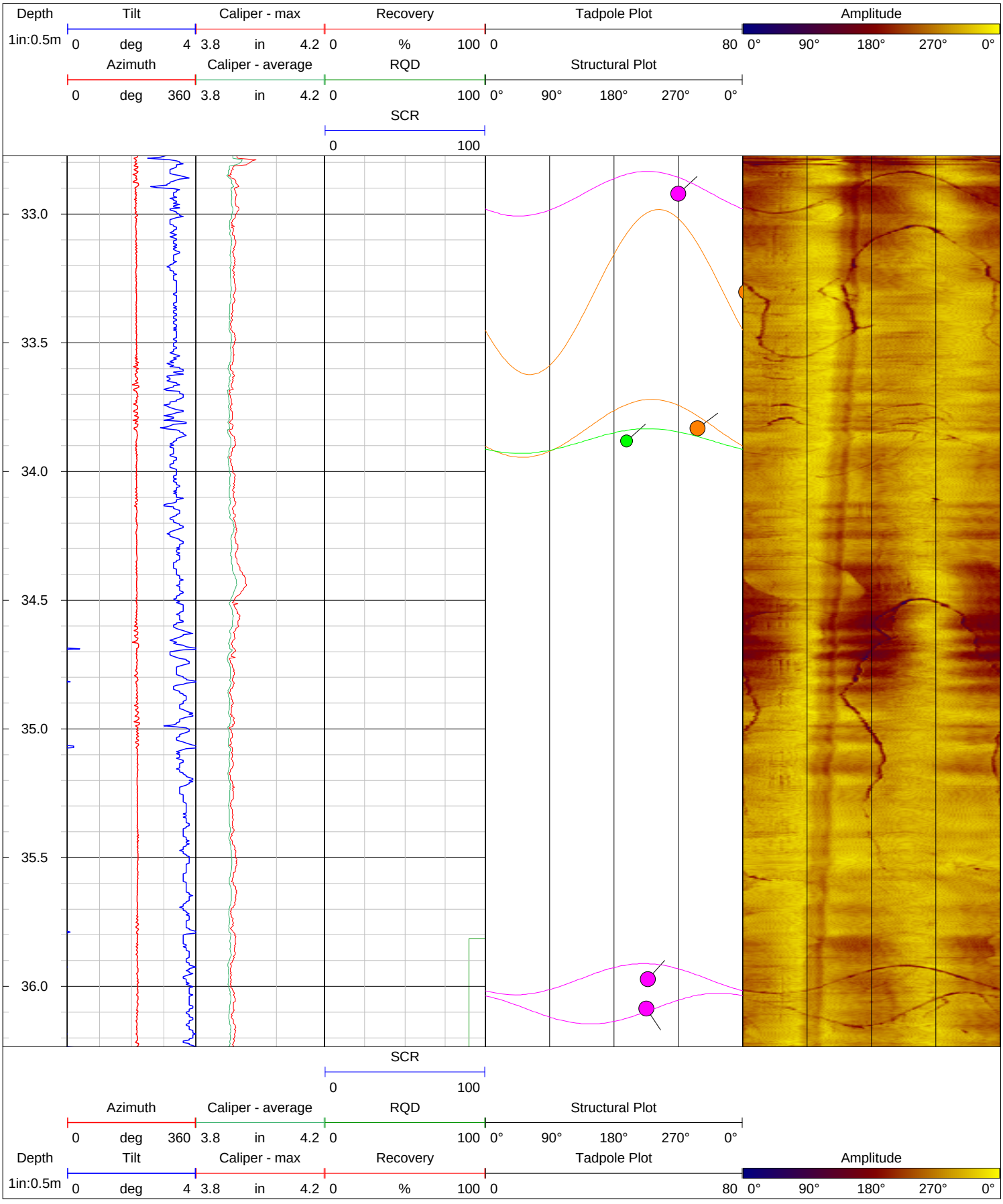
LELU ISLAND, BRITISH COLUMBIA, CANADA



ACOUSTIC TELEVIEWER LOG - BORING BH03

PACIFIC NORTHWEST LNG PROJECT

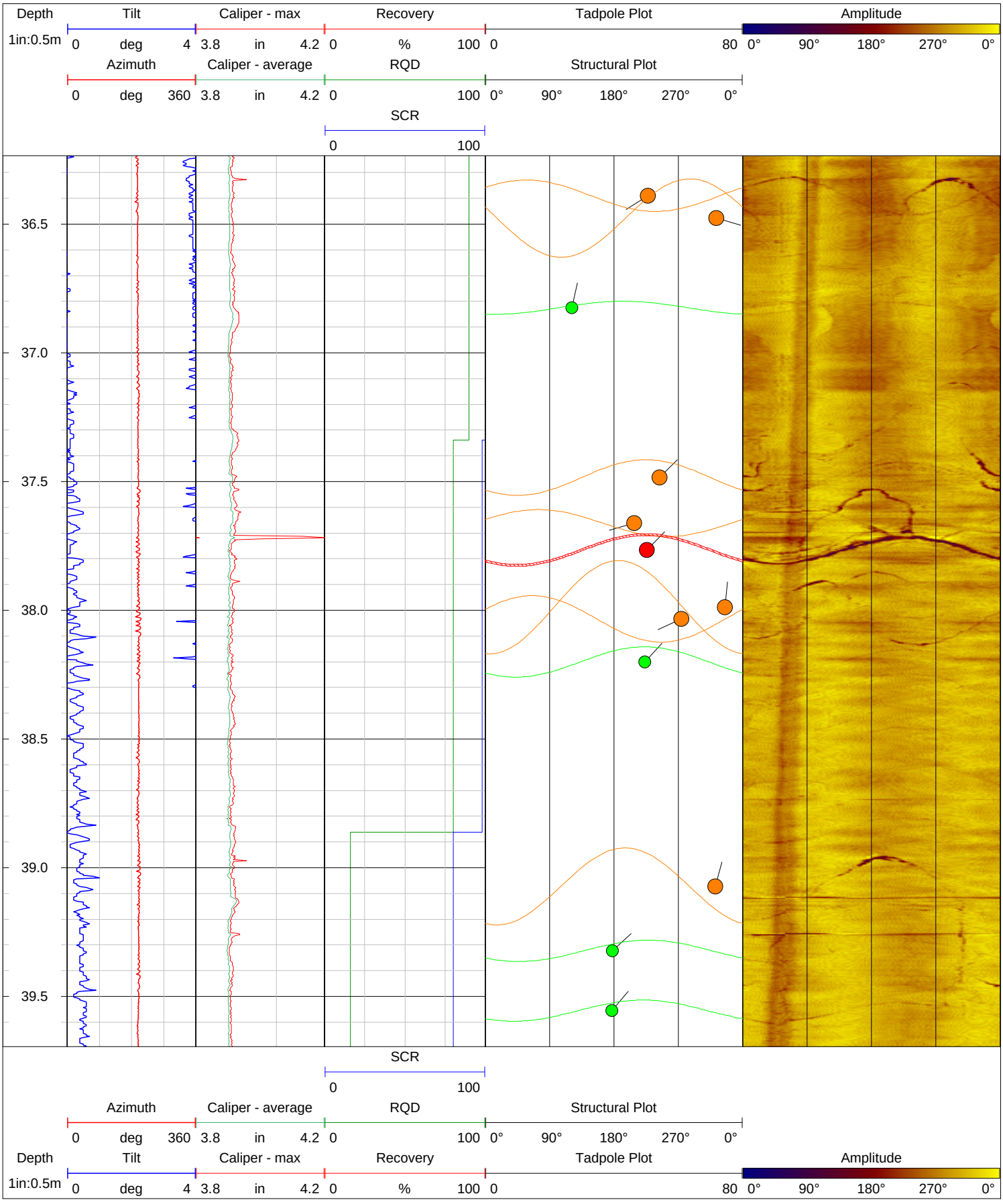
LELU ISLAND, BRITISH COLUMBIA, CANADA



ACOUSTIC TELEVIEWER LOG - BORING BH03

PACIFIC NORTHWEST LNG PROJECT

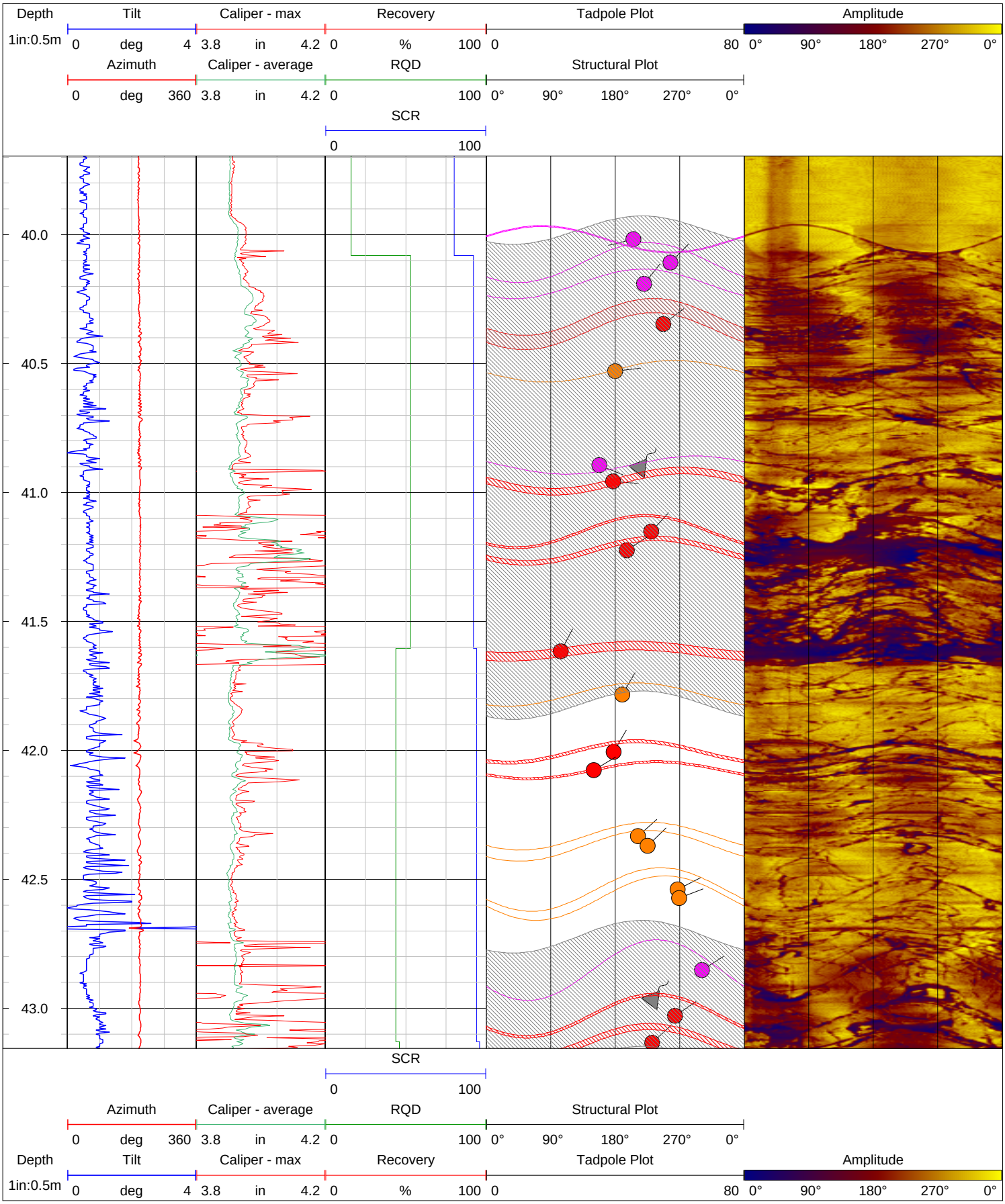
LELU ISLAND, BRITISH COLUMBIA, CANADA



ACOUSTIC TELEVIEWER LOG - BORING BH03

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

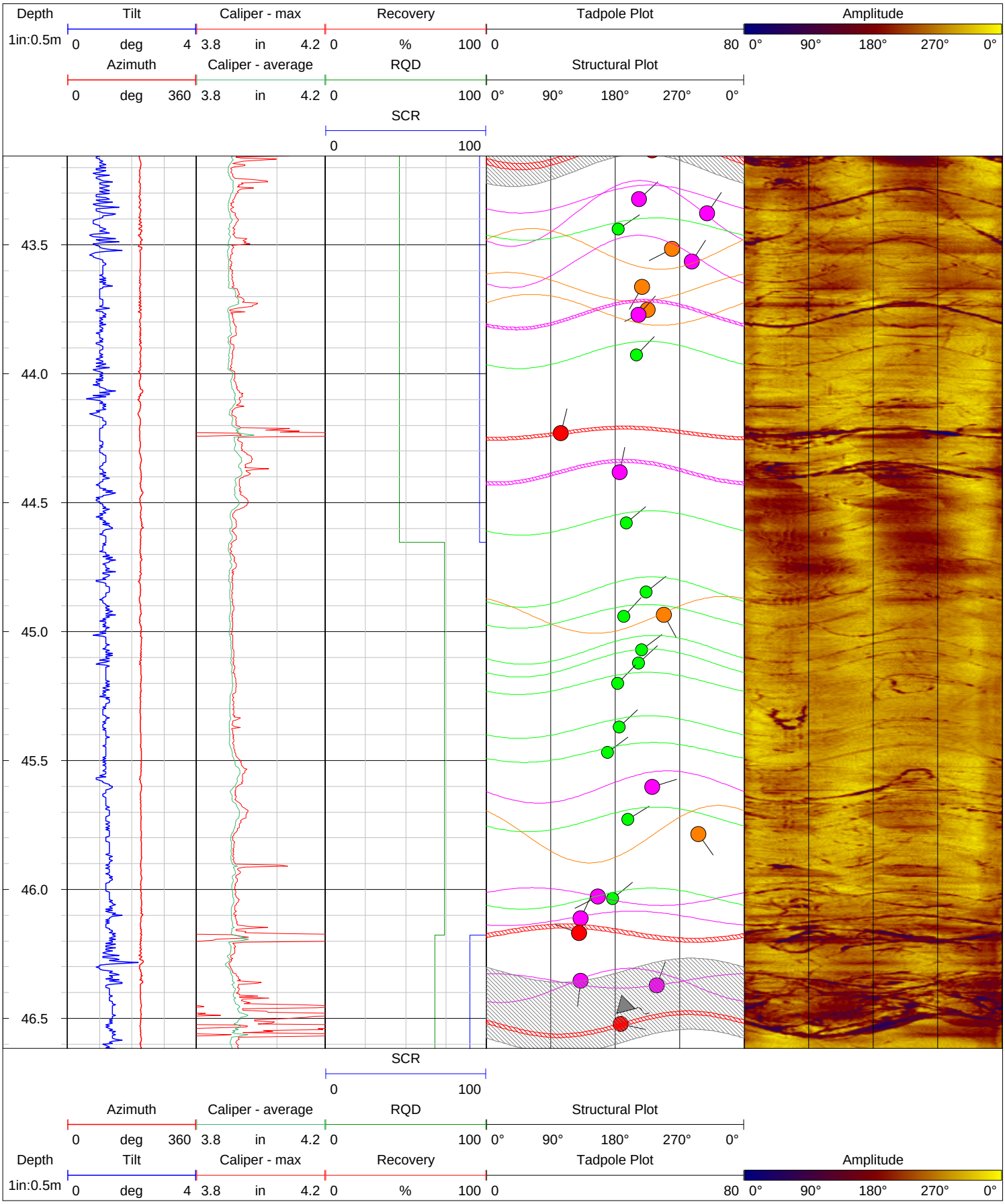


ACOUSTIC TELEVIEWER LOG - BORING BH03

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE B2.12

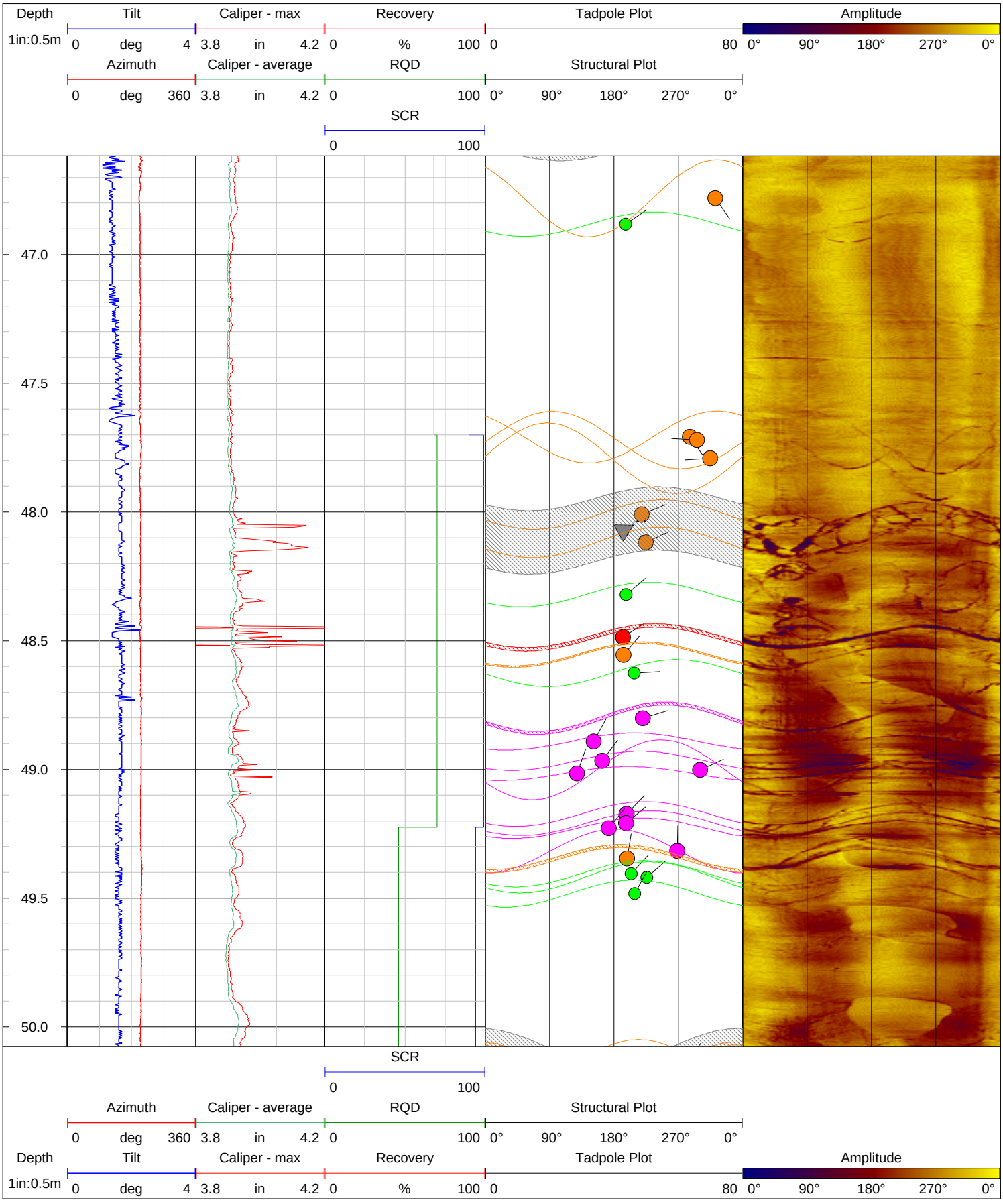


ACOUSTIC TELEVIEWER LOG - BORING BH03

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

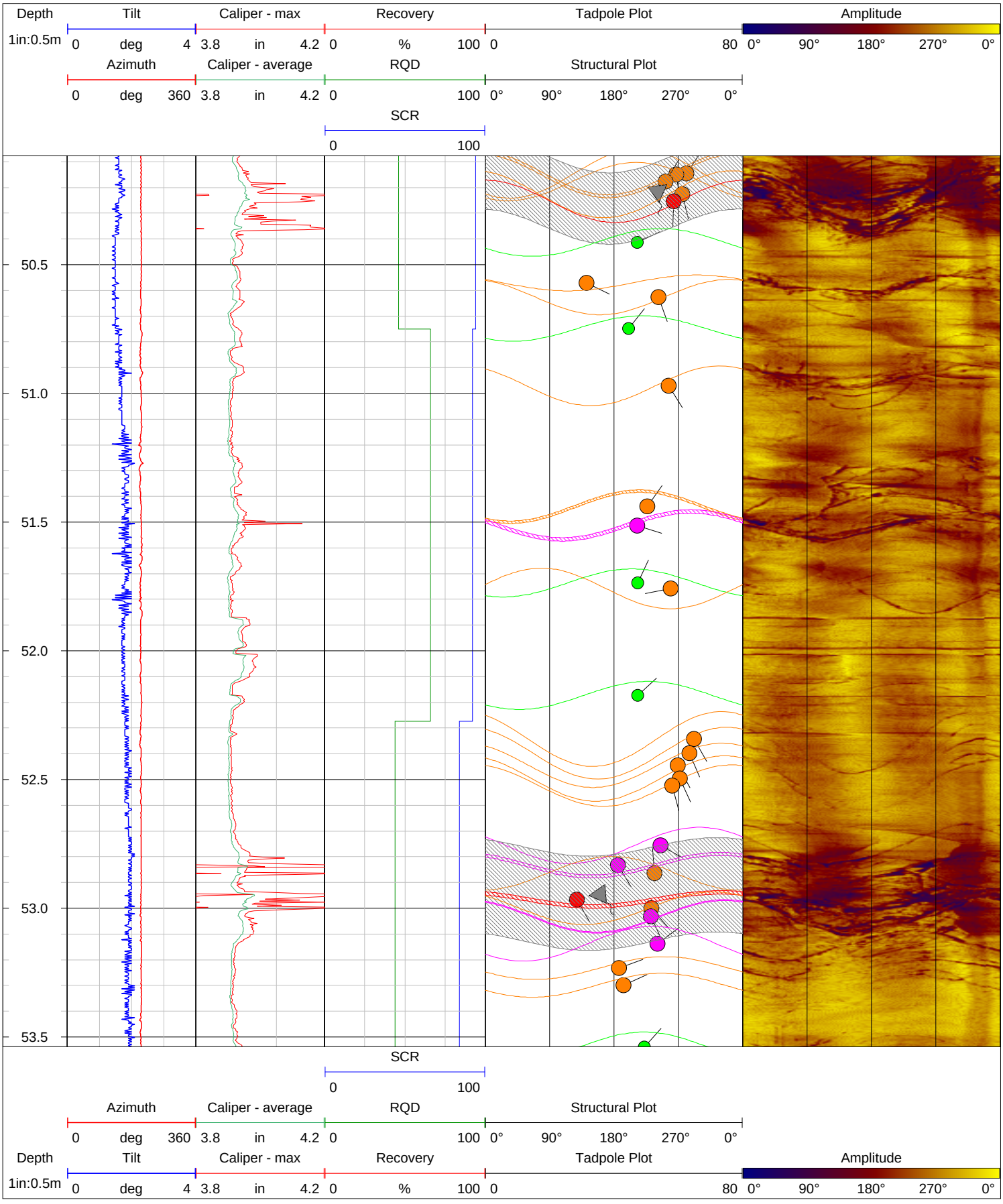
PLATE B2.13



ACOUSTIC TELEVIEWER LOG - BORING BH03

PACIFIC NORTHWEST LNG PROJECT

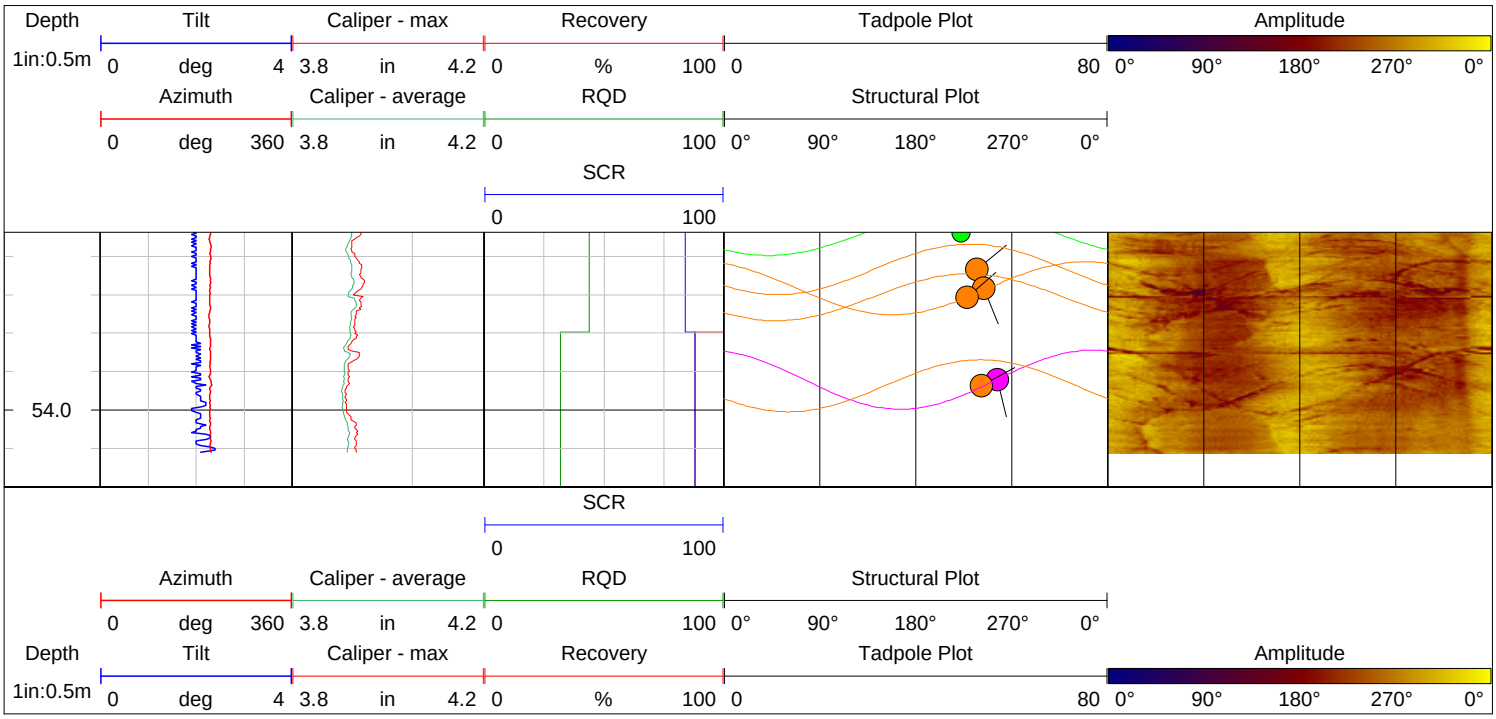
LELU ISLAND, BRITISH COLUMBIA, CANADA



ACOUSTIC TELEVIEWER LOG - BORING BH03

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

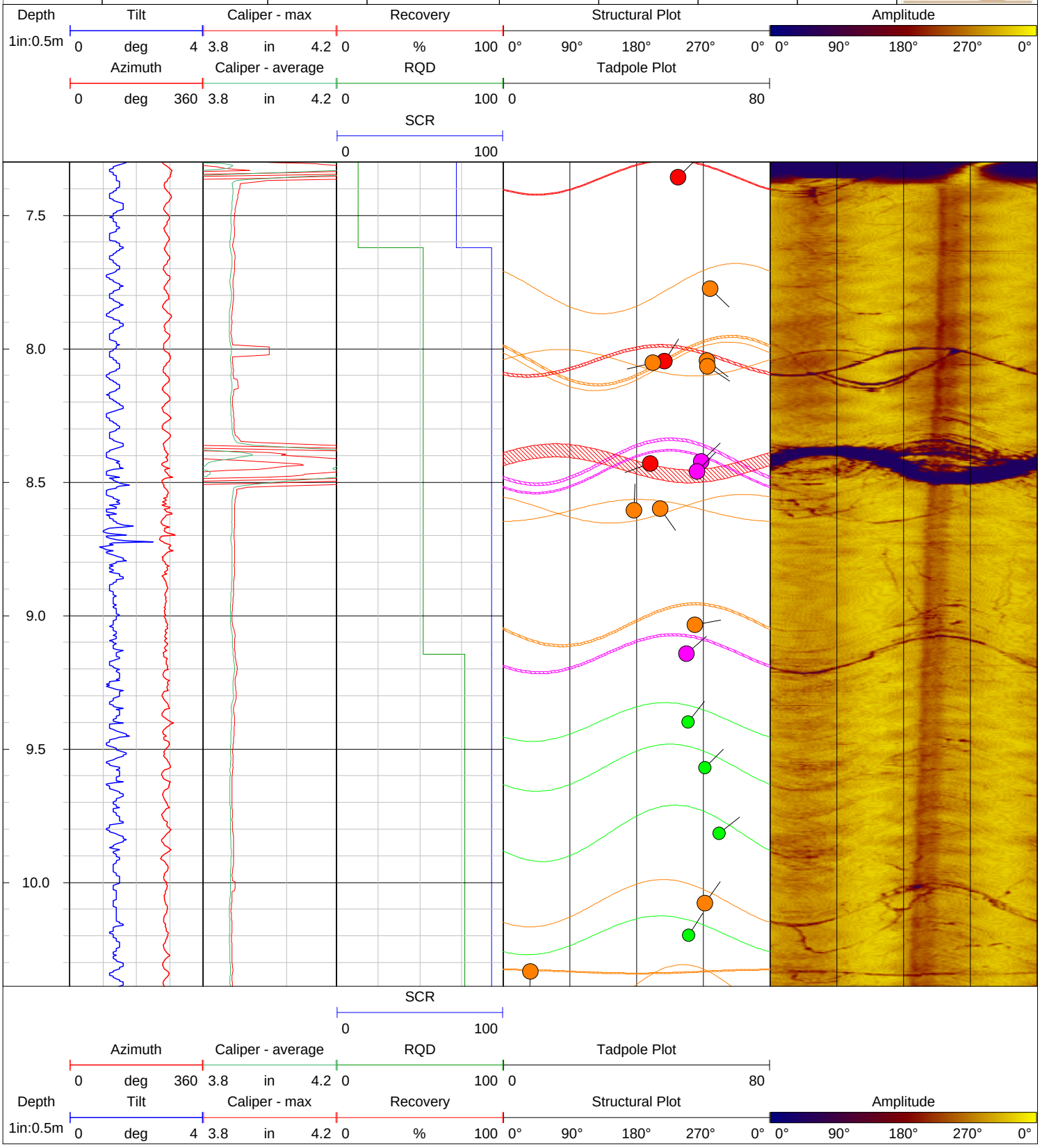


ACOUSTIC TELEVIEWER LOG - BORING BH03

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

Project:	04.10130058	Boring:	BH10	Depth:	54.86 m	Log Depth:	53.89 m
Date:	07/07/2013	Run:	One / Up	Elevation:	27.80 m	Operator:	DV

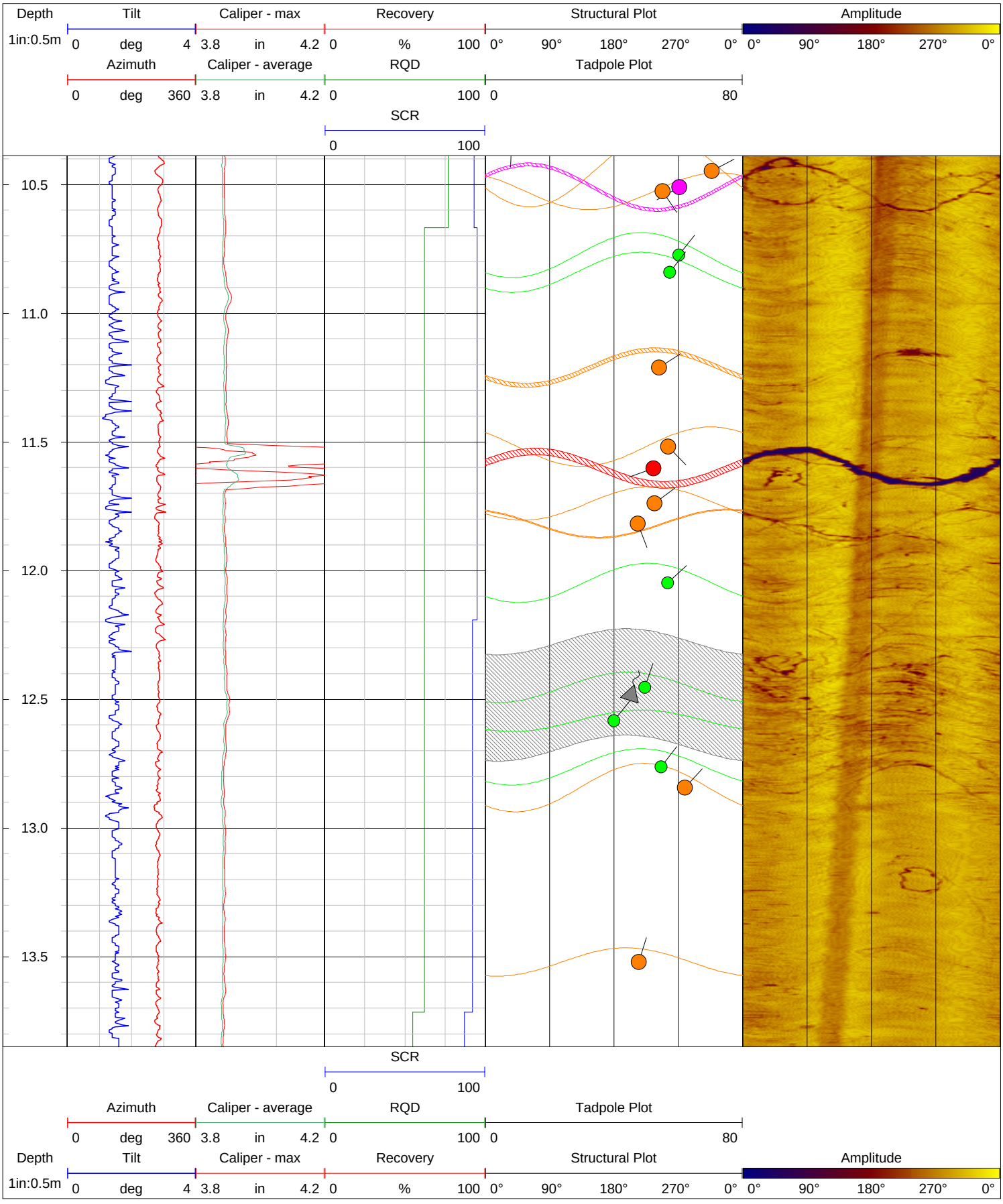


ACOUSTIC TELEVIEWER LOG - BORING BH10

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

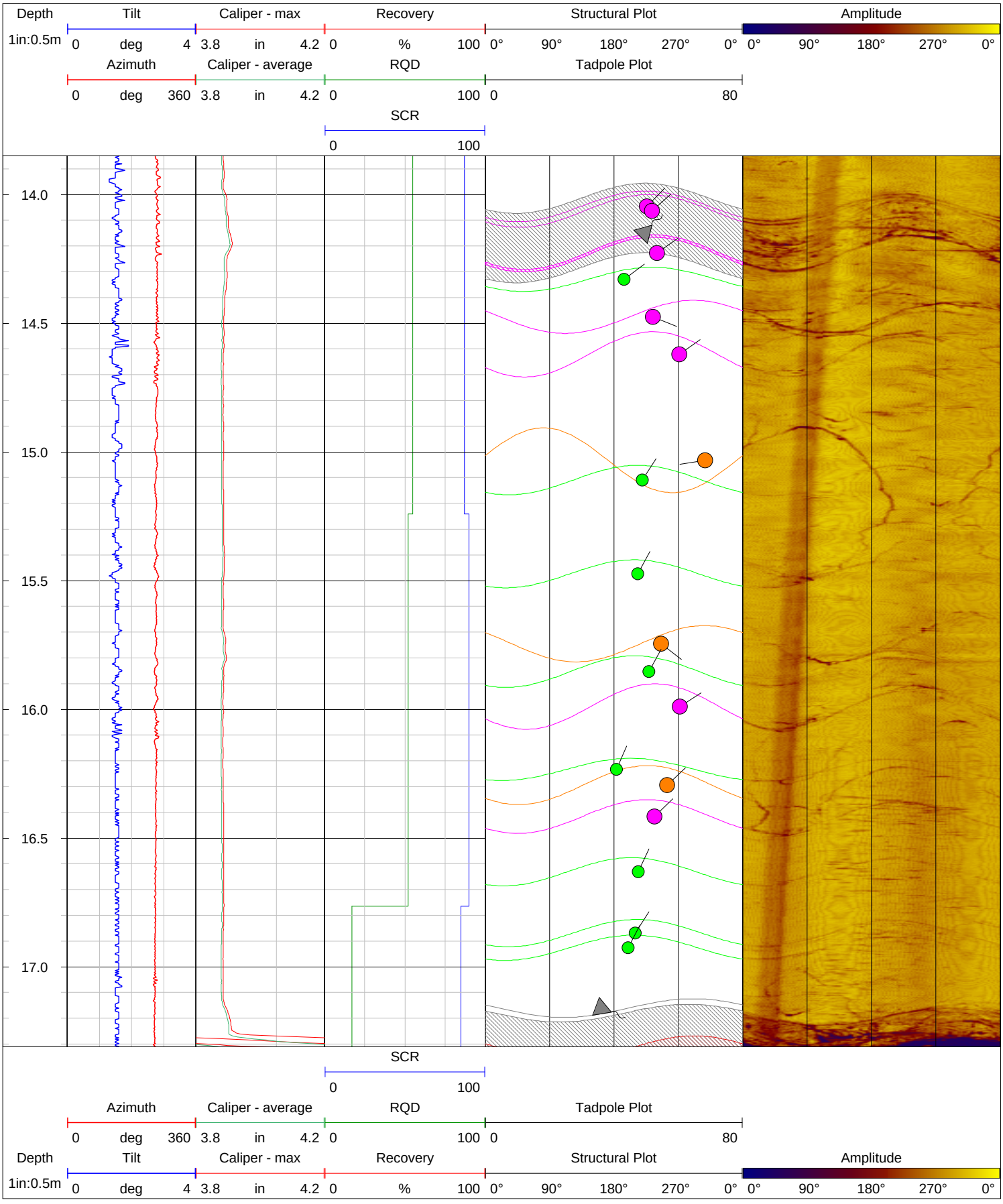
PLATE B3.1



ACOUSTIC TELEVIEWER LOG - BORING BH10

PACIFIC NORTHWEST LNG PROJECT

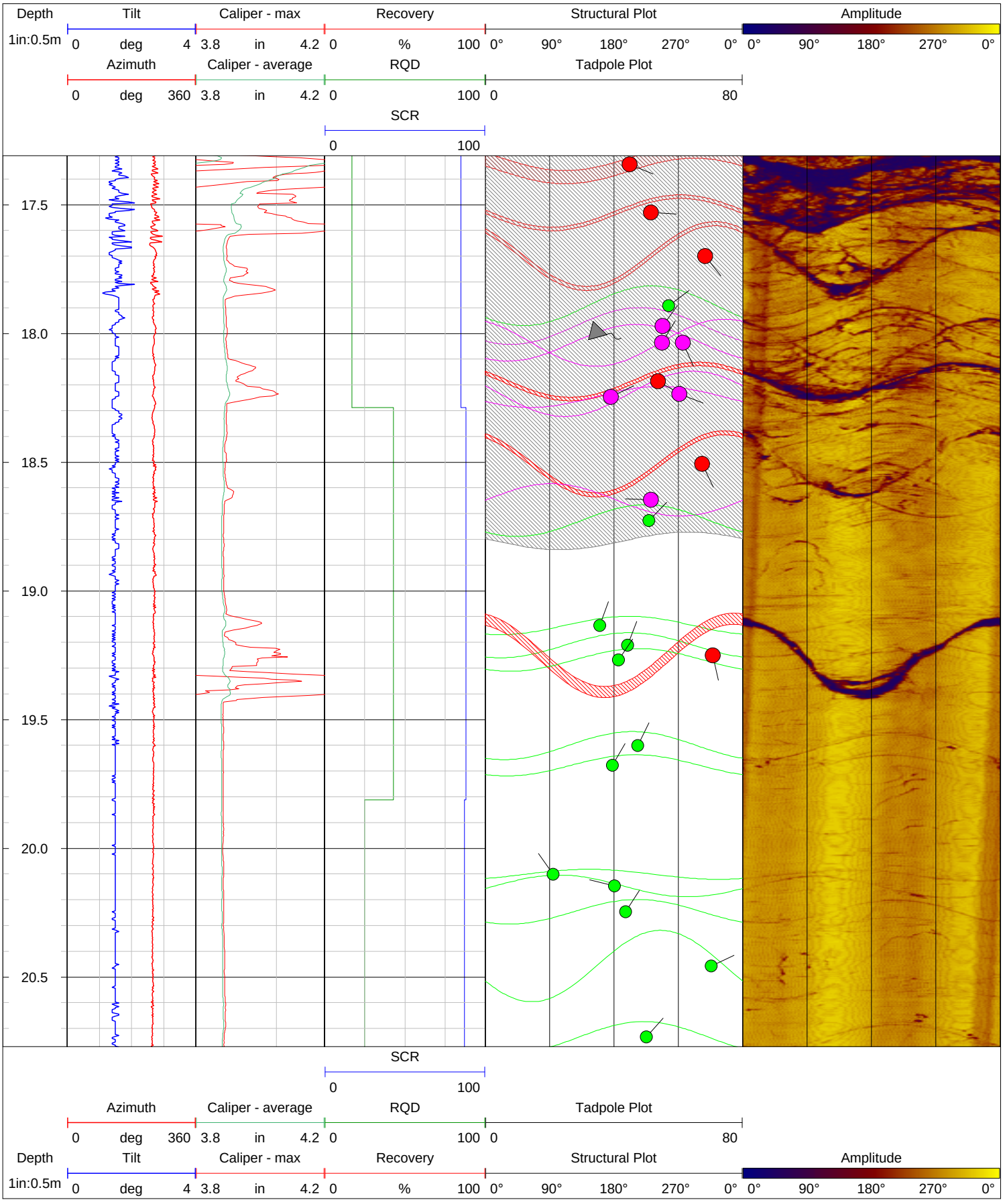
LELU ISLAND, BRITISH COLUMBIA, CANADA



ACOUSTIC TELEVIEWER LOG - BORING BH10

PACIFIC NORTHWEST LNG PROJECT

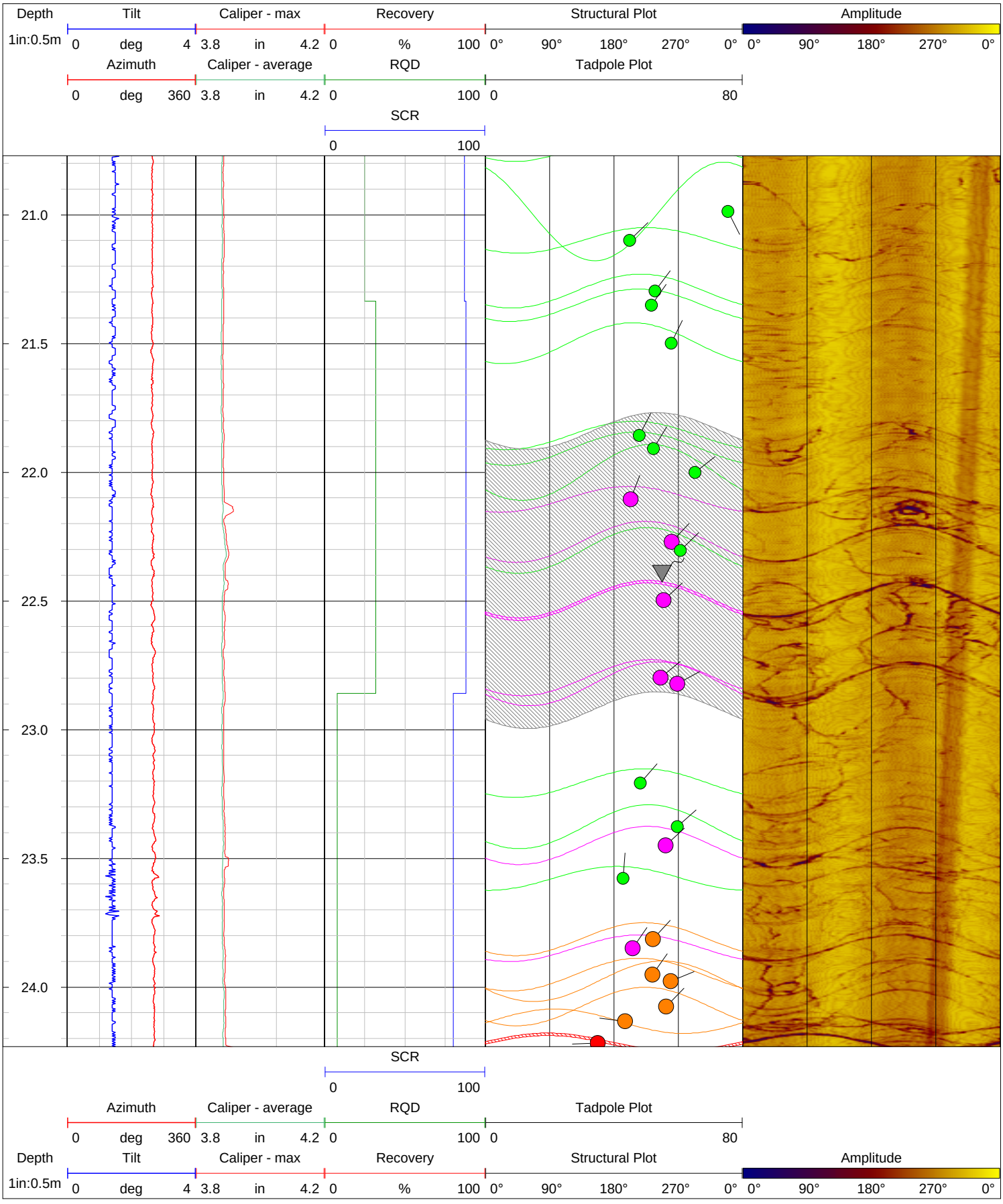
LELU ISLAND, BRITISH COLUMBIA, CANADA



ACOUSTIC TELEVIEWER LOG - BORING BH10

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

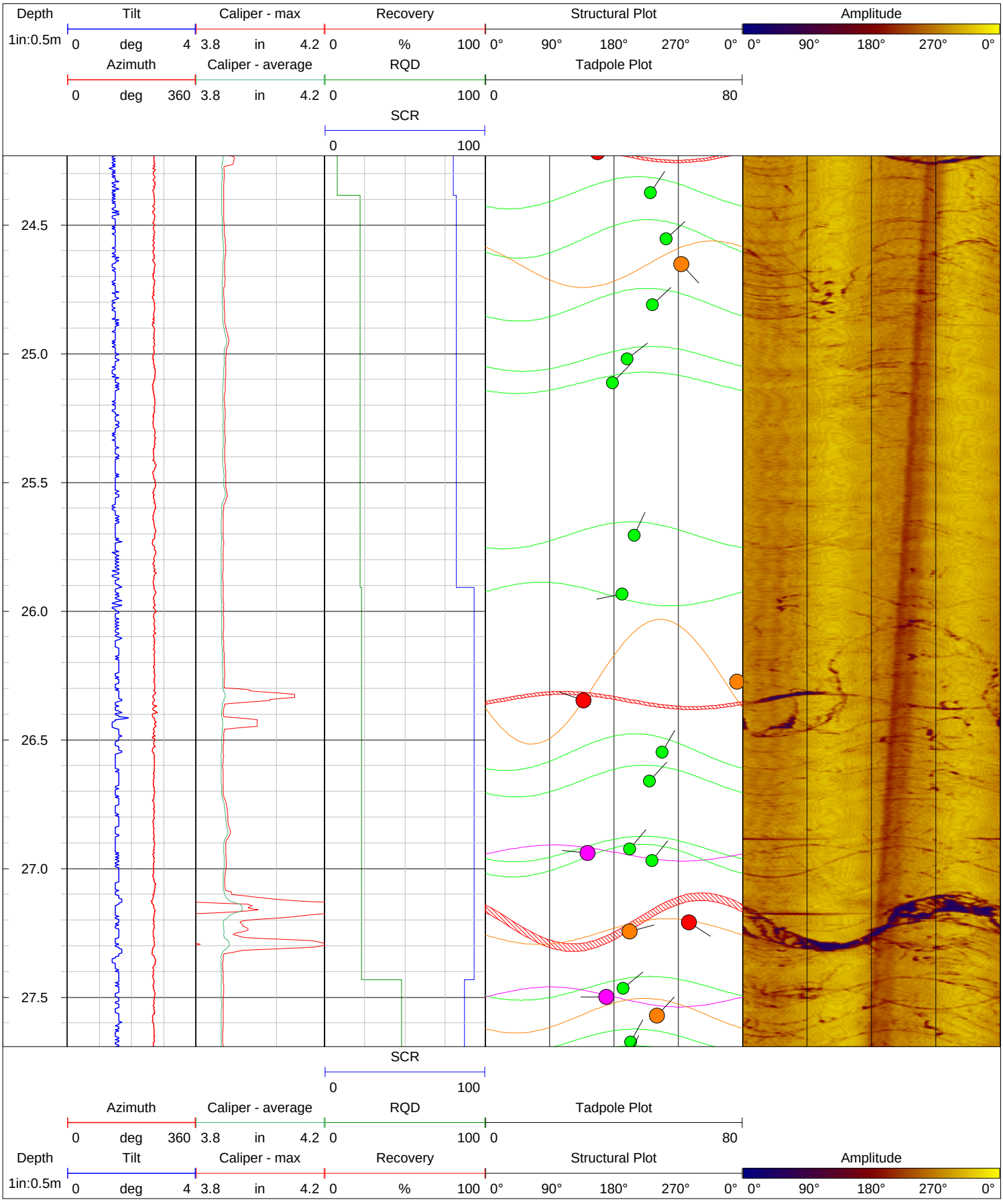


ACOUSTIC TELEVIEWER LOG - BORING BH10

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

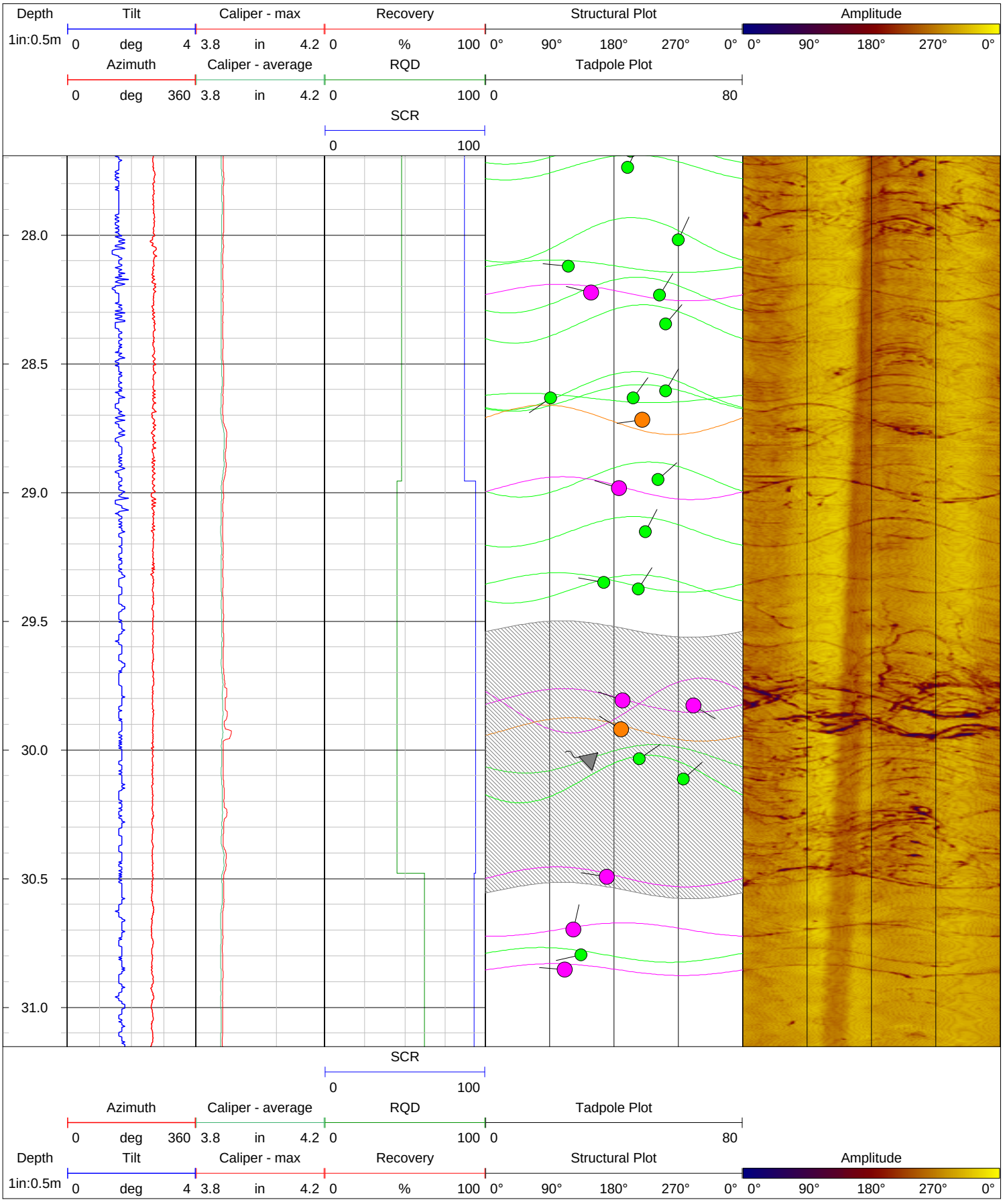
PLATE B3.5



ACOUSTIC TELEVIEWER LOG - BORING BH10

PACIFIC NORTHWEST LNG PROJECT

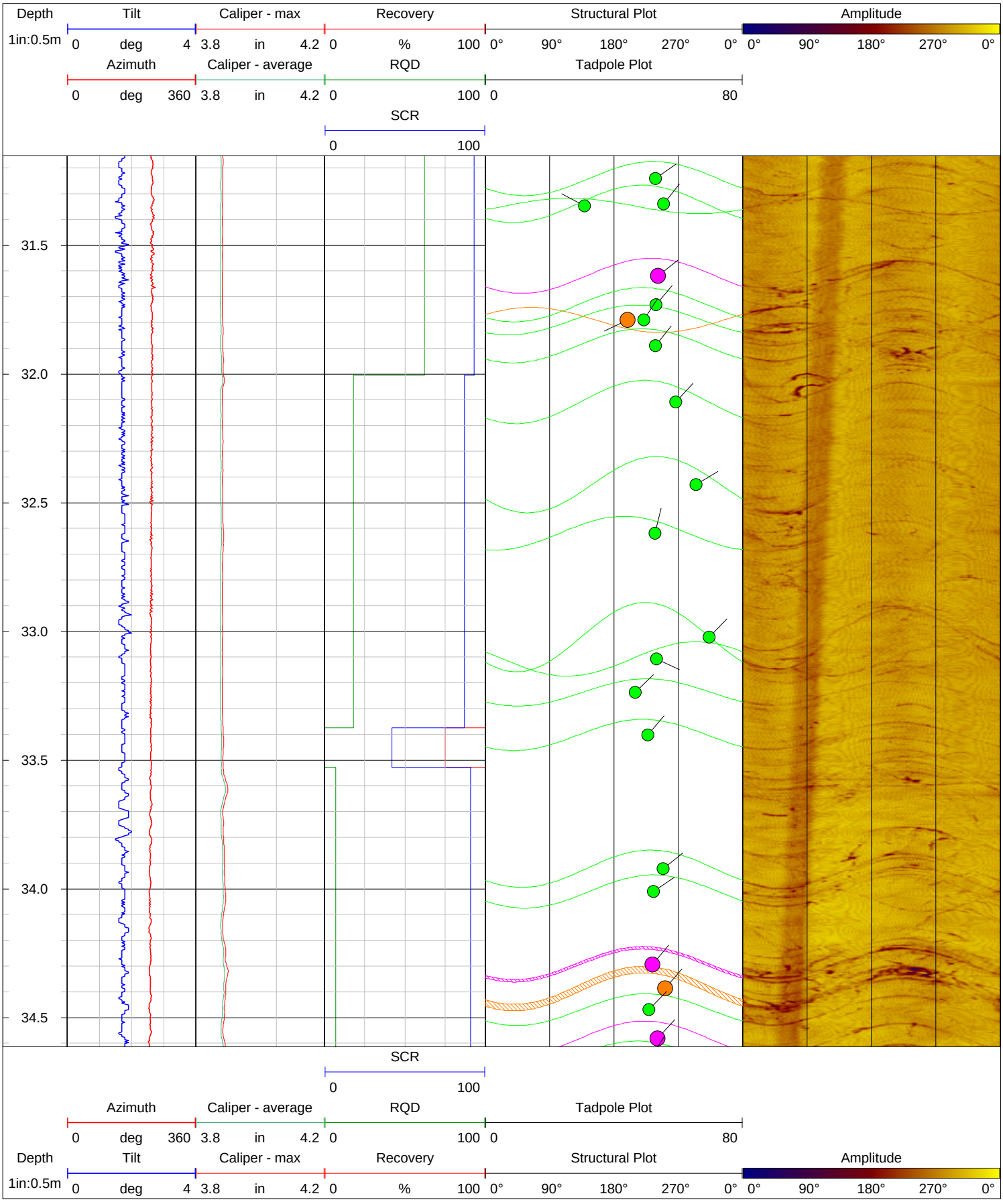
LELU ISLAND, BRITISH COLUMBIA, CANADA



ACOUSTIC TELEVIEWER LOG - BORING BH10

PACIFIC NORTHWEST LNG PROJECT

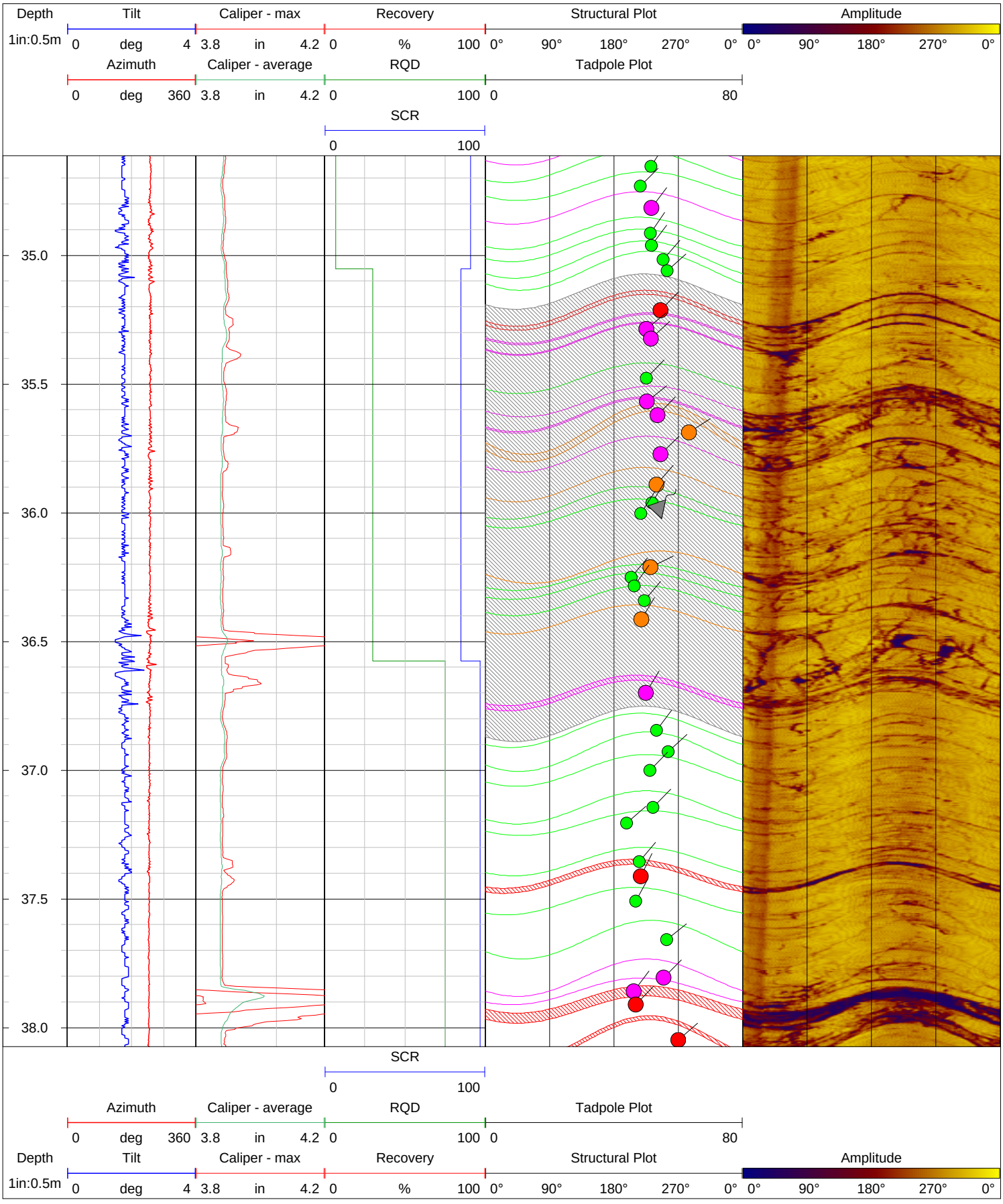
LELU ISLAND, BRITISH COLUMBIA, CANADA



ACOUSTIC TELEVIEWER LOG - BORING BH10

PACIFIC NORTHWEST LNG PROJECT

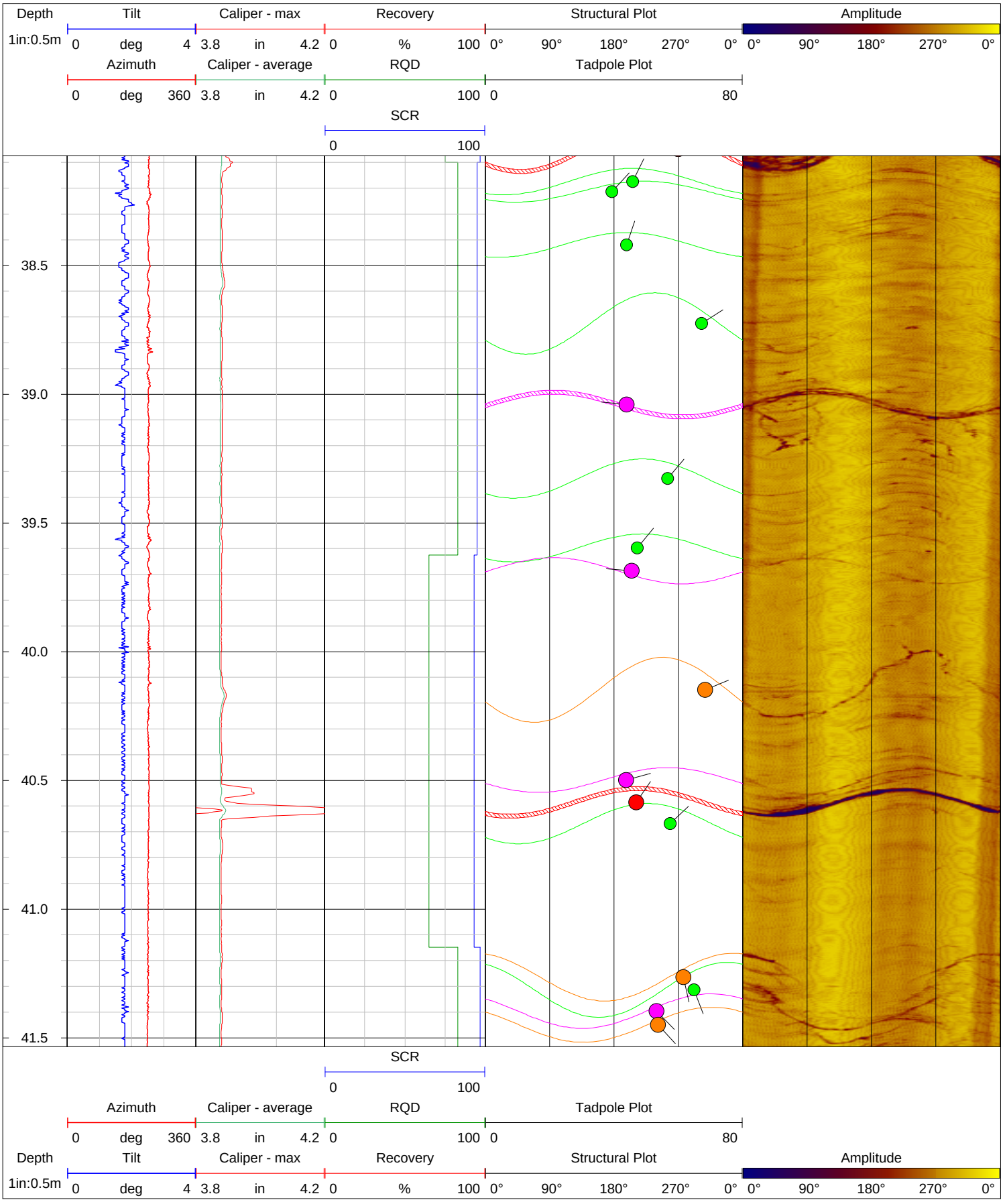
LELU ISLAND, BRITISH COLUMBIA, CANADA



ACOUSTIC TELEVIEWER LOG - BORING BH10

PACIFIC NORTHWEST LNG PROJECT

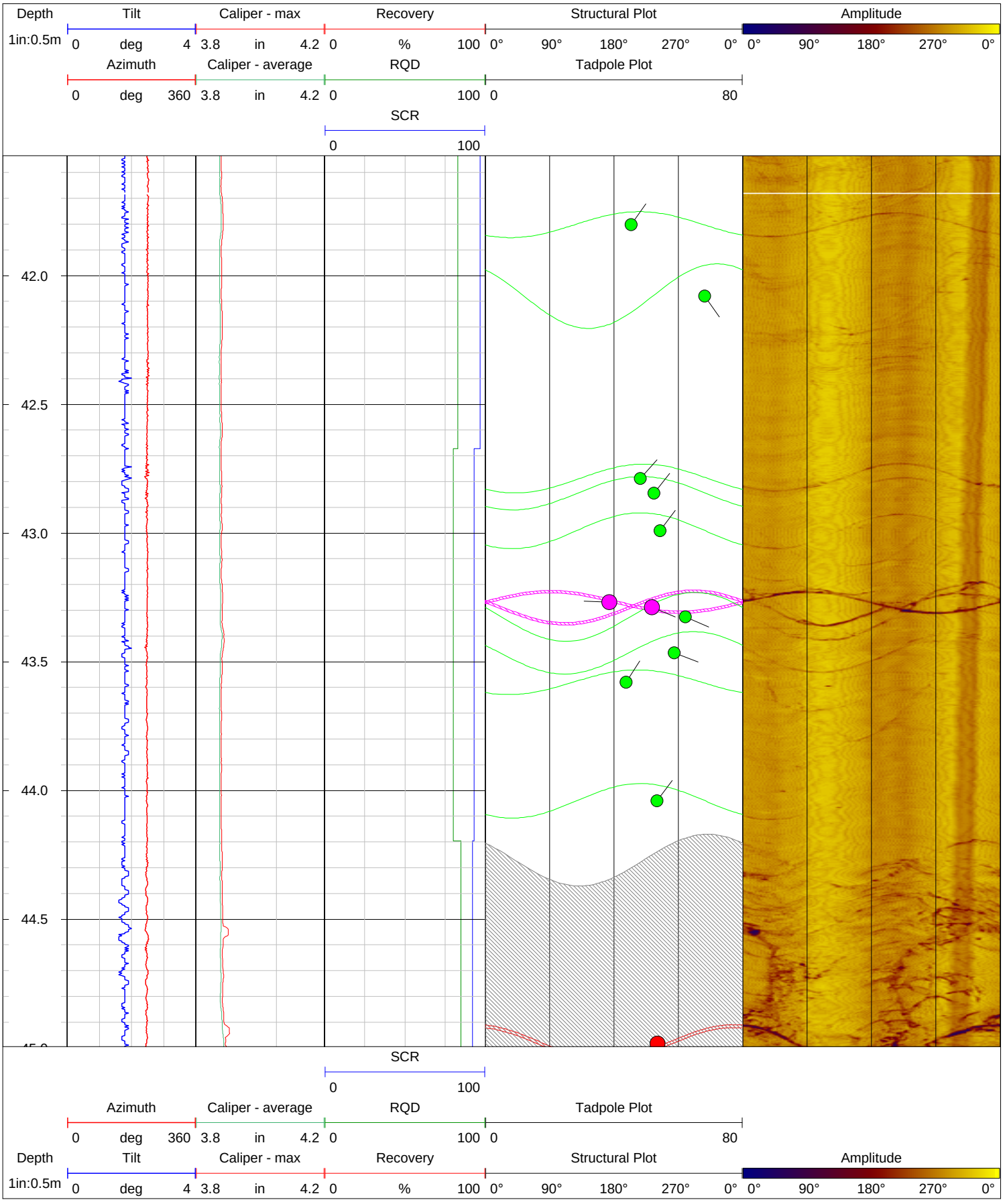
LELU ISLAND, BRITISH COLUMBIA, CANADA



ACOUSTIC TELEVIEWER LOG - BORING BH10

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

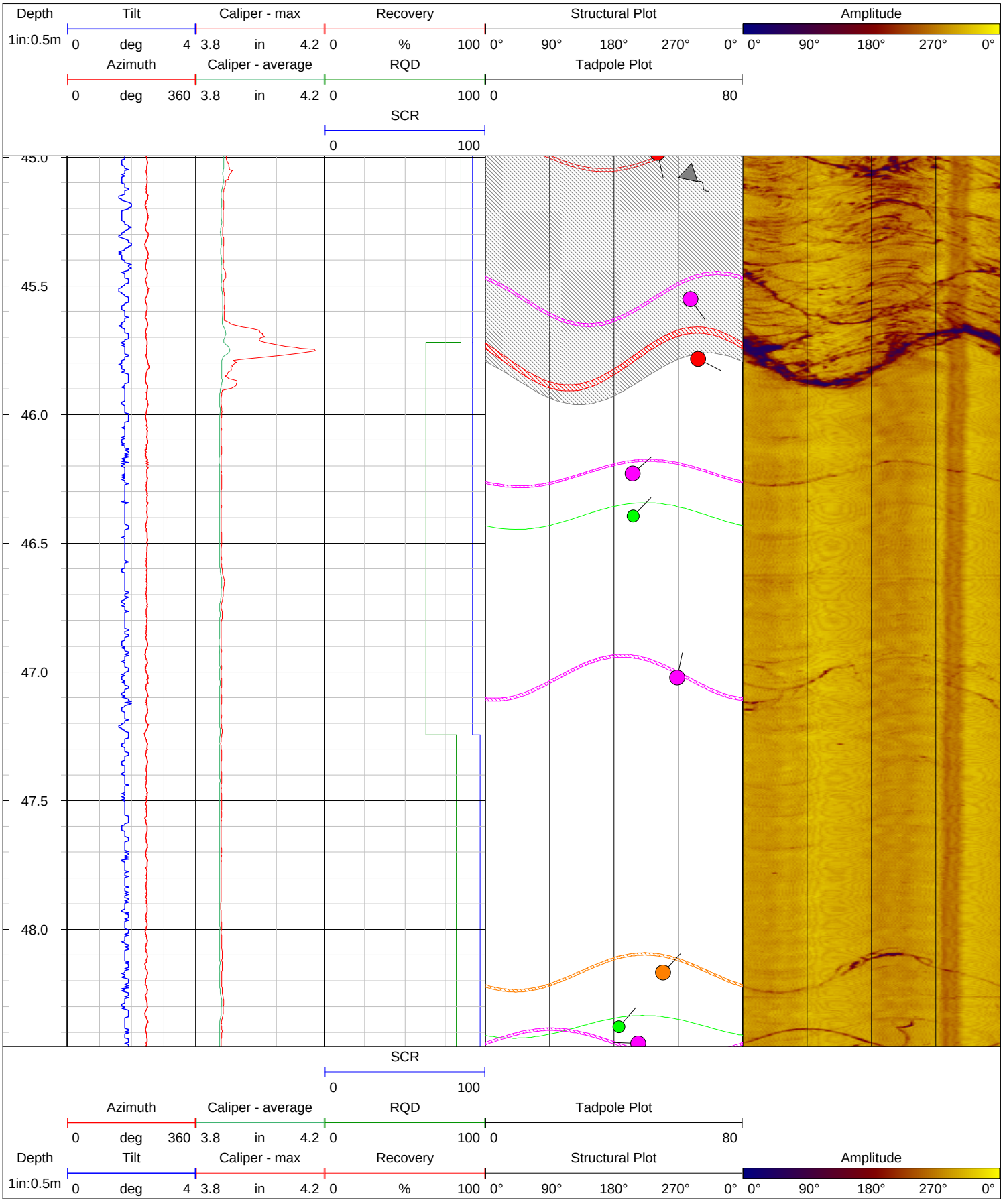


ACOUSTIC TELEVIEWER LOG - BORING BH10

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE B3.11

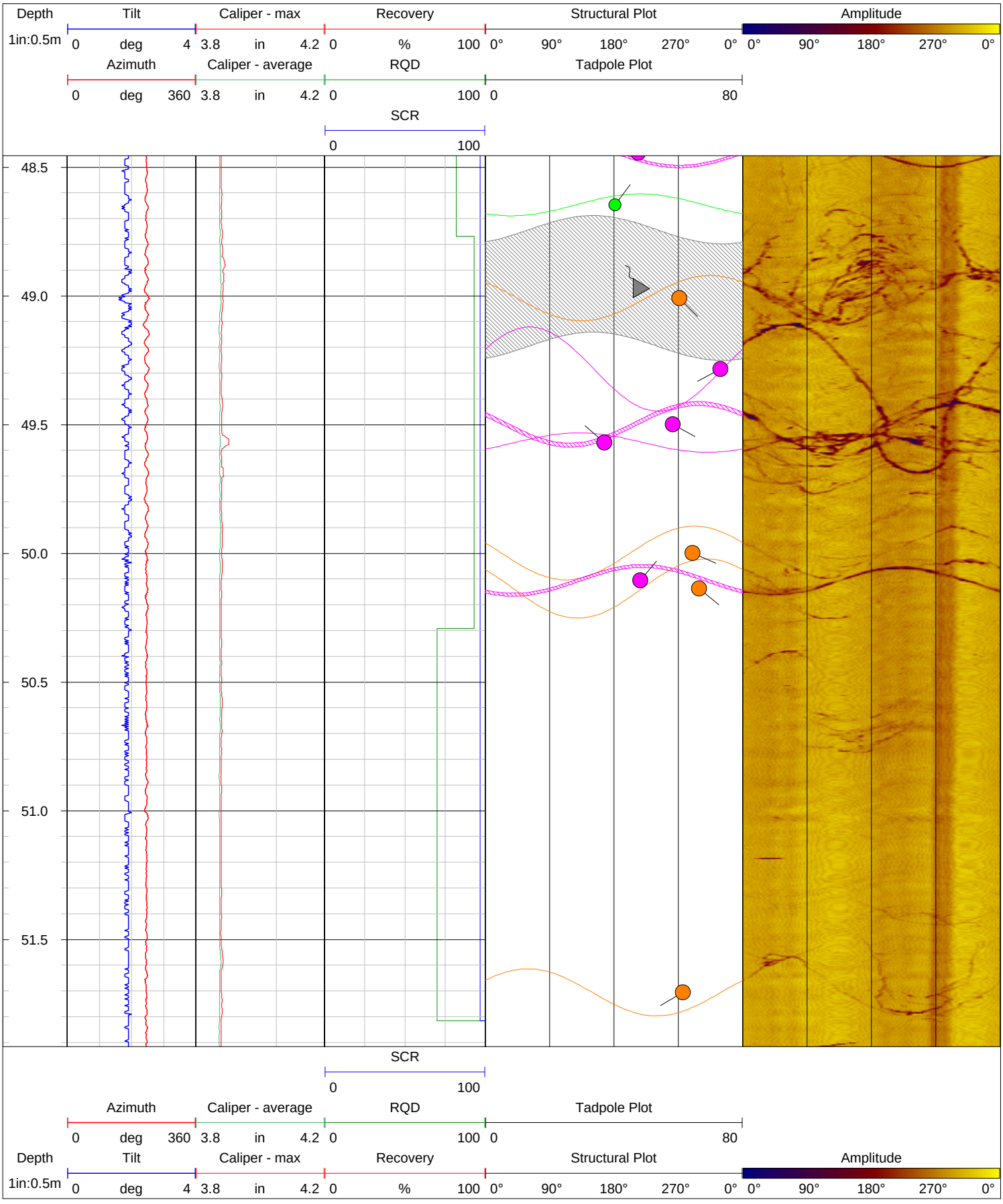


ACOUSTIC TELEVIEWER LOG - BORING BH10

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

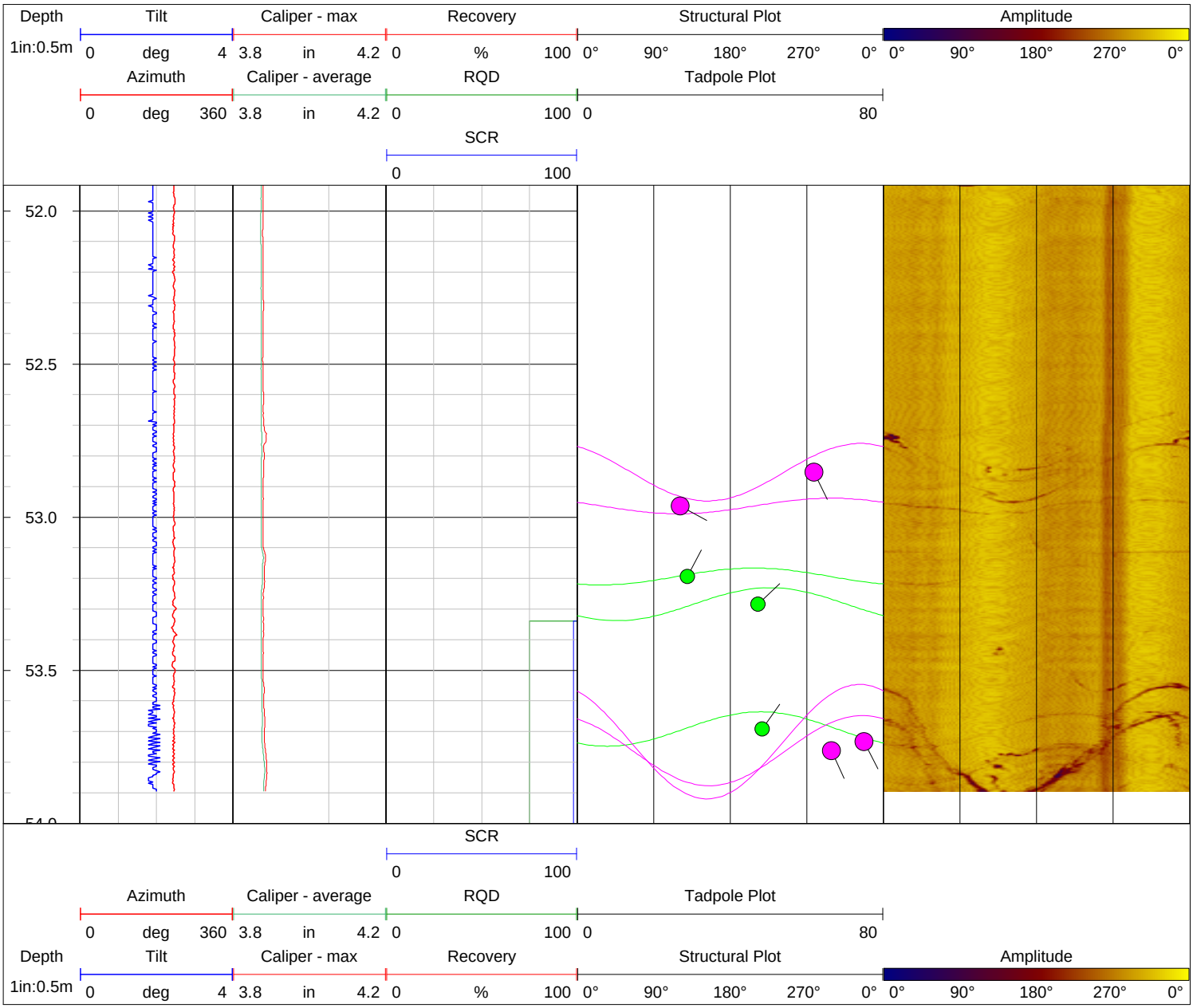
PLATE B3.12



ACOUSTIC TELEVIEWER LOG - BORING BH10

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

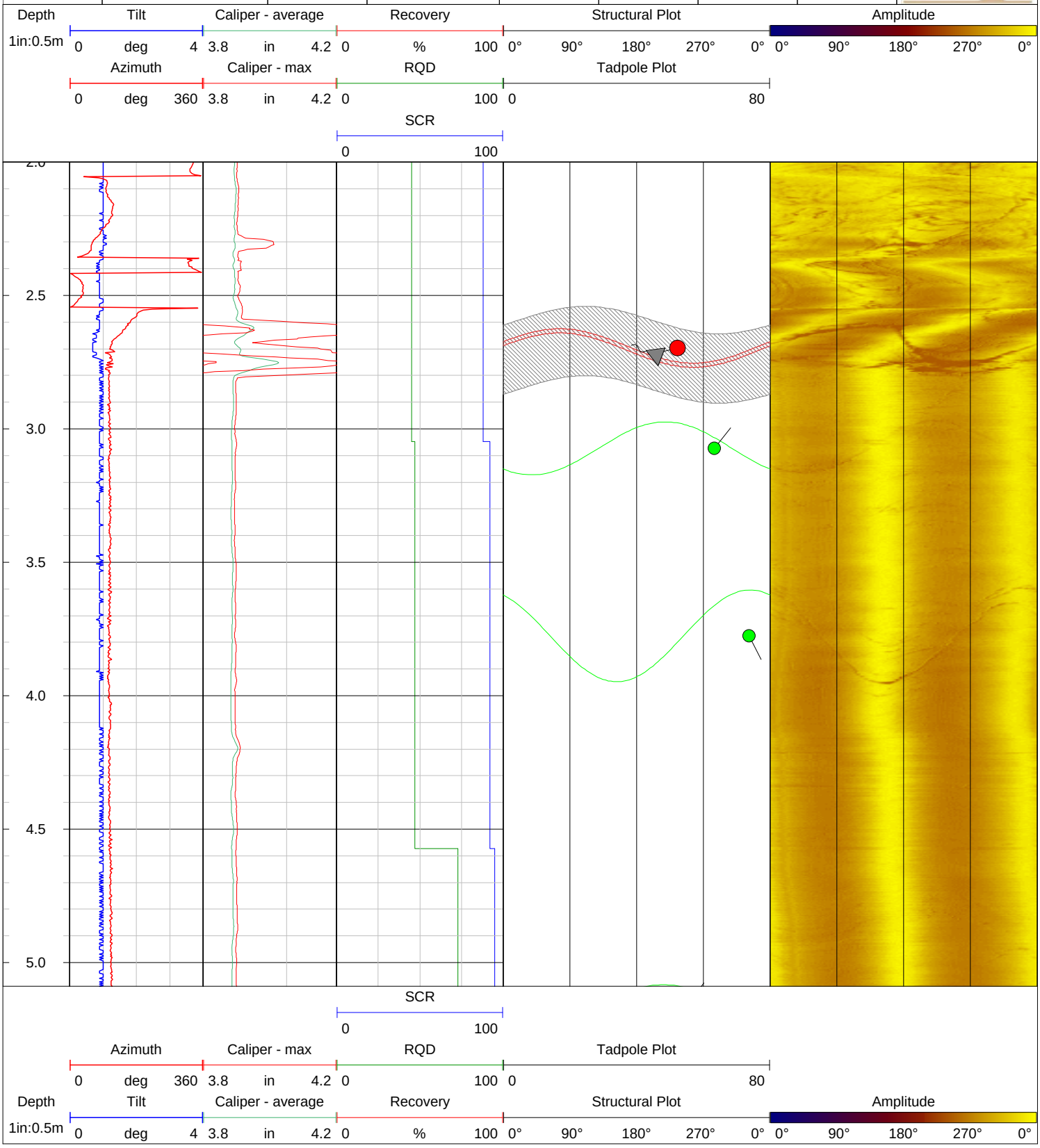


ACOUSTIC TELEVIEWER LOG - BORING BH10

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

Project:	04.10130058	Boring:	BH14	Depth:	59.44 m	Log Depth:	59.78 m
Date:	07/04/2013	Run:	Three / Up	Elevation:	29.65 m	Operator:	DV

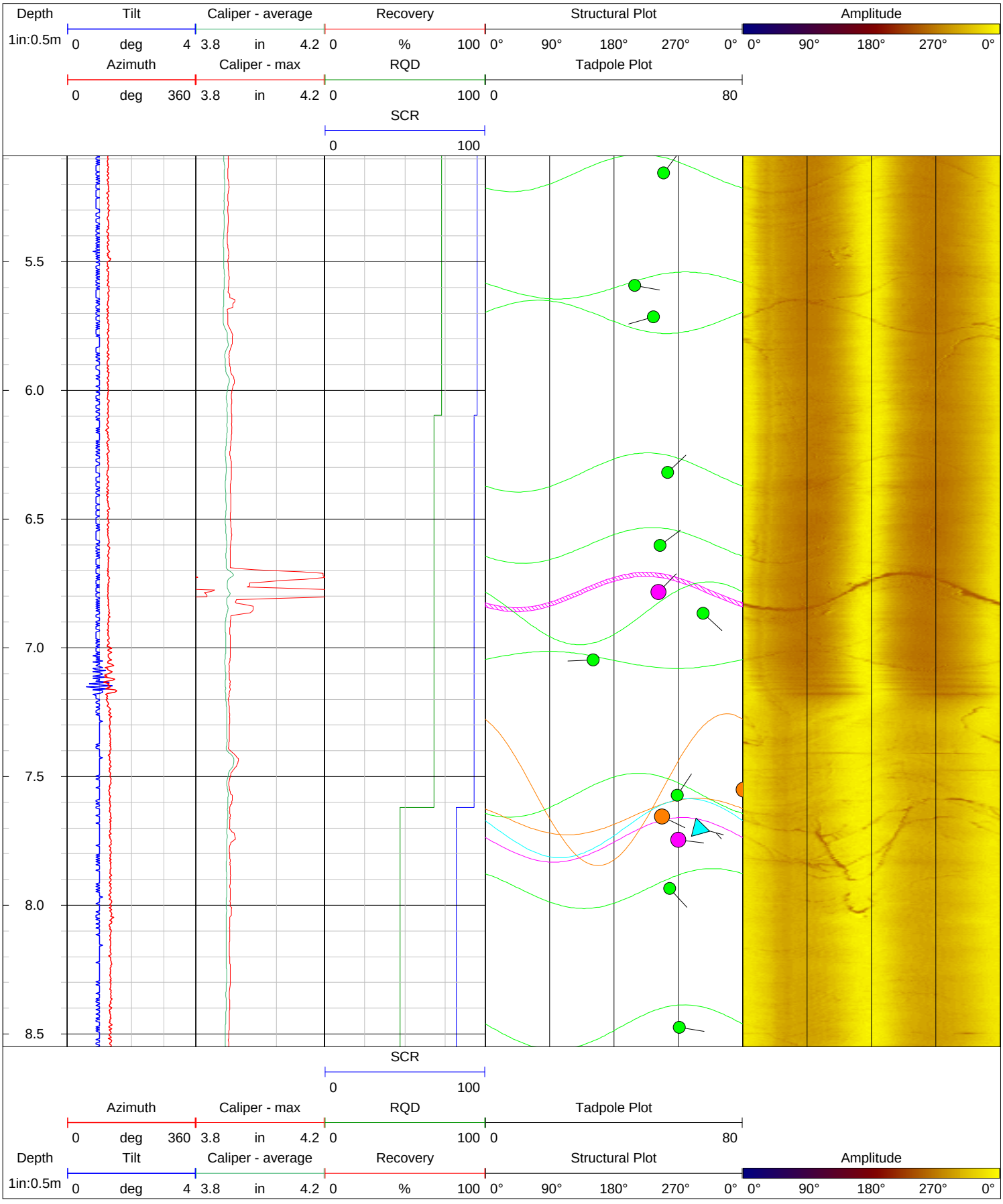


ACOUSTIC TELEVIEWER LOG - BORING BH14

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE B4.1

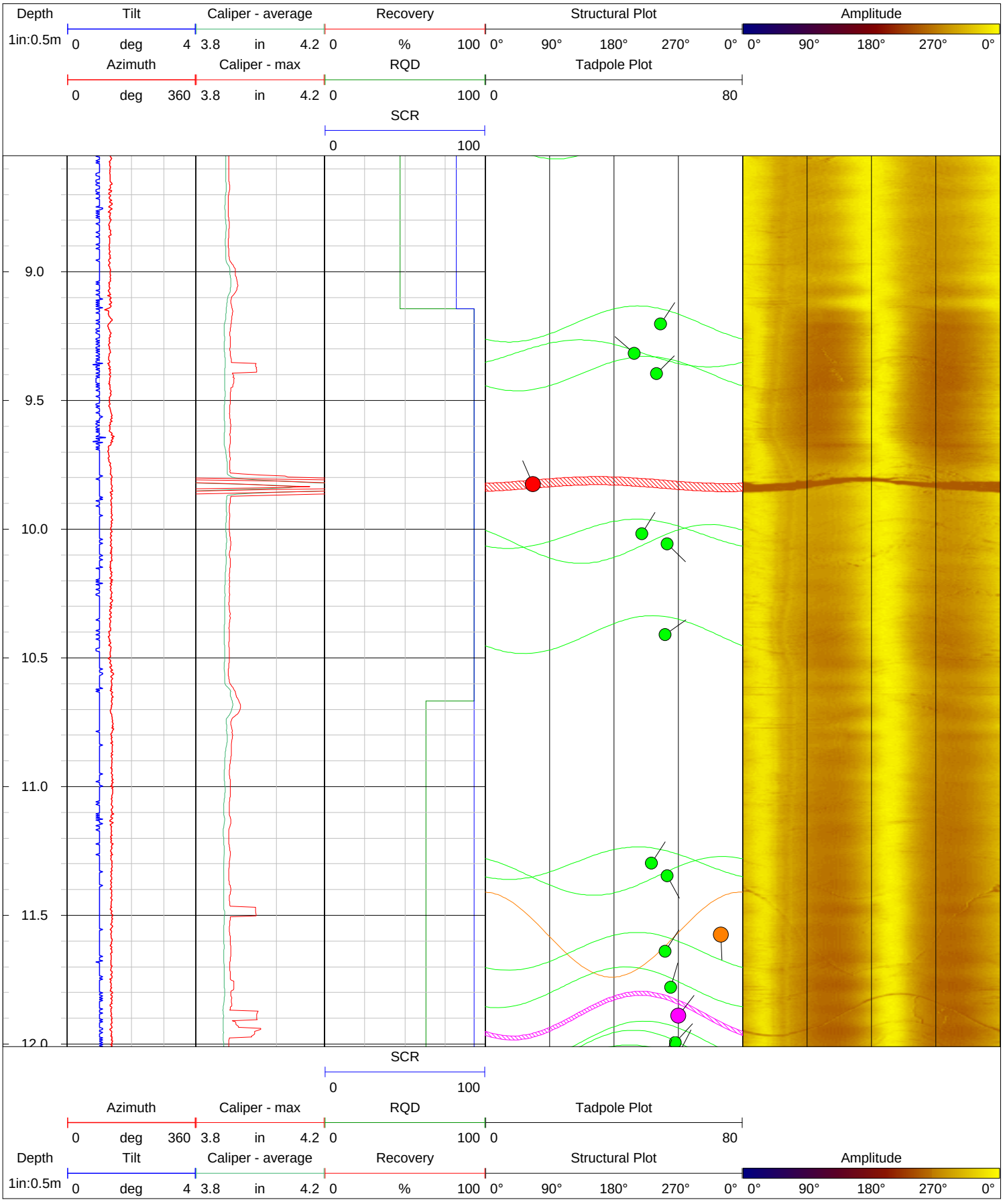


ACOUSTIC TELEVIEWER LOG - BORING BH14

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

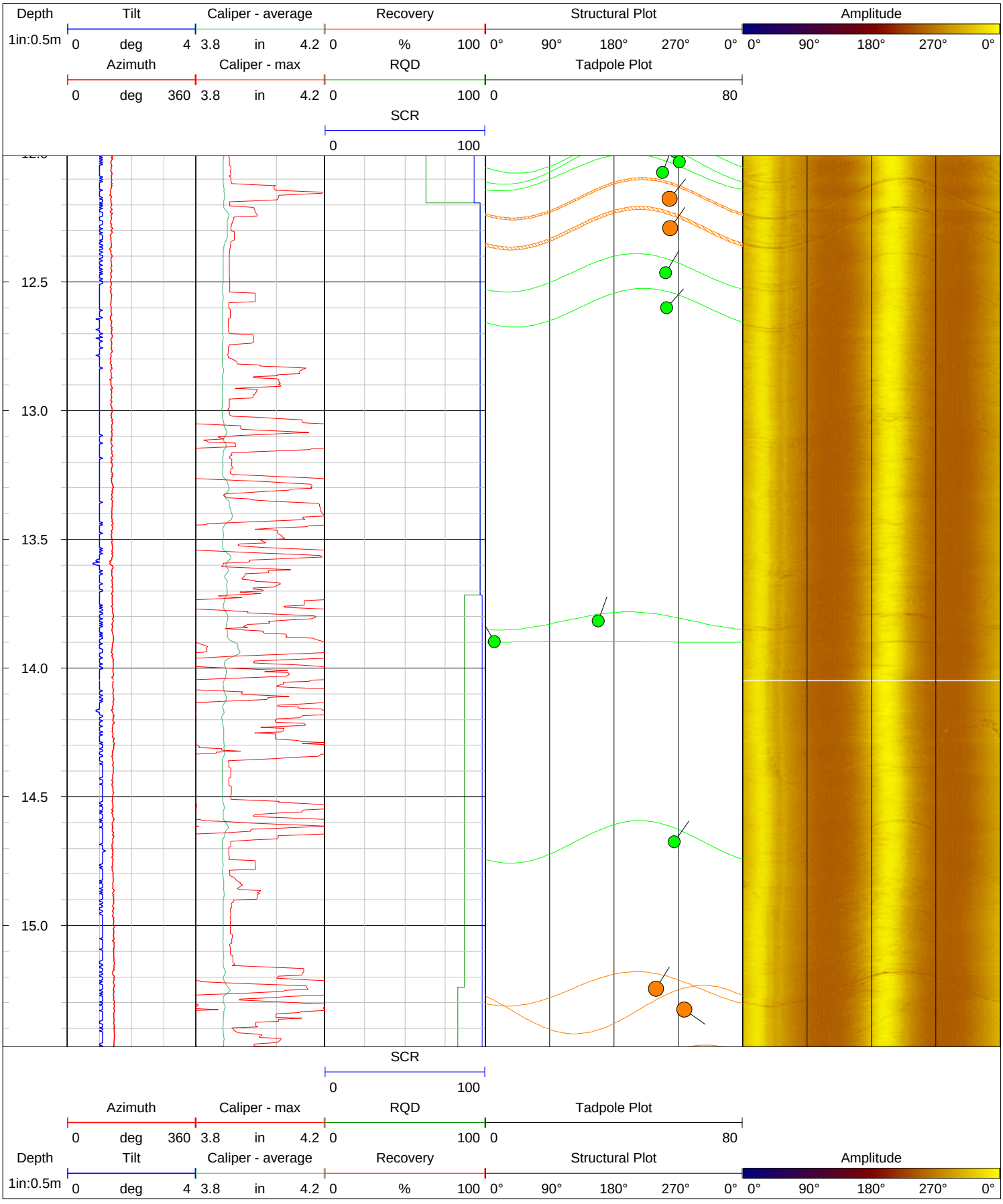
PLATE B4.2



ACOUSTIC TELEVIEWER LOG - BORING BH14

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

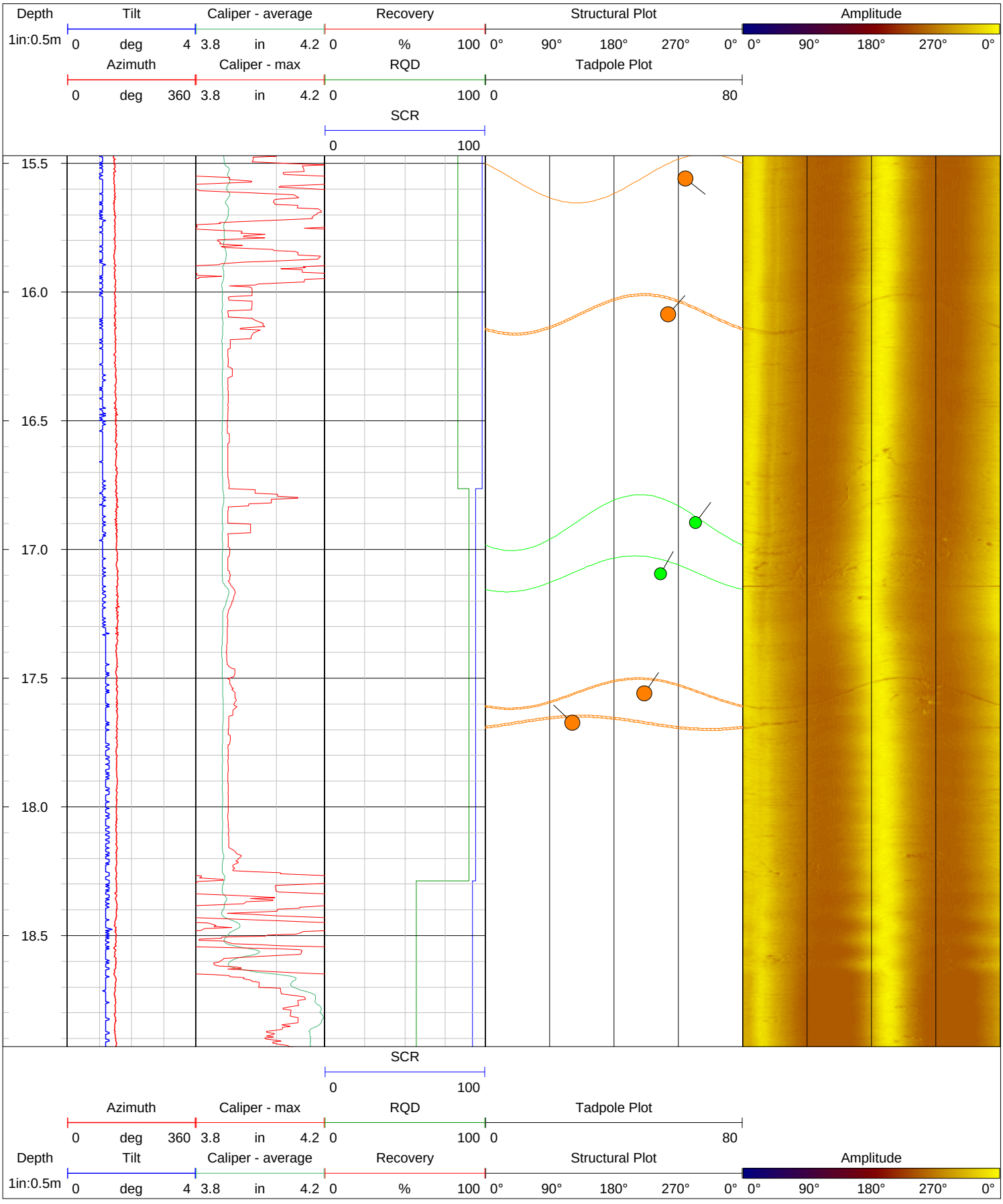


ACOUSTIC TELEVIEWER LOG - BORING BH14

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

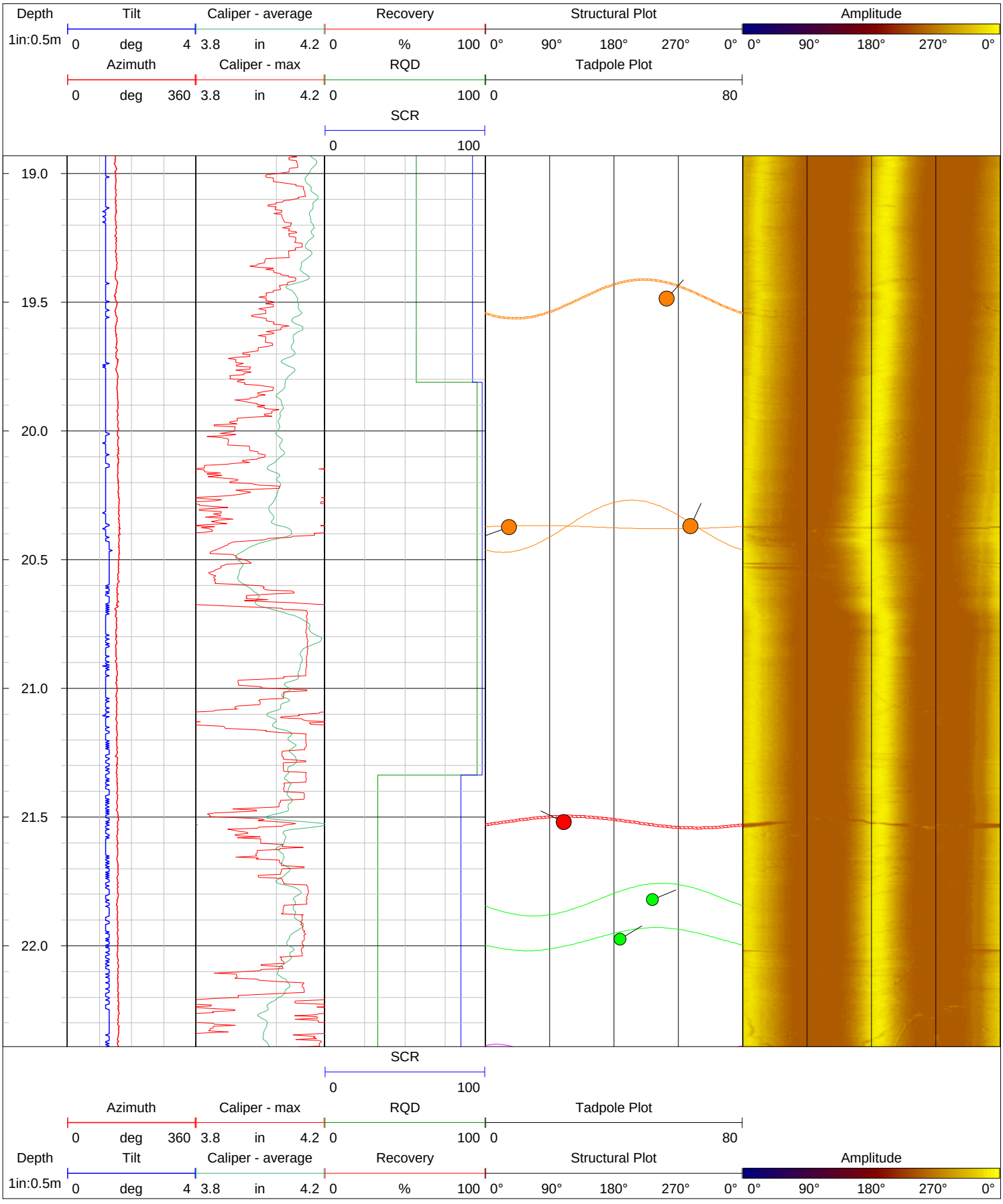
PLATE B4.4



ACOUSTIC TELEVIEWER LOG - BORING BH14

PACIFIC NORTHWEST LNG PROJECT

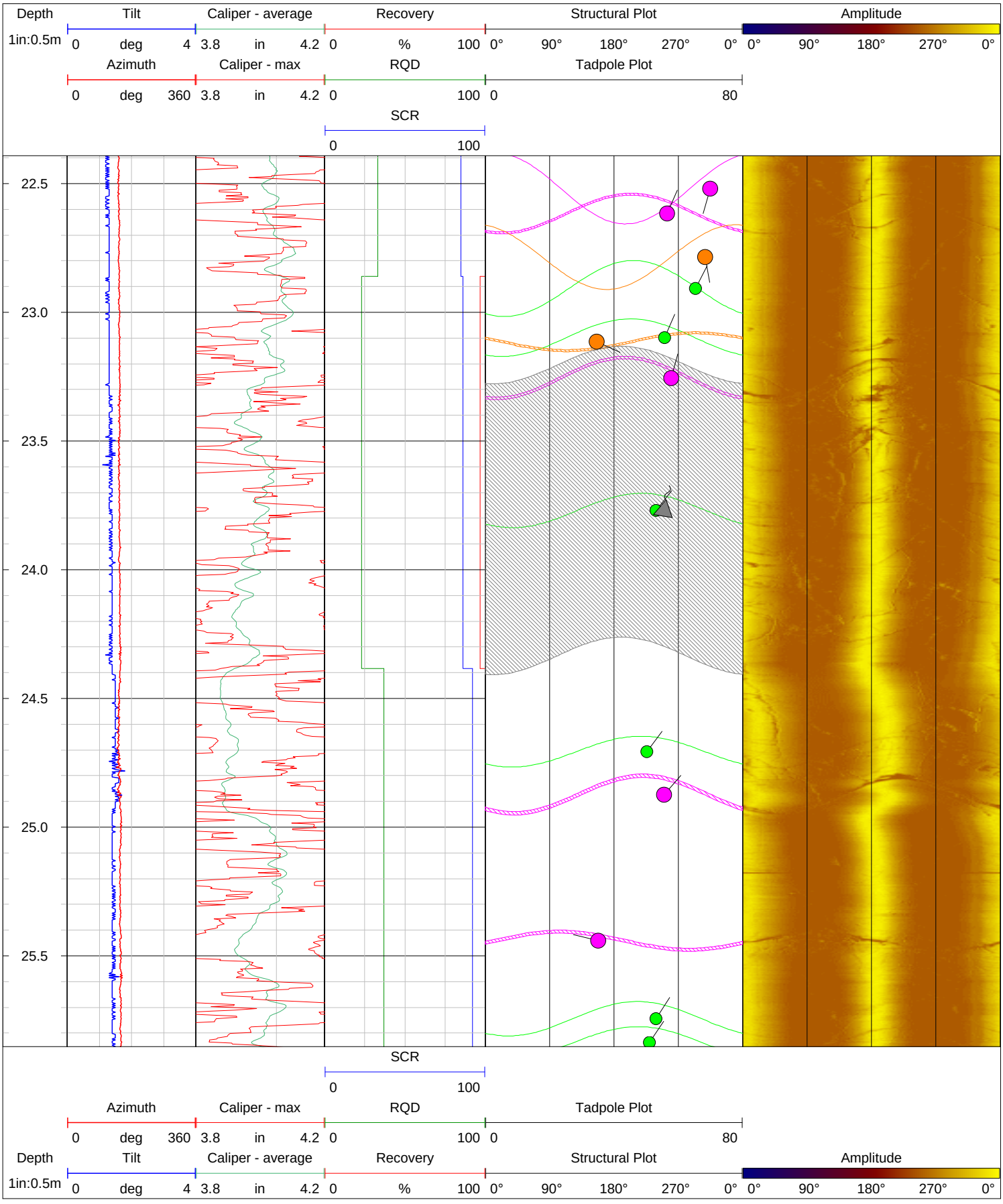
LELU ISLAND, BRITISH COLUMBIA, CANADA



ACOUSTIC TELEVIEWER LOG - BORING BH14

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

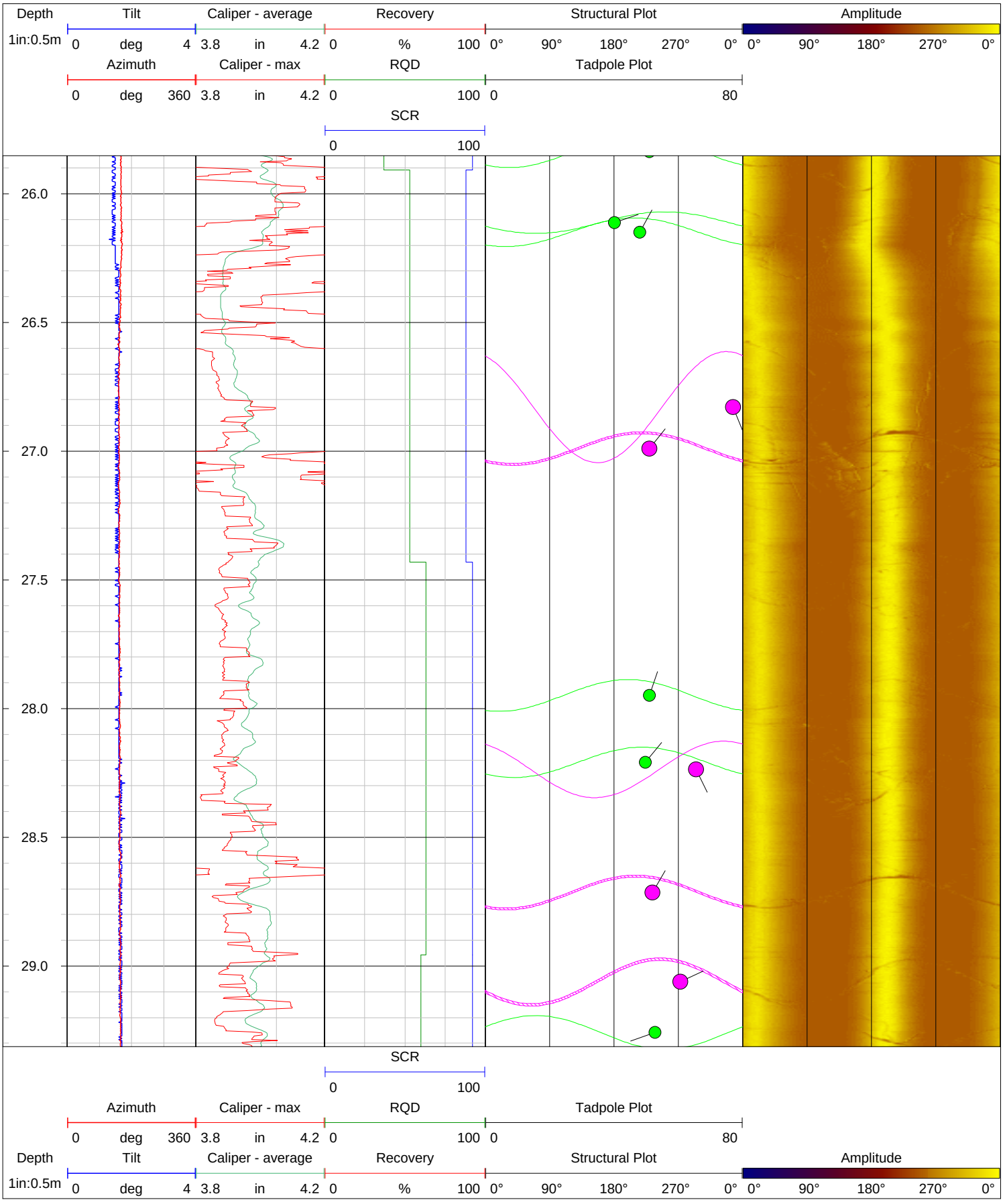


ACOUSTIC TELEVIEWER LOG - BORING BH14

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

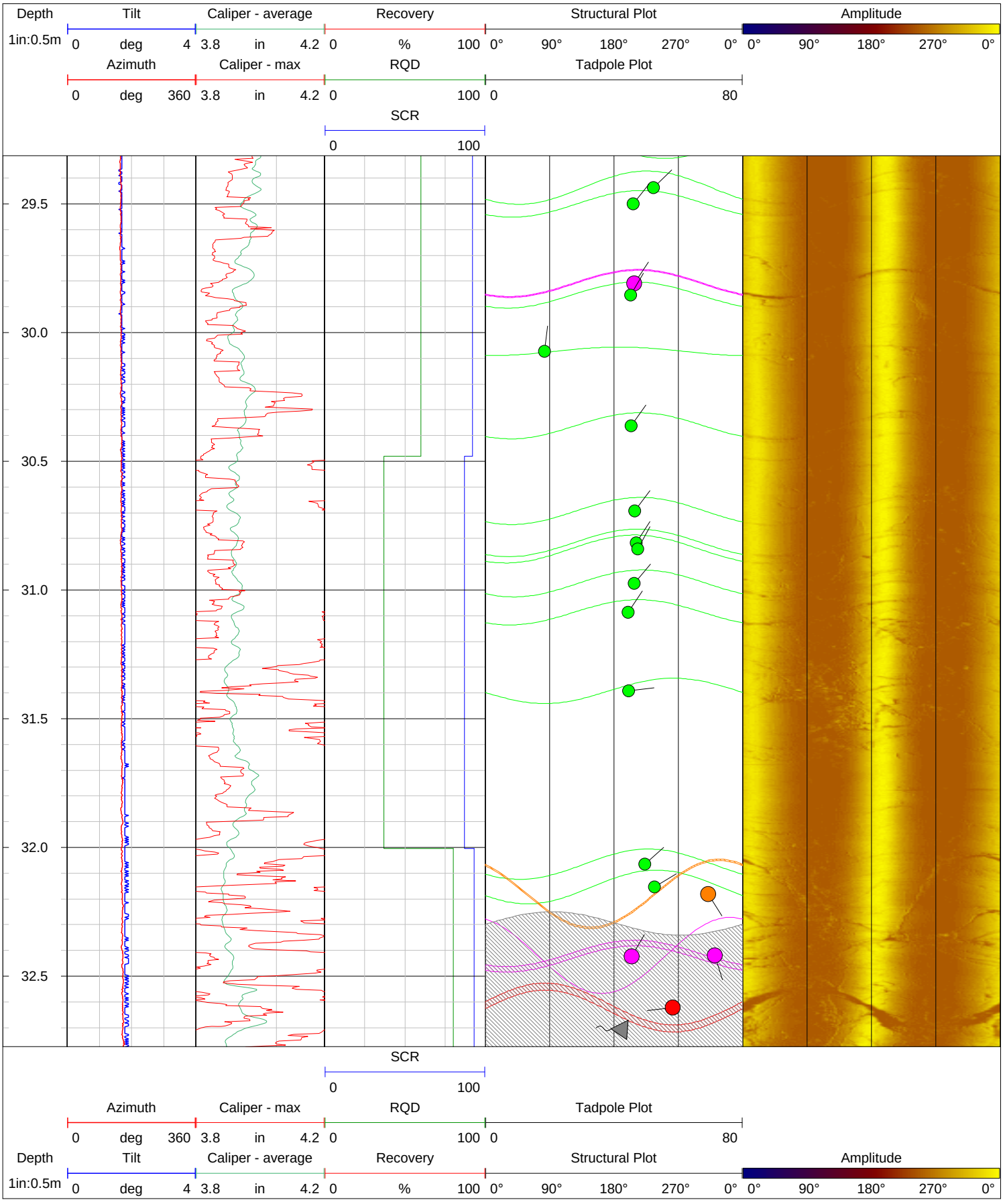
PLATE B4.7



ACOUSTIC TELEVIEWER LOG - BORING BH14

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

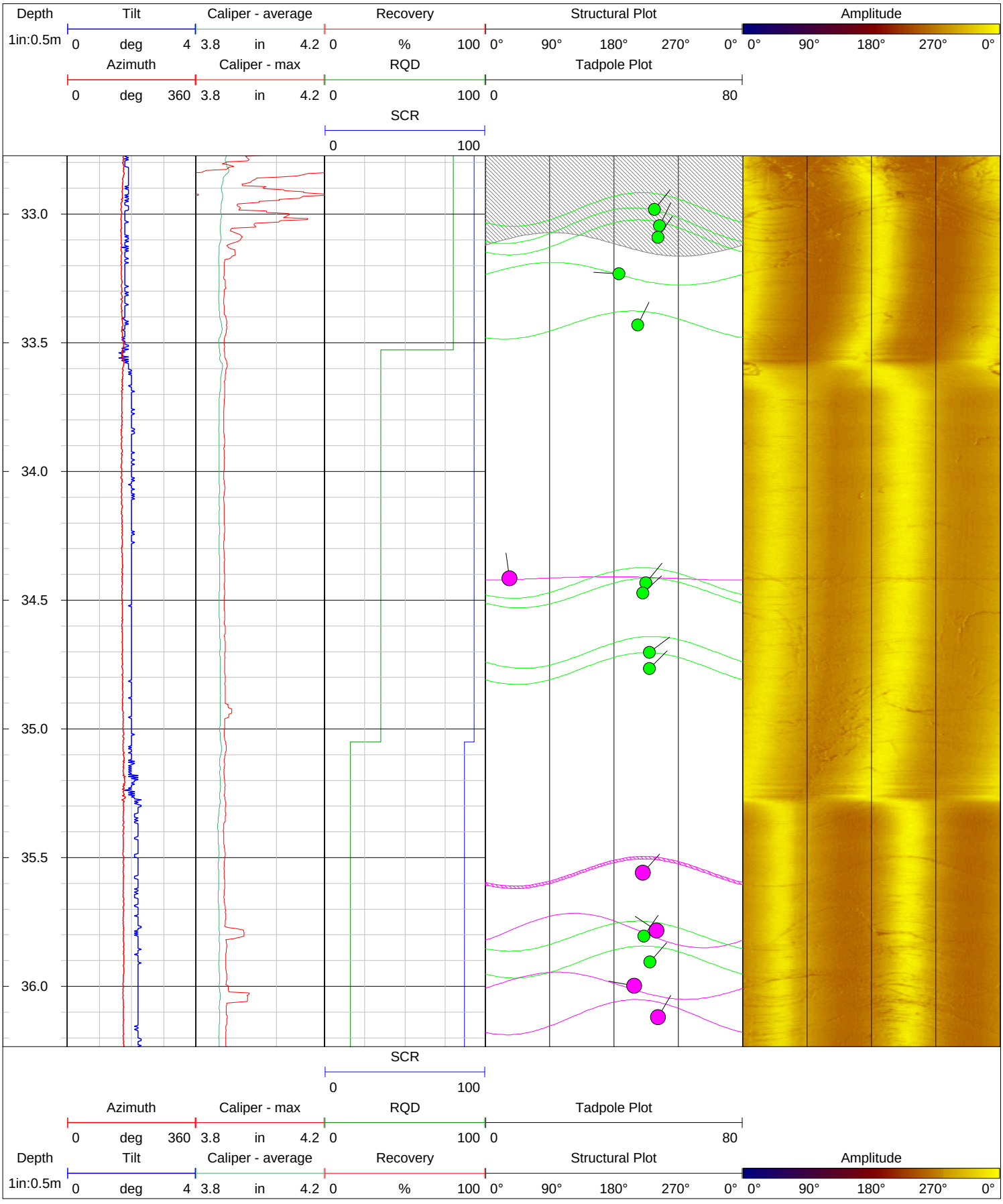


ACOUSTIC TELEVIEWER LOG - BORING BH14

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

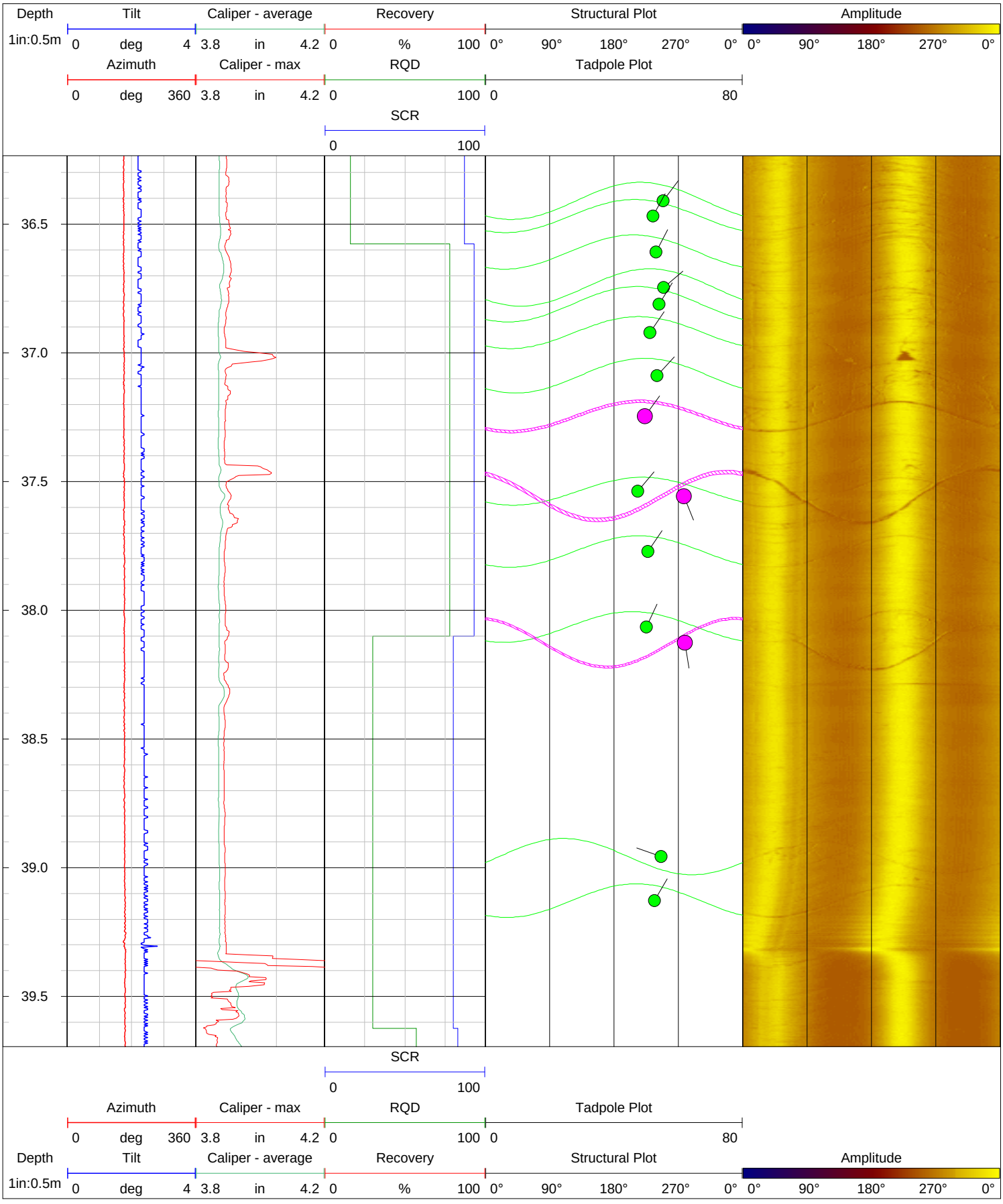
PLATE B4.9



ACOUSTIC TELEVIEWER LOG - BORING BH14

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

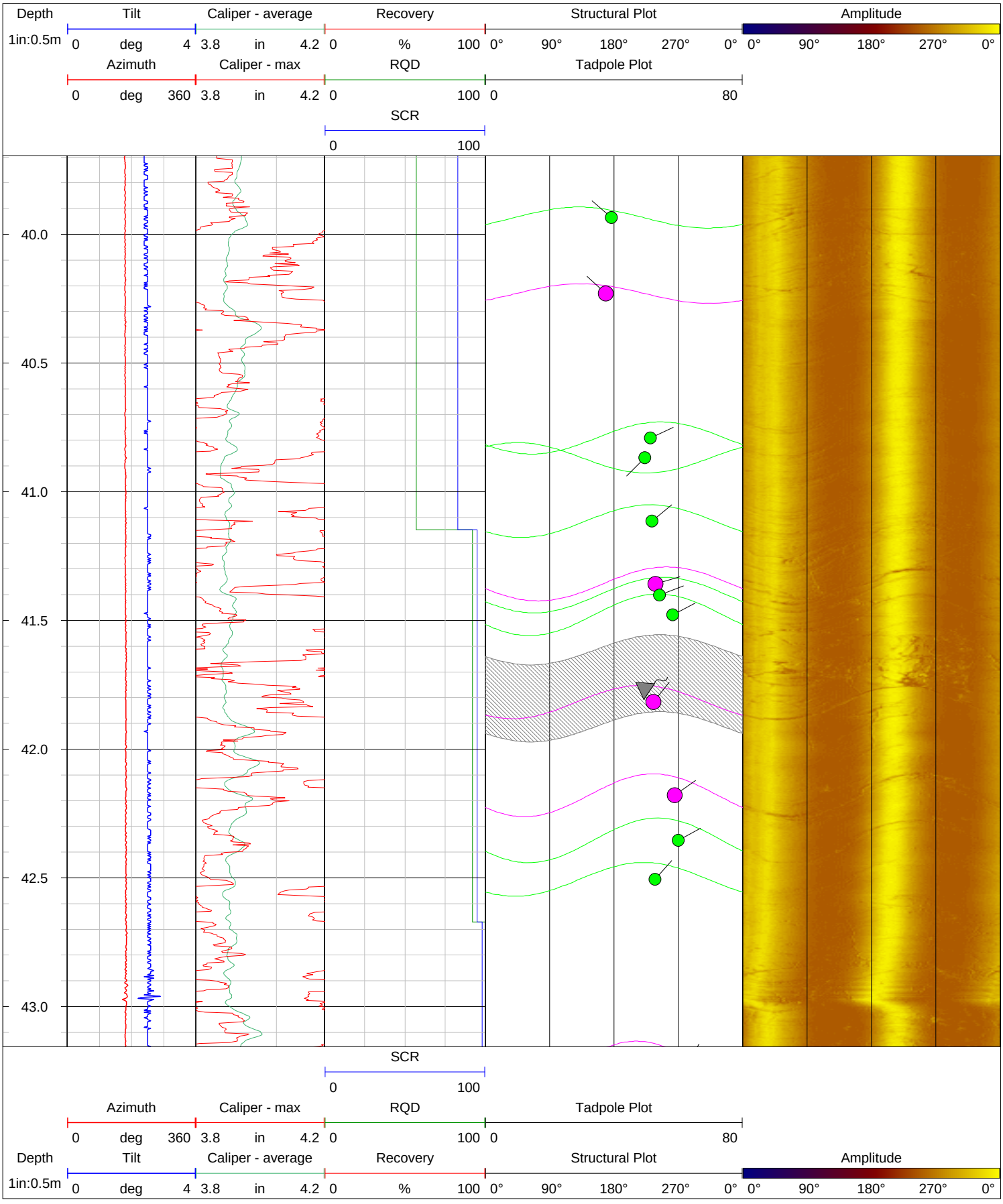


ACOUSTIC TELEVIEWER LOG - BORING BH14

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

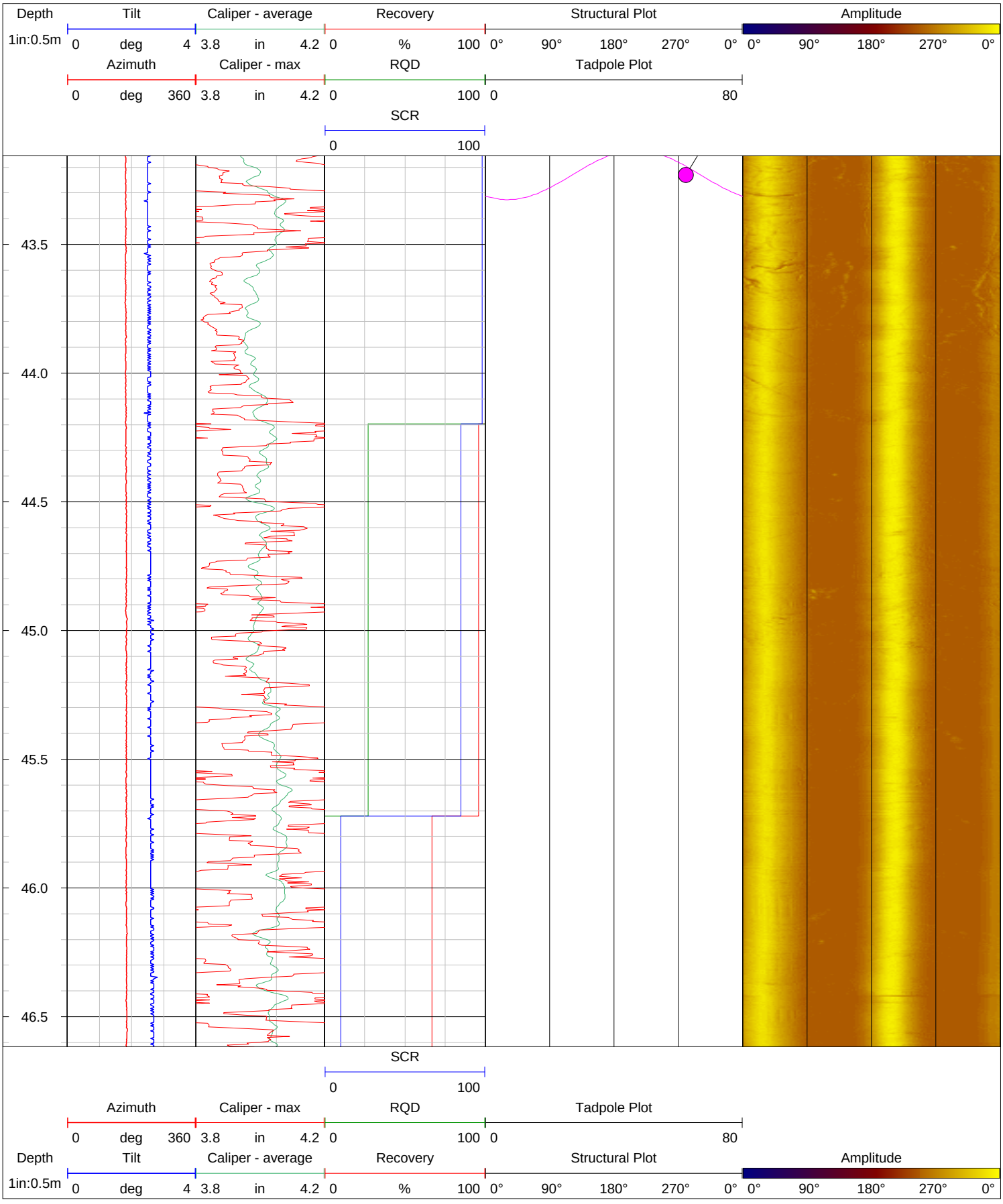
PLATE B4.11



ACOUSTIC TELEVIEWER LOG - BORING BH14

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

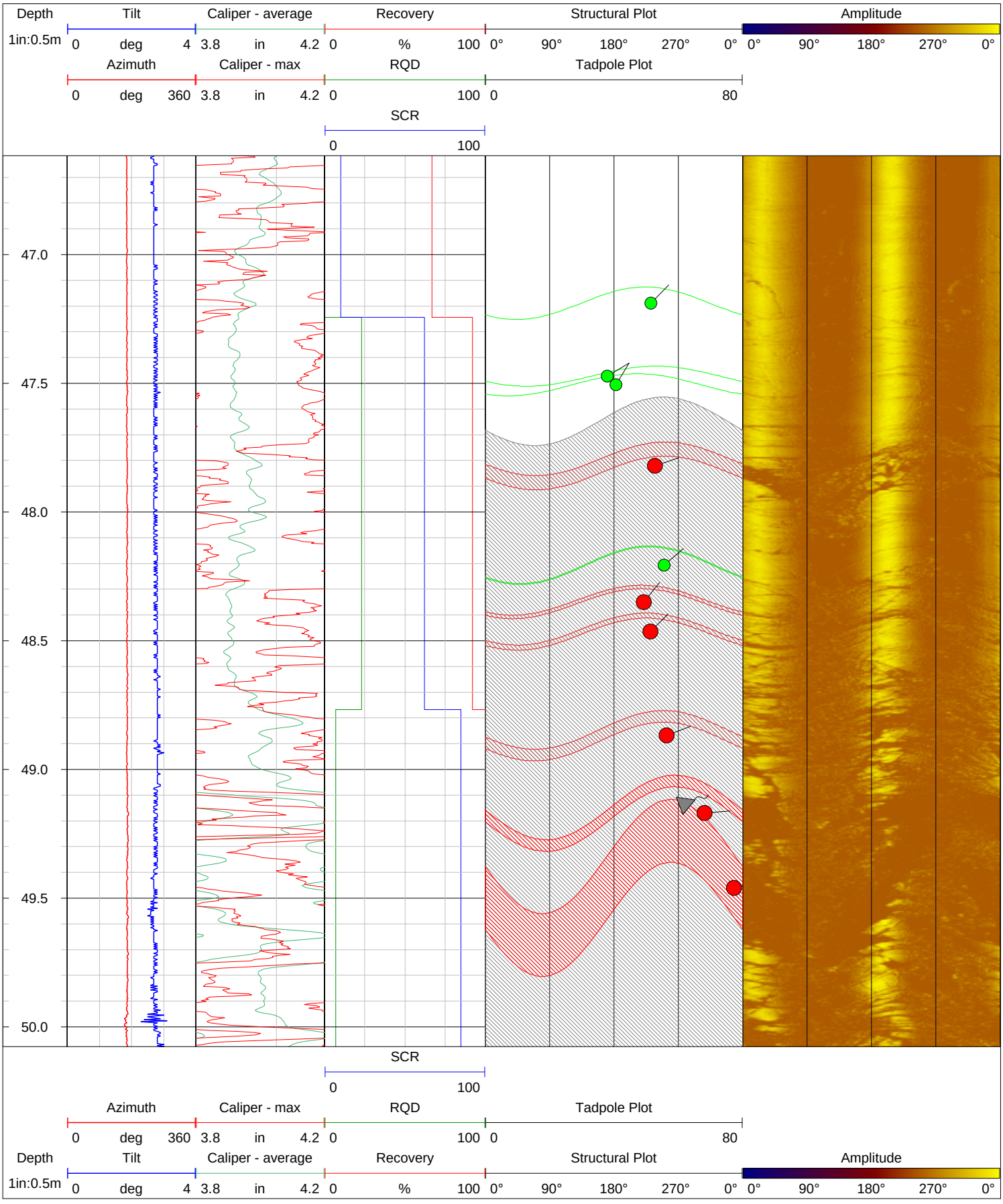


ACOUSTIC TELEVIEWER LOG - BORING BH14

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE B4.13

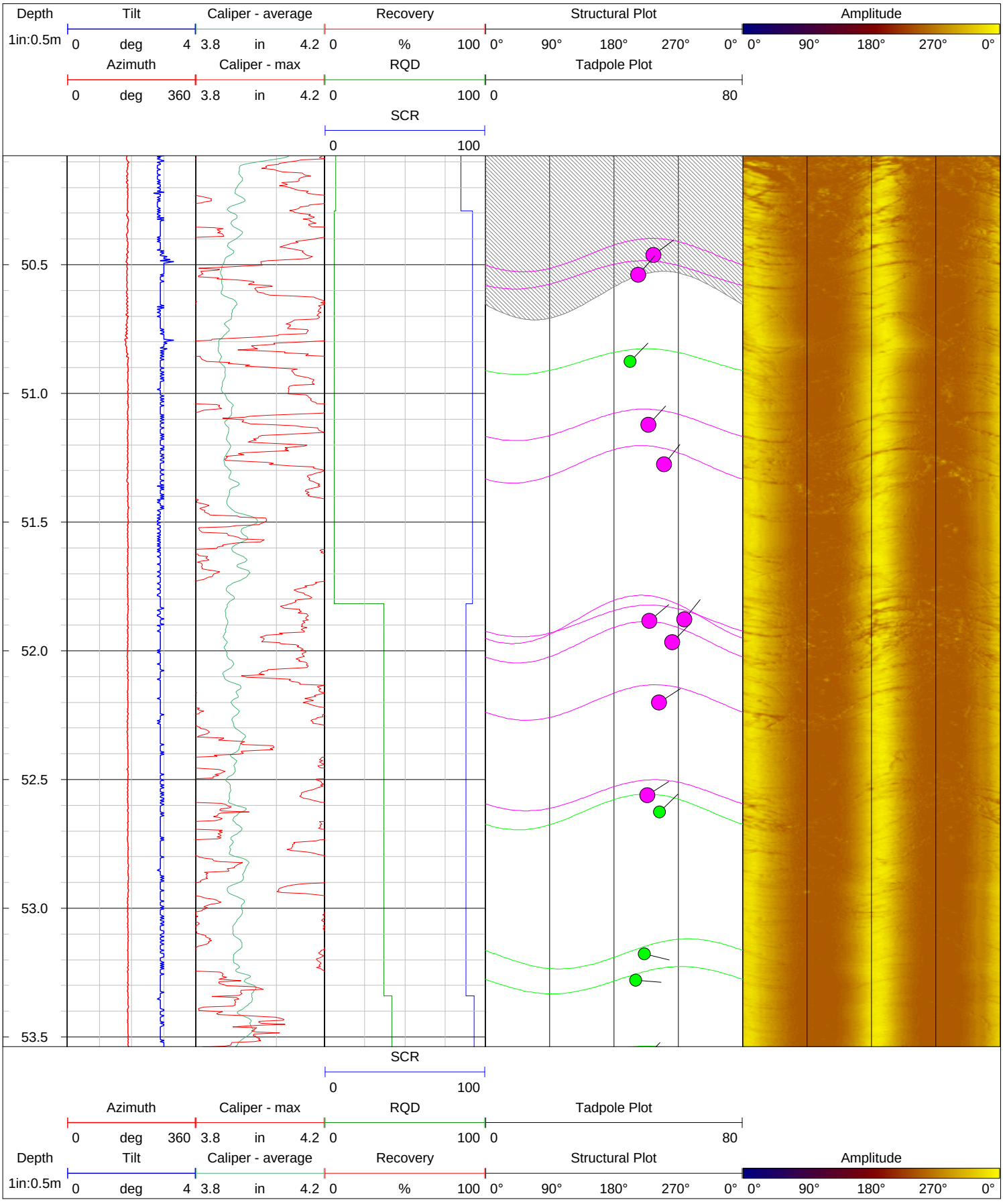


ACOUSTIC TELEVIEWER LOG - BORING BH14

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE B4.14

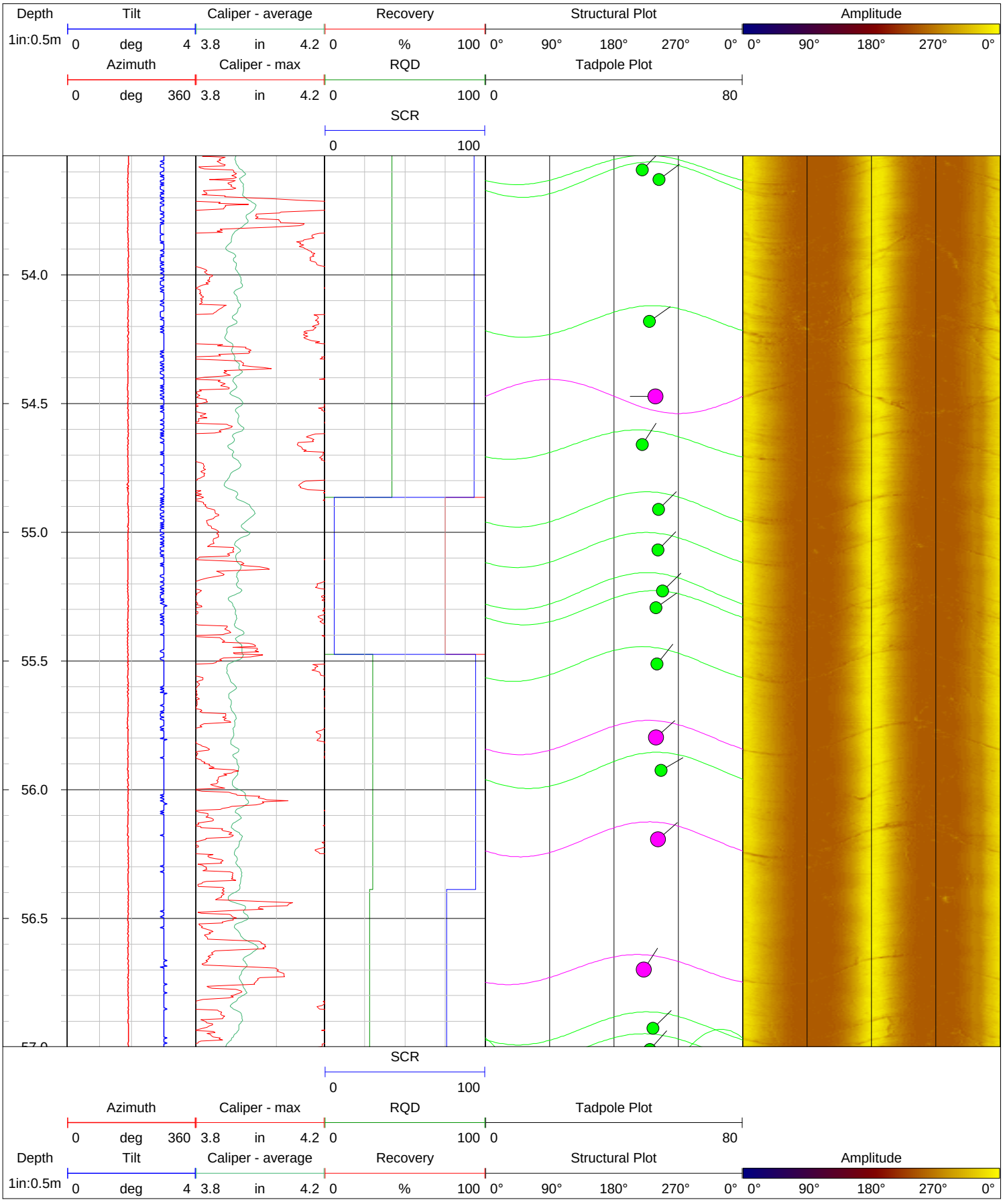


ACOUSTIC TELEVIEWER LOG - BORING BH14

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

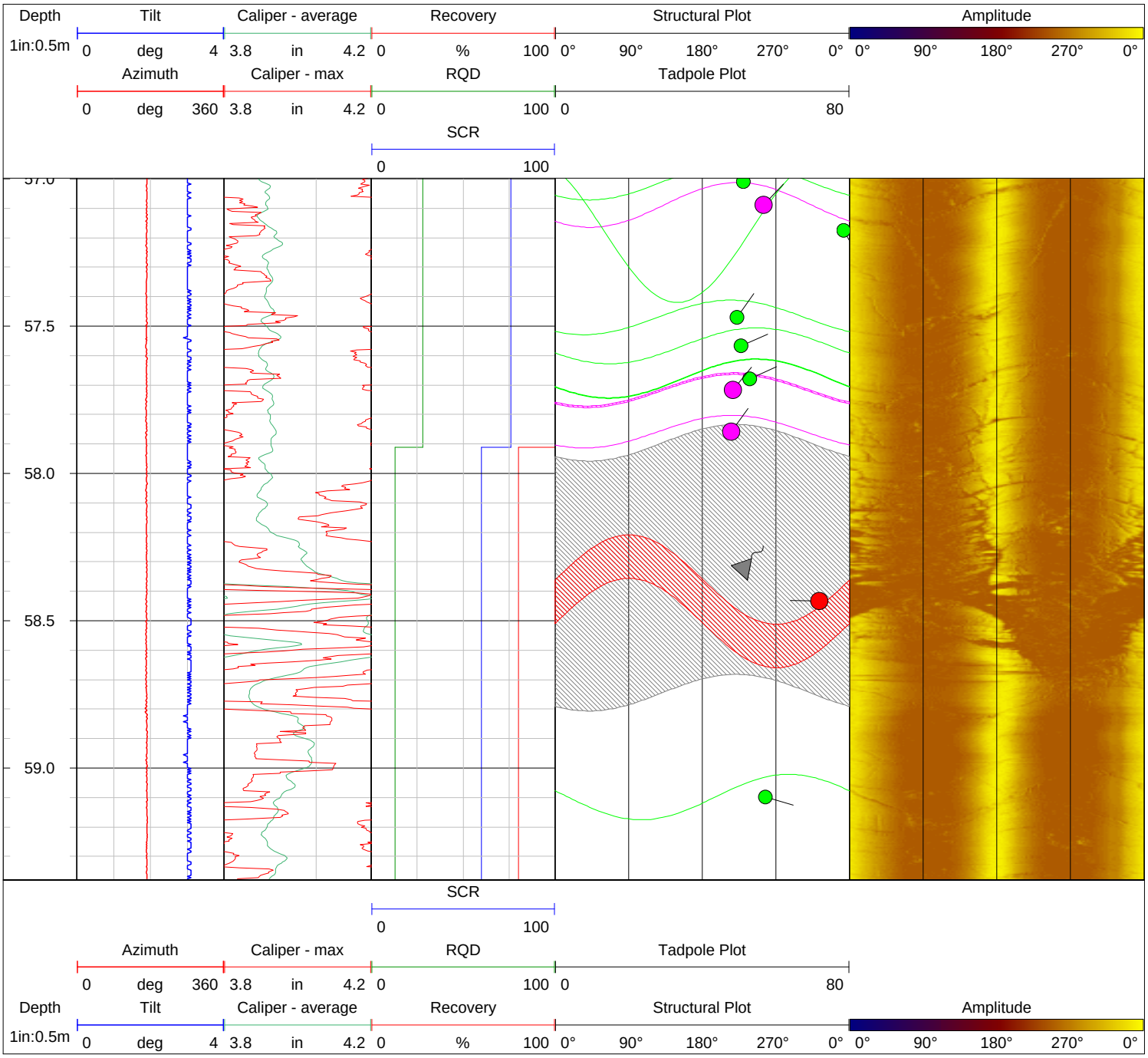
PLATE B4.15



ACOUSTIC TELEVIEWER LOG - BORING BH14

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

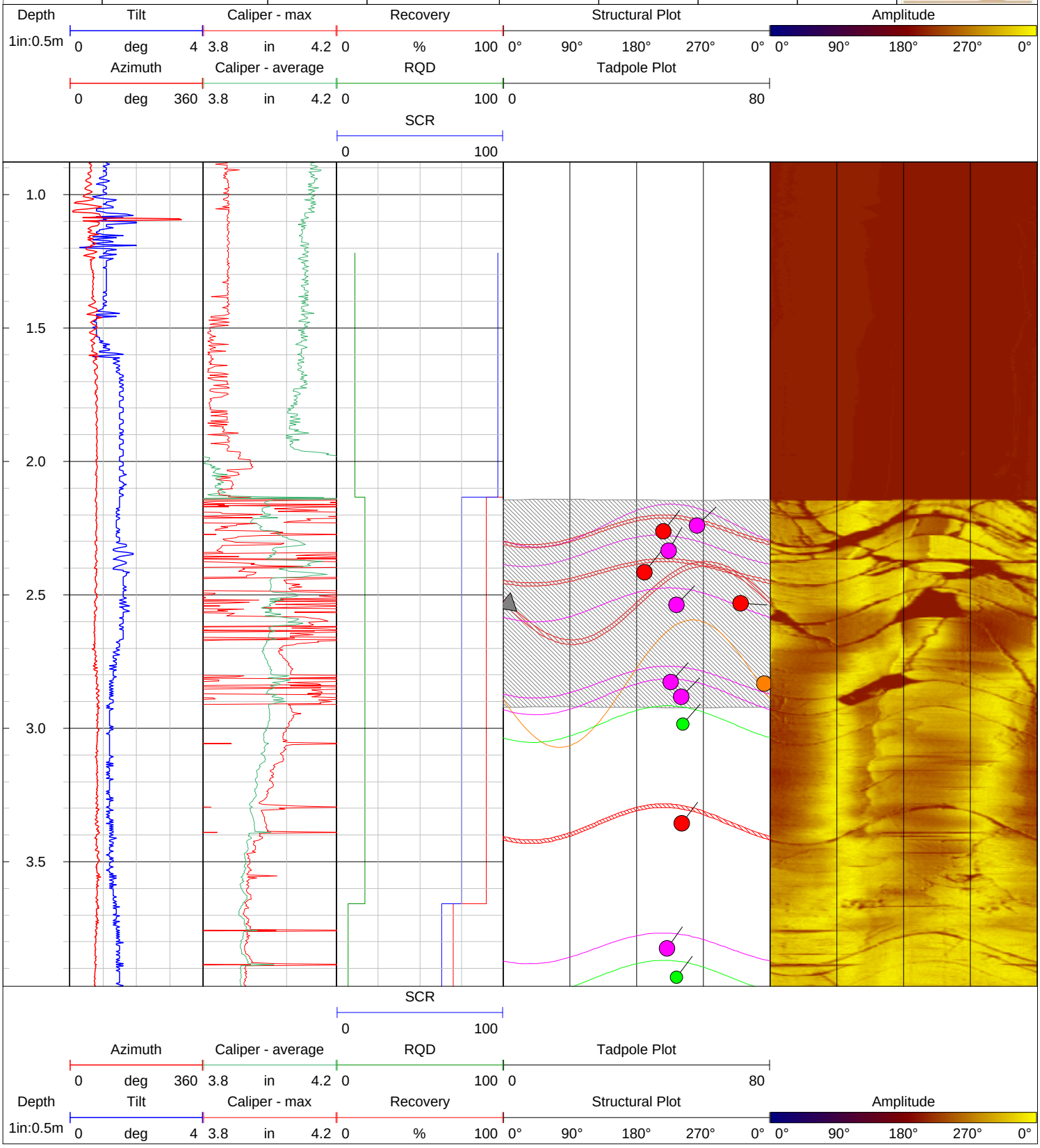


ACOUSTIC TELEVIEWER LOG - BORING BH14

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

Project:	04.10130058	Boring:	BH20	Depth:	59.44 m	Log Depth:	57.76 m
Date:	July 6, 2013	Run:	One / Up	Elevation:	30.6 m	Operator:	DV

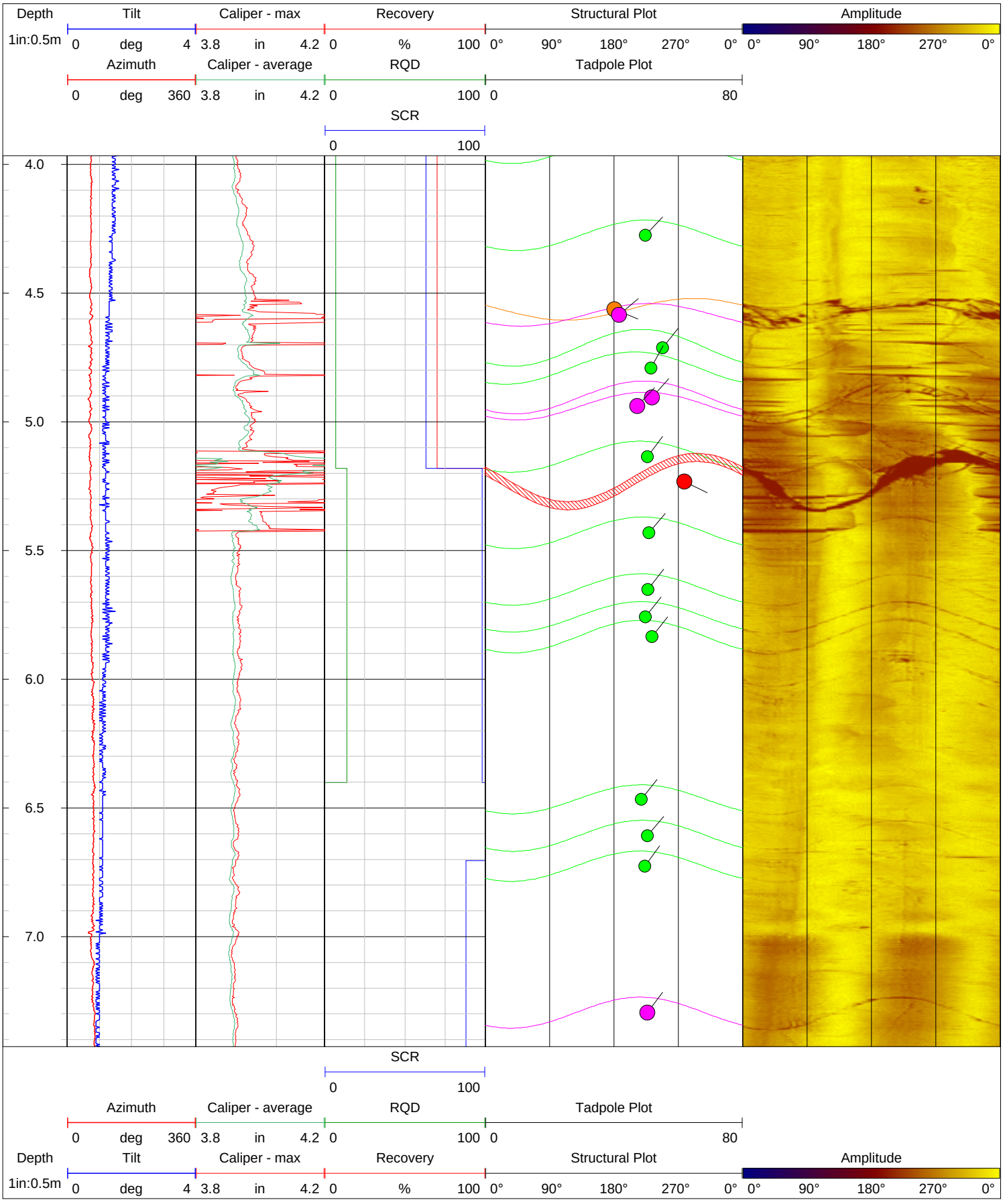


ACOUSTIC TELEVIEWER LOG - BORING BH20

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE B5.1

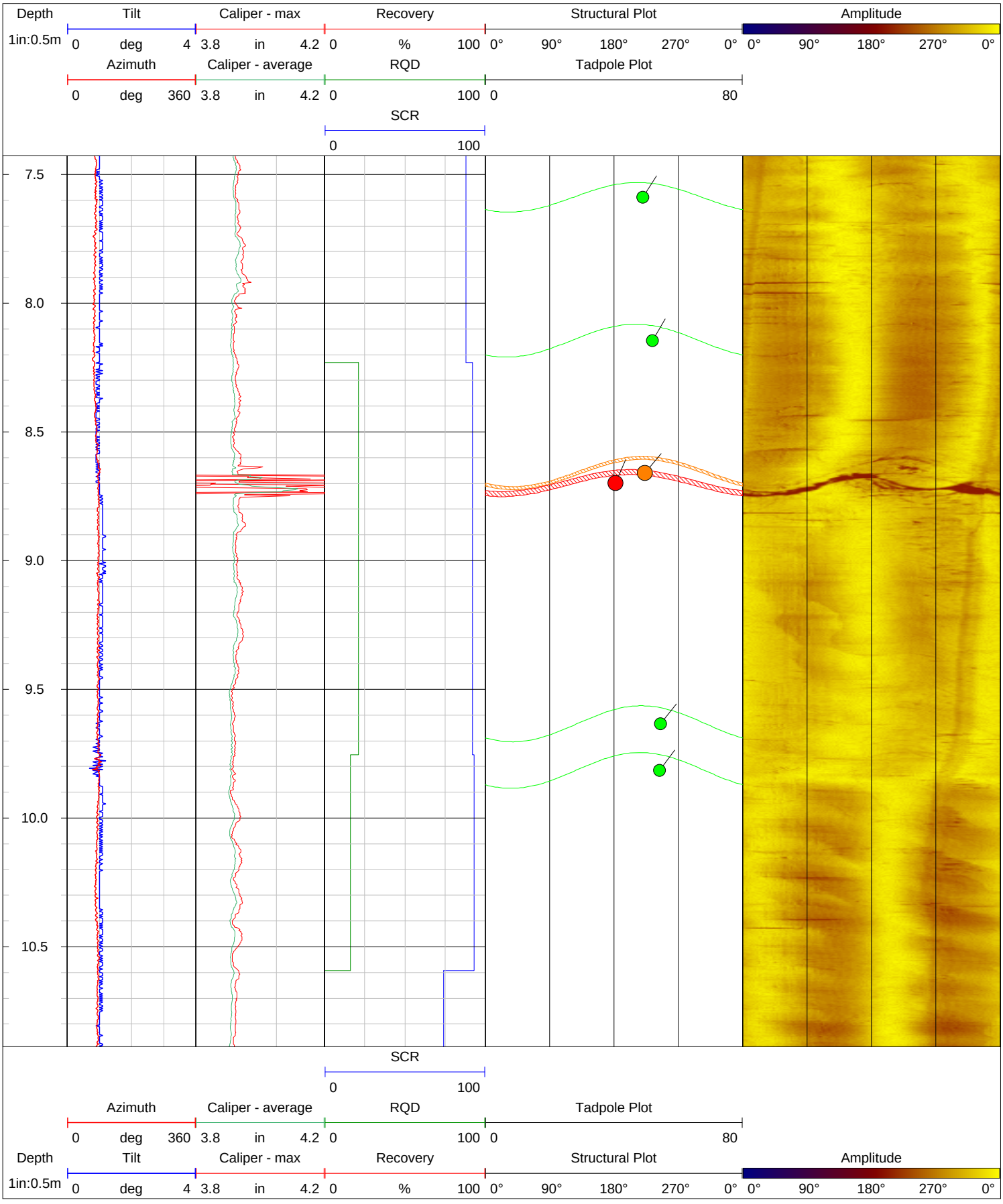


ACOUSTIC TELEVIEWER LOG - BORING BH20

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

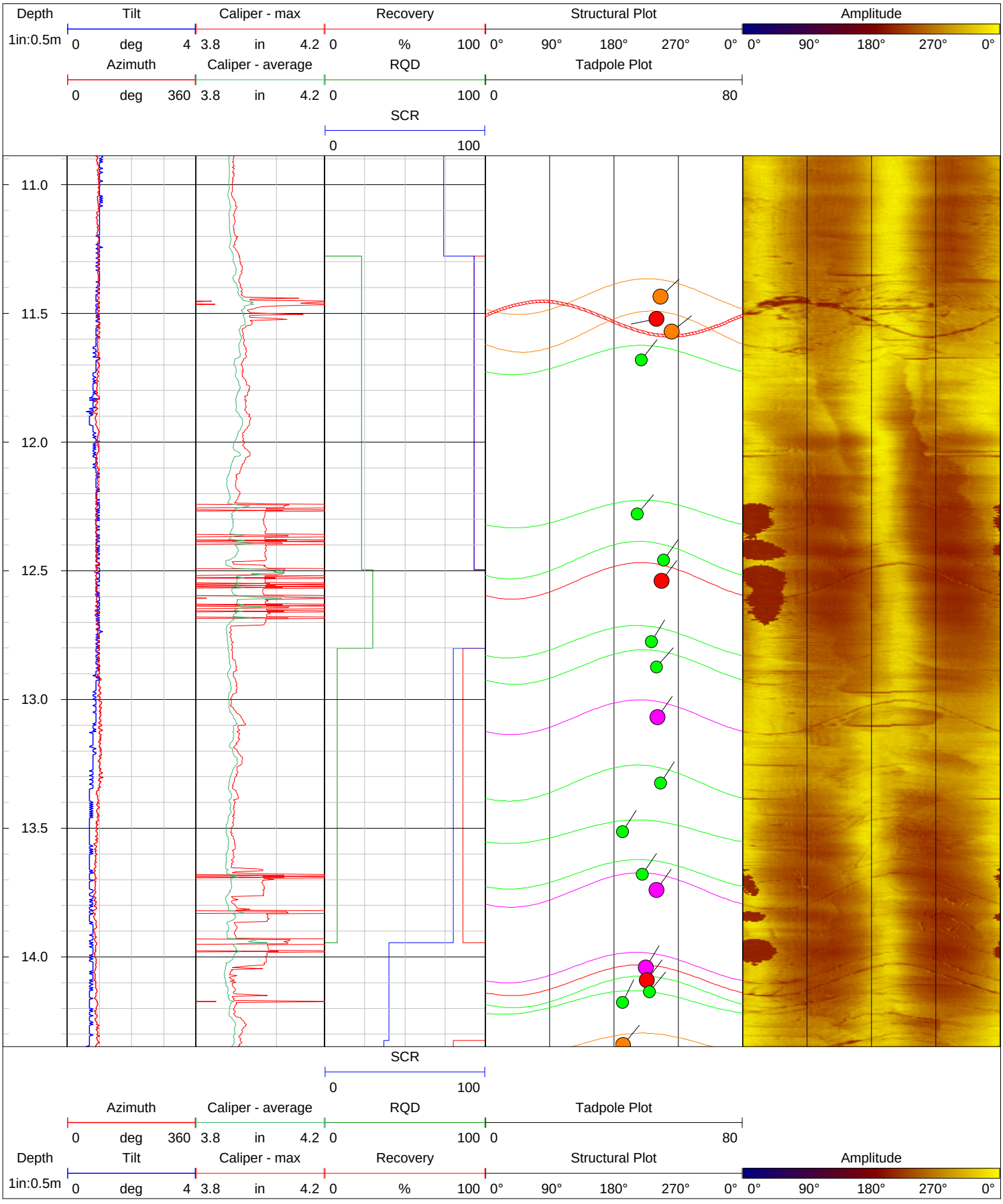
PLATE B5.2



ACOUSTIC TELEVIEWER LOG - BORING BH20

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

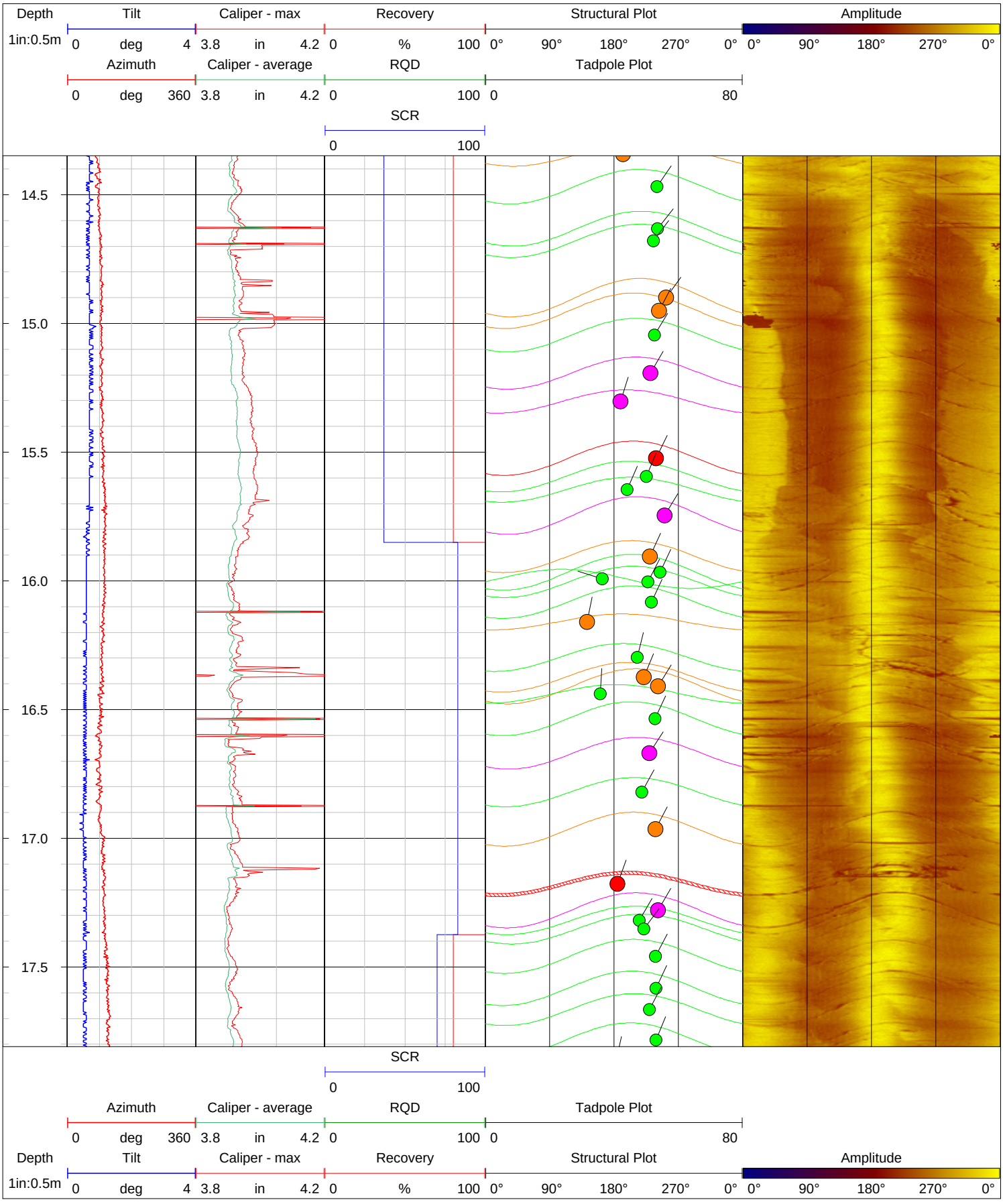


ACOUSTIC TELEVIEWER LOG - BORING BH20

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE B5.4

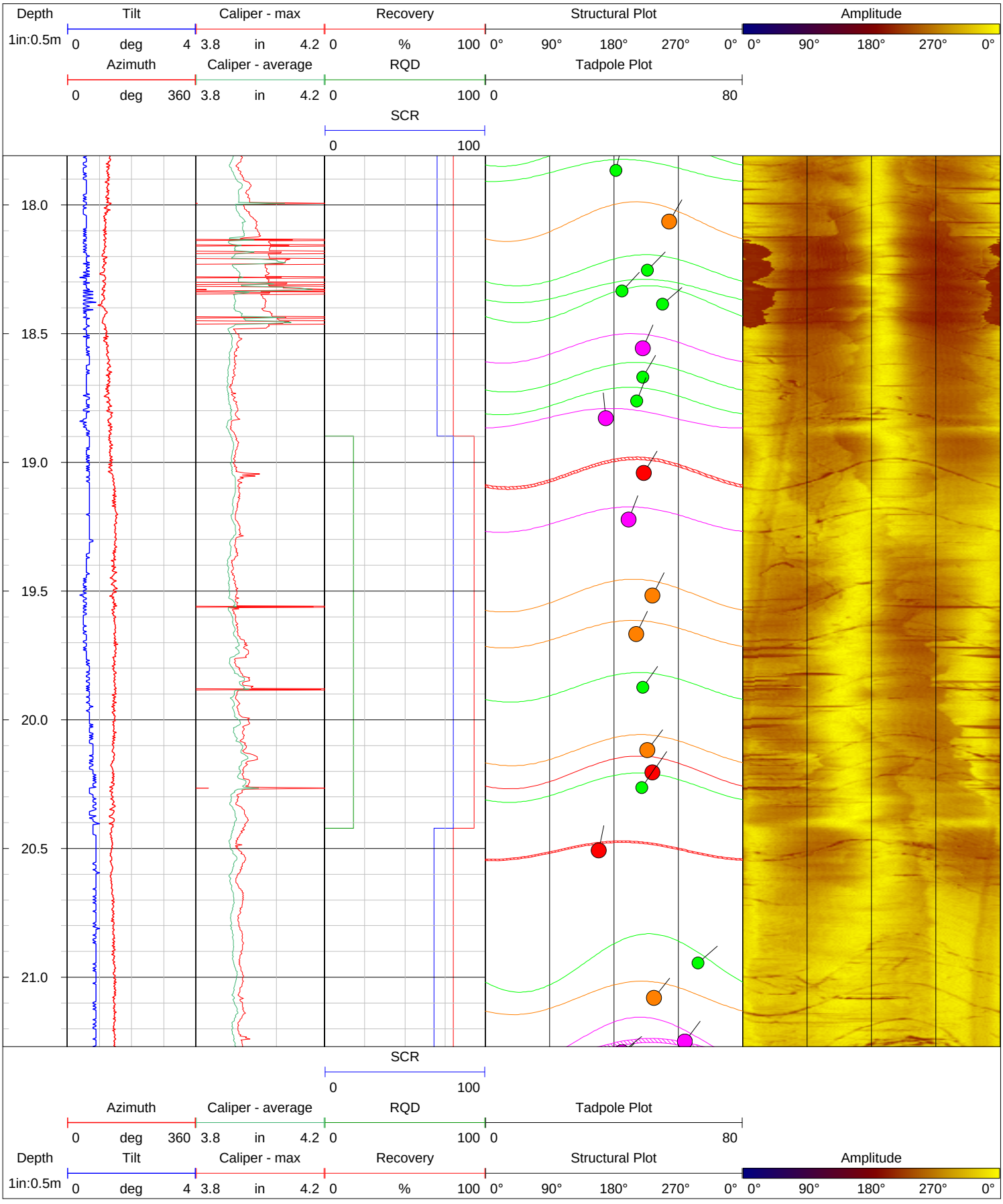


ACOUSTIC TELEVIEWER LOG - BORING BH20

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

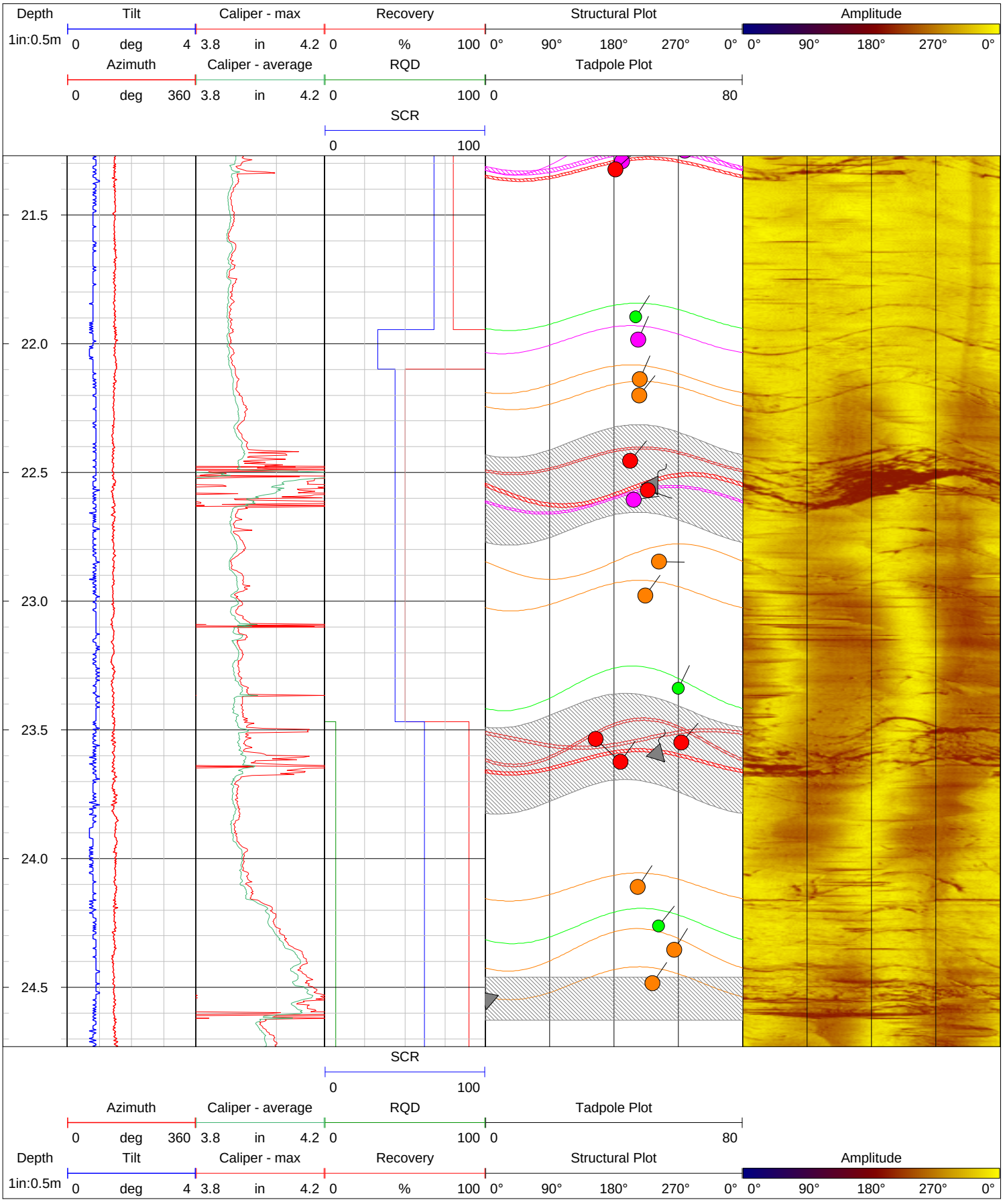
PLATE B5.5



ACOUSTIC TELEVIEWER LOG - BORING BH20

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

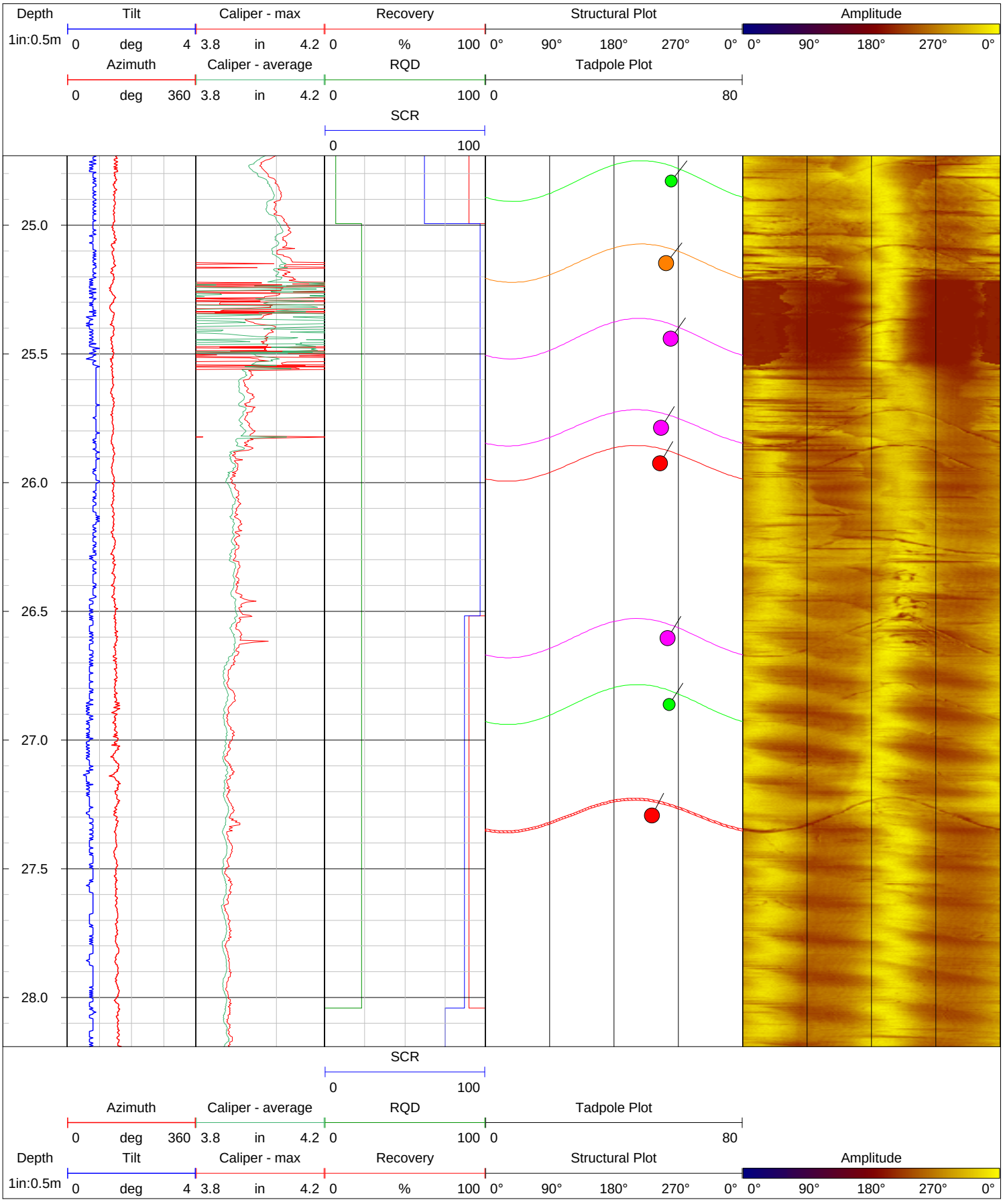


ACOUSTIC TELEVIEWER LOG - BORING BH20

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

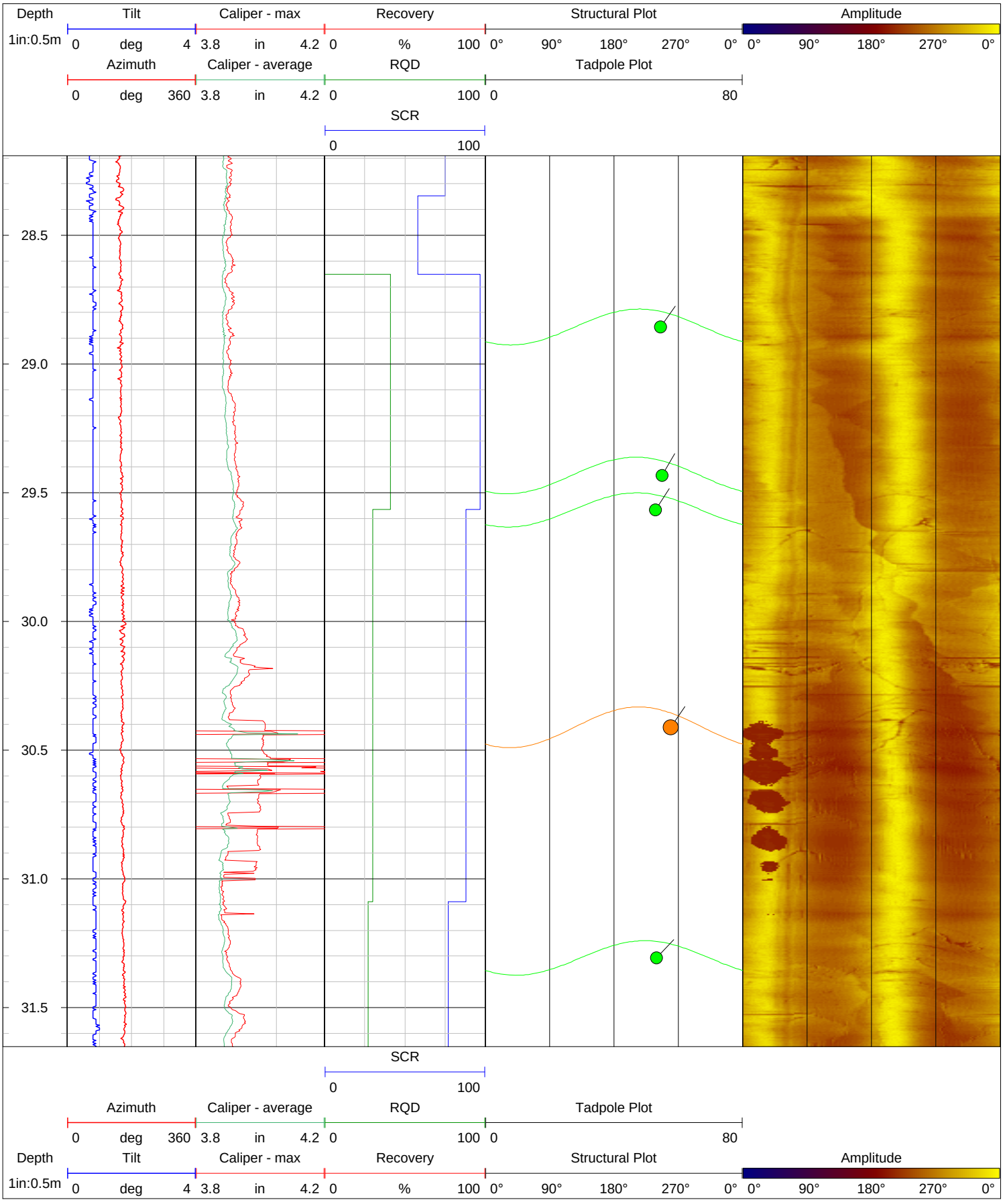
PLATE B5.7



ACOUSTIC TELEVIEWER LOG - BORING BH20

PACIFIC NORTHWEST LNG PROJECT

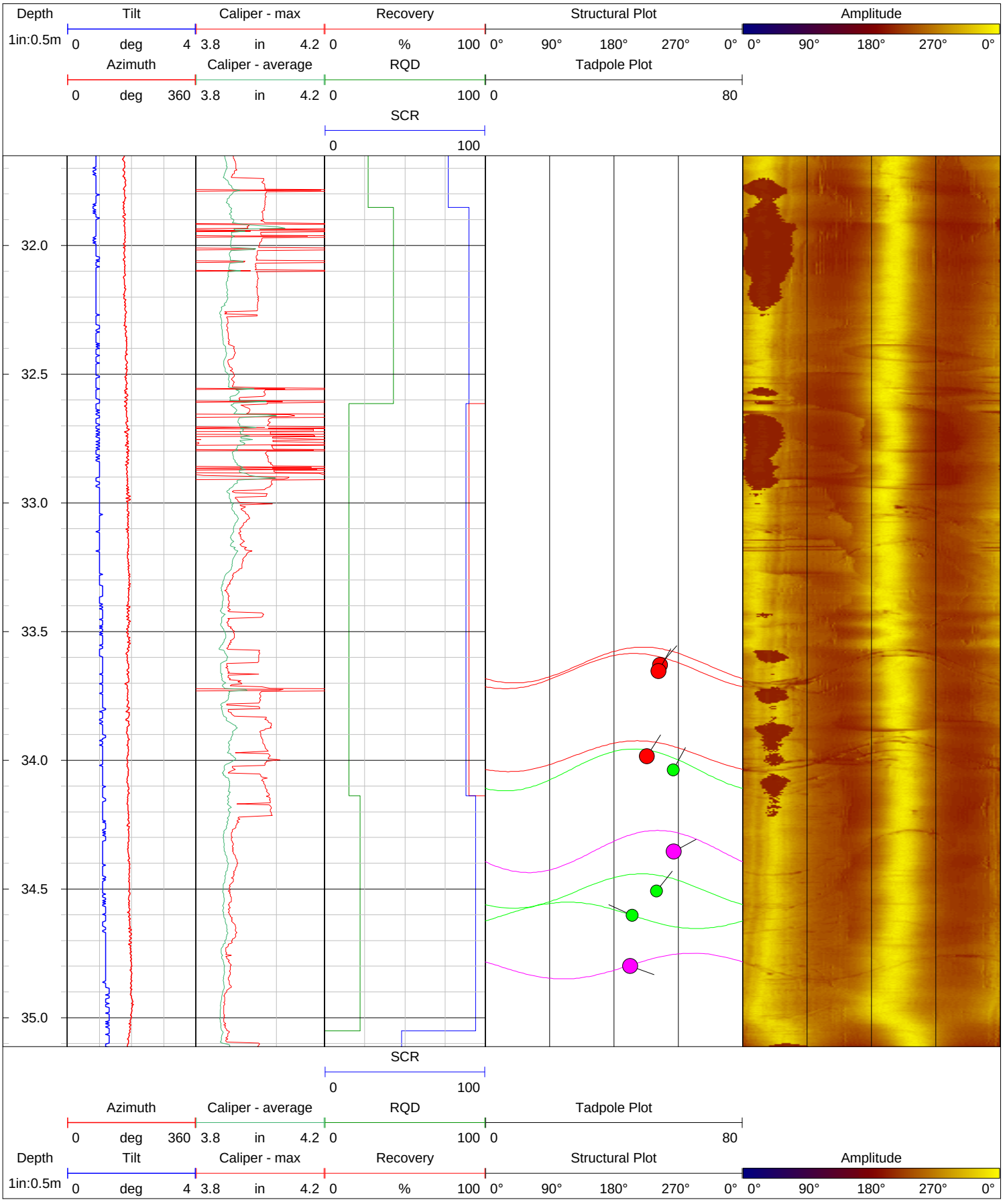
LELU ISLAND, BRITISH COLUMBIA, CANADA



ACOUSTIC TELEVIEWER LOG - BORING BH20

PACIFIC NORTHWEST LNG PROJECT

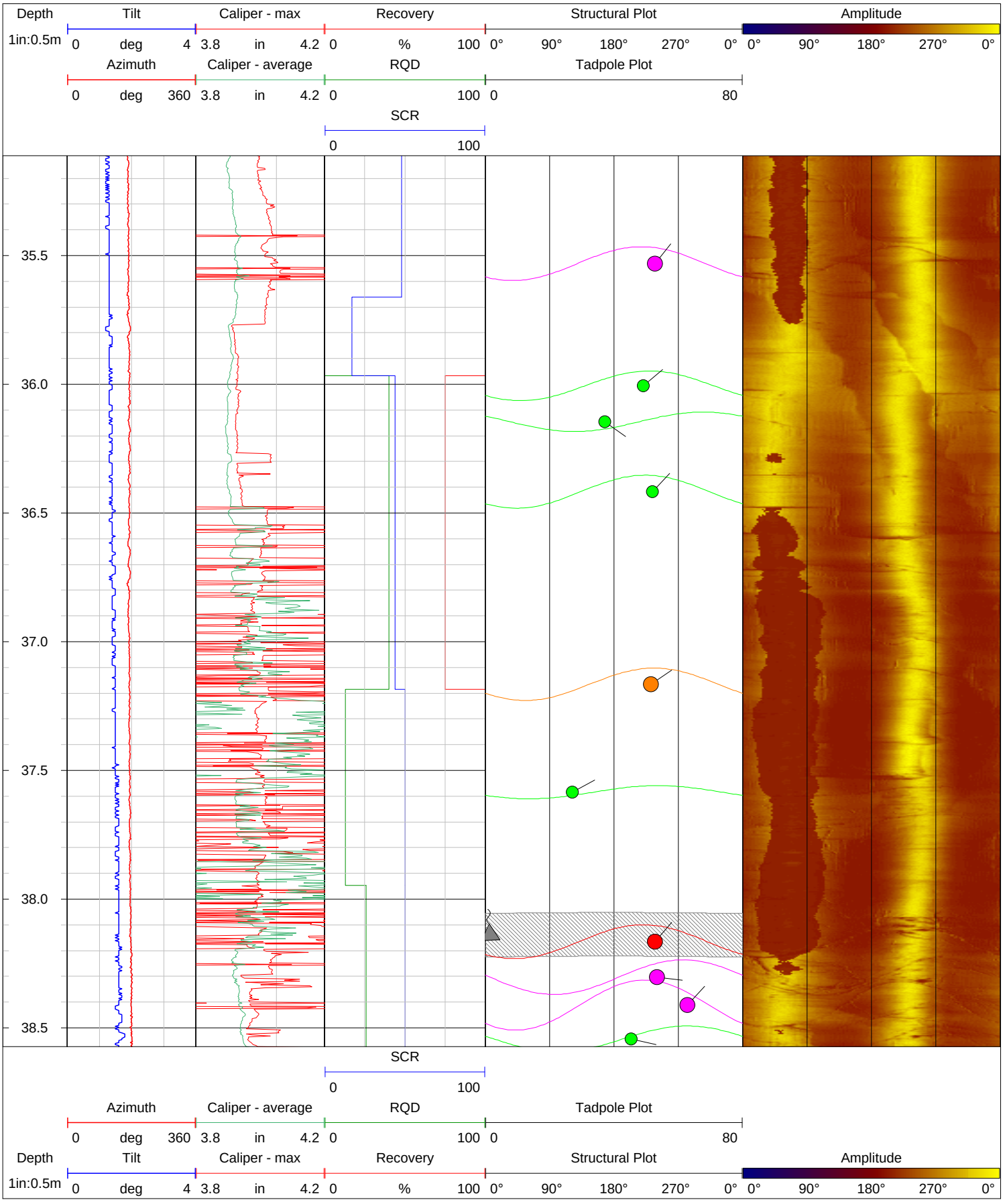
LELU ISLAND, BRITISH COLUMBIA, CANADA



ACOUSTIC TELEVIEWER LOG - BORING BH20

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

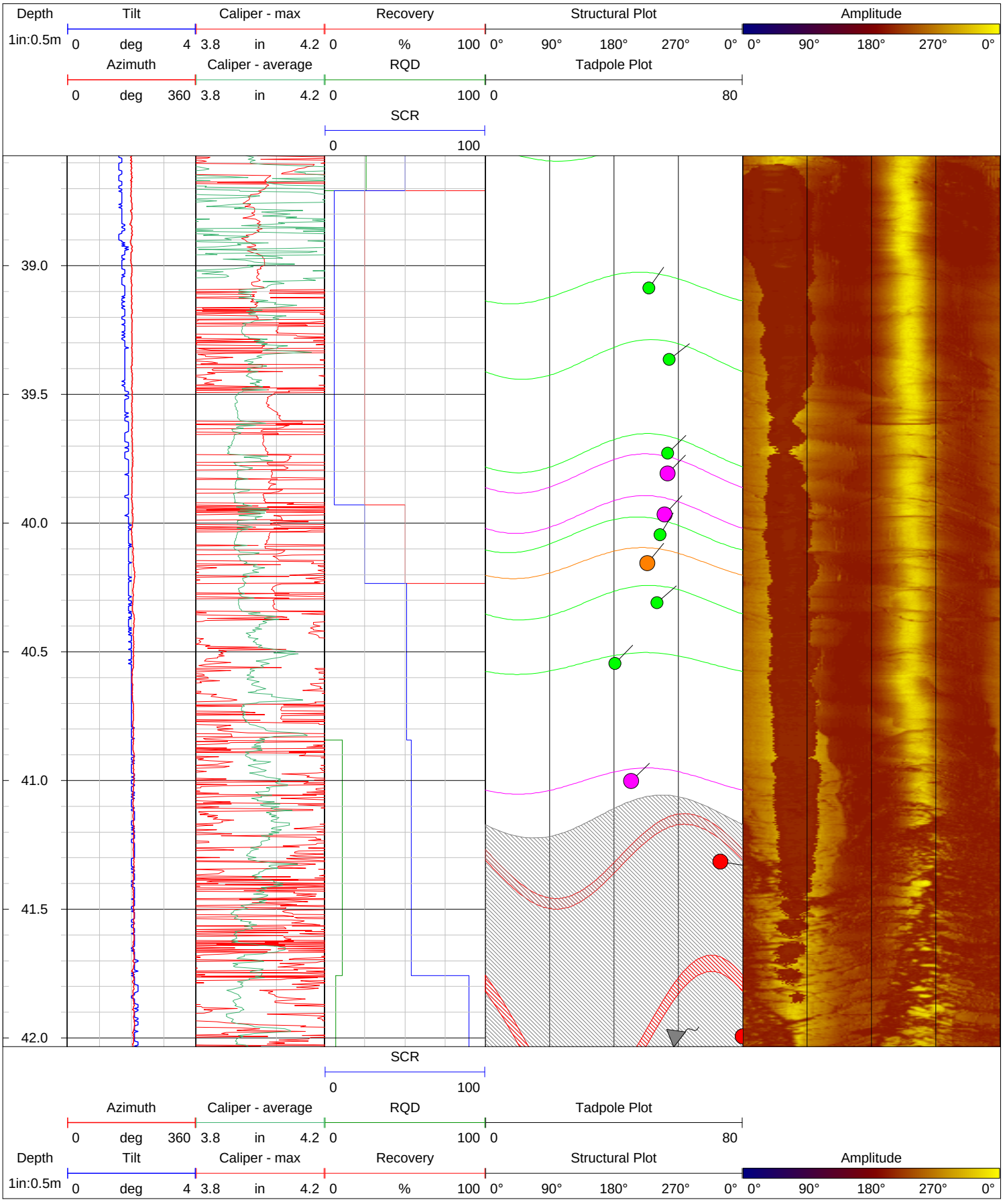


ACOUSTIC TELEVIEWER LOG - BORING BH20

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE B5.11

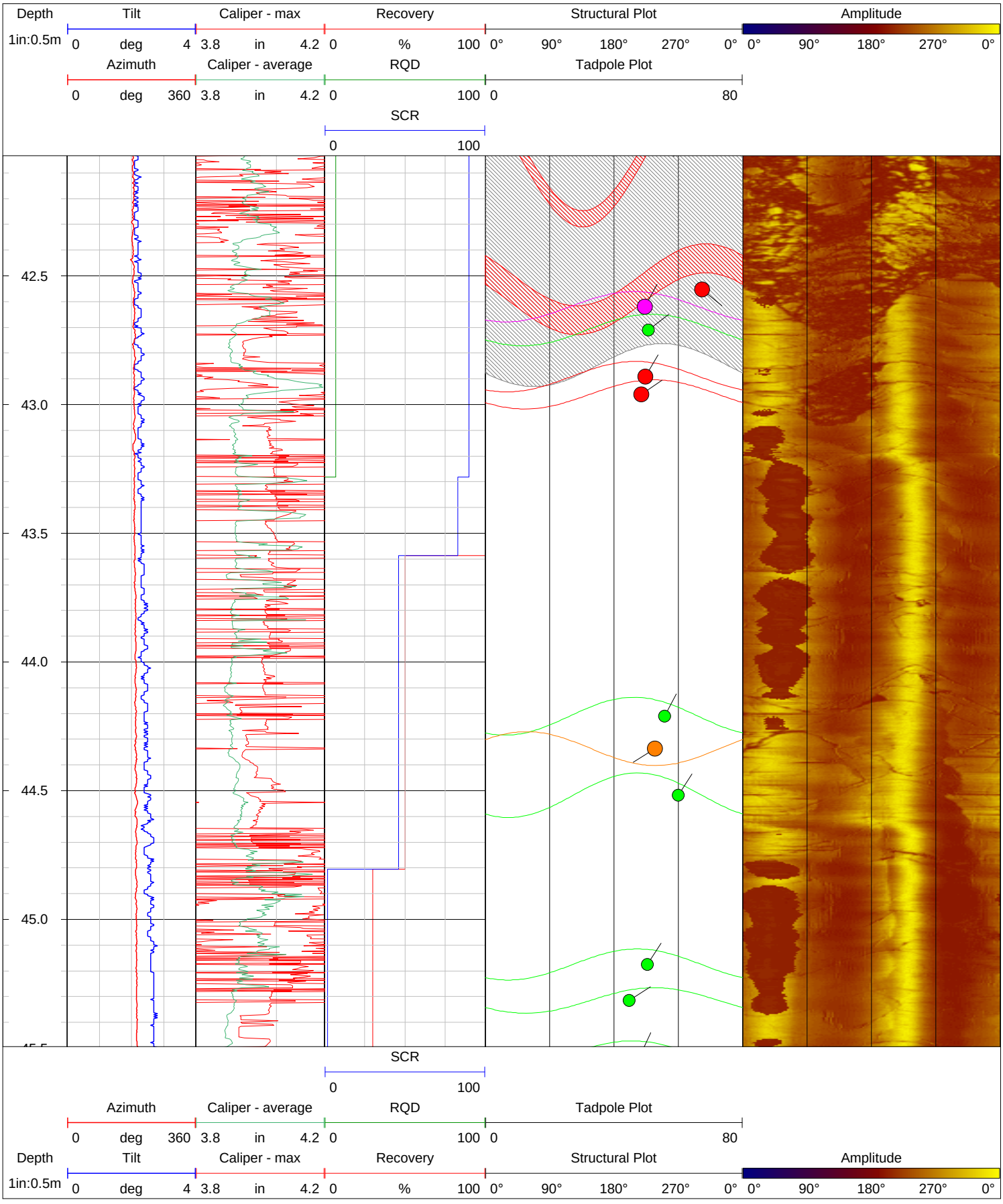


ACOUSTIC TELEVIEWER LOG - BORING BH20

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE B5.12

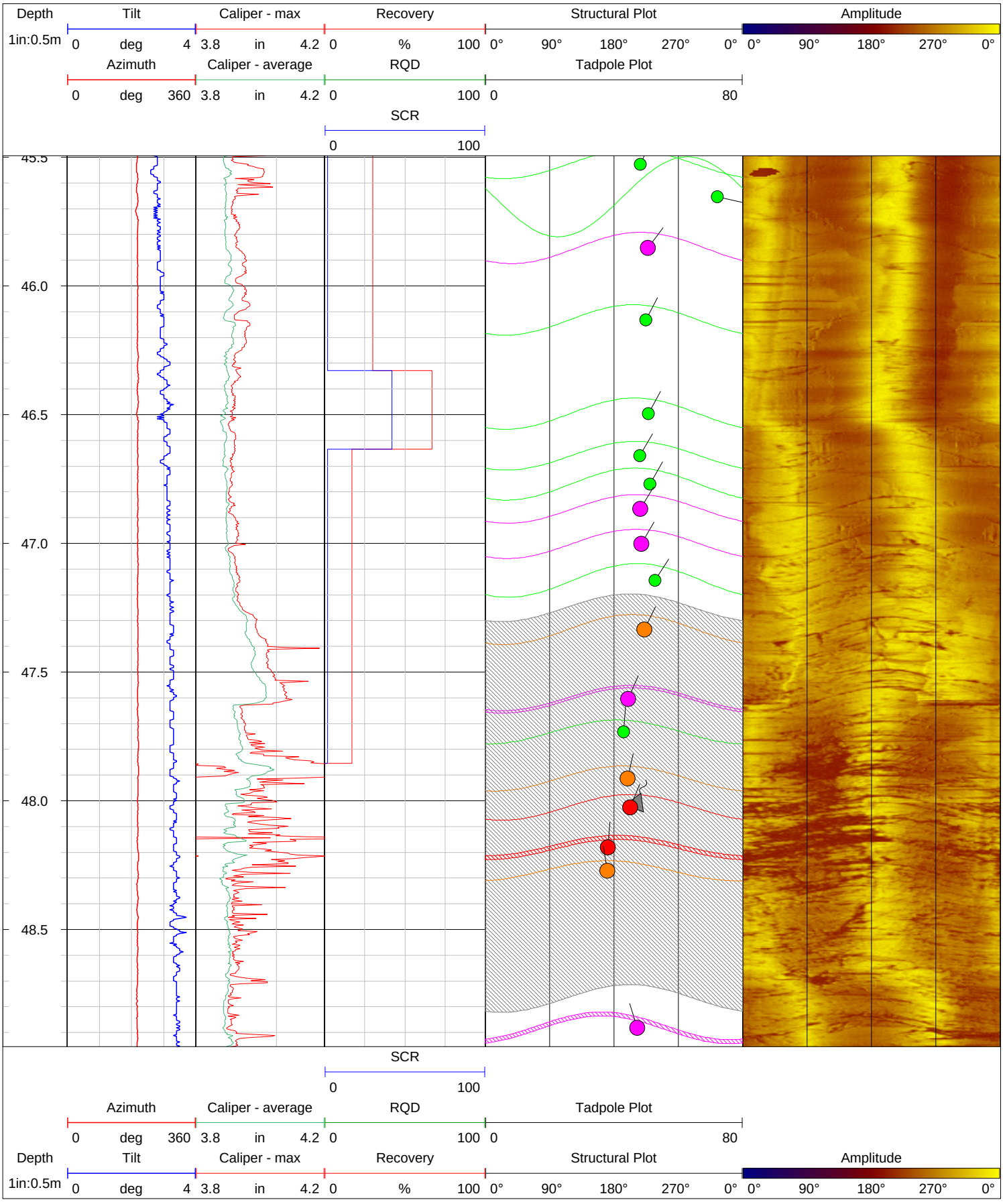


ACOUSTIC TELEVIEWER LOG - BORING BH20

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

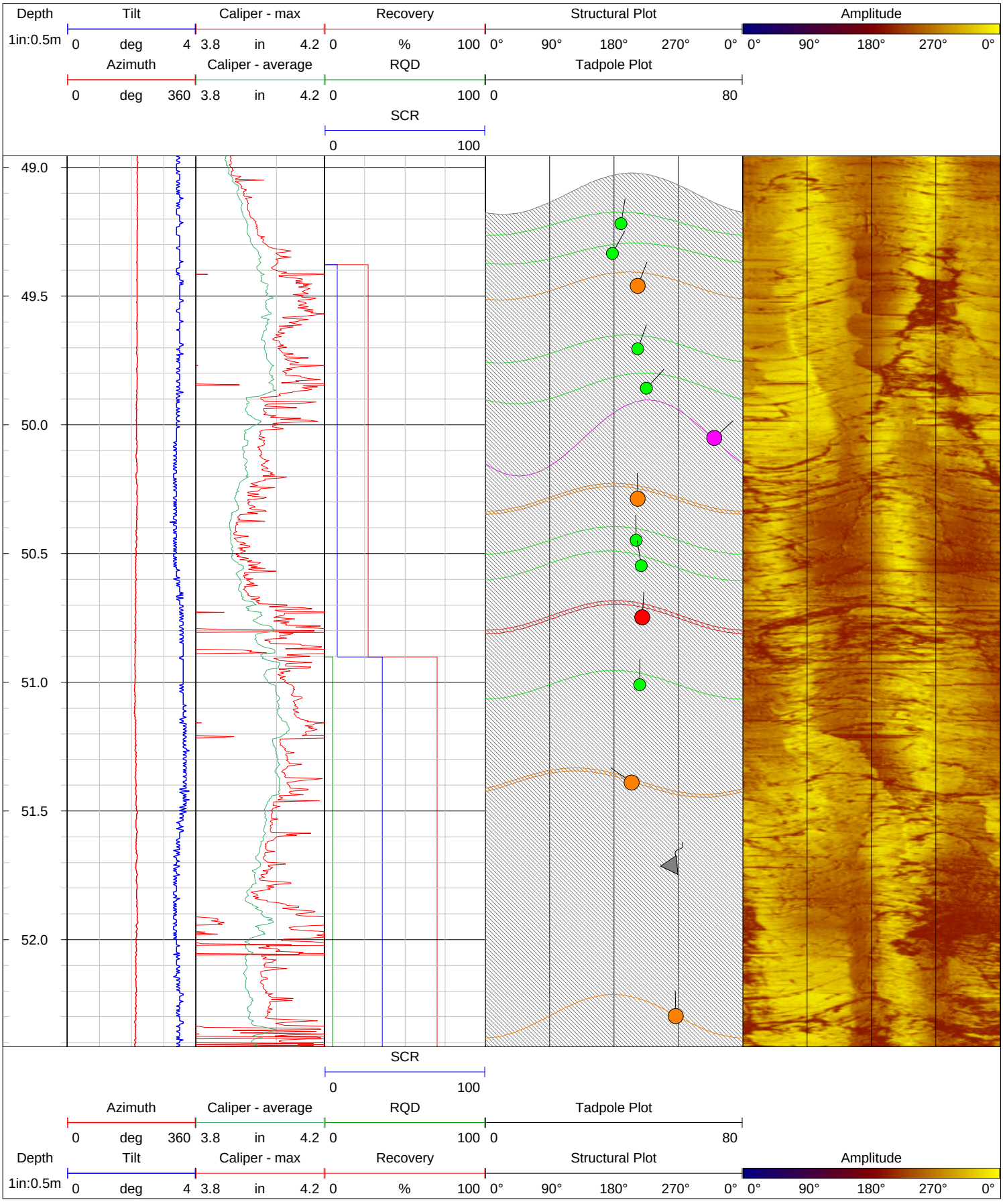
PLATE B5.13



ACOUSTIC TELEVIEWER LOG - BORING BH20

PACIFIC NORTHWEST LNG PROJECT

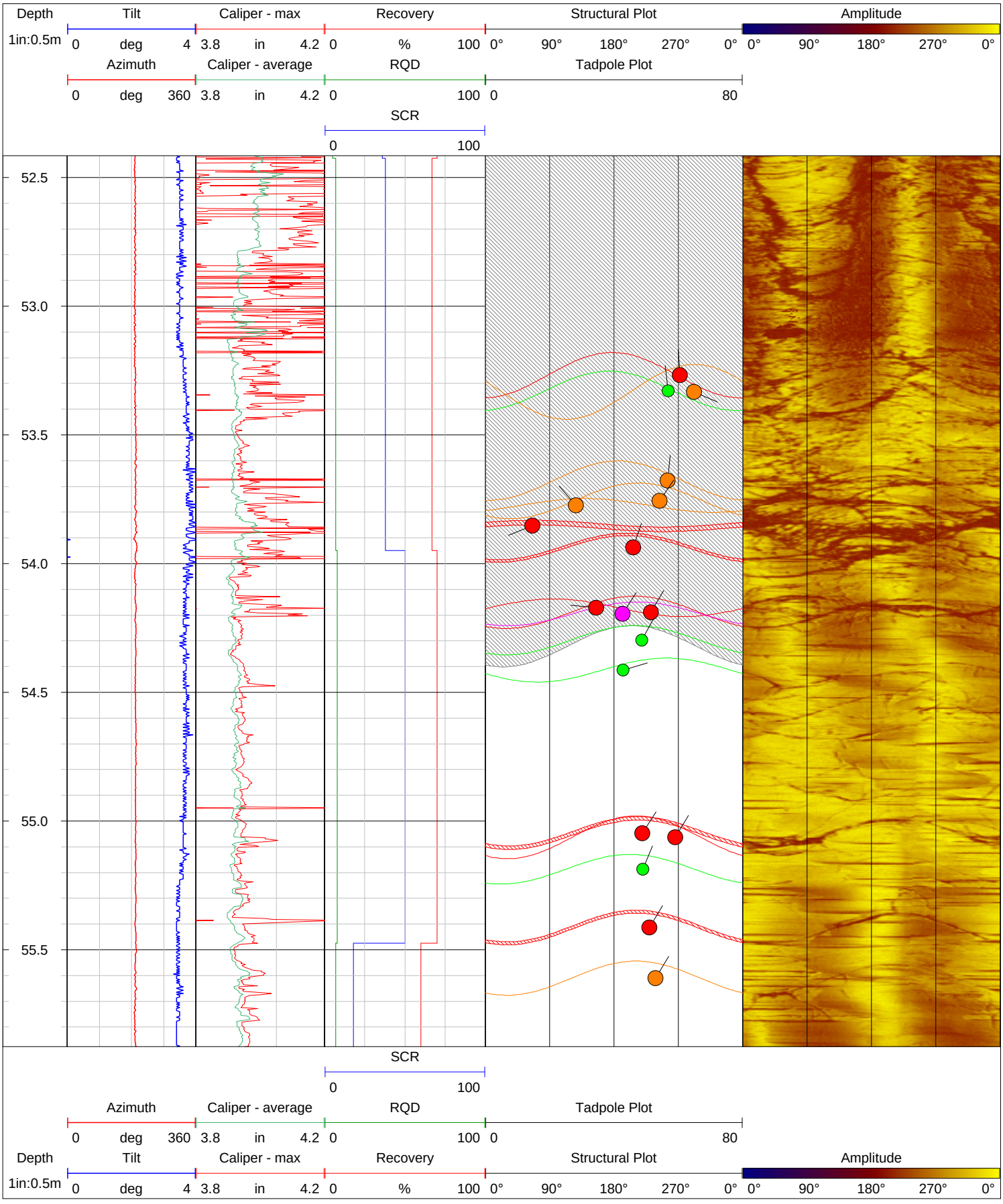
LELU ISLAND, BRITISH COLUMBIA, CANADA



ACOUSTIC TELEVIEWER LOG - BORING BH20

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

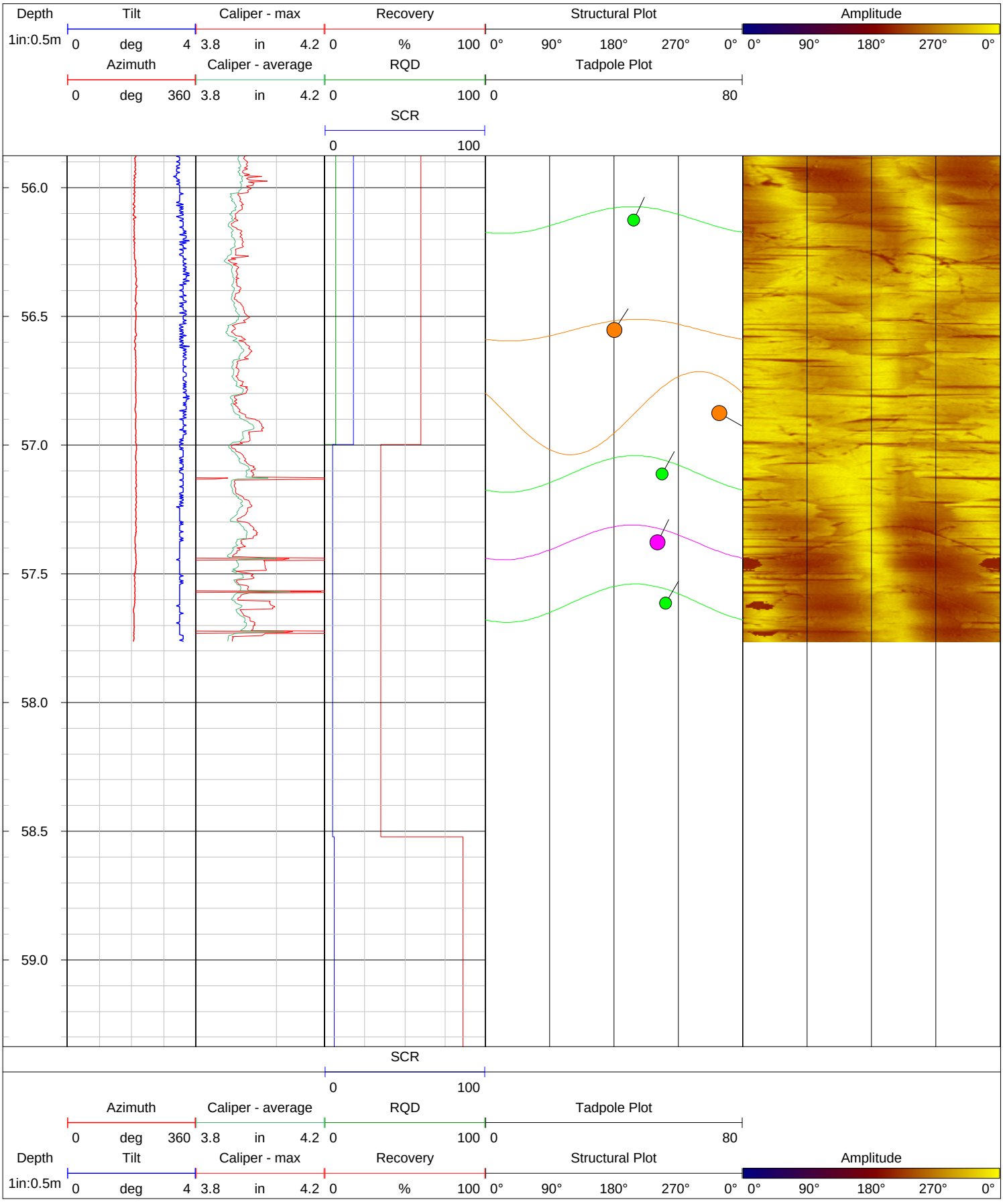


ACOUSTIC TELEVIEWER LOG - BORING BH20

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE B5.16



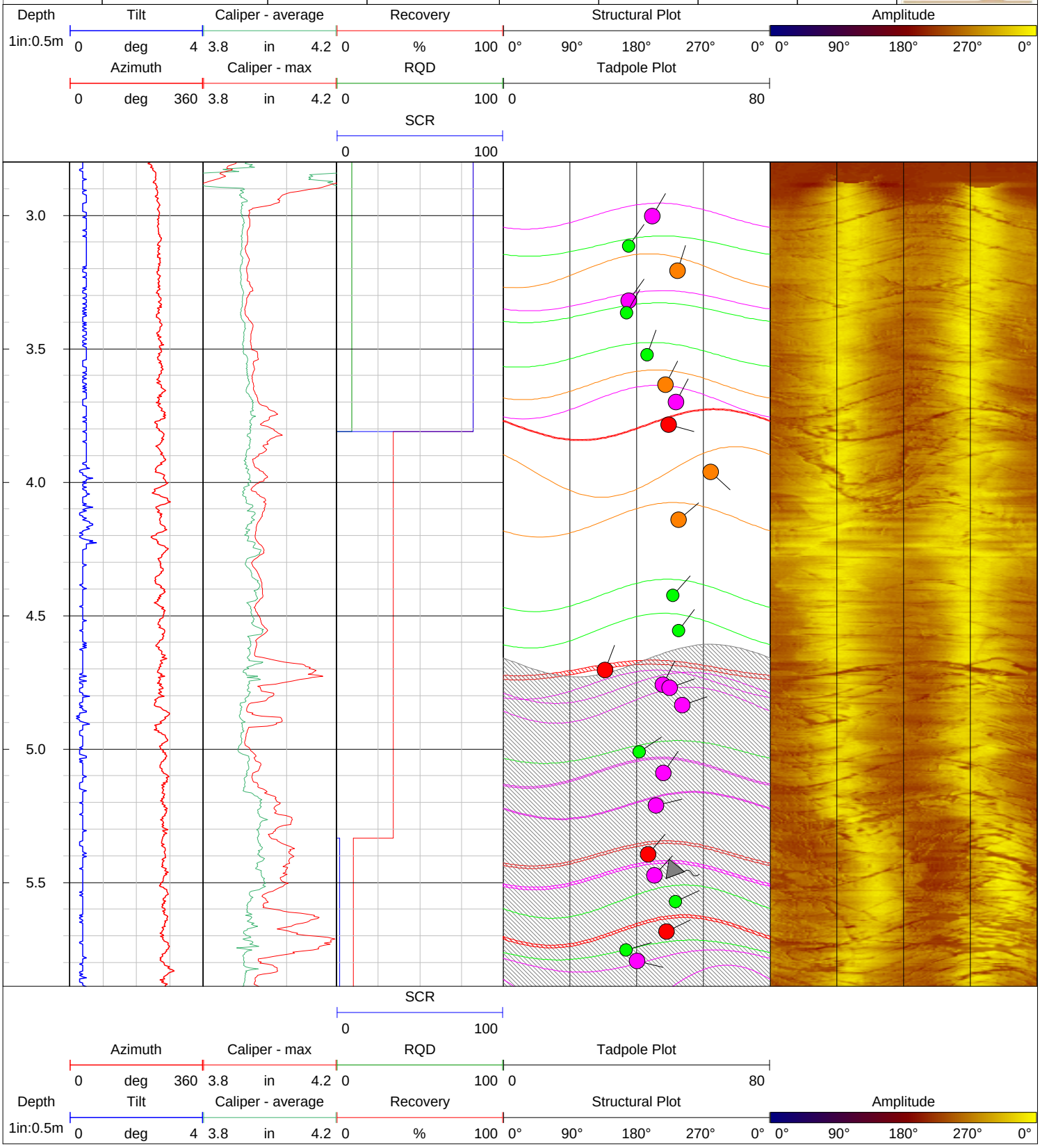
ACOUSTIC TELEVIEWER LOG - BORING BH20

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE B5.17

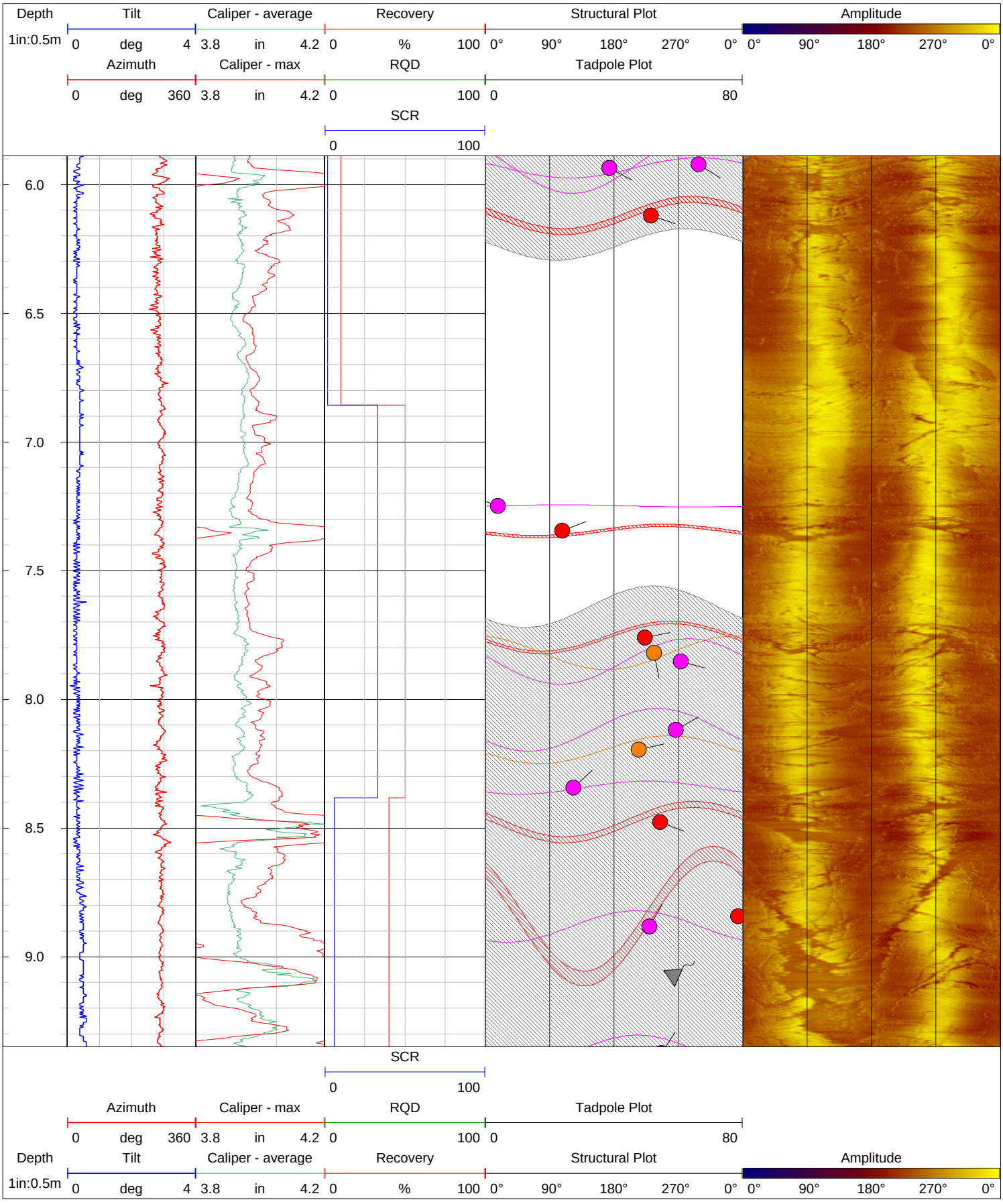
Project:	04.10130058	Boring:	BH24	Depth:	55.40 m	Log Depth:	53.25 m
Date:	July 11, 2013	Run:	One / Up	Elevation:	24.3 m	Operator:	DV



ACOUSTIC TELEVIEWER LOG - BORING BH24

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

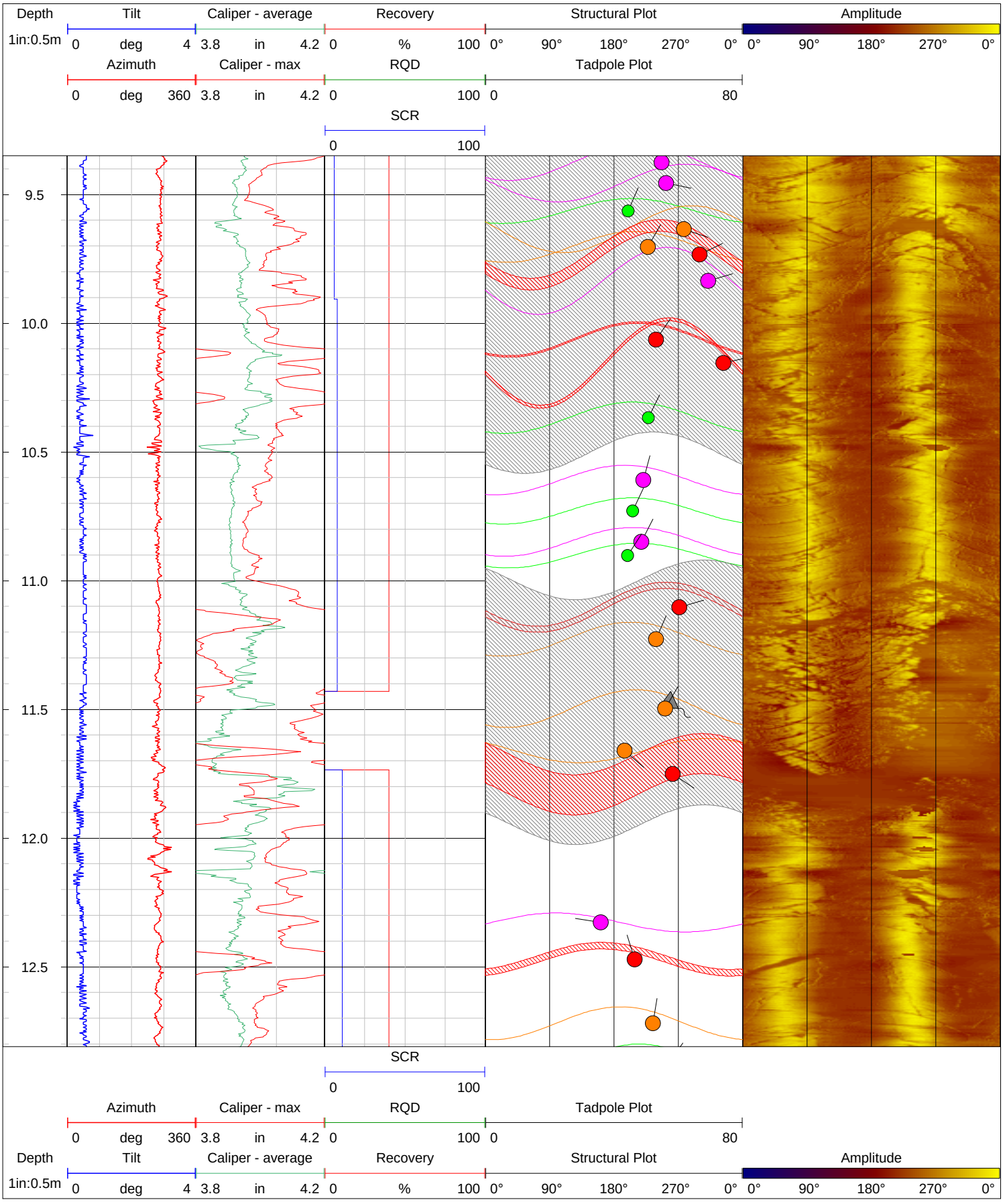


ACOUSTIC TELEVIEWER LOG - BORING BH24

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE B6.2

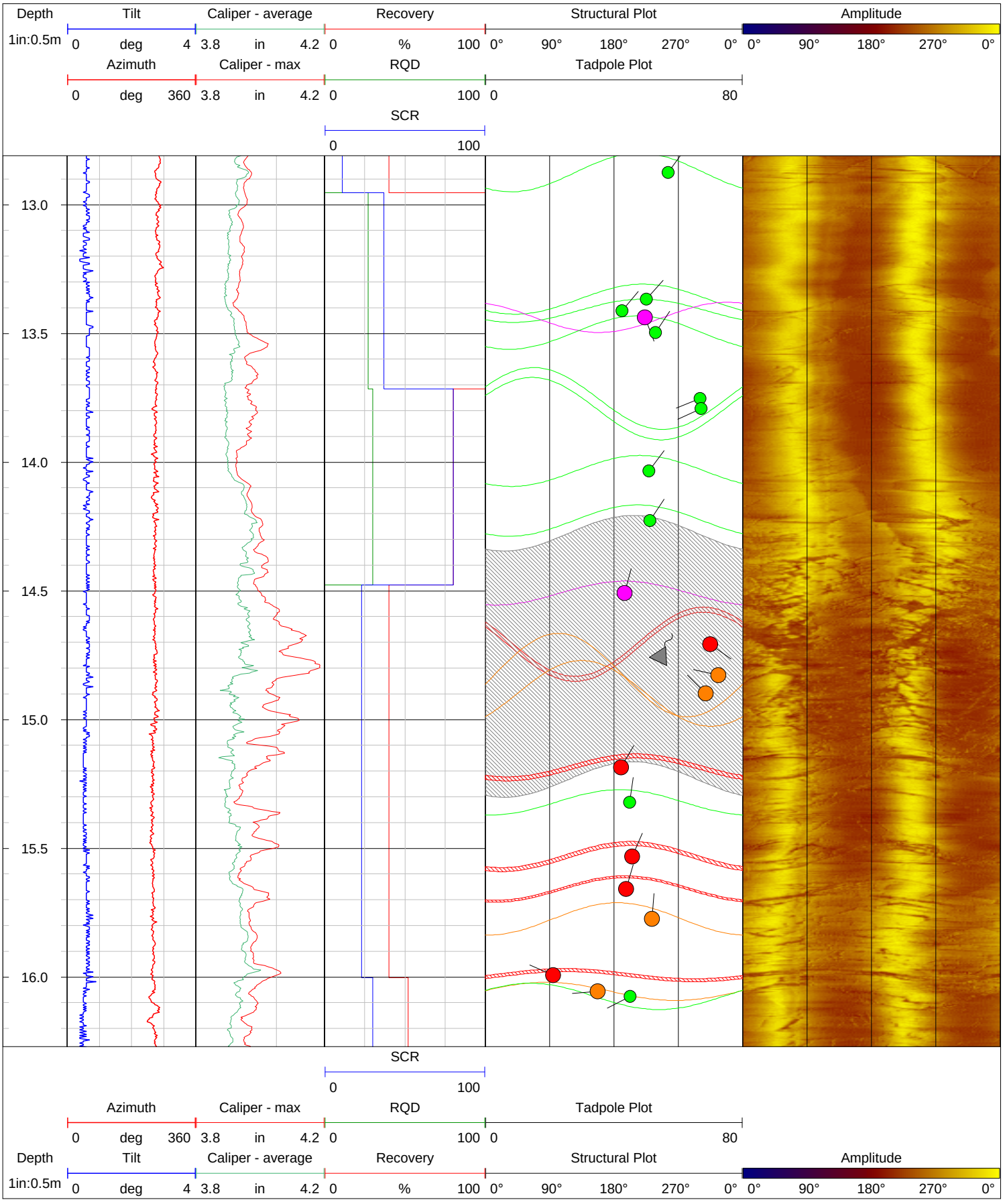


ACOUSTIC TELEVIEWER LOG - BORING BH24

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

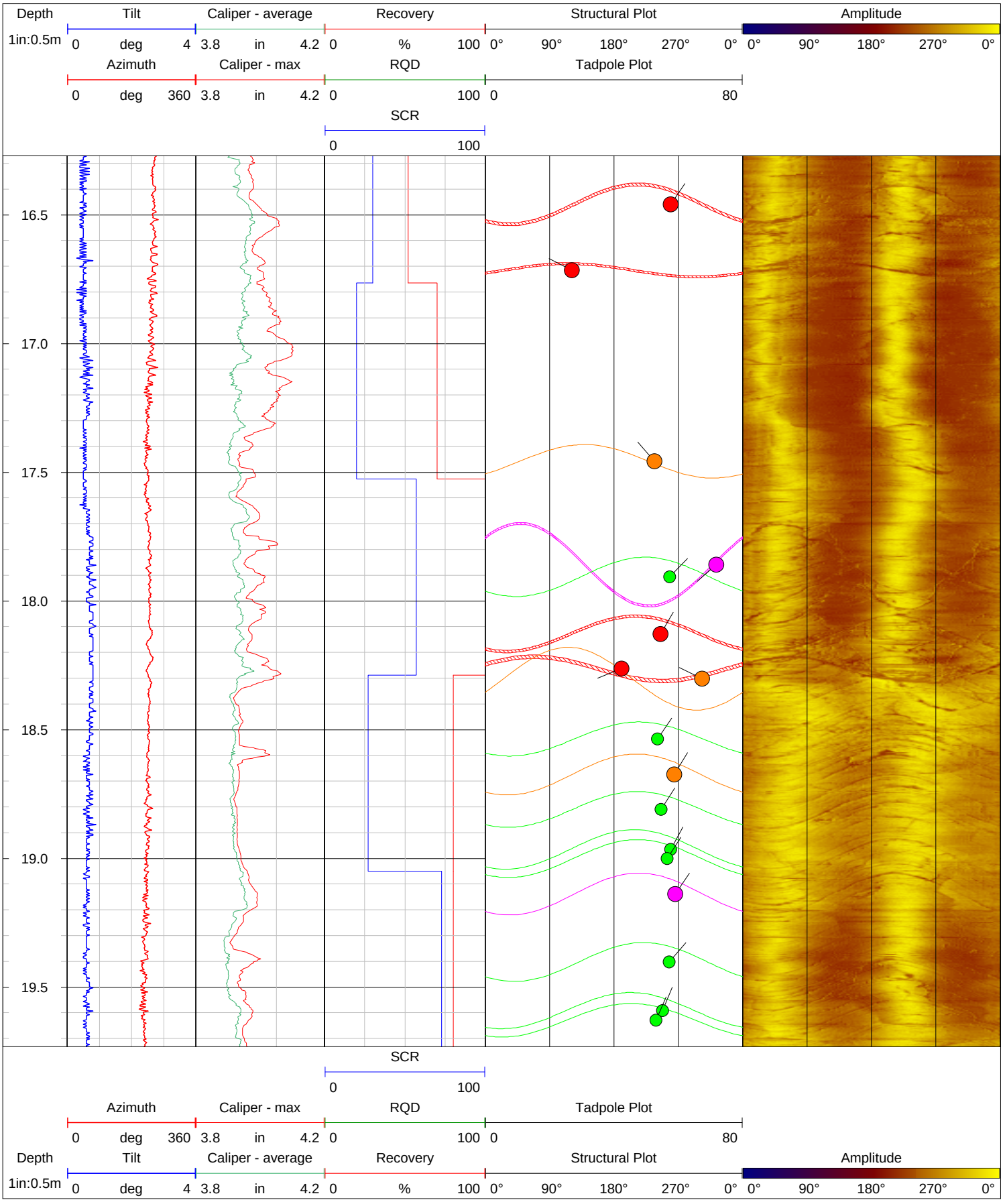
PLATE B6.3



ACOUSTIC TELEVIEWER LOG - BORING BH24

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

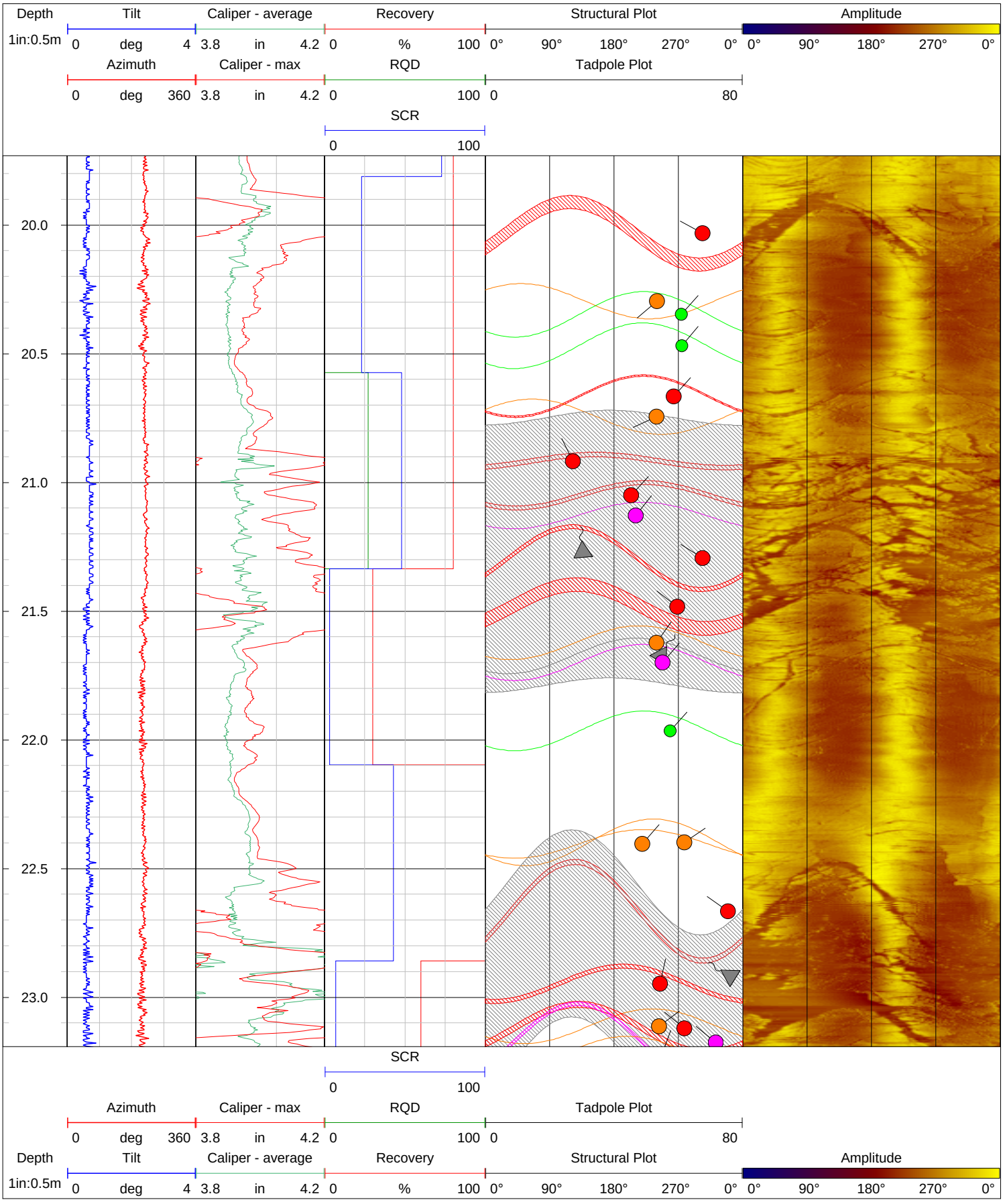


ACOUSTIC TELEVIEWER LOG - BORING BH24

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

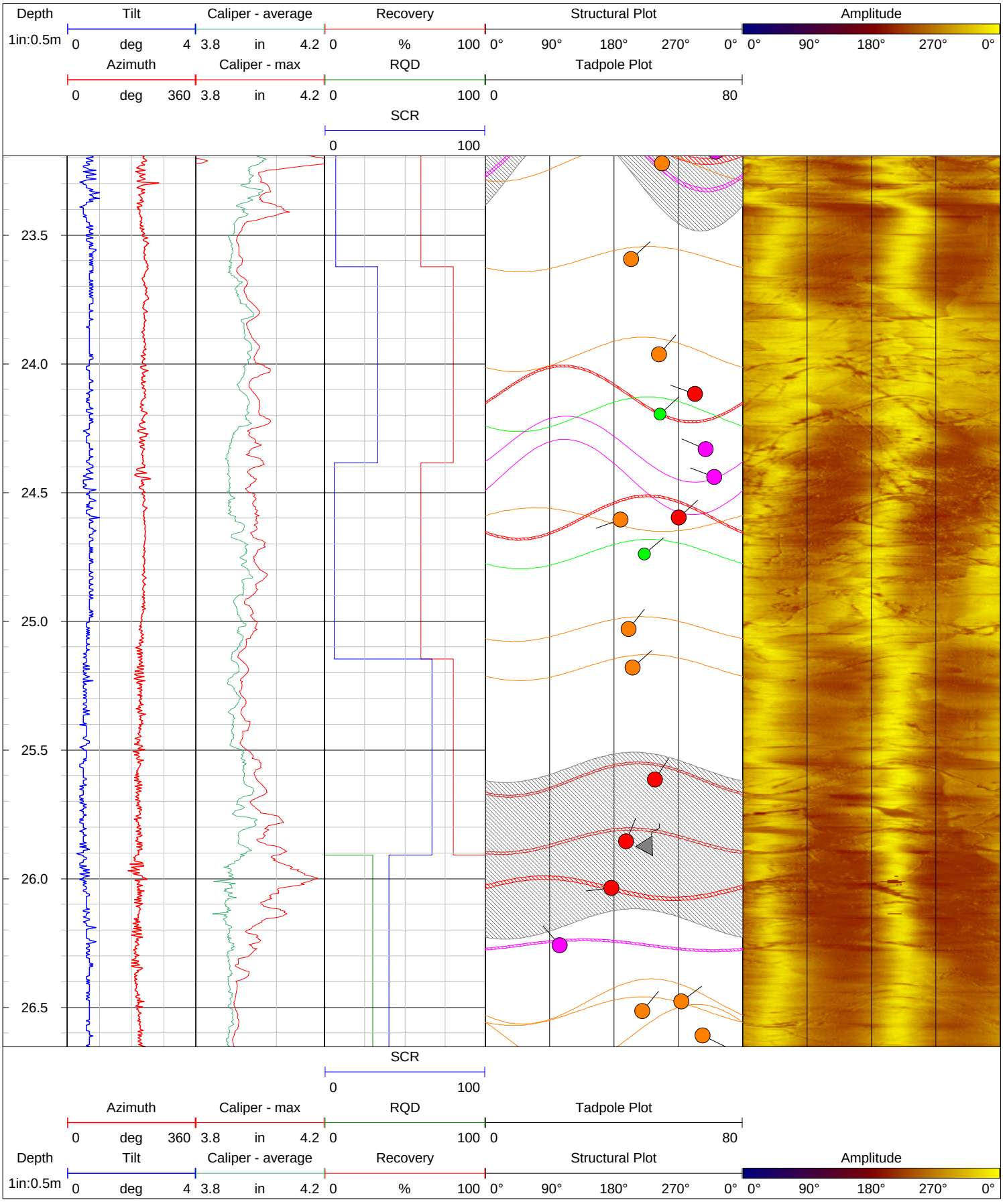
PLATE B6.5



ACOUSTIC TELEVIEWER LOG - BORING BH24

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

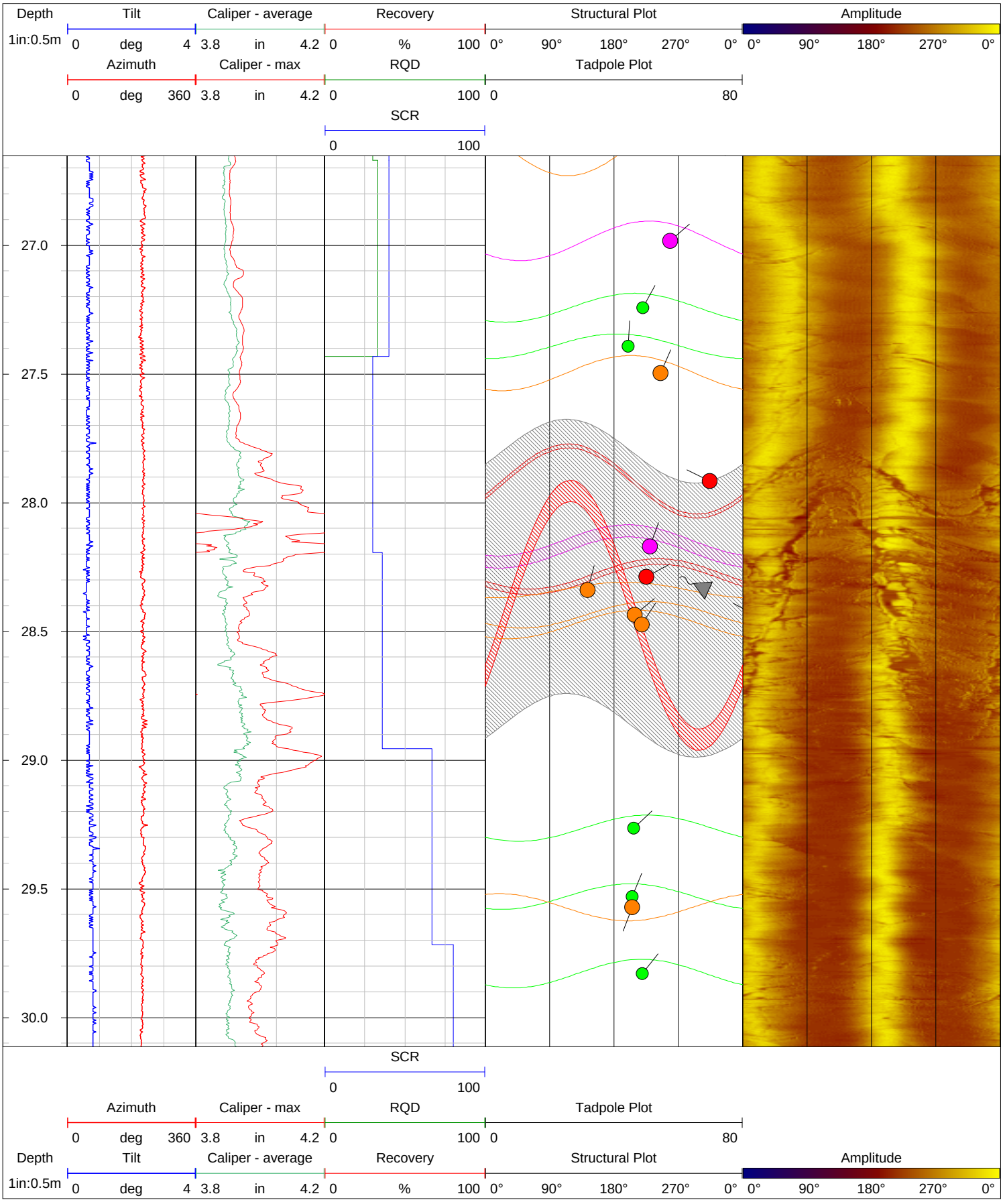


ACOUSTIC TELEVIEWER LOG - BORING BH24

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE B6.7

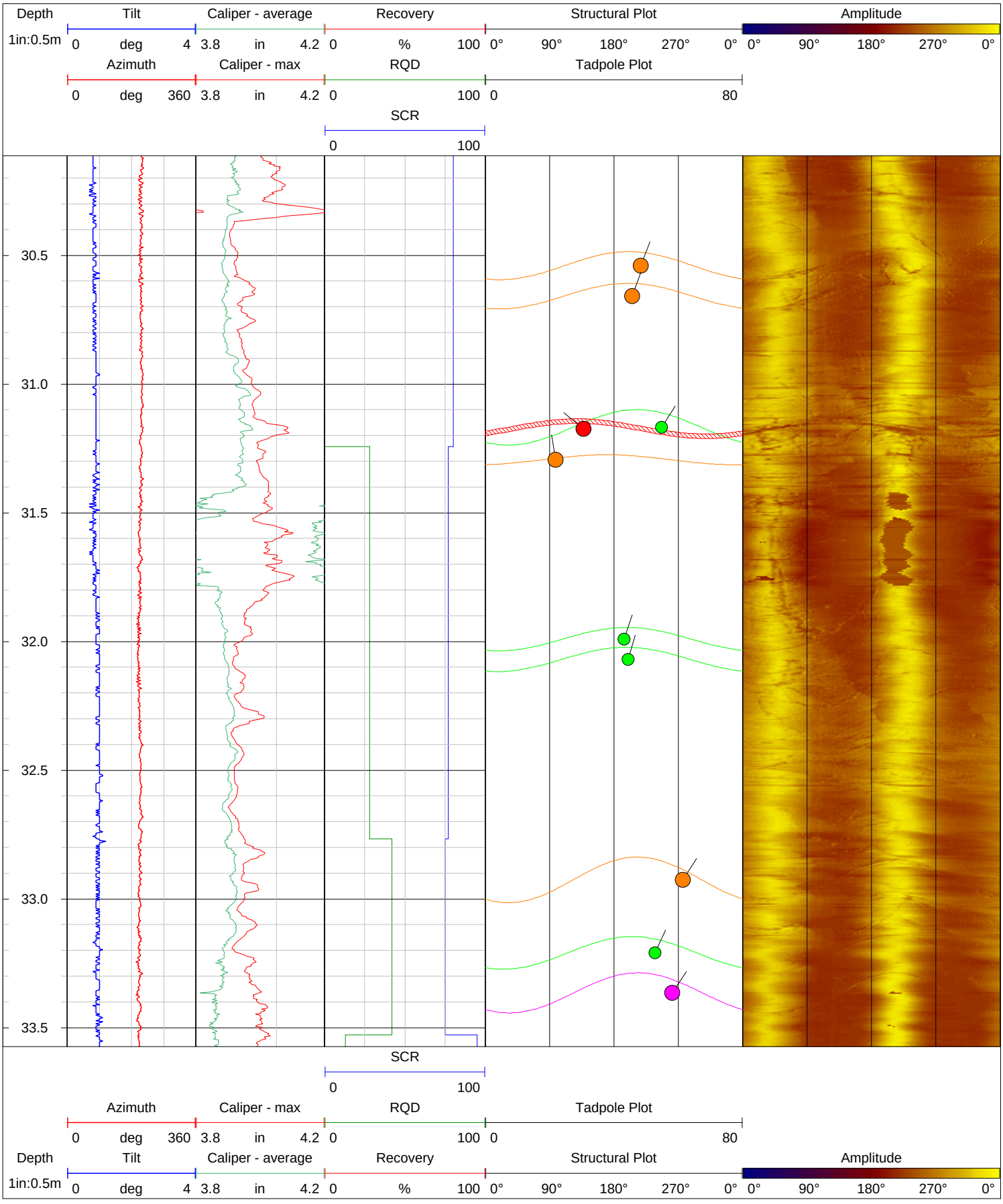


ACOUSTIC TELEVIEWER LOG - BORING BH24

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE B6.8

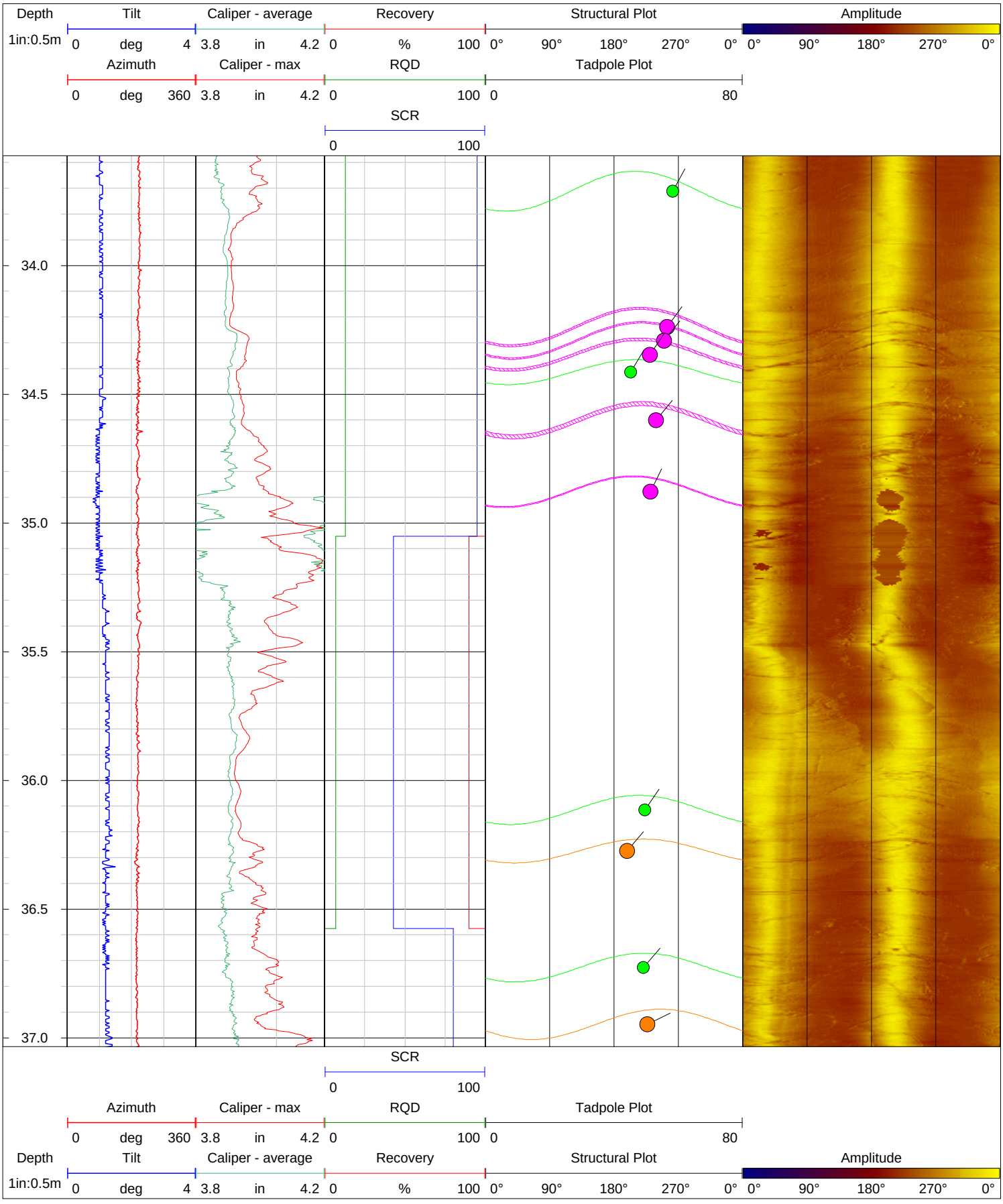


ACOUSTIC TELEVIEWER LOG - BORING BH24

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

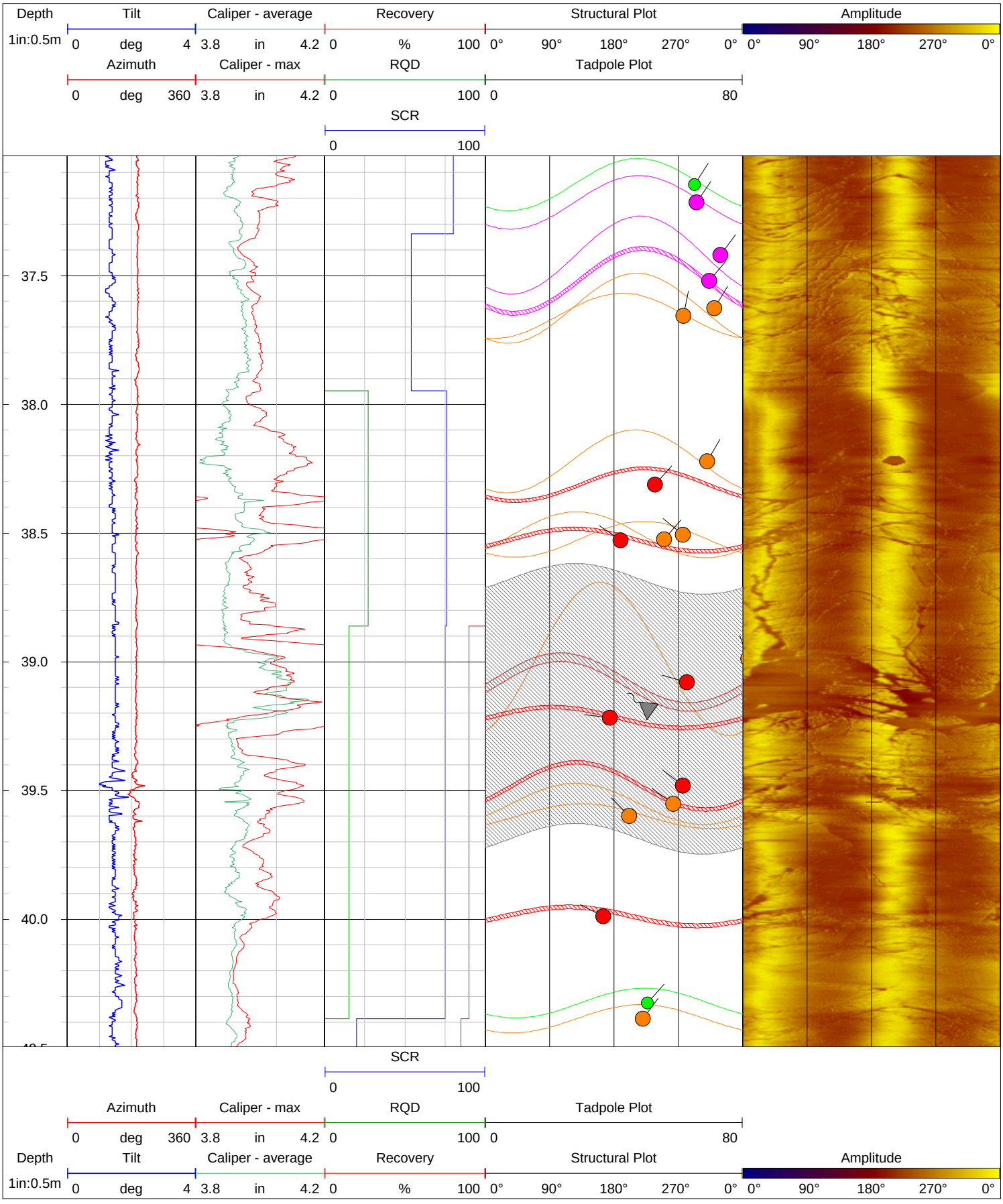
PLATE B6.9



ACOUSTIC TELEVIEWER LOG - BORING BH24

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

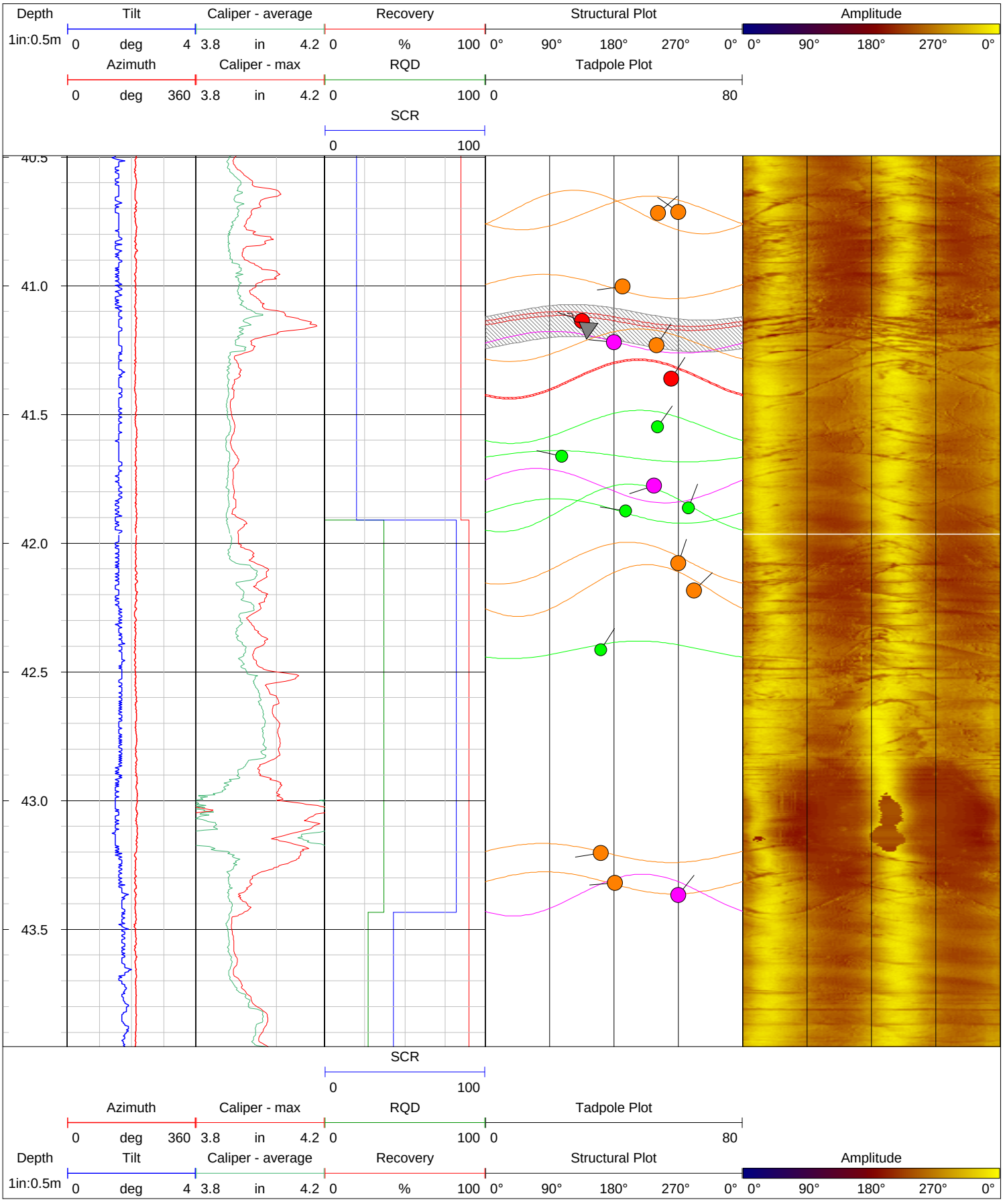


ACOUSTIC TELEVIEWER LOG - BORING BH24

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE B6.11

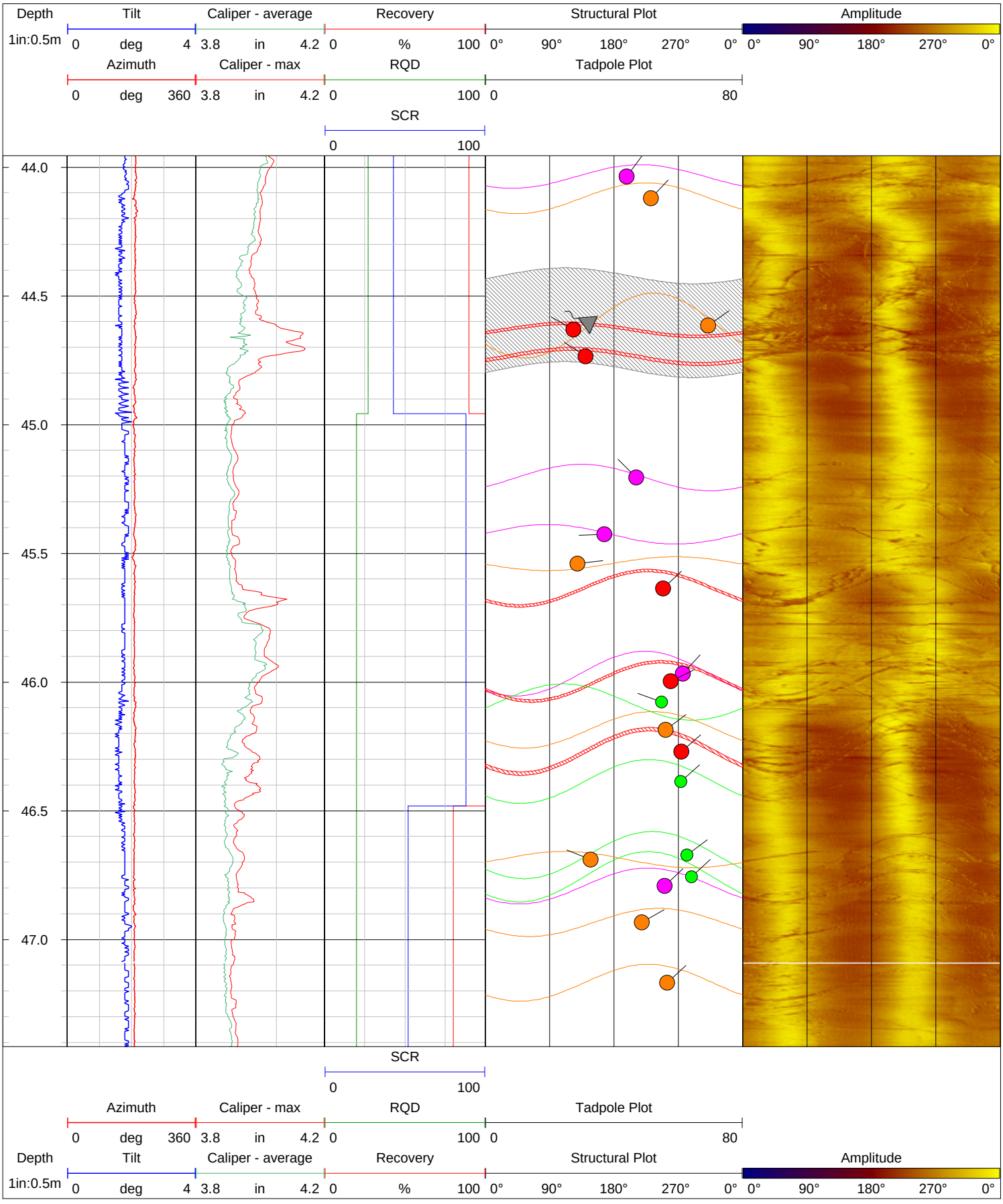


ACOUSTIC TELEVIEWER LOG - BORING BH24

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

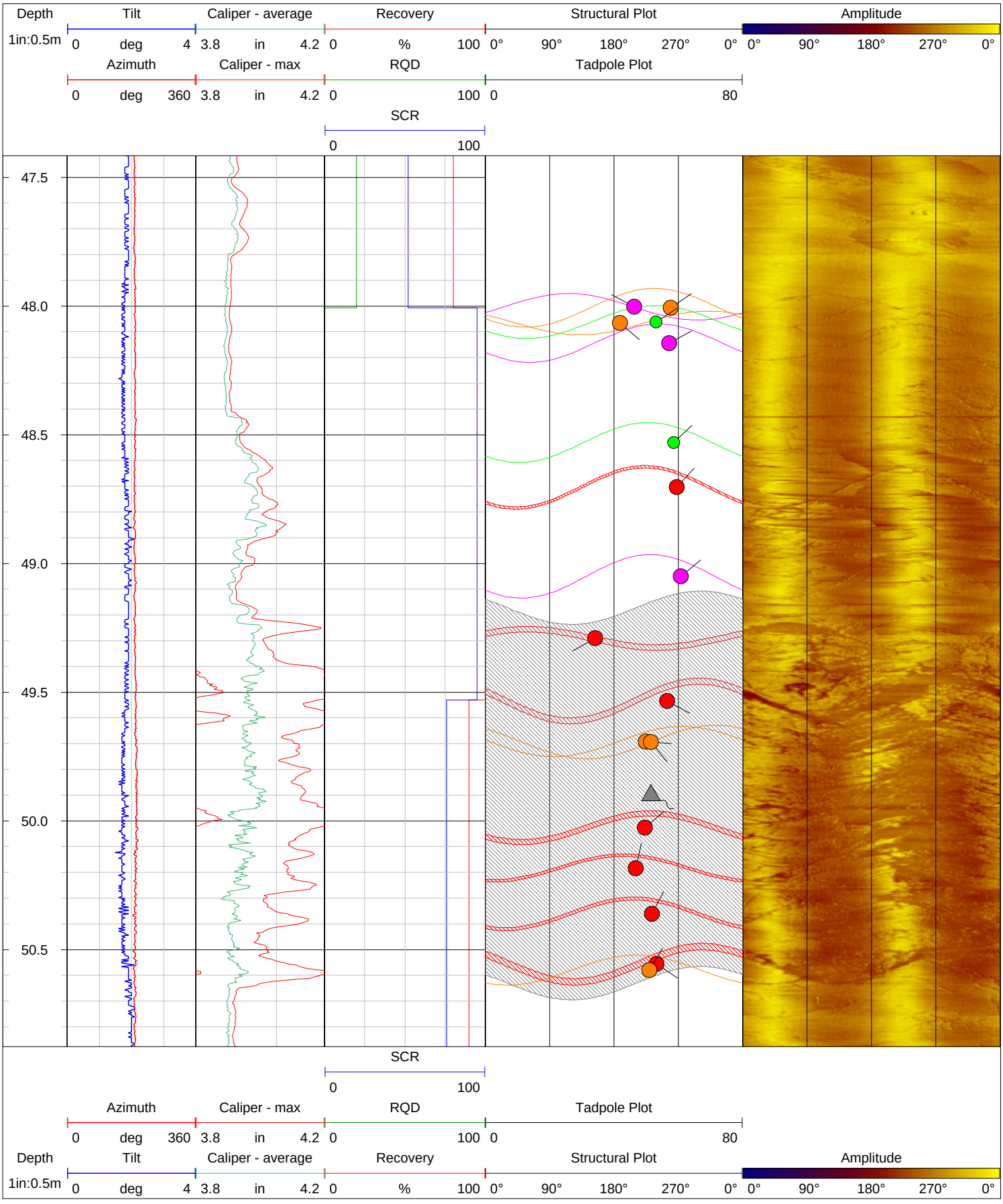
PLATE B6.12



ACOUSTIC TELEVIEWER LOG - BORING BH24

PACIFIC NORTHWEST LNG PROJECT

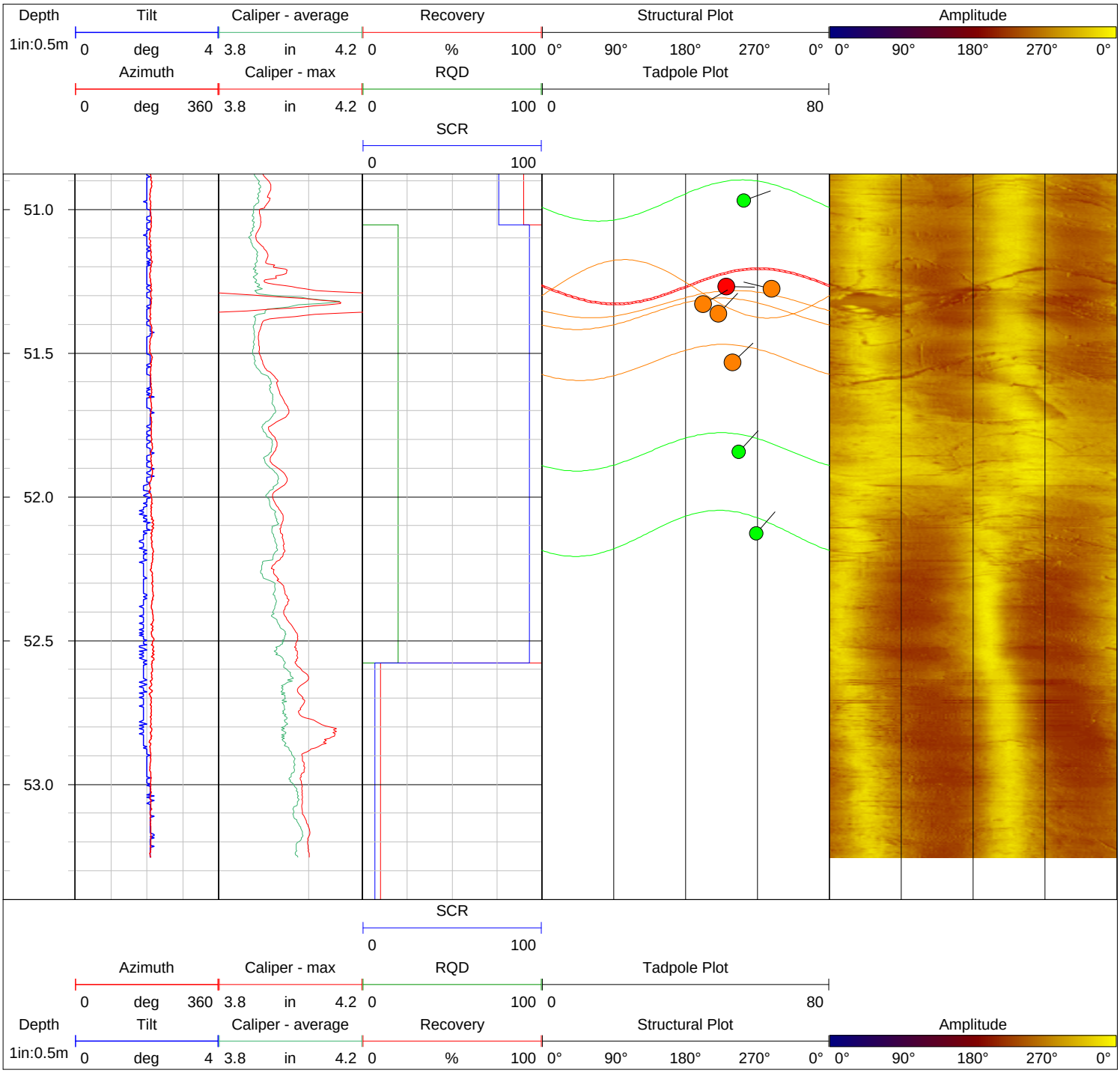
LELU ISLAND, BRITISH COLUMBIA, CANADA



ACOUSTIC TELEVIEWER LOG - BORING BH24

PACIFIC NORTHWEST LNG PROJECT

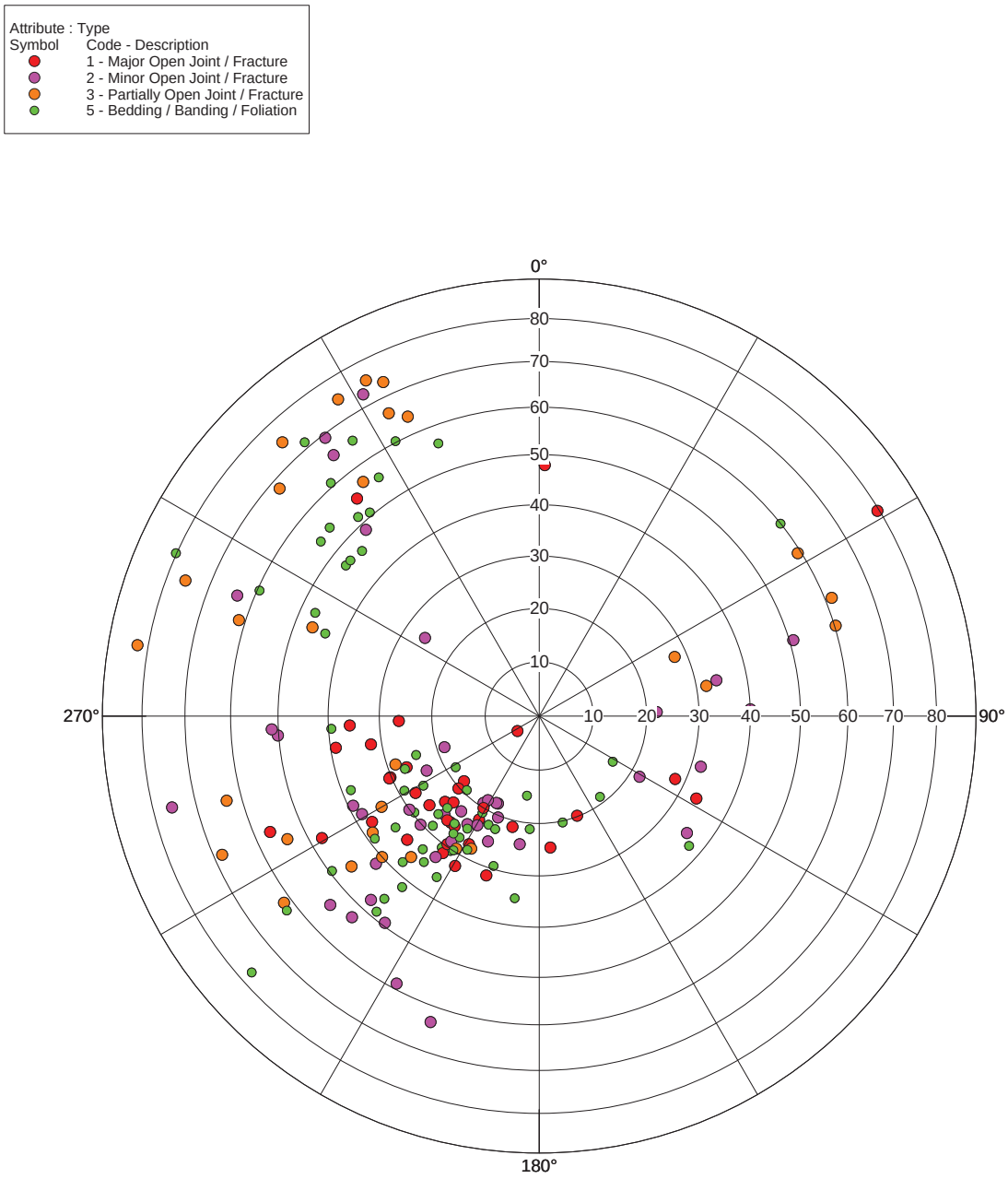
LELU ISLAND, BRITISH COLUMBIA, CANADA



ACOUSTIC TELEVIEWER LOG - BORING BH24

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA



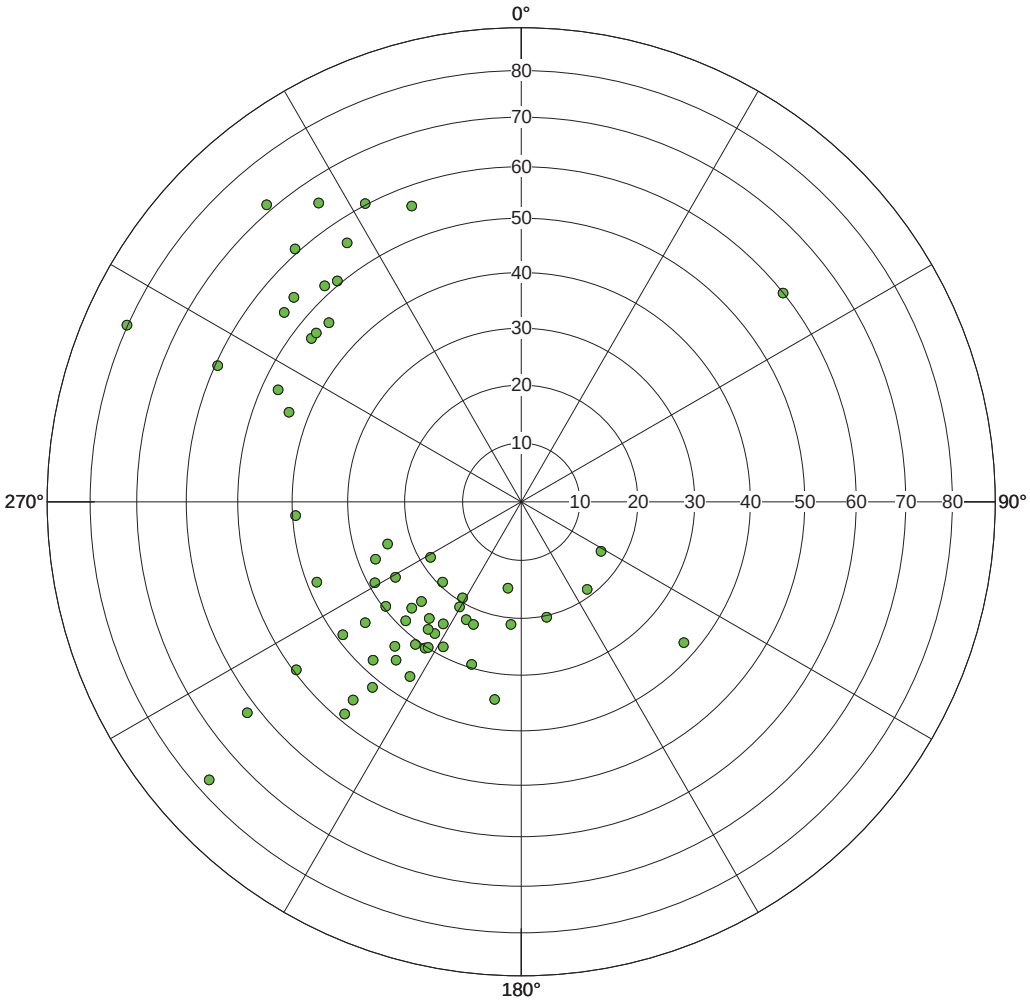
Schmidt Plot (Dip) - LH - Type
Plot: Structural Plot
Depth: from 7.76 to 52.88 [m]

ACOUSTIC TELEVIEWER - ROSE PLOT OF INTERPRETED STRUCTURES - BORING BH01

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

Attribute : Type
Symbol Code - Description
5 - Bedding / Banding / Foliation



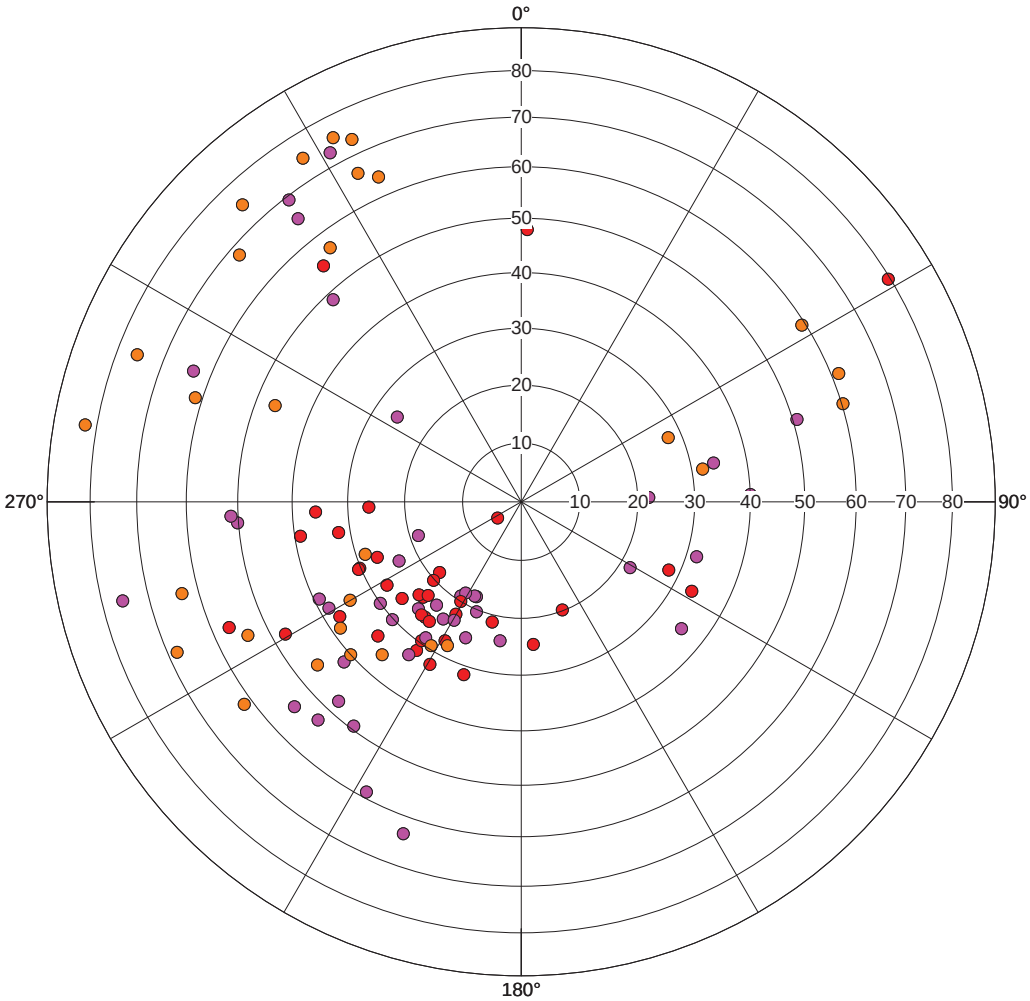
Schmidt Plot (Dip) - LH - Type
Plot: Structural Plot
Depth: from 7.76 to 52.88 [m]

ACOUSTIC TELEVIEWER - ROSE PLOT OF INTERPRETED STRUCTURES - BORING BH01

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

Attribute : Type
Symbol Code - Description
1 - Major Open Joint / Fracture
2 - Minor Open Joint / Fracture
3 - Partially Open Joint / Fracture



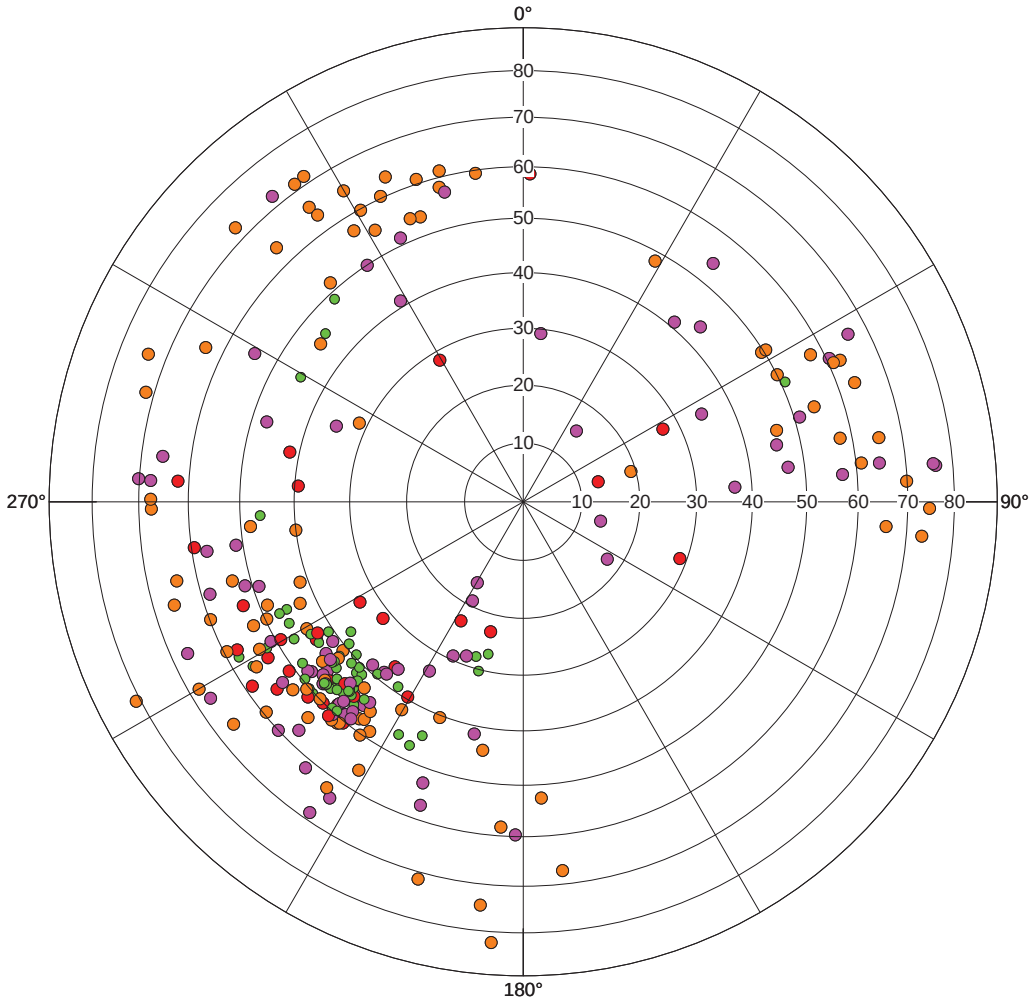
Schmidt Plot (Dip) - LH - Type
Plot: Structural Plot
Depth: from 7.76 to 52.88 [m]

ACOUSTIC TELEVIEWER - ROSE PLOT OF INTERPRETED STRUCTURES - BORING BH01

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

Attribute : Type
Symbol Code - Description
1 - Major Open Joint / Fracture
2 - Minor Open Joint / Fracture
3 - Partially Open Joint / Fracture
5 - Bedding / Banding / Foliation



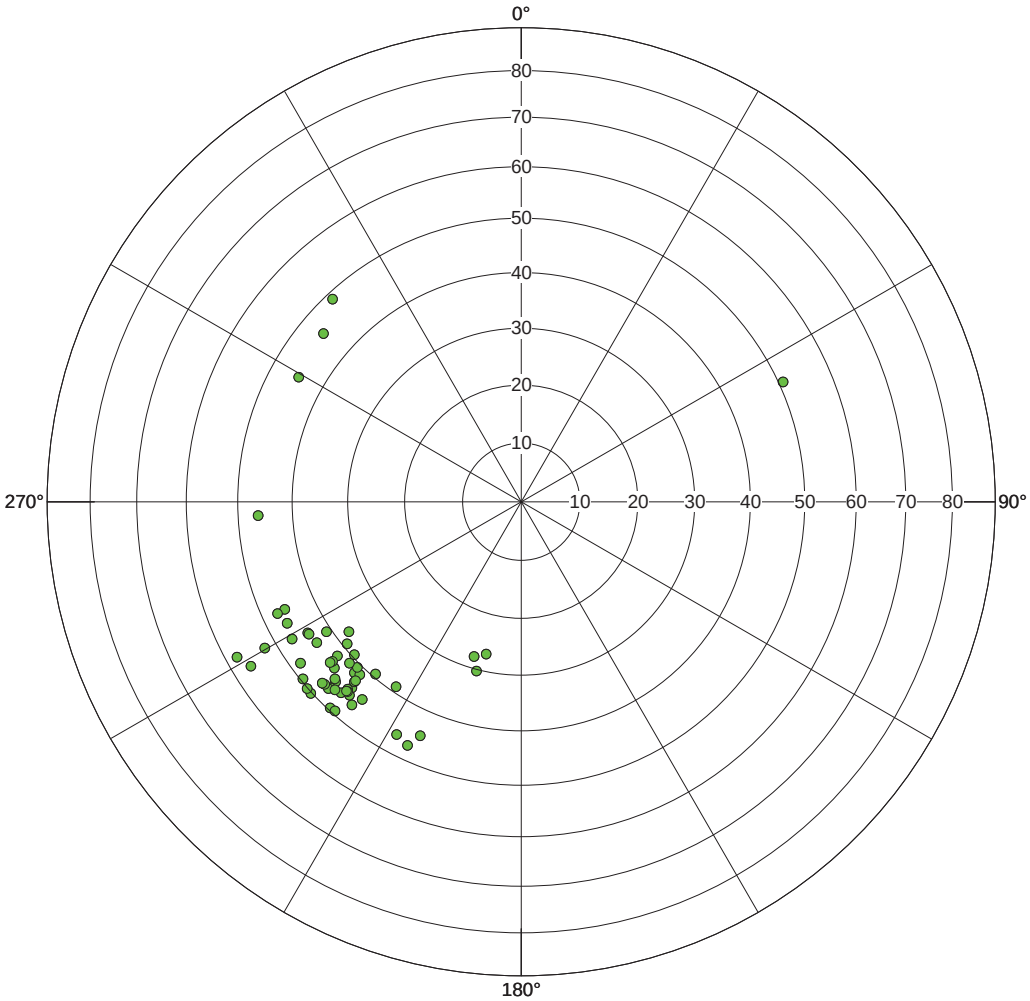
Schmidt Plot (Dip) - LH - Type
Plot: Structural Plot
Depth: from 2.18 to 53.94 [m]

ACOUSTIC TELEVIEWER - ROSE PLOT OF INTERPRETED STRUCTURES - BORING BH03

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

Attribute : Type
Symbol Code - Description
● 5 - Bedding / Banding / Foliation

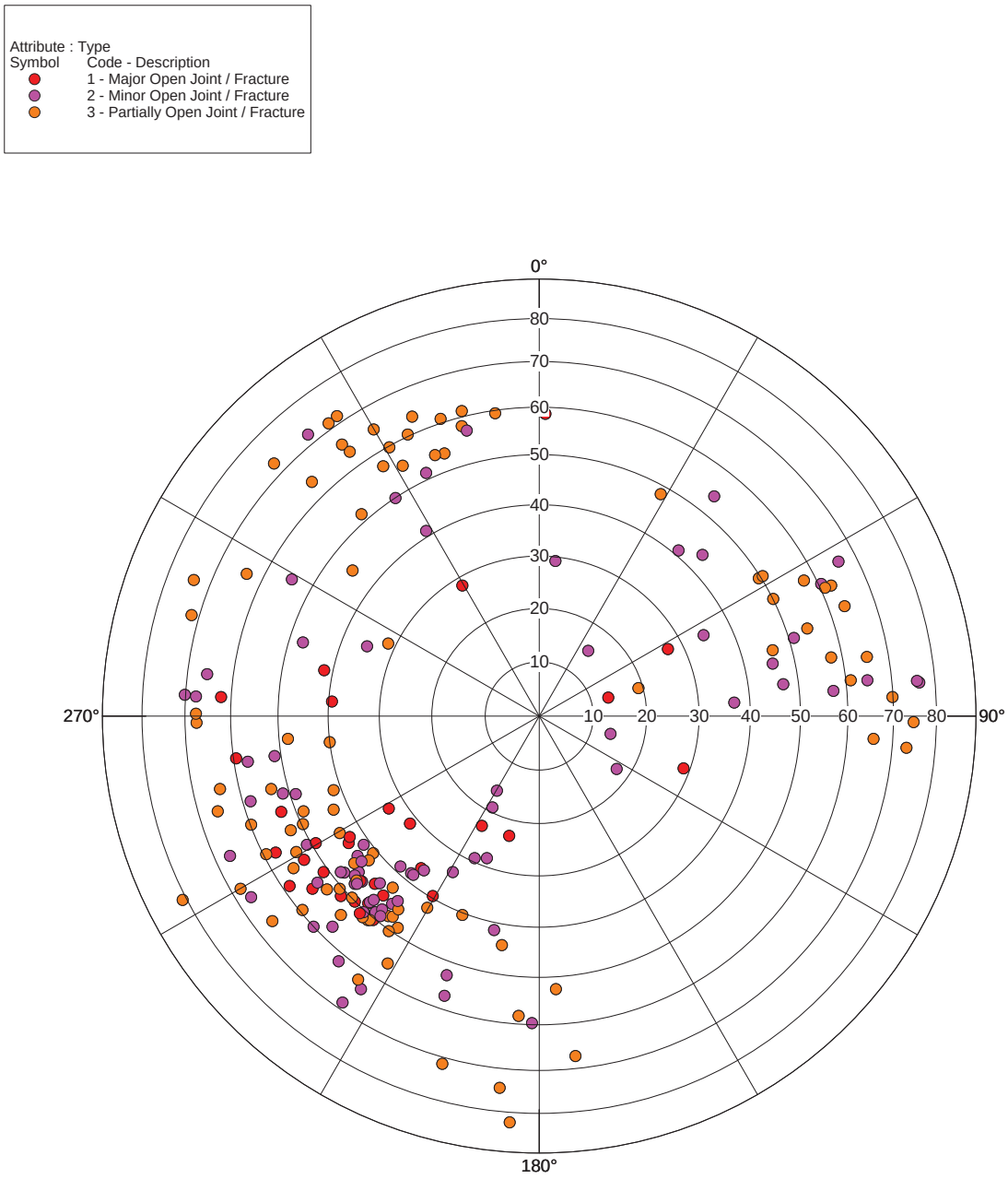


Schmidt Plot (Dip) - LH - Type
Plot: Structural Plot
Depth: from 2.18 to 53.94 [m]

ACOUSTIC TELEVIEWER - ROSE PLOT OF INTERPRETED STRUCTURES - BORING BH03

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

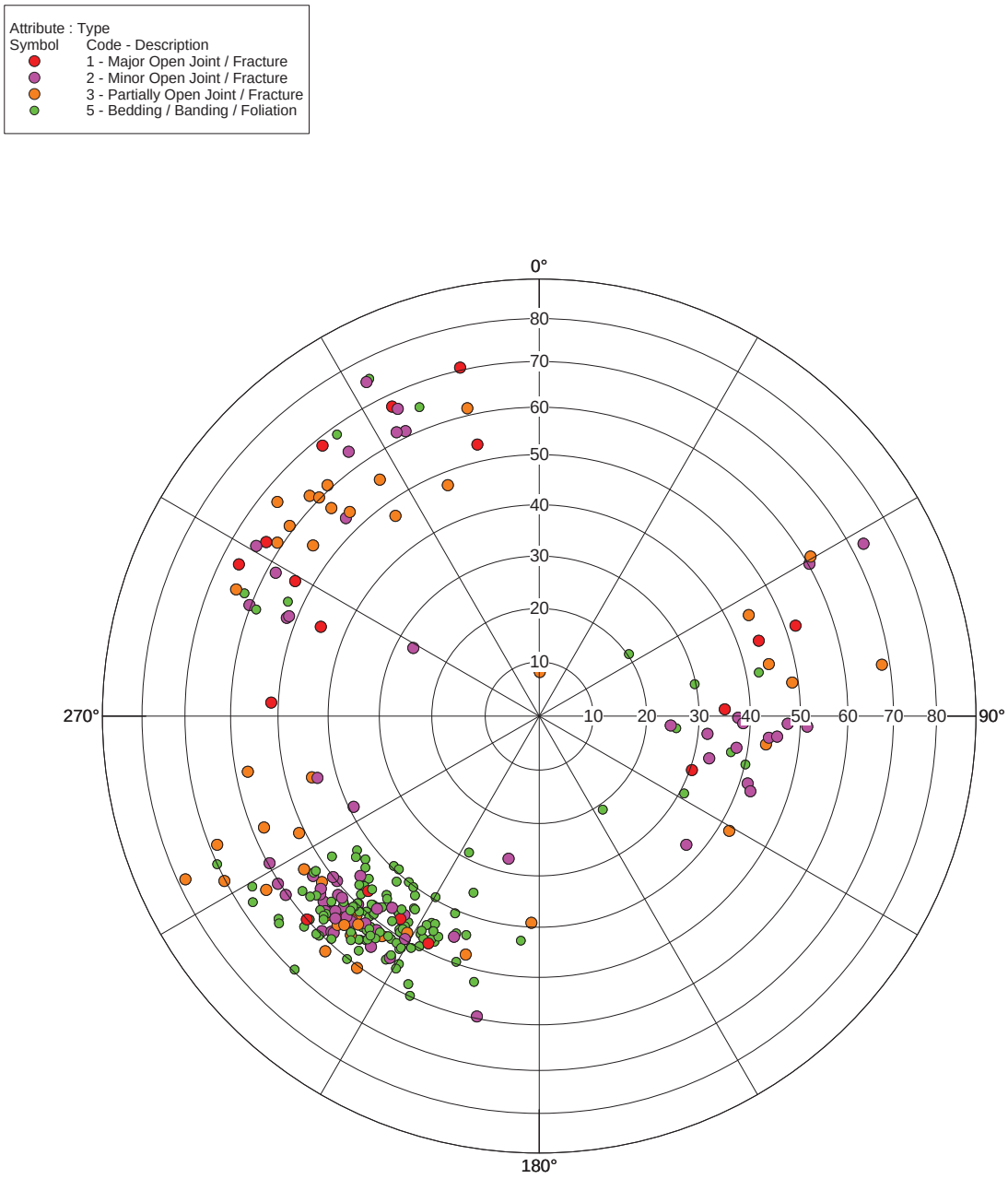


Schmidt Plot (Dip) - LH - Type
Plot: Structural Plot
Depth: from 2.18 to 53.94 [m]

ACOUSTIC TELEVIEWER - ROSE PLOT OF INTERPRETED STRUCTURES - BORING BH03

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA



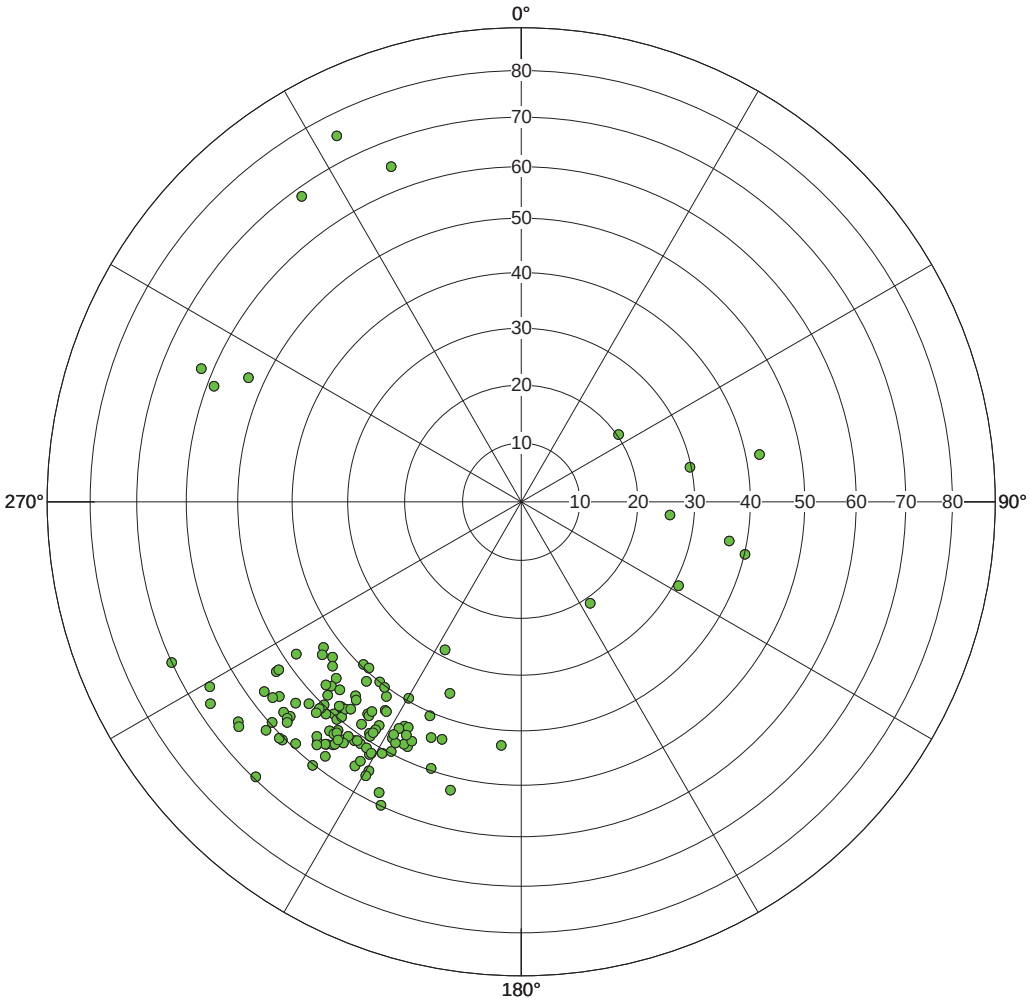
Schmidt Plot (Dip) - LH - Type
Plot: Structural Plot
Depth: from 7.36 to 53.76 [m]

ACOUSTIC TELEVIEWER - ROSE PLOT OF INTERPRETED STRUCTURES - BORING BH10

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

Attribute : Type
Symbol Code - Description
5 - Bedding / Banding / Foliation



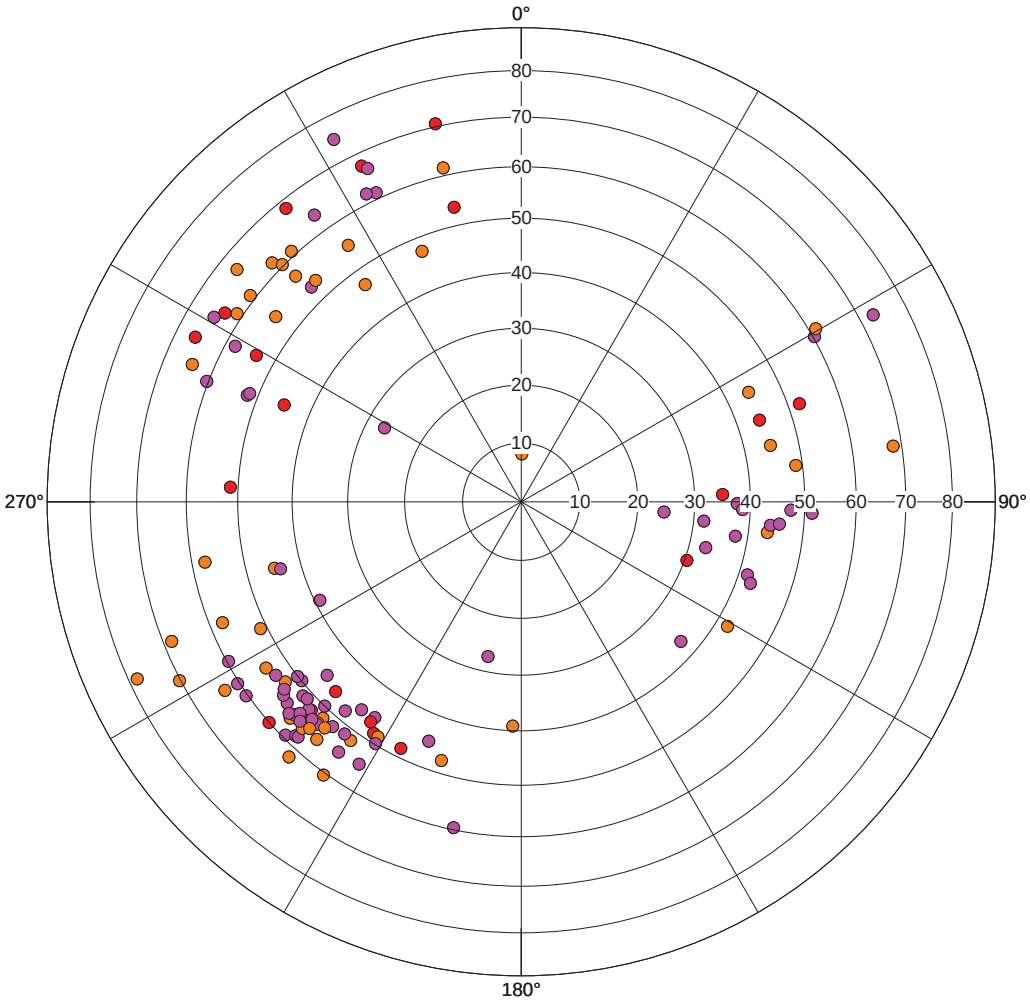
Schmidt Plot (Dip) - LH - Type
Plot: Structural Plot
Depth: from 7.36 to 53.76 [m]

ACOUSTIC TELEVIEWER - ROSE PLOT OF INTERPRETED STRUCTURES - BORING BH10

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

Attribute : Type
Symbol Code - Description
1 - Major Open Joint / Fracture
2 - Minor Open Joint / Fracture
3 - Partially Open Joint / Fracture

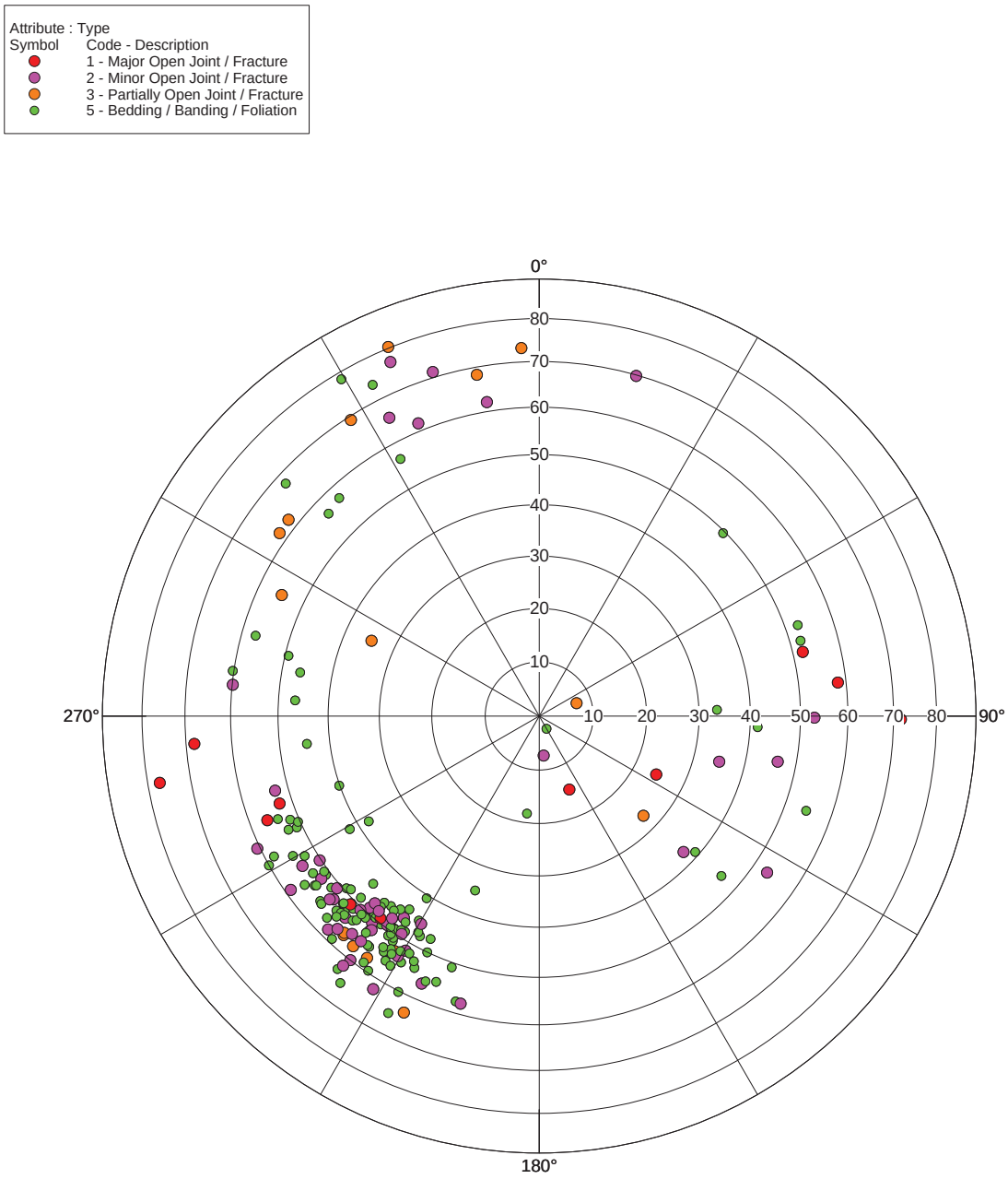


Schmidt Plot (Dip) - LH - Type
Plot: Structural Plot
Depth: from 7.36 to 53.76 [m]

ACOUSTIC TELEVIEWER - ROSE PLOT OF INTERPRETED STRUCTURES - BORING BH10

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA



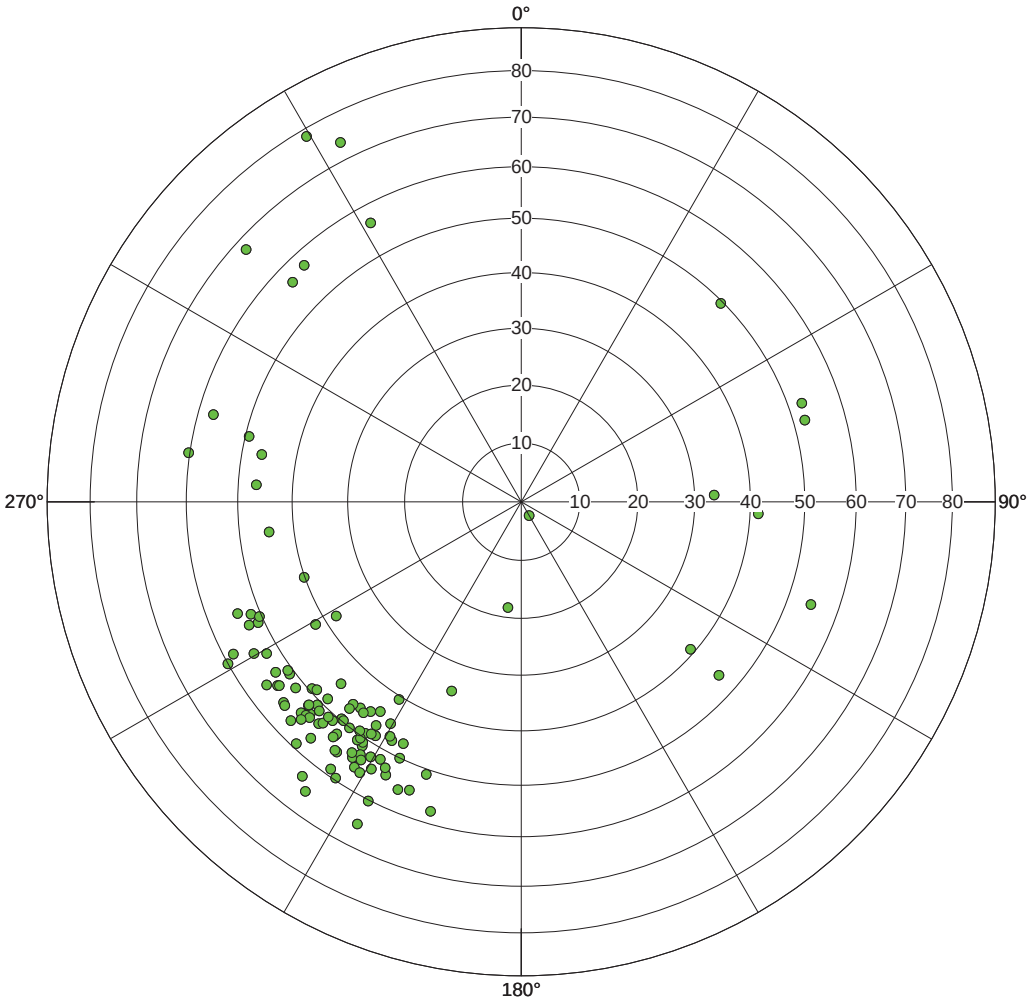
Schmidt Plot (Dip) - LH - Type
Plot: Structural Plot
Depth: from 2.70 to 59.10 [m]

ACOUSTIC TELEVIEWER - ROSE PLOT OF INTERPRETED STRUCTURES - BORING BH14

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

Attribute : Type
Symbol Code - Description
5 - Bedding / Banding / Foliation



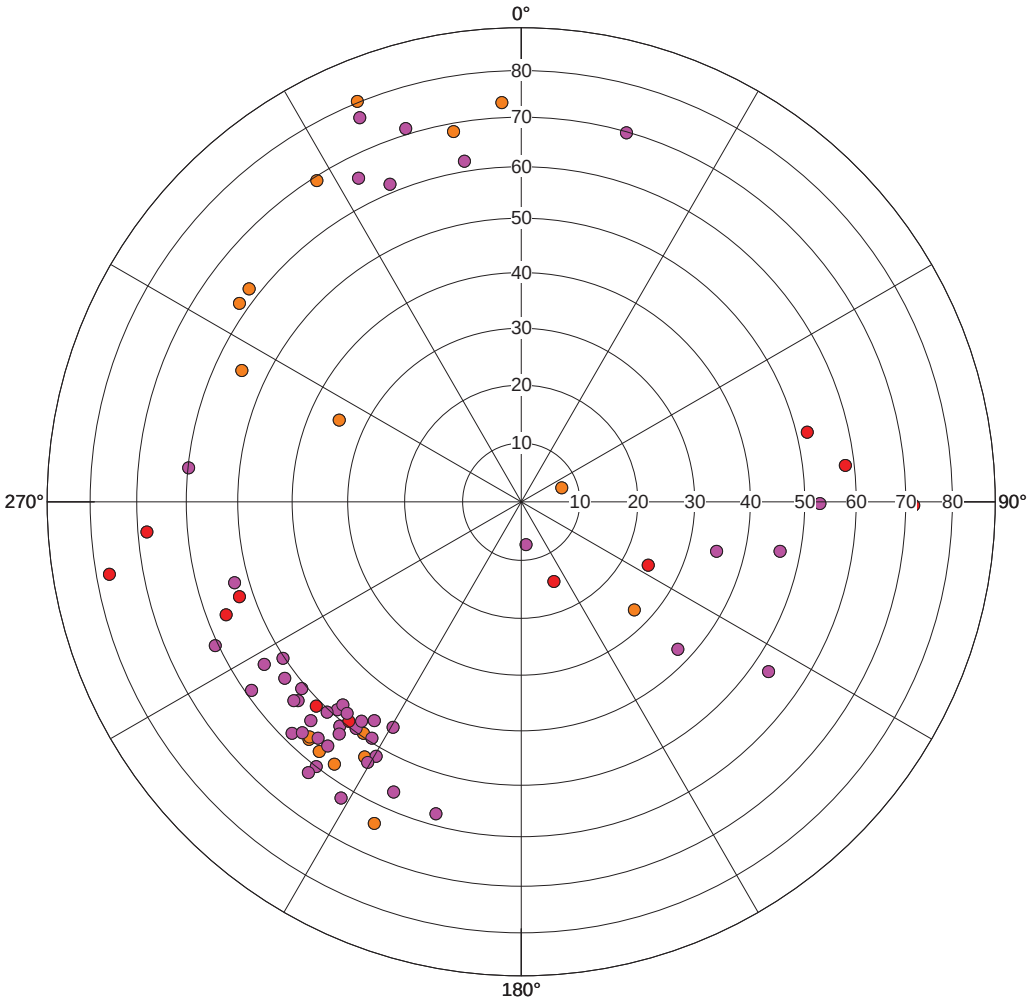
Schmidt Plot (Dip) - LH - Type
Plot: Structural Plot
Depth: from 2.70 to 59.10 [m]

ACOUSTIC TELEVIEWER - ROSE PLOT OF INTERPRETED STRUCTURES - BORING BH14

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

Attribute : Type
Symbol Code - Description
1 - Major Open Joint / Fracture
2 - Minor Open Joint / Fracture
3 - Partially Open Joint / Fracture

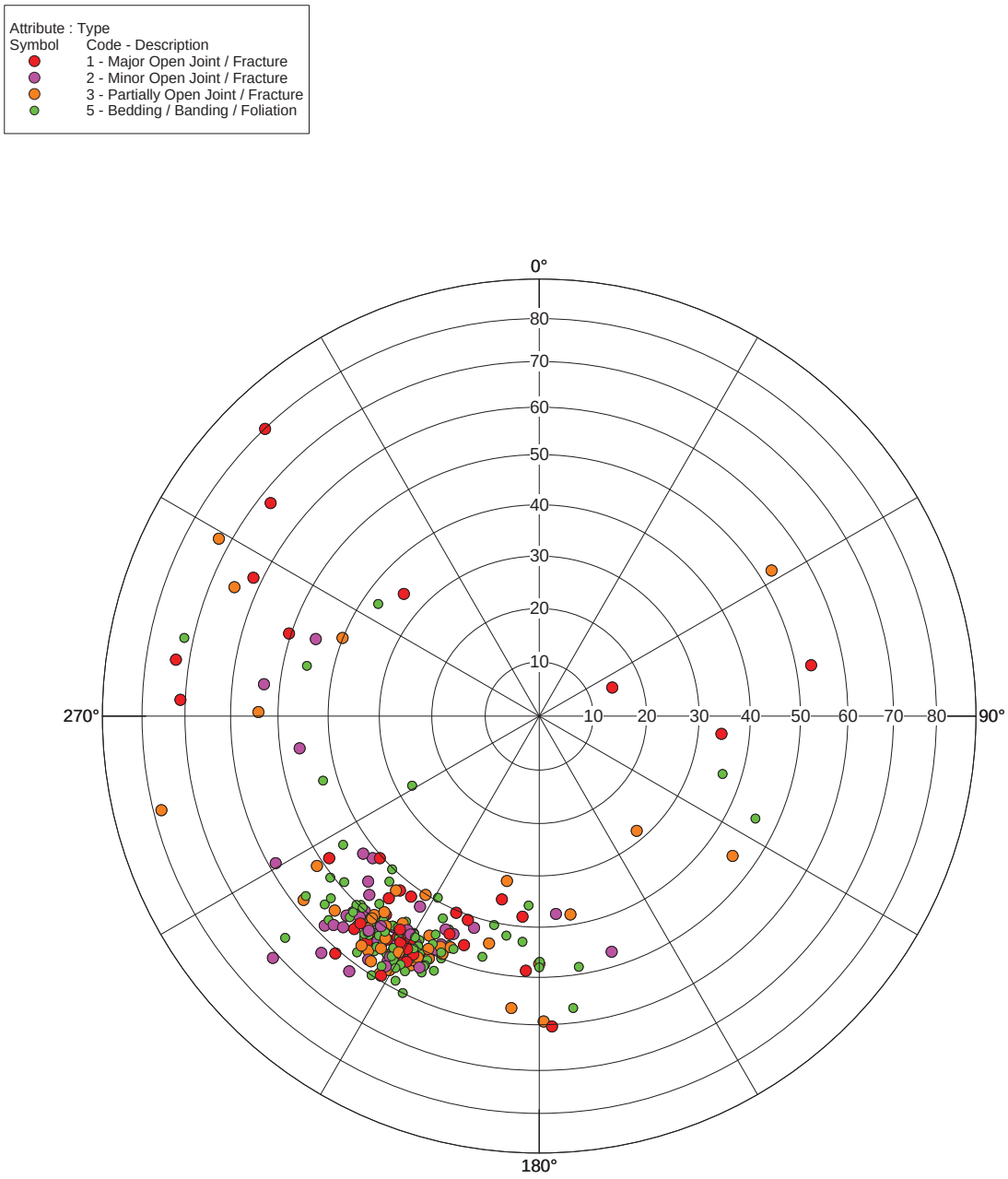


Schmidt Plot (Dip) - LH - Type
Plot: Structural Plot
Depth: from 2.70 to 59.10 [m]

ACOUSTIC TELEVIEWER - ROSE PLOT OF INTERPRETED STRUCTURES - BORING BH14

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

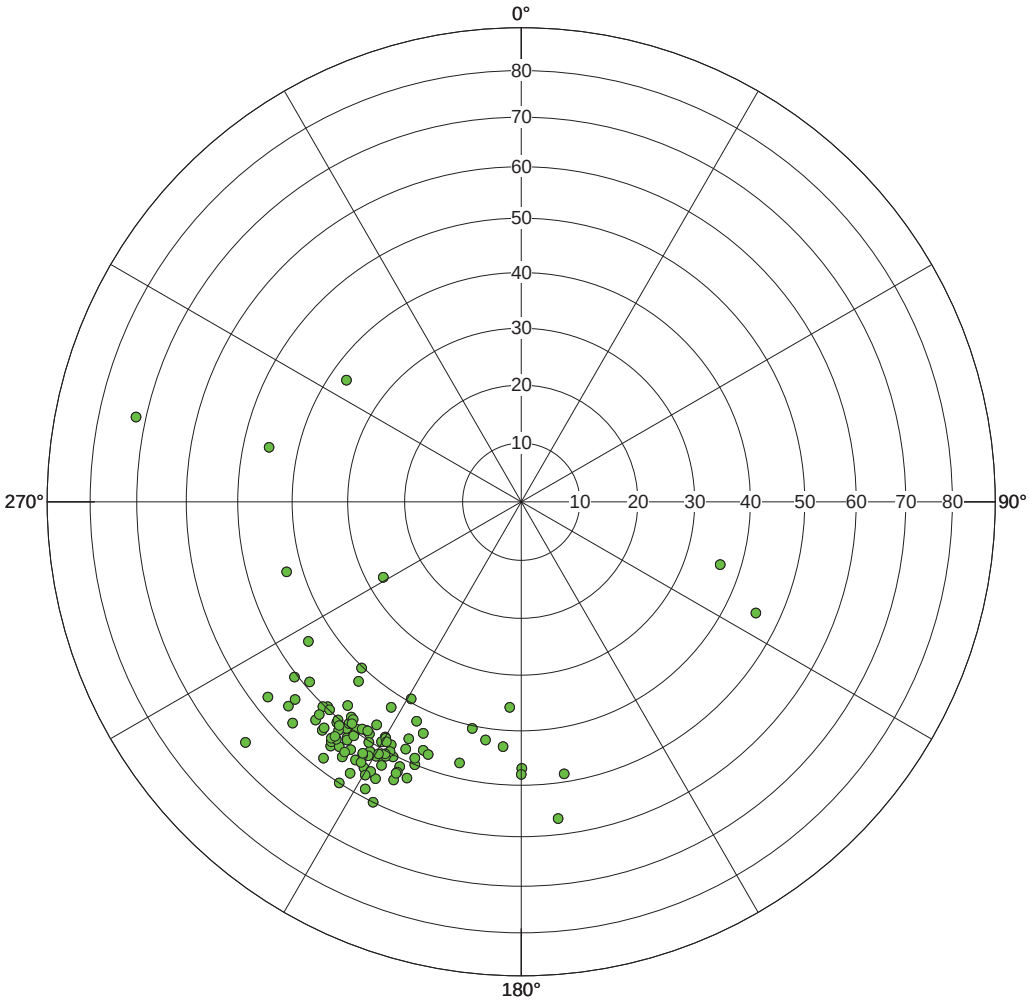


ACOUSTIC TELEVIEWER - ROSE PLOT OF INTERPRETED STRUCTURES - BORING BH20

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

Attribute : Type
Symbol Code - Description
5 - Bedding / Banding / Foliation



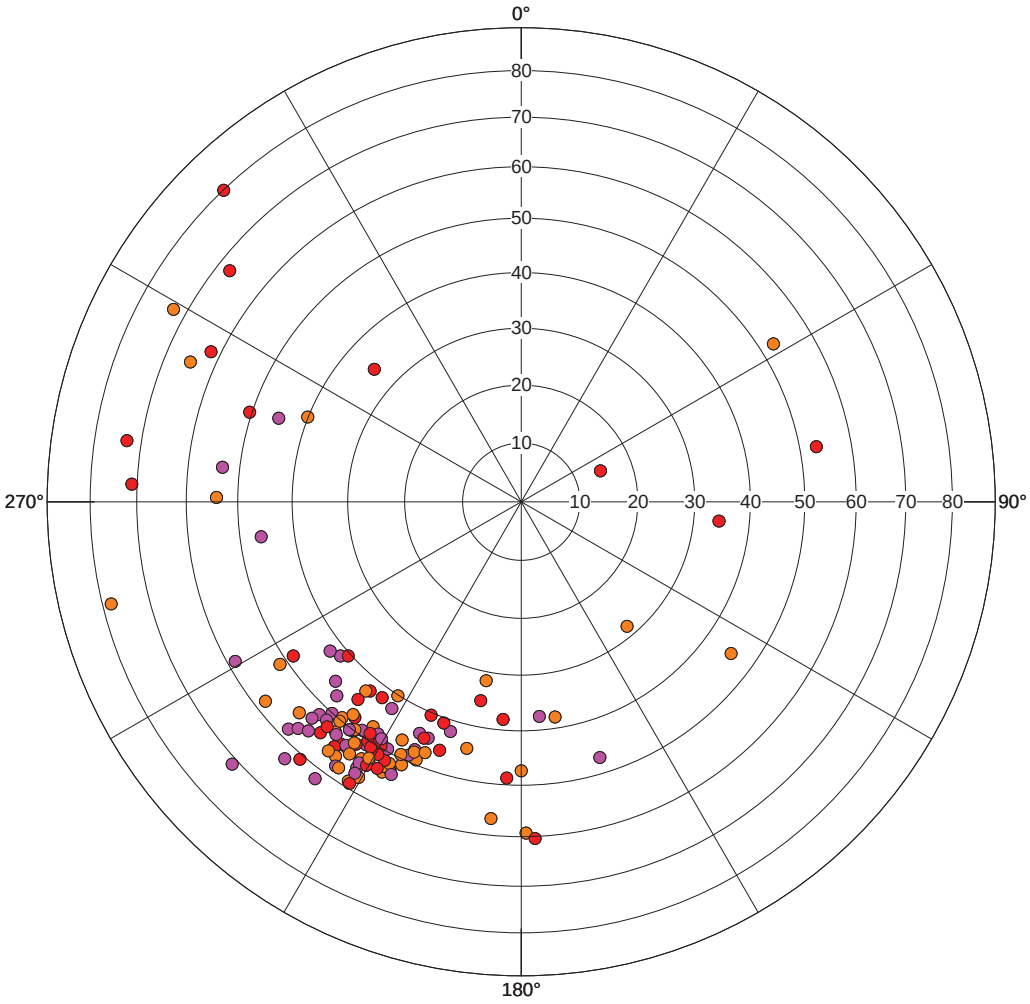
Schmidt Plot (Dip) - LH - Type
Plot: Structural Plot
Depth: from 2.24 to 57.61 [m]

ACOUSTIC TELEVIEWER - ROSE PLOT OF INTERPRETED STRUCTURES - BORING BH20

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

Attribute : Type
Symbol Code - Description
1 - Major Open Joint / Fracture
2 - Minor Open Joint / Fracture
3 - Partially Open Joint / Fracture

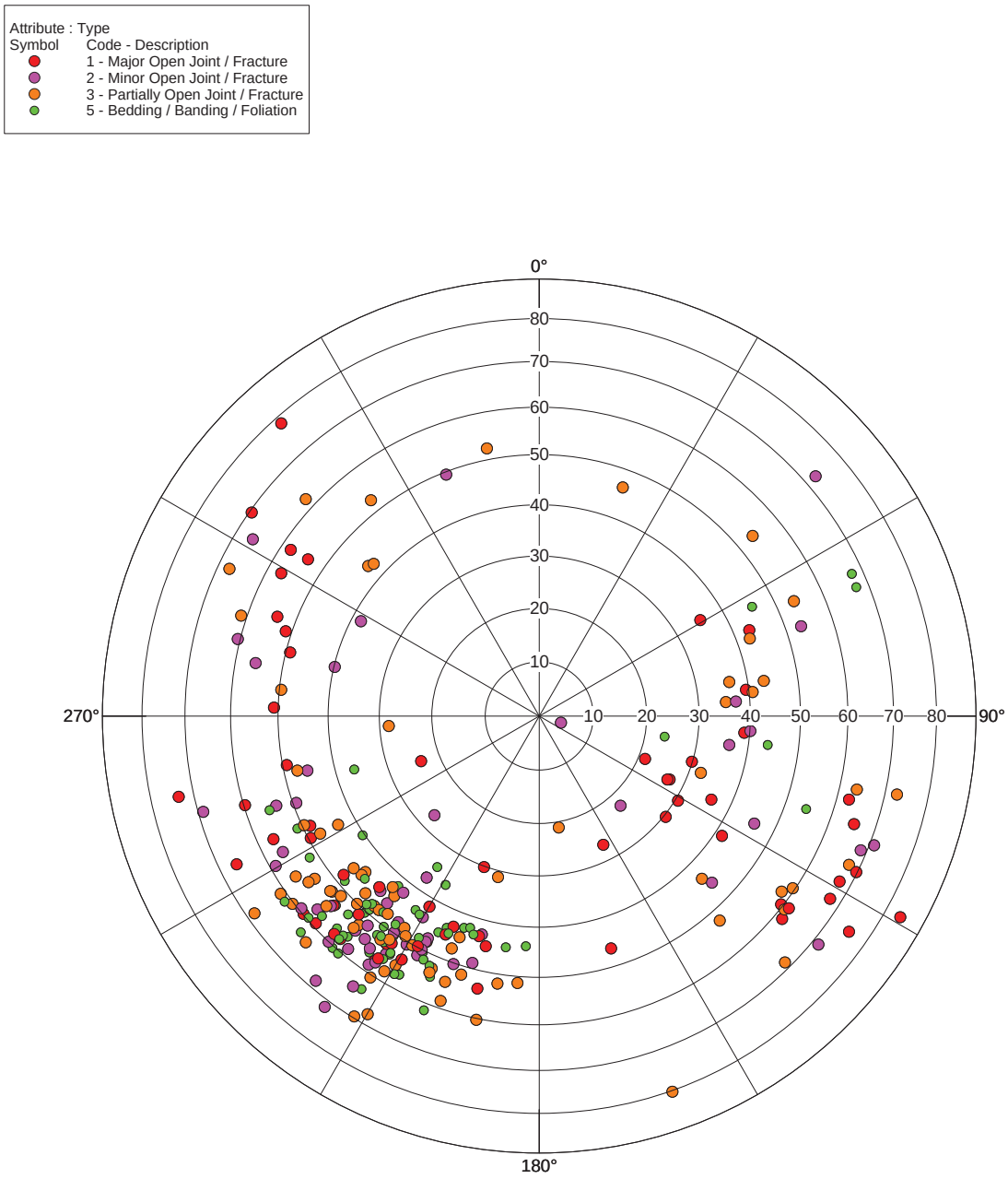


Schmidt Plot (Dip) - LH - Type
Plot: Structural Plot
Depth: from 2.24 to 57.61 [m]

ACOUSTIC TELEVIEWER - ROSE PLOT OF INTERPRETED STRUCTURES - BORING BH20

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA



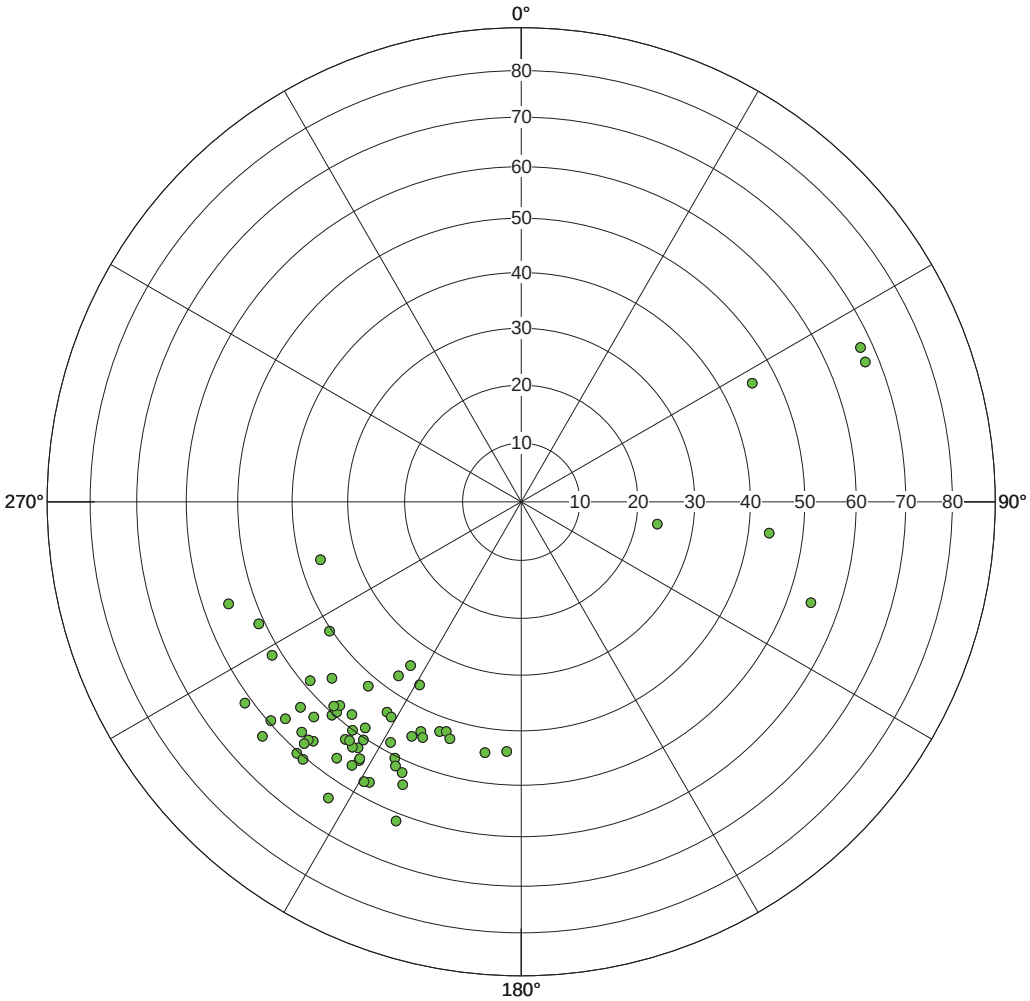
Schmidt Plot (Dip) - LH - Type
Plot: Structural Plot
Depth: from 3.00 to 52.13 [m]

ACOUSTIC TELEVIEWER - ROSE PLOT OF INTERPRETED STRUCTURES - BORING BH24

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

Attribute : Type
Symbol Code - Description
● 5 - Bedding / Banding / Foliation



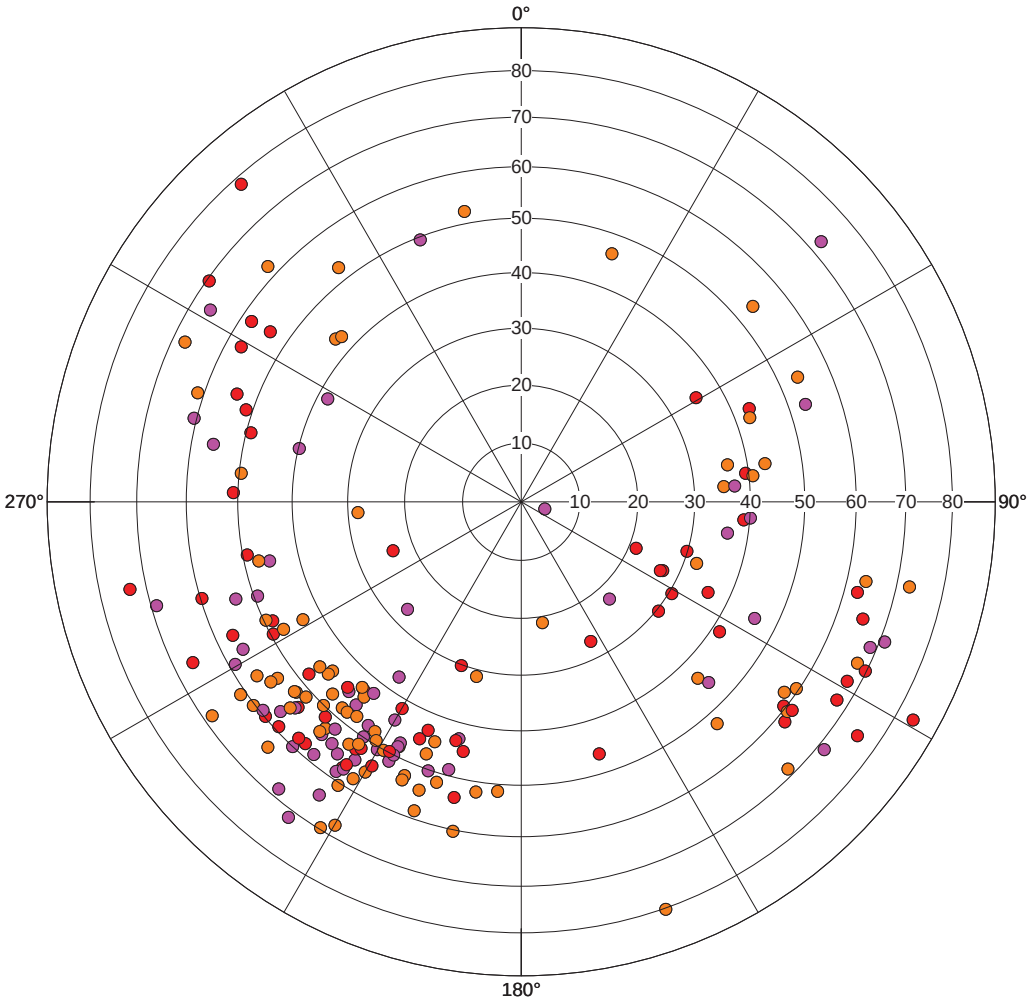
Schmidt Plot (Dip) - LH - Type
Plot: Structural Plot
Depth: from 3.00 to 52.13 [m]

ACOUSTIC TELEVIEWER - ROSE PLOT OF INTERPRETED STRUCTURES - BORING BH24

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

Attribute : Type
Symbol Code - Description
1 - Major Open Joint / Fracture
2 - Minor Open Joint / Fracture
3 - Partially Open Joint / Fracture



Schmidt Plot (Dip) - LH - Type
Plot: Structural Plot
Depth: from 3.00 to 52.13 [m]

ACOUSTIC TELEVIEWER - ROSE PLOT OF INTERPRETED STRUCTURES - BORING BH24

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

APPENDIX C

PS Suspension Logging Results

APPENDIX C – PS SUSPENSION LOGGING

C.1 General

As part of the pre FEED level geotechnical study for the proposed Pacific Northwest LNG Project, PS Suspension Logging data was acquired to determine the in-situ compression and shear wave velocity profiles of the subsurface. This data can be used to assess the dynamic soil properties to assist with determining the dynamic spring constants and dynamic response of foundations.

C.2 Methodology

The PS suspension logging tool is a single probe that contains a seismic source and two bi-axial receivers, separated by a 1 m interval. The probe is lowered into the uncased borehole to the test elevation, and the seismic source is actuated. During each actuation, three individual shots that are optimized for positive and negative polarity shear waves and compression waves, respectively, are recorded on separate data channels. If needed, the operator can stack multiple shots in order to increase the signal to noise ratio and facilitate identification of the compression and shear wave arrivals. The probe is then raised 1 m to the next test elevation and the process repeated.

PS Suspension Logging data was acquired in a total of six onshore borings (BH-01, BH-03, BH-10, BH-14, BH-20 and BH24), and nearshore boring BH-35. The data was acquired with an OYO PS Logging probe, a Robertson Geologging 500 m winch and Micrologger logging console, and the OYO Digital Suspension Logging software.

The logging probe was deployed by rigging the wireline cable through a sheave suspended from derrick of the drill rig. For the onshore borings, the probe was lowered into the boring until the cablehead of the probe was at the ground surface and zero depth was referenced on the logging system. The probe was then lowered to the base of the boreholes and data recorded whilst raising the probe within the open-hole portions of the boreholes. Prior to withdrawing the probe from the drill string, the zero depth mark was reoccupied to ensure the depth measurements were within tolerance. In order to correct the depth of the wireline measurements, offsets from the cablehead to the probe measurement points (from manufacturer specifications) were applied using post-processing software. For nearshore boring, the zero depth mark was taken at the jack-up deck and offsets from the deck to waterline and sea level to sea floor were applied.

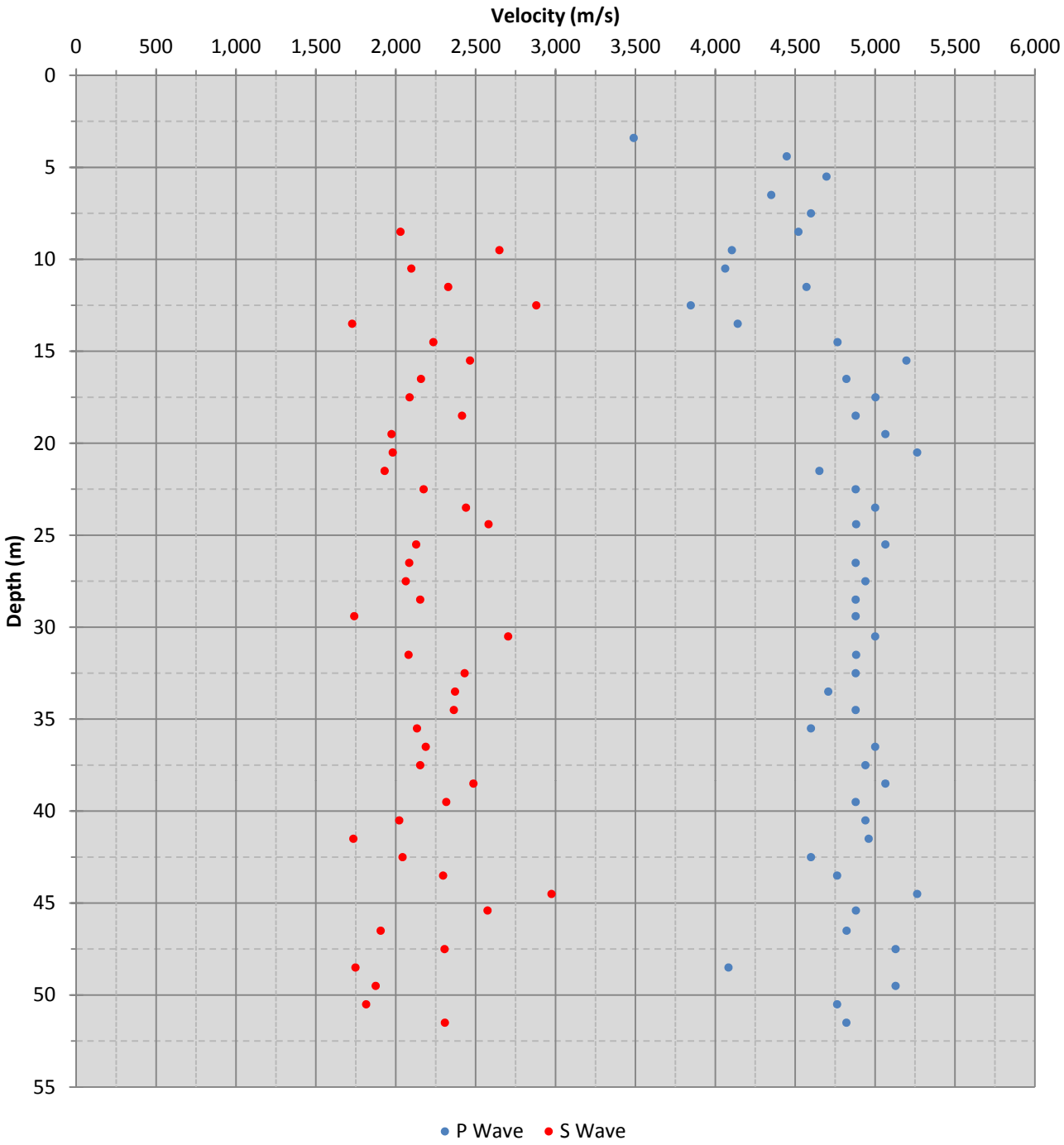
C.3 Data Analysis

Analysis of the PS Suspension Logging data was carried out using the GIS-Soft GLog Sus package. For each test elevation, the difference in arrival time of the compression and shear waves between the near and far receivers was calculated and used to compute the respective interval velocities. These interval velocities have been presented on the accompanying Plates

C1.1, C2.1, C3.1, C4.1, C5.1, C6.1, and C7.1 for borings BH-01, BH-03, BH-10, BH-14, BH-20, BH24 and BH-35, respectively.

The onshore borings all predominantly consist of rock profiles and the compression and shear wave velocities are generally greater than 4,000 m/s and 1,500 m/s, respectively. Profiles of the calculated Poisson's ratio and calculated small-strain Shear Modulus (based on unit weights from laboratory tests) are also presented (Plates C1.2 and C1.3, C2.2 and C2.3, etc.).

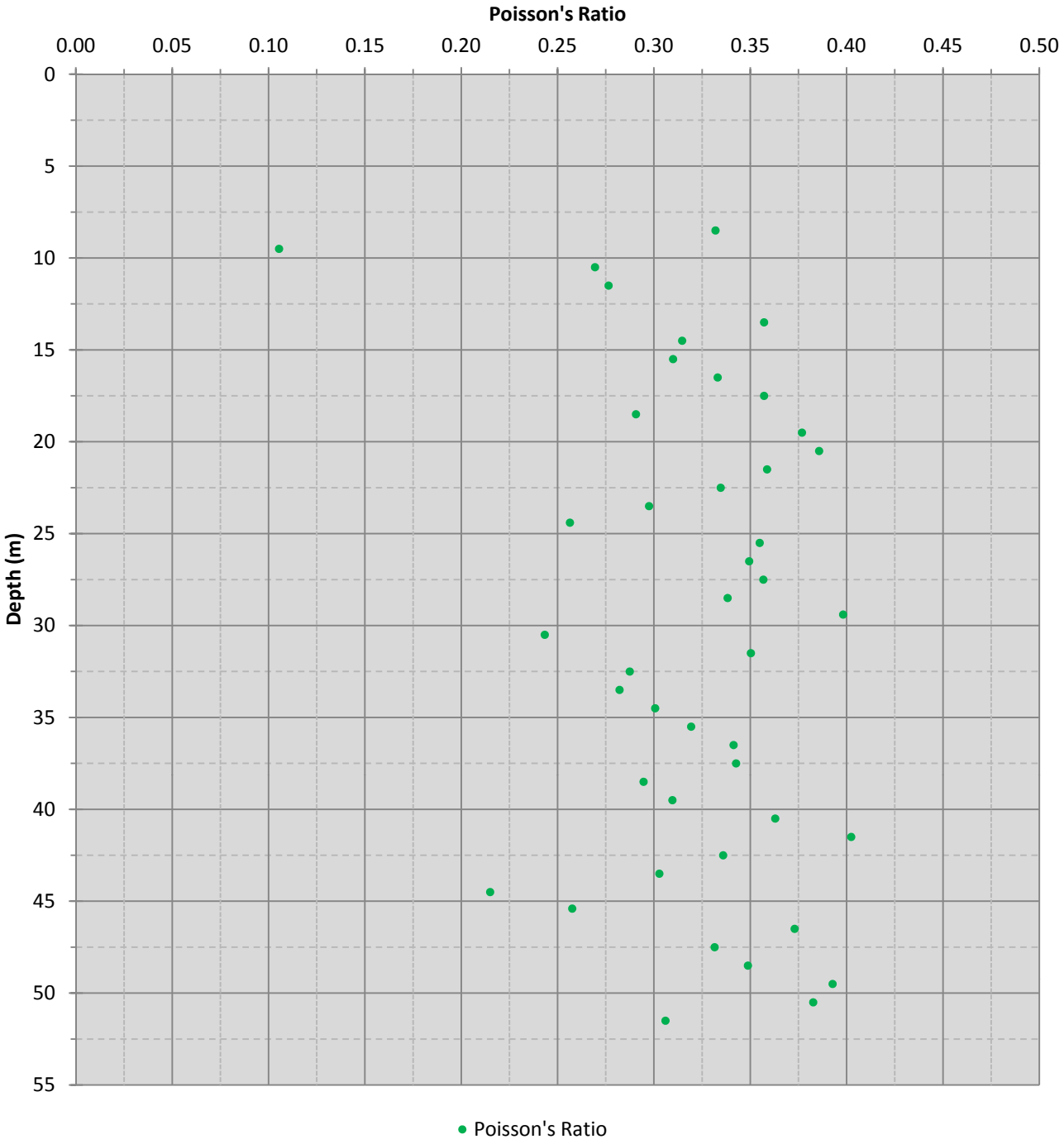
PS Suspension Logging data from nearshore boring BH-35 (Plate C7) was conducted within a soil profile and throughout the majority of the boring, compression wave velocities of approximately 1,400 m/s were computed. As such, it is likely that the probe has recorded a seismic wave traveling from the source to the receivers that is within the borehole fluid, rather than within the formation. For this reason, the computed compression wave velocities have not been presented. The shear wave arrivals are unaffected by this phenomena (as they do not propagate in fluids) and the computed velocities are generally in the range of 120 to 250 m/s.



PS SUSPENSION LOGGING RESULTS - CALCULATED INTERVAL VELOCITIES - BORING BH01

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

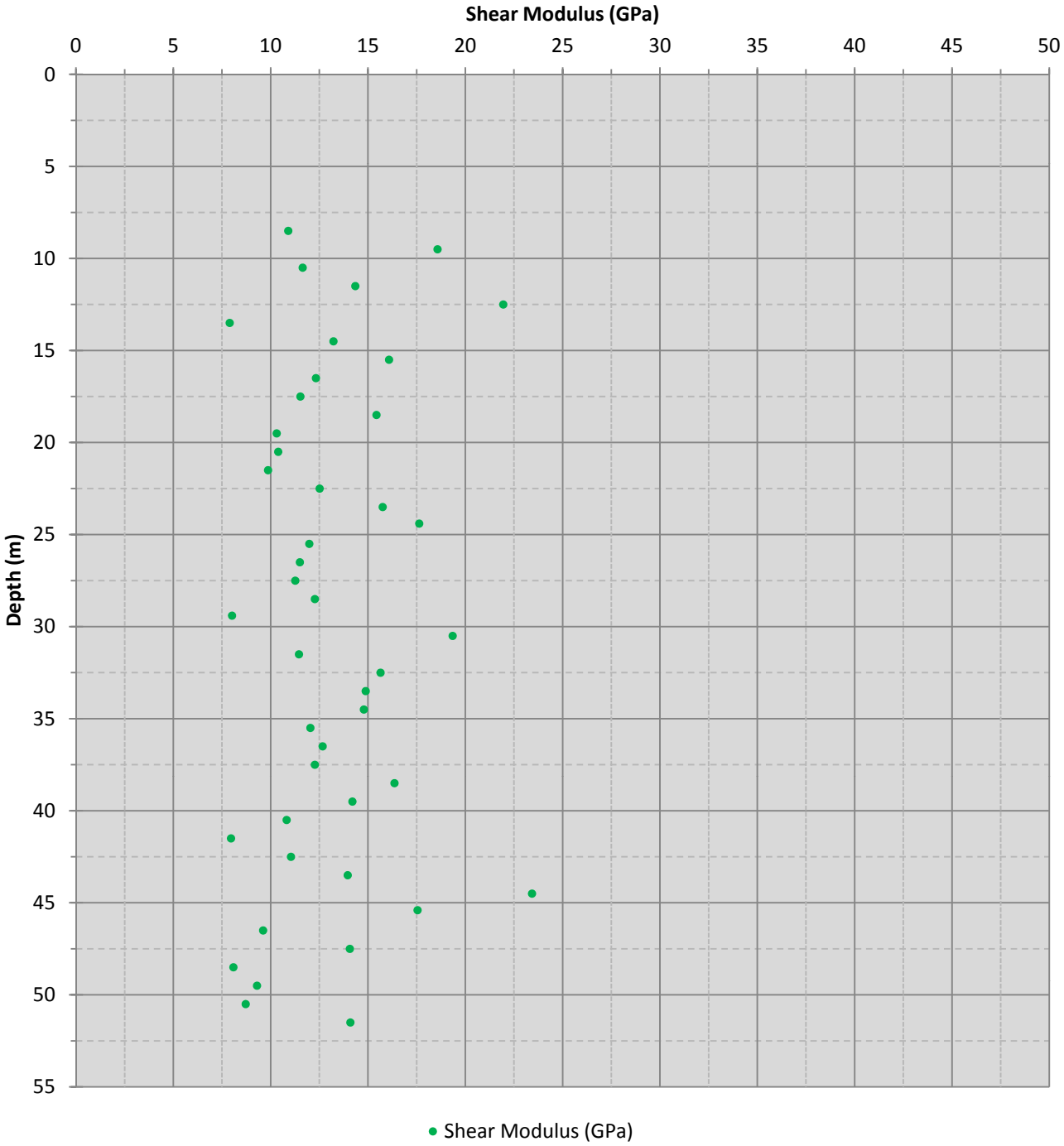


PS SUSPENSION LOGGING RESULTS - CALCULATED POISSON'S RATIO - BORING BH01

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

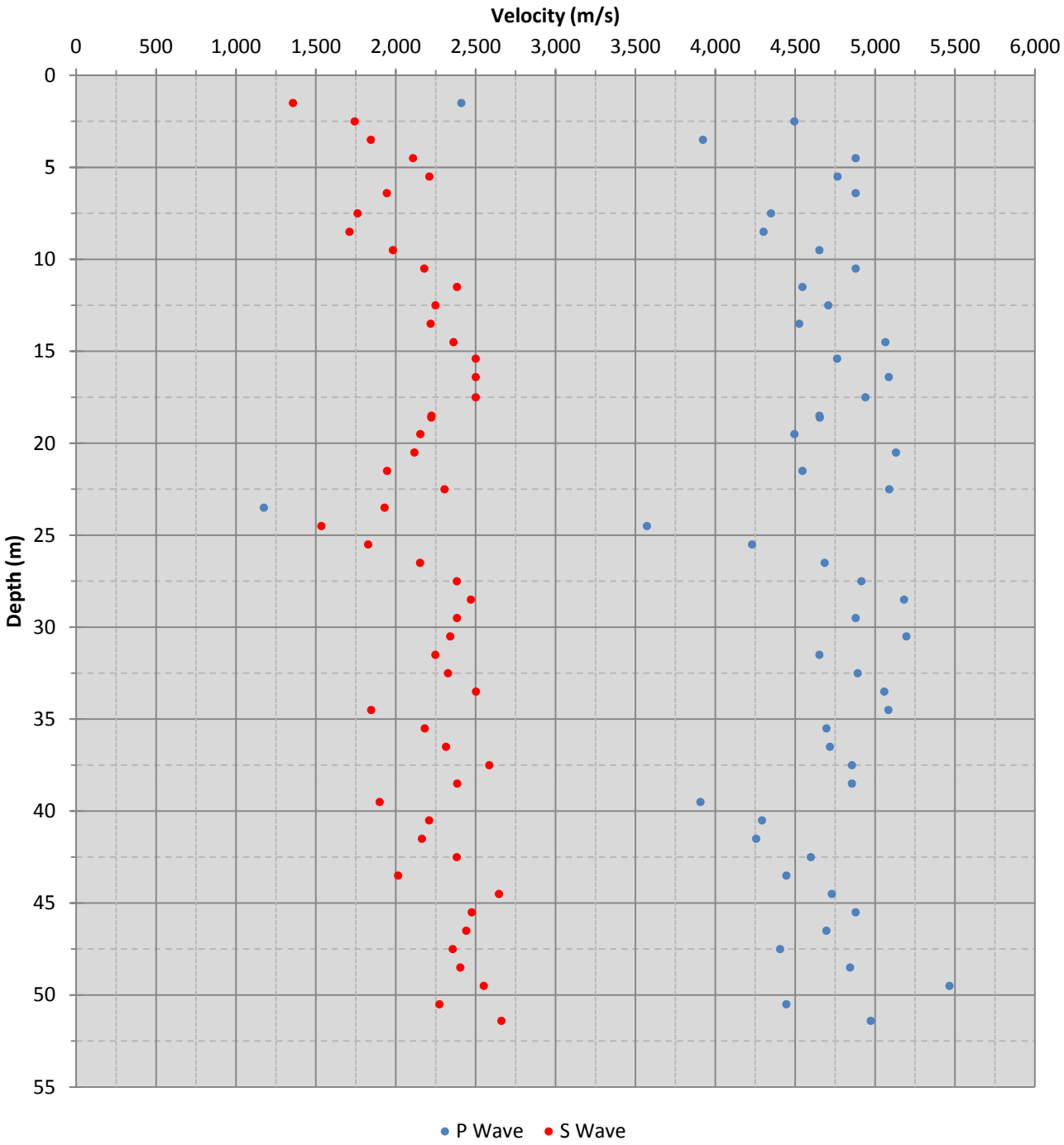
PLATE C1.2



PS SUSPENSION LOGGING RESULTS - CALCULATED SHEAR MODULUS - BORING BH01

PACIFIC NORTHWEST LNG PROJECT

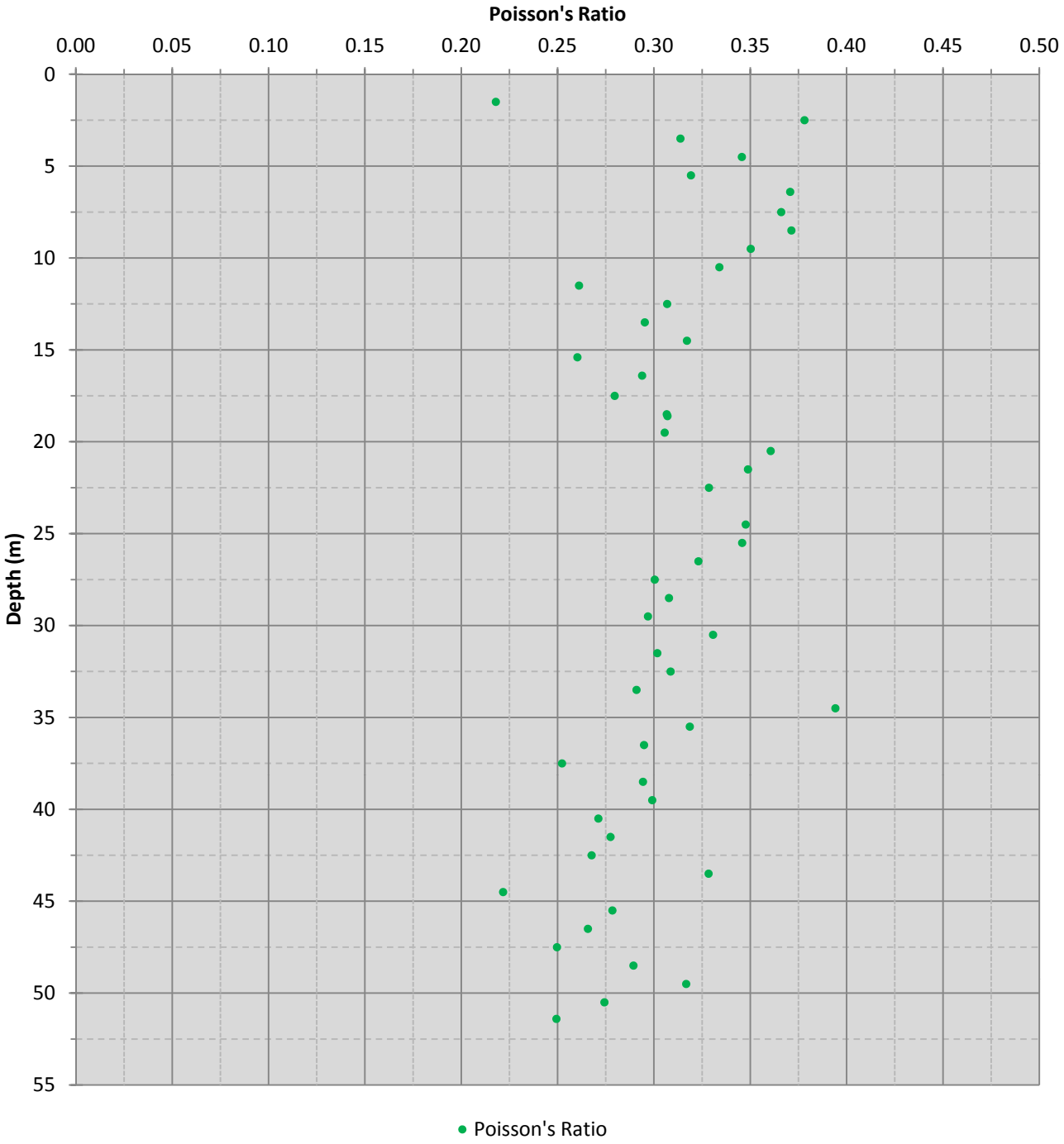
LELU ISLAND, BRITISH COLUMBIA, CANADA



PS SUSPENSION LOGGING RESULTS - CALCULATED INTERVAL VELOCITIES - BORING BH03

PACIFIC NORTHWEST LNG PROJECT

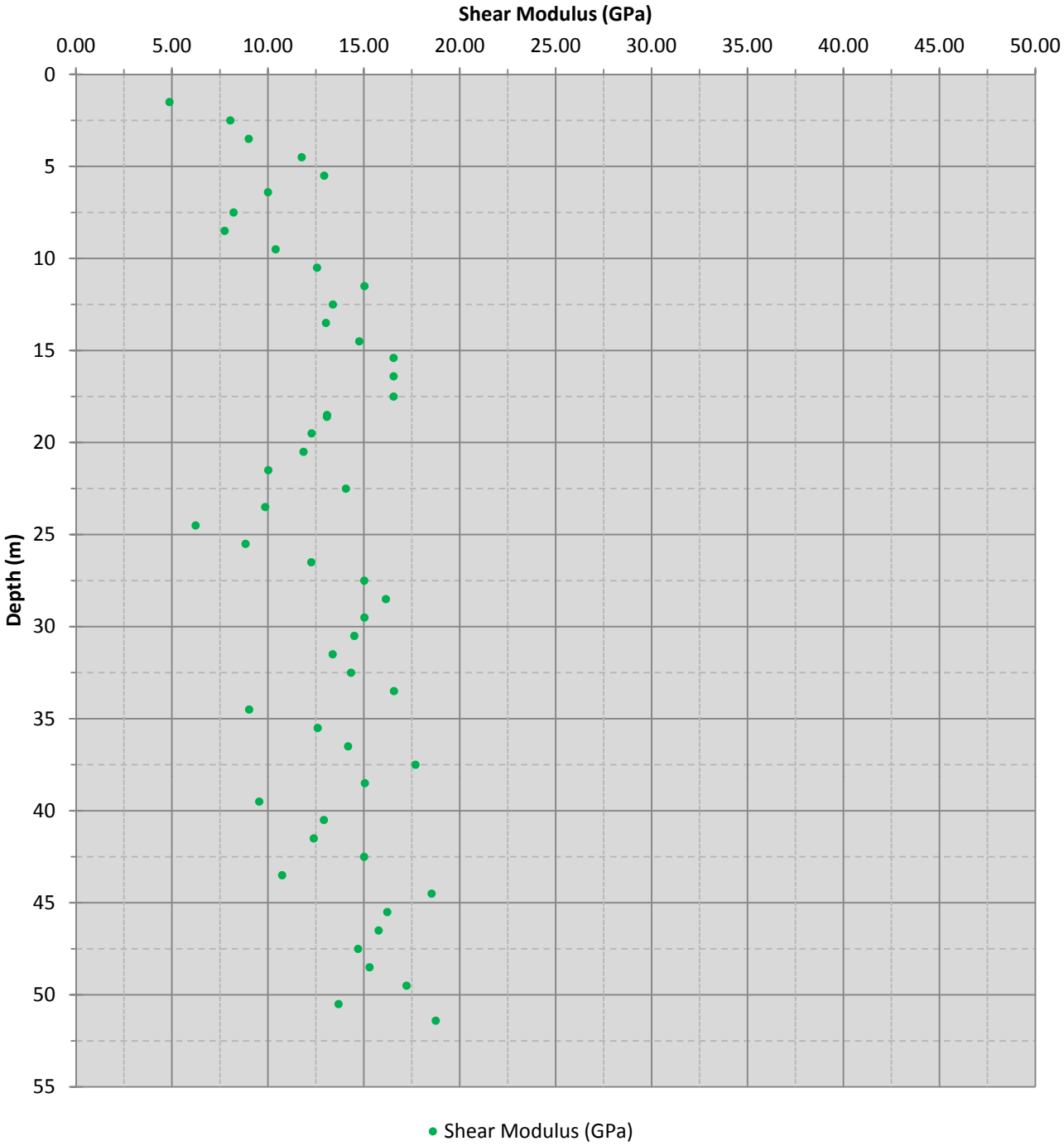
LELU ISLAND, BRITISH COLUMBIA, CANADA



PS SUSPENSION LOGGING RESULTS - CALCULATED POISSON'S RATIO - BORING BH03

PACIFIC NORTHWEST LNG PROJECT

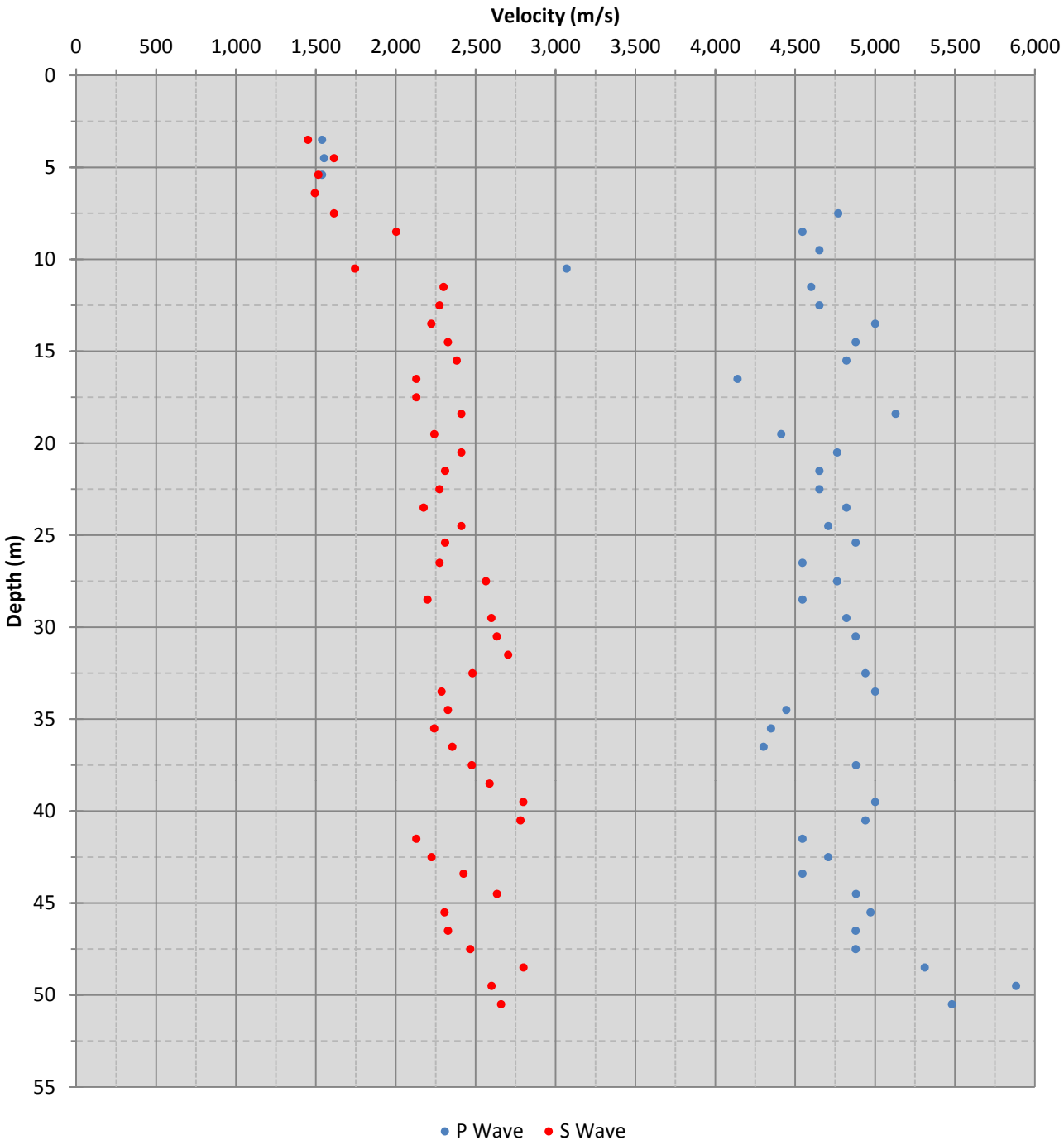
LELU ISLAND, BRITISH COLUMBIA, CANADA



PS SUSPENSION LOGGING RESULTS - CALCULATED SHEAR MODULUS - BORING BH03

PACIFIC NORTHWEST LNG PROJECT

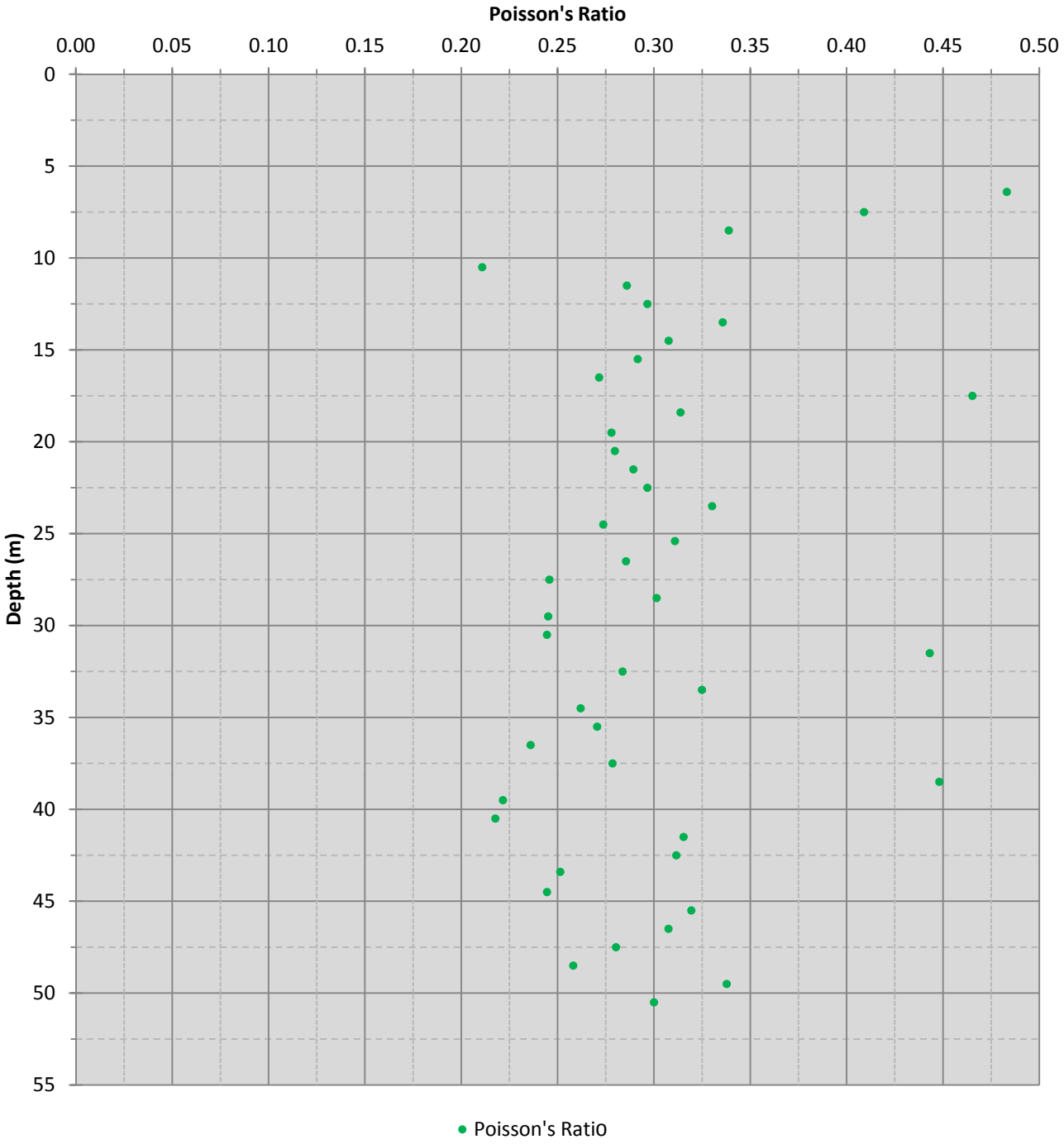
LELU ISLAND, BRITISH COLUMBIA, CANADA



PS SUSPENSION LOGGING RESULTS - CALCULATED INTERVAL VELOCITIES - BORING BH10

PACIFIC NORTHWEST LNG PROJECT

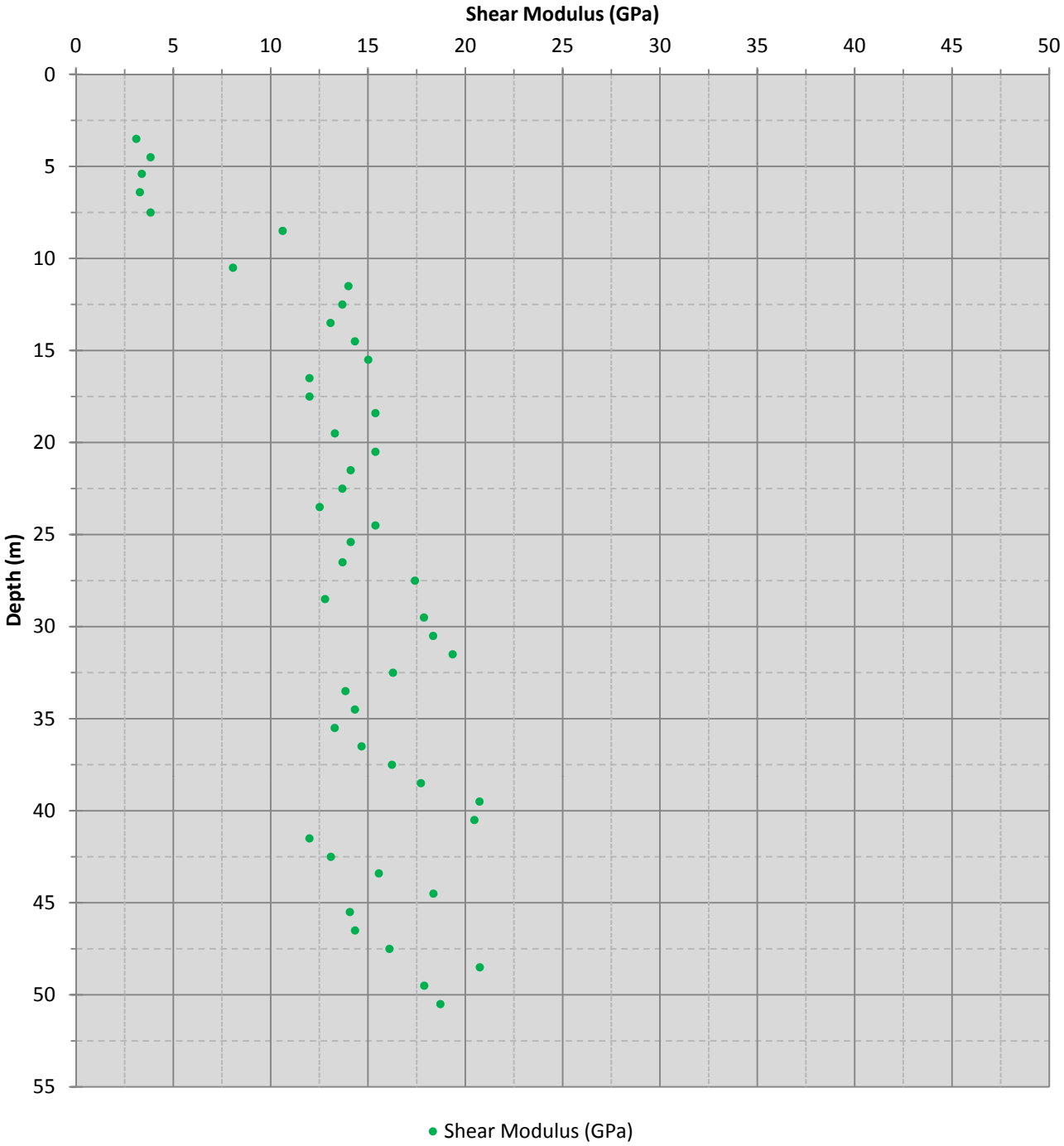
LELU ISLAND, BRITISH COLUMBIA, CANADA



PS SUSPENSION LOGGING RESULTS - CALCULATED POISSON'S RATIO - BORING BH10

PACIFIC NORTHWEST LNG PROJECT

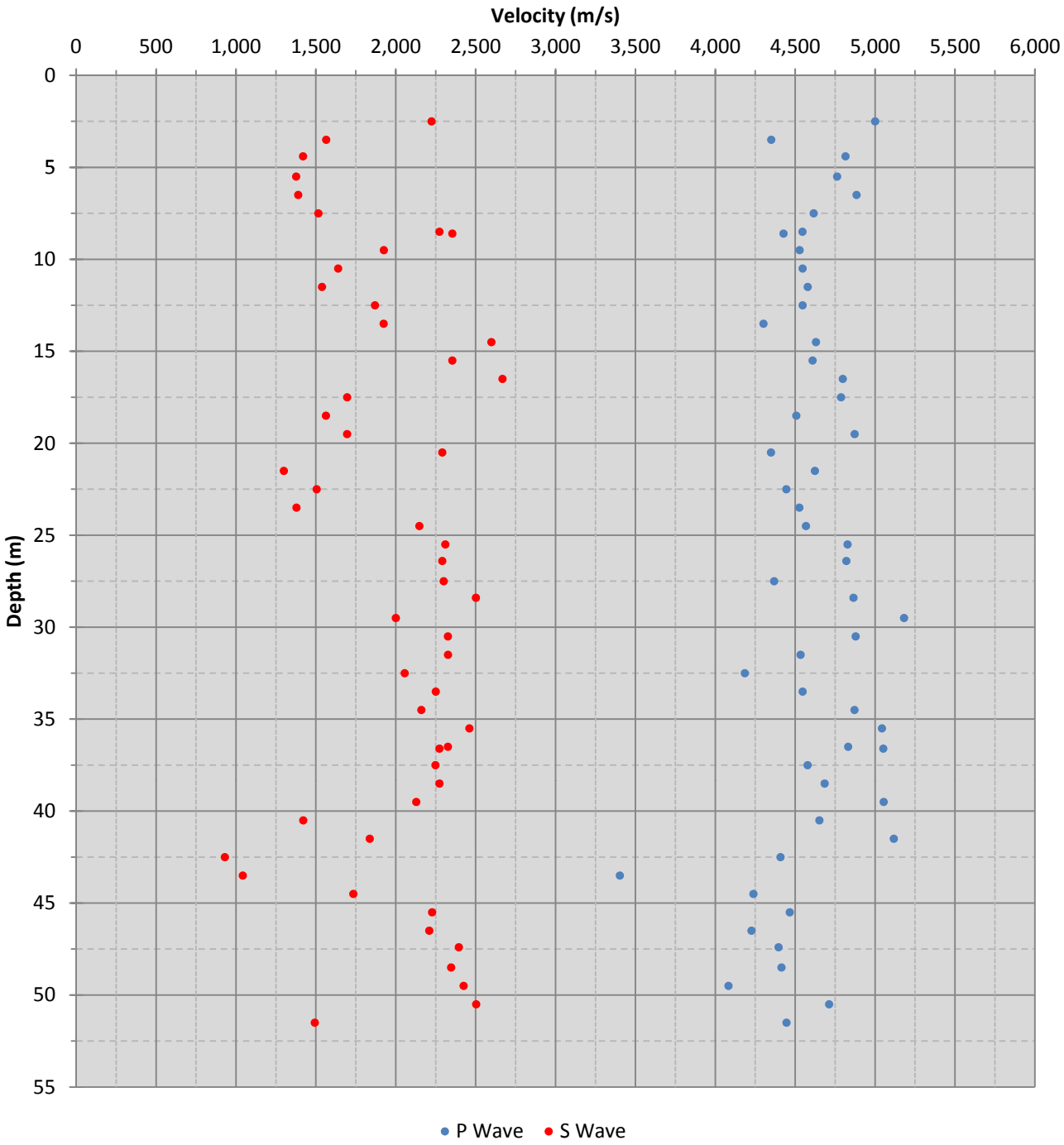
LELU ISLAND, BRITISH COLUMBIA, CANADA



PS SUSPENSION LOGGING RESULTS - CALCULATED SHEAR MODULUS - BORING BH10

PACIFIC NORTHWEST LNG PROJECT

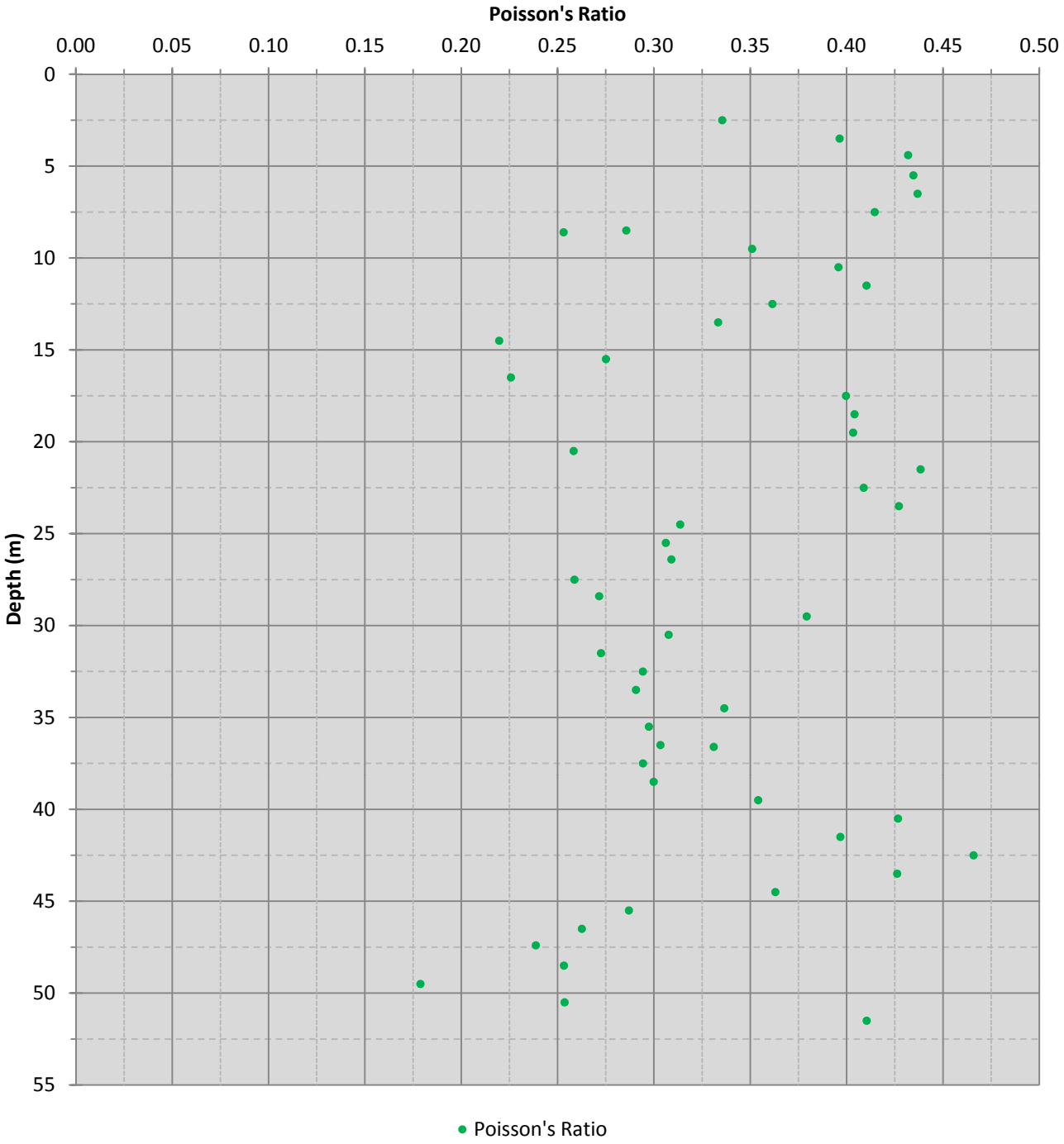
LELU ISLAND, BRITISH COLUMBIA, CANADA



PS SUSPENSION LOGGING RESULTS - CALCULATED INTERVAL VELOCITIES - BORING BH14

PACIFIC NORTHWEST LNG PROJECT

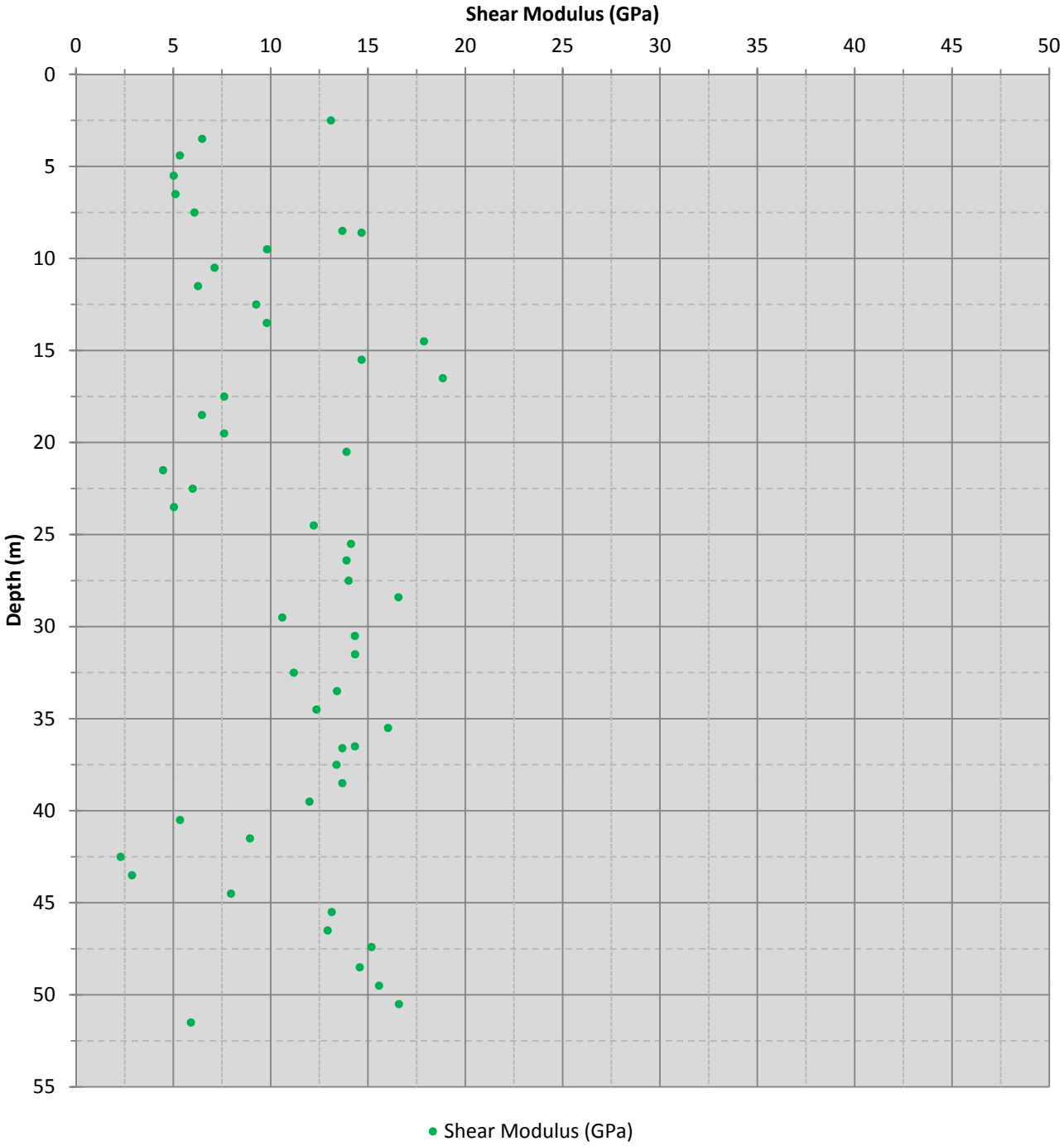
LELU ISLAND, BRITISH COLUMBIA, CANADA



PS SUSPENSION LOGGING RESULTS - CALCULATED POISSON'S RATIO - BORING BH14

PACIFIC NORTHWEST LNG PROJECT

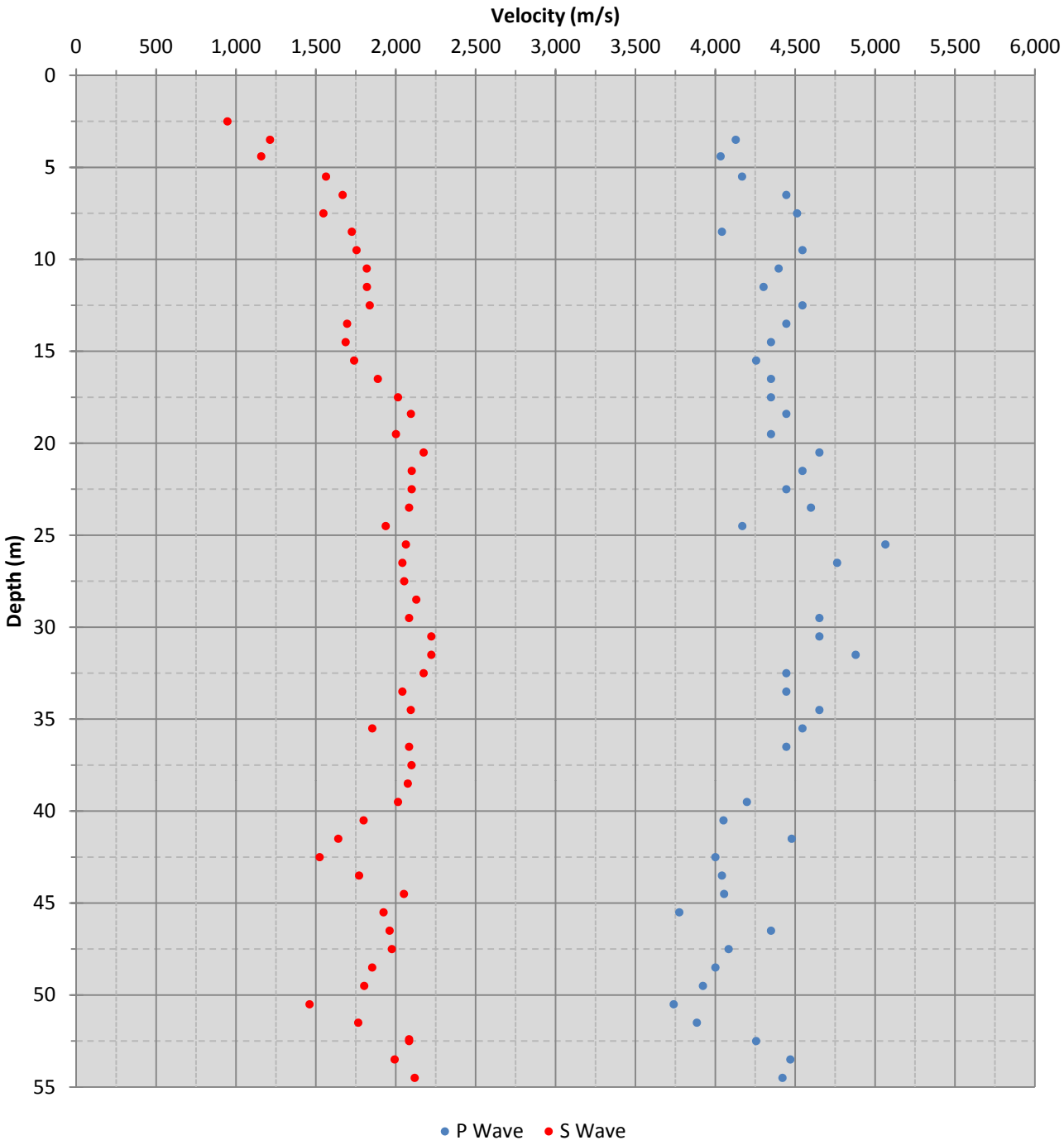
LELU ISLAND, BRITISH COLUMBIA, CANADA



PS SUSPENSION LOGGING RESULTS - CALCULATED SHEAR MODULUS - BORING BH14

PACIFIC NORTHWEST LNG PROJECT

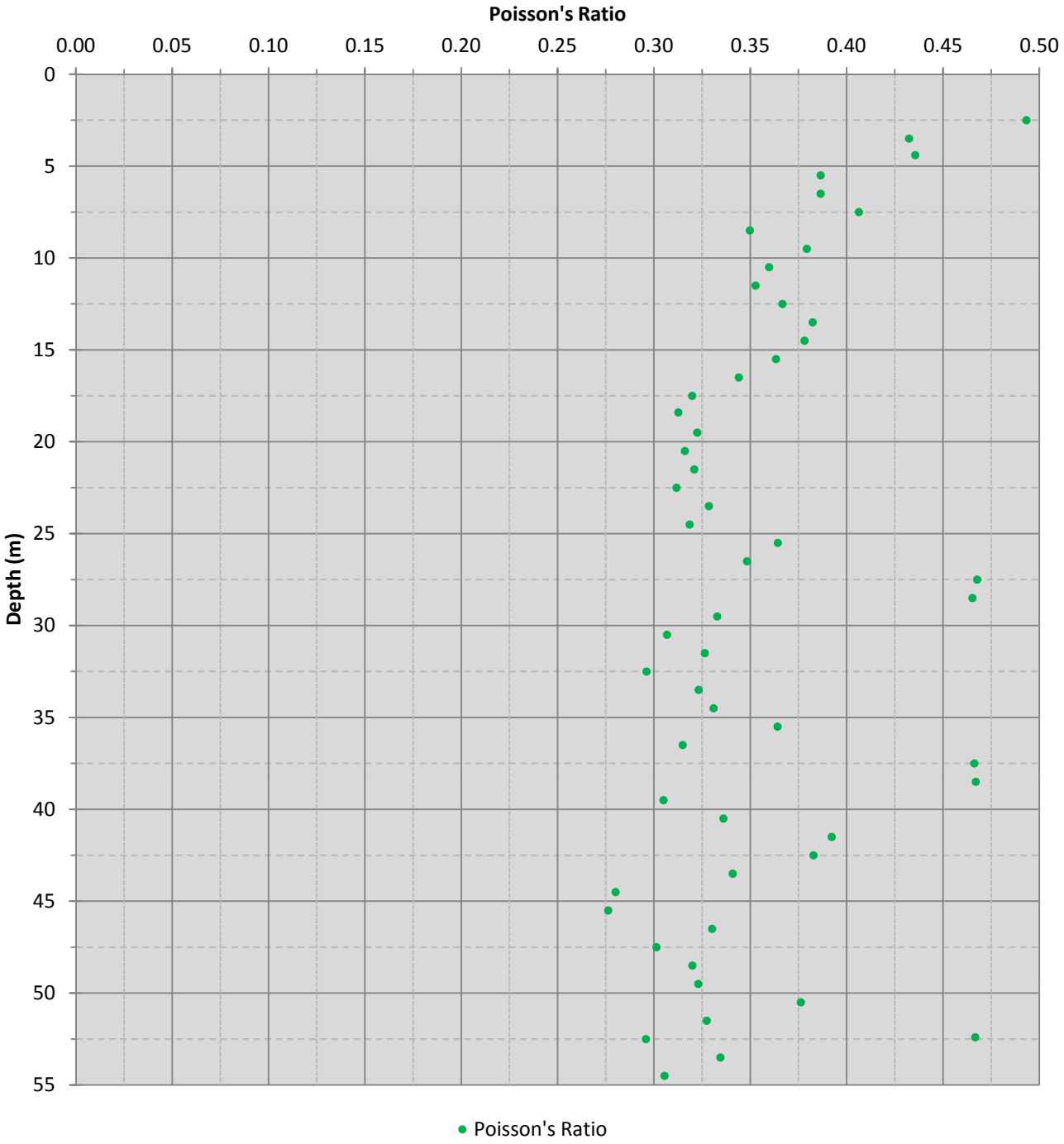
LELU ISLAND, BRITISH COLUMBIA, CANADA



PS SUSPENSION LOGGING RESULTS - CALCULATED INTERVAL VELOCITIES - BORING BH20

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

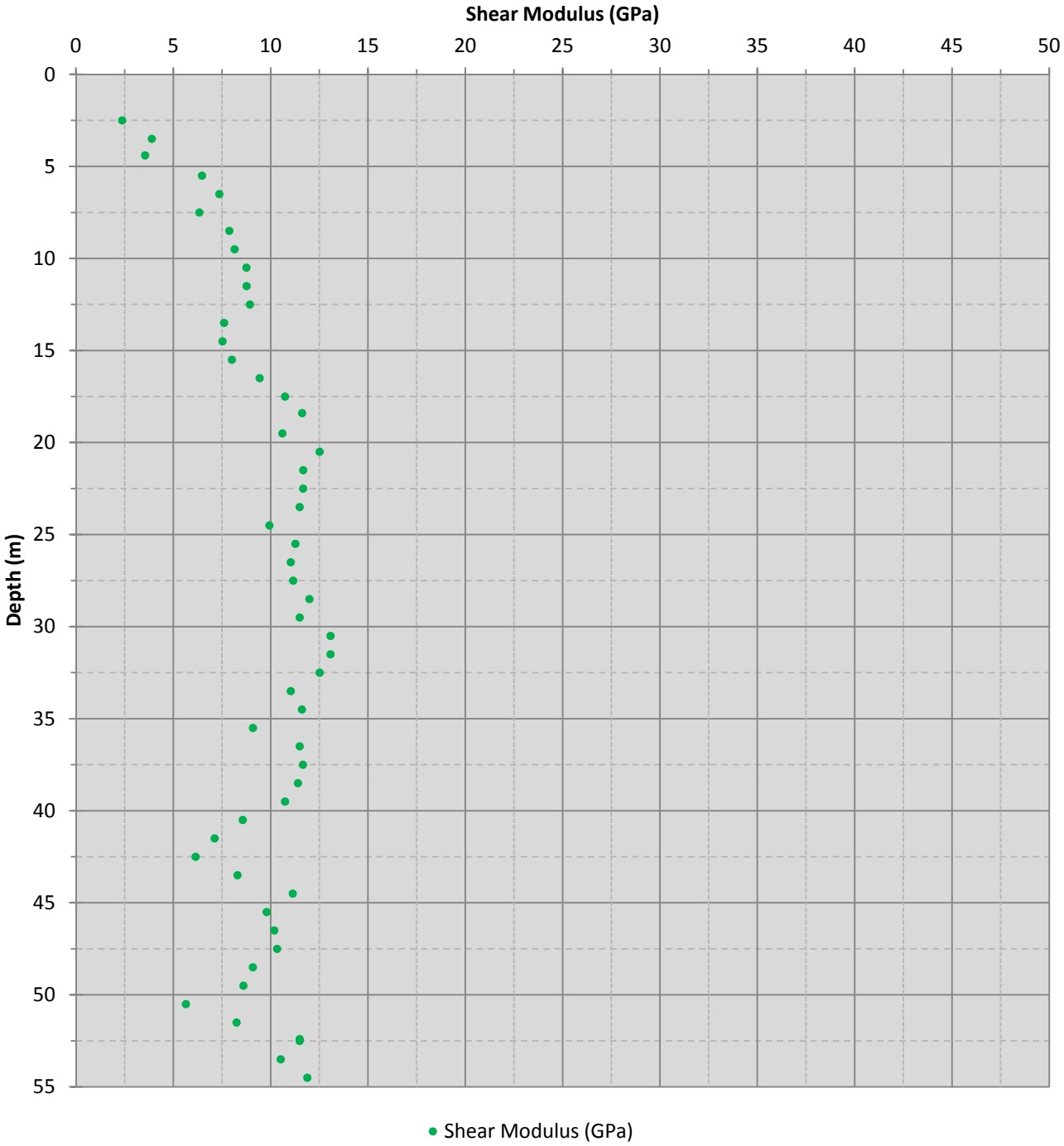


PS SUSPENSION LOGGING RESULTS - CALCULATED POISSON'S RATIO - BORING BH20

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

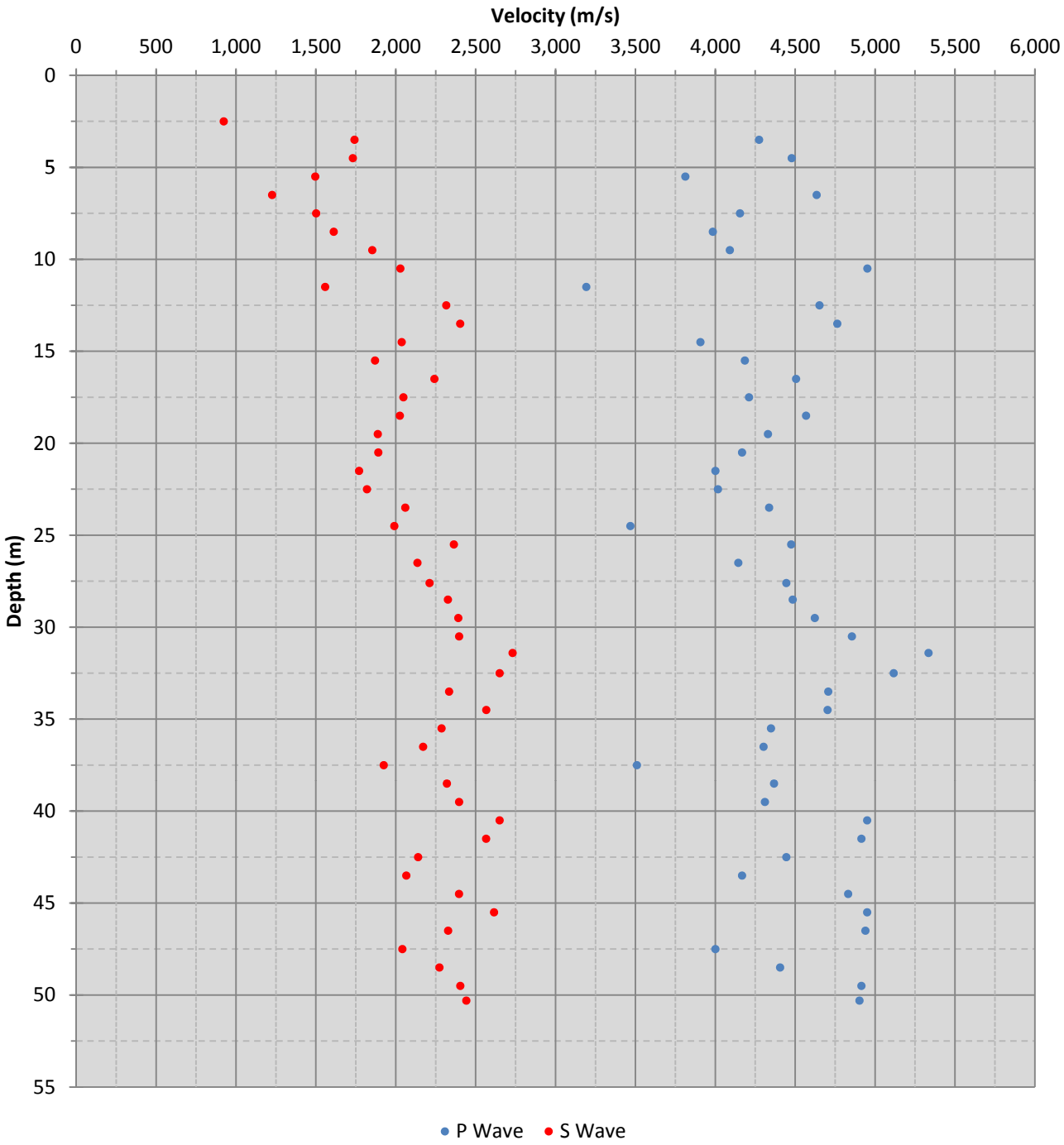
PLATE C5.2



PS SUSPENSION LOGGING RESULTS - CALCULATED SHEAR MODULUS - BORING BH20

PACIFIC NORTHWEST LNG PROJECT

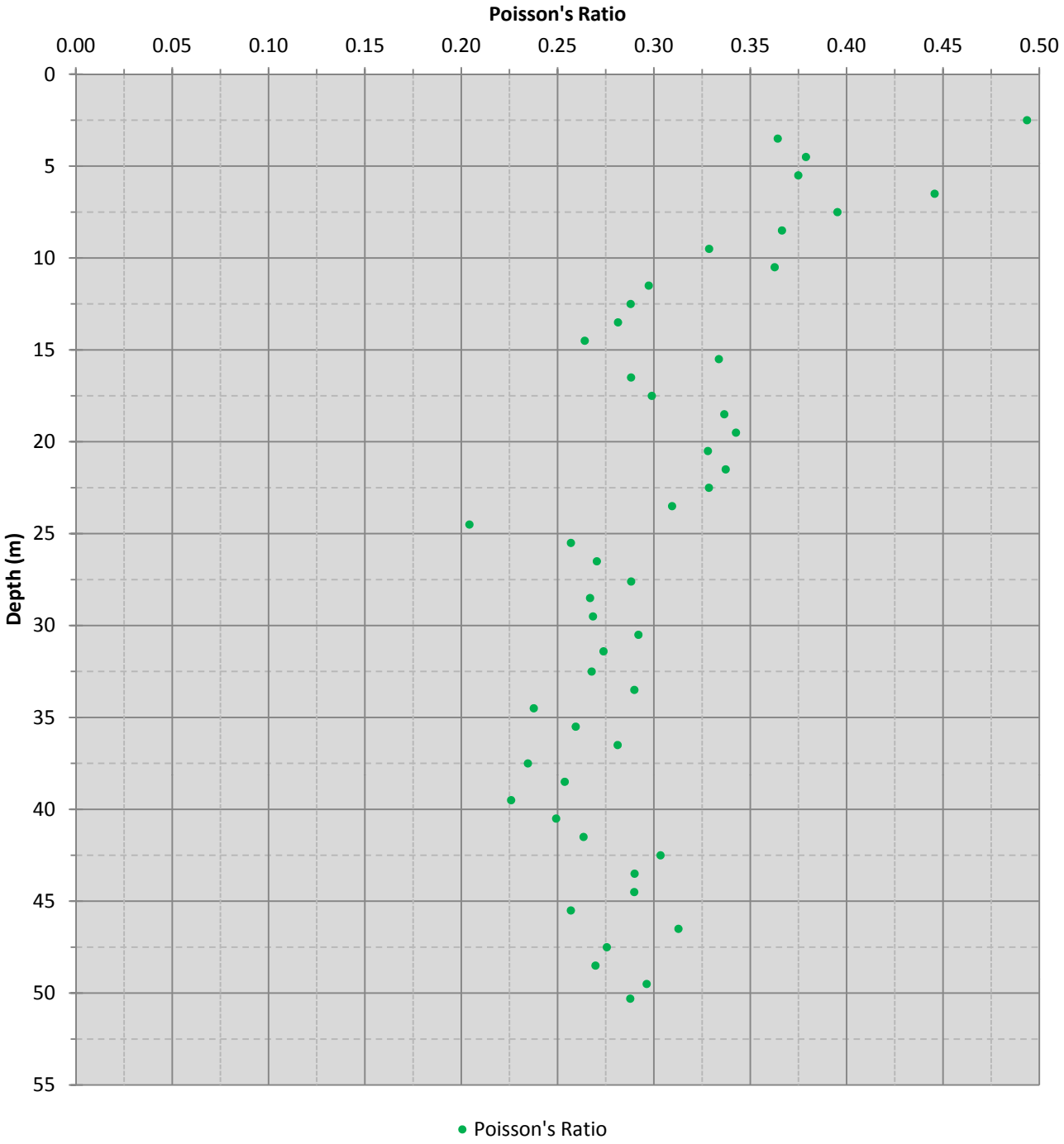
LELU ISLAND, BRITISH COLUMBIA, CANADA



PS SUSPENSION LOGGING RESULTS - CALCULATED INTERVAL VELOCITIES - BORING BH24

PACIFIC NORTHWEST LNG PROJECT

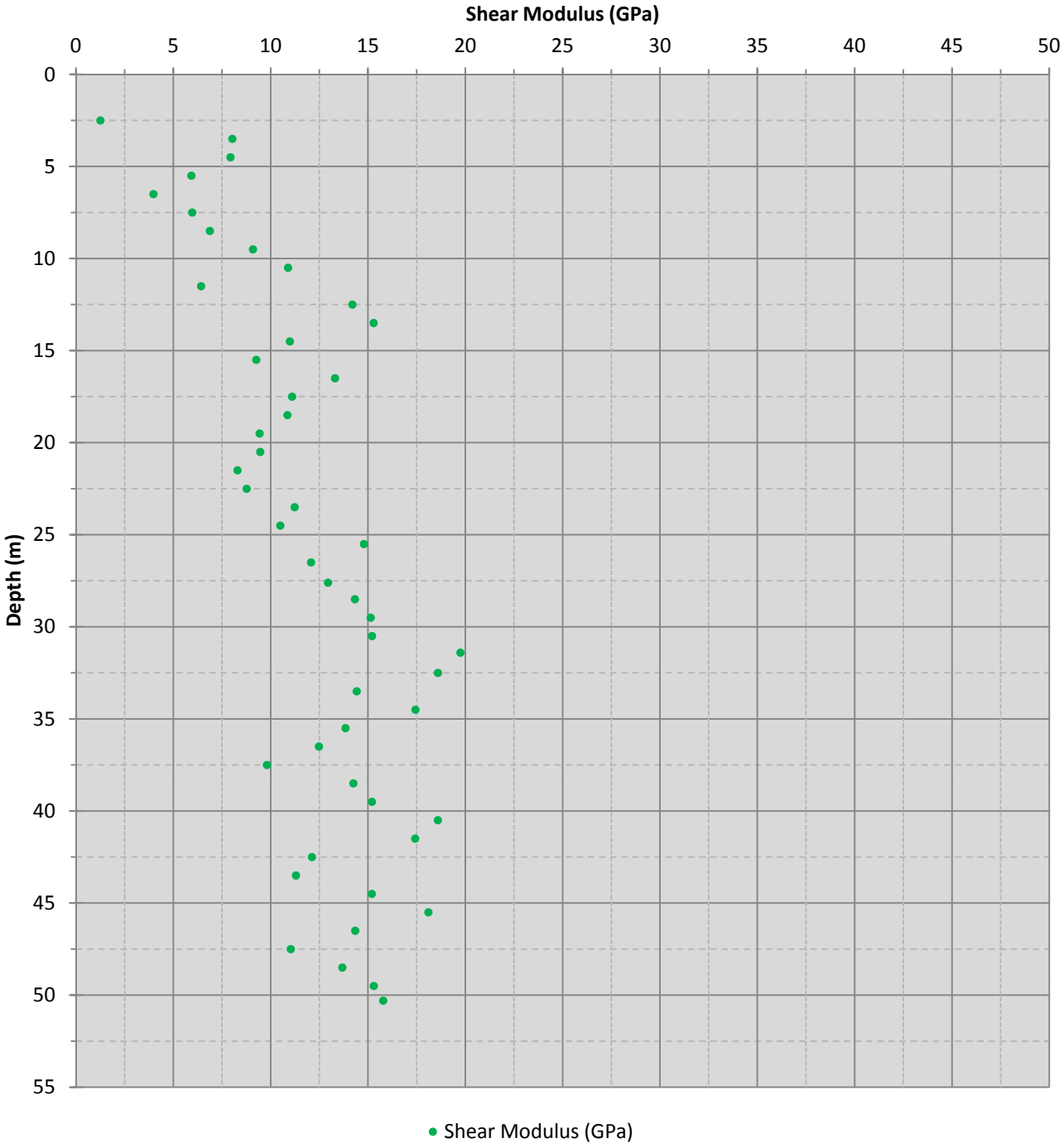
LELU ISLAND, BRITISH COLUMBIA, CANADA



PS SUSPENSION LOGGING RESULTS - CALCULATED POISSON'S RATIO - BORING BH24

PACIFIC NORTHWEST LNG PROJECT

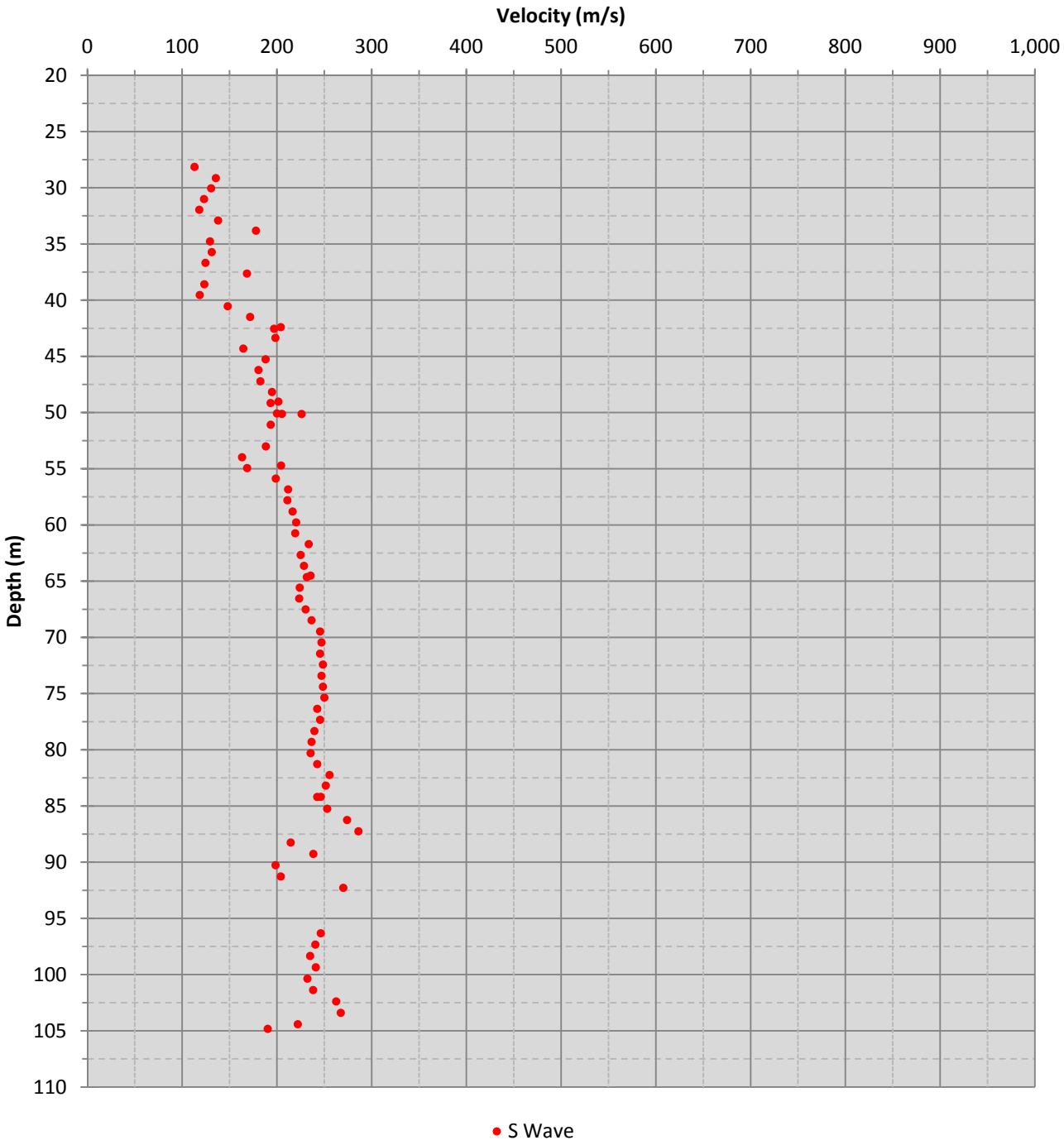
LELU ISLAND, BRITISH COLUMBIA, CANADA



PS SUSPENSION LOGGING RESULTS - CALCULATED SHEAR MODULUS - BORING BH24

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

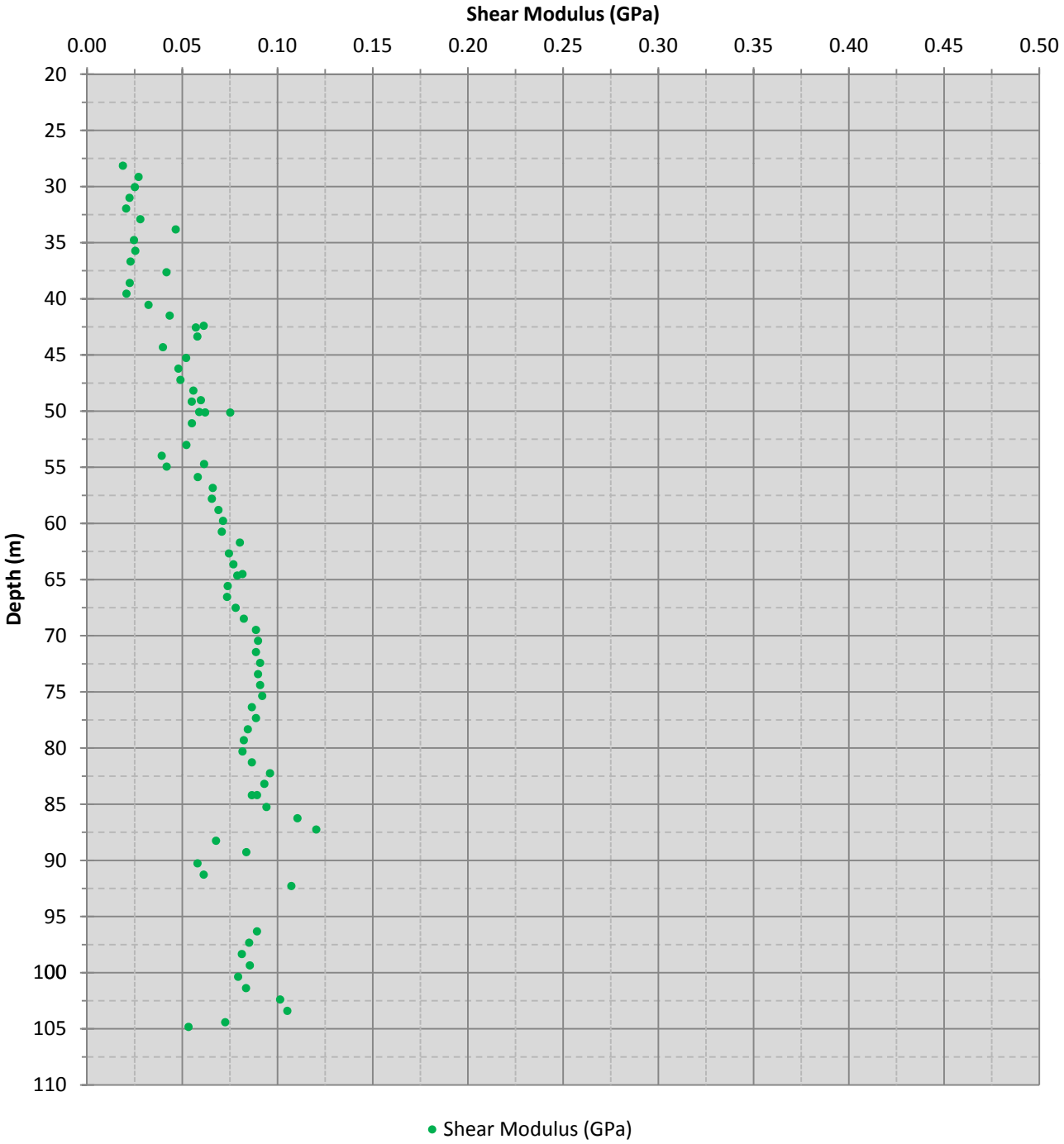


PS SUSPENSION LOGGING RESULTS - CALCULATED INTERVAL VELOCITIES - BORING BH35

PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE C7.1



PS SUSPENSION LOGGING RESULTS - CALCULATED SHEAR MODULUS - BORING BH35

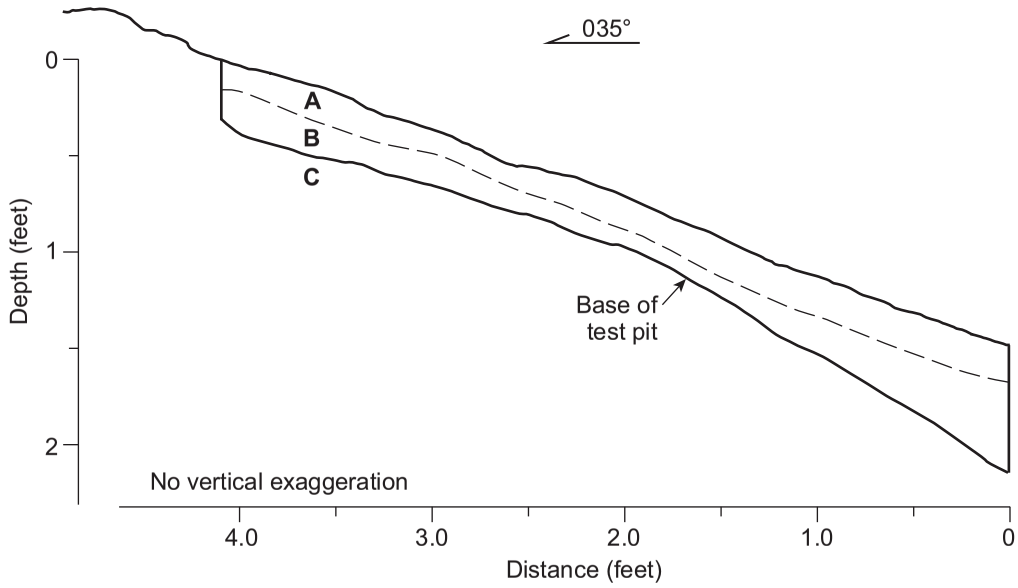
PACIFIC NORTHWEST LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE C7.2

APPENDIX D

Log of Test Pits



Unit Descriptions

Unit A: Root mat with humus and silt (Pt-OH); dusky red (2.5YR 3/2); moist; very soft; estimated 25-50% partially humified organic material and organic silt; lower contact wavy and clear over 2 to 3 cm.

Unit B: Very fine sandy silt (ML) (residual soil); very dark grey (10YR 3/1); moist; very soft; common fine sand- to silt-sized detrital mica indicates local schistose/phyllitic bedrock as parent material; lower contact wavy and clear over 2 to 3 cm.

Unit C: Very fine sand and silt (saprolite with relict bedrock fabric); black (5YR 2.5/1) with tan mottling; damp; medium dense/soft; lower contact wavy and sharp over 1 cm. Grades to phyllite (bedrock), mottled tan to grayish brown, R0-R2, foliation orientation 307°/32°; prominent joint sets oriented 310°/90° and 295°/90°.

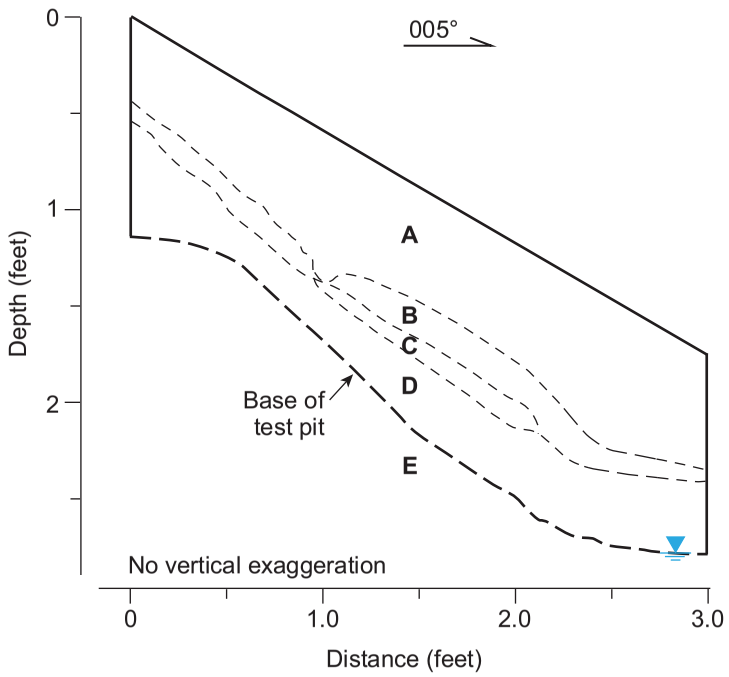
Notes: 1. Ground surfaces consists of low vegetation and moss.
2. Ground surface slopes 21°.
3. Excavated July 17, 2013, logged July 17, 2013.

Test pit TP-2, view southeast

Test pit TP-2, view northeast

Test Pit TP-2

PLATE D-1



Unit Descriptions

Unit A: Root mat with humus and silt (Pt-OH); dark reddish brown (5YR 2.5/2); moist; very soft; estimated 25-50% partially humified organic material and organic silt; lower contact wavy and clear over 2 to 3 cm.

Unit B: Silty very fine sand (SM) (residual soil); gray (5Y 5/1); moist; very loose; abundant fine sand- to silt-sized detrital mica indicates local schistose/phyllitic bedrock as parent material; lower contact wavy and clear over 2 to 3 cm.

Unit C: Organic silt (OH); very dark grey (10YR 3/1); moist to damp; very soft; estimated 50-75% partially to fully humified organic material; lower contact wavy and clear over 3 to 5 cm.

Unit D: Silty sand (saprolite with very weak relict bedrock fabric); mottled gray, tan, and brown; moist; loose; lower contact wavy and clear over 1 to 3 cm.

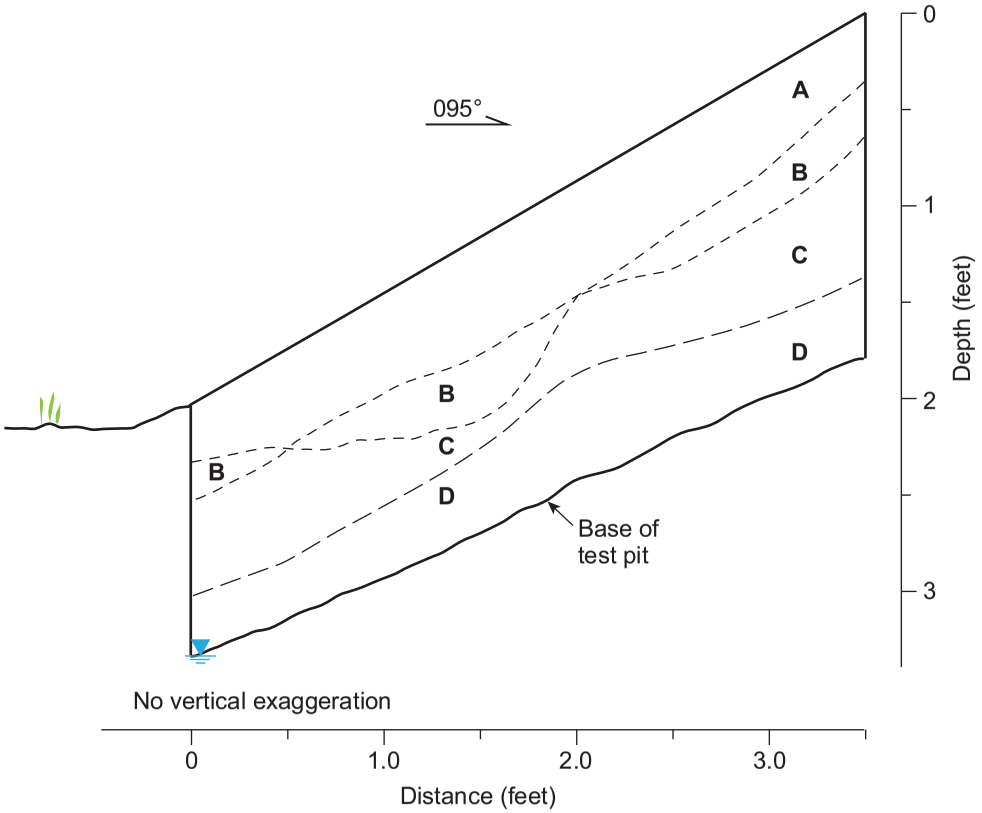
Unit E: Phyllitic schist/phyllite, tan to dark gray to orangish brown, R0-R1, moderately to highly weathered, micaceous, foliation oriented 310°/52°.

Notes: 1. Ground cover consists of moss.
2. Ground surface slopes 30°.
3. Excavated July 17, 2013, logged July 17, 3013.

Test pit TP-3, view south

Test pit TP-3, view west

Test Pit TP-3



Unit Descriptions

Unit A: Root mat with humus and silt (Pt-OH); very dark brown (7.5YR 2.5/2); moist; soft; estimated 25-50% partially humified organic material and organic silt; lower contact wavy and clear over 3 to 5 cm.

Unit B: Organic silt (OH); dark brown (10YR 3/3); moist; very soft; estimated 50-75% partially to fully humified organic material; lower contact wavy and clear over 3 to 5 cm.

Unit C: Very fine sandy silt (ML) (residual soil); black (2.5Y 2.5/1) with tan mottling; wet; soft; abundant fine sand- to silt-sized detrital mica indicates local schistose/phyllitic bedrock as parent material; lower contact wavy and clear over 2 to 3 cm.

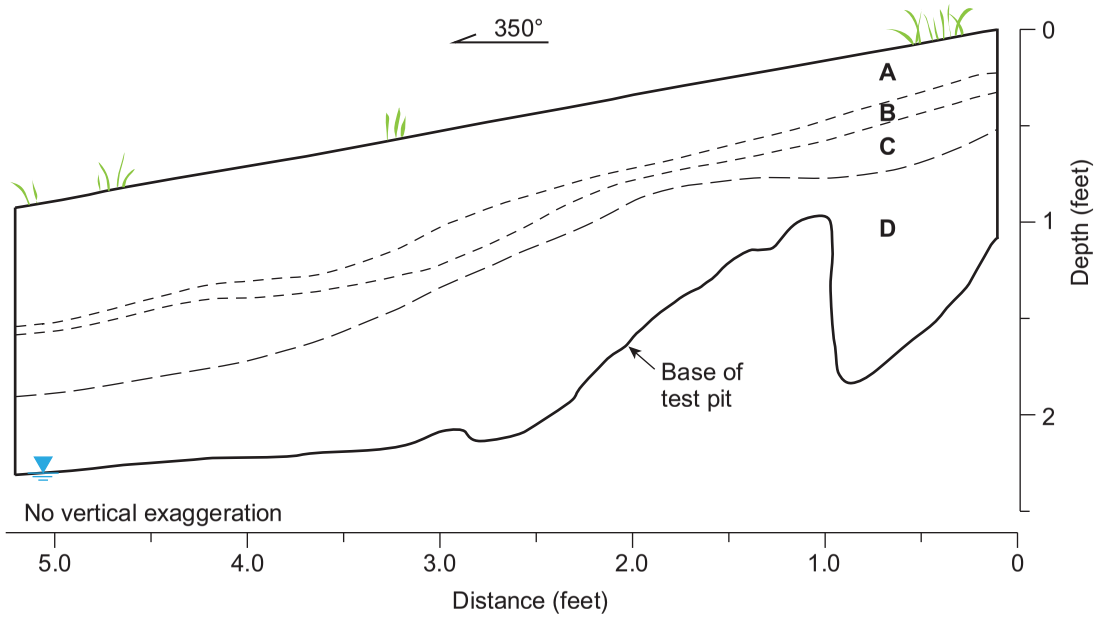
Unit D: Phyllite/phyllitic shale, tan to dark gray to orangish brown, R0-R1, moderately to highly weathered, micaceous, foliation oriented 315°/55°.

Notes: 1. Ground cover consists of low vegetation and moss.
2. Ground surface slopes 30°.
3. Excavated July 17, 2013, logged July 17, 3013.

Test pit TP-5, view west

Test pit TP-5, view south

Test Pit TP-4



Unit Descriptions

Unit A: Root mat with humus and silt (Pt-OH); dark brown (7.5YR 3/2); moist; soft; estimated 25-50% partially humified organic material and organic silt; lower contact wavy and clear over 3 to 5 cm.

Unit B: Organic silt (OH); brown (10YR 4/4); moist; very soft; estimated 50-75% partially to fully humified organic material; lower contact wavy and clear over 2 to 5 cm.

Unit C: Very fine sandy silt (ML) (residual soil); dark grey (2.5YR 4/1); moist; very soft; abundant fine sand- to silt-sized detrital mica indicates local schistose/phyllitic bedrock as parent material; lower contact wavy and clear over 2 to 3 cm.

Unit D: Phyllite/phyllitic schist, tan to dark gray, R0-R2, highly weathered, micaceous, foliation oriented 302°/61°, prominent joint set oriented 350°/68°.

Notes: 1. Ground cover consists of low vegetation and moss.
2. Ground surface slopes 10°.
3. Excavated July 16, 2013, logged July 16, 3013.

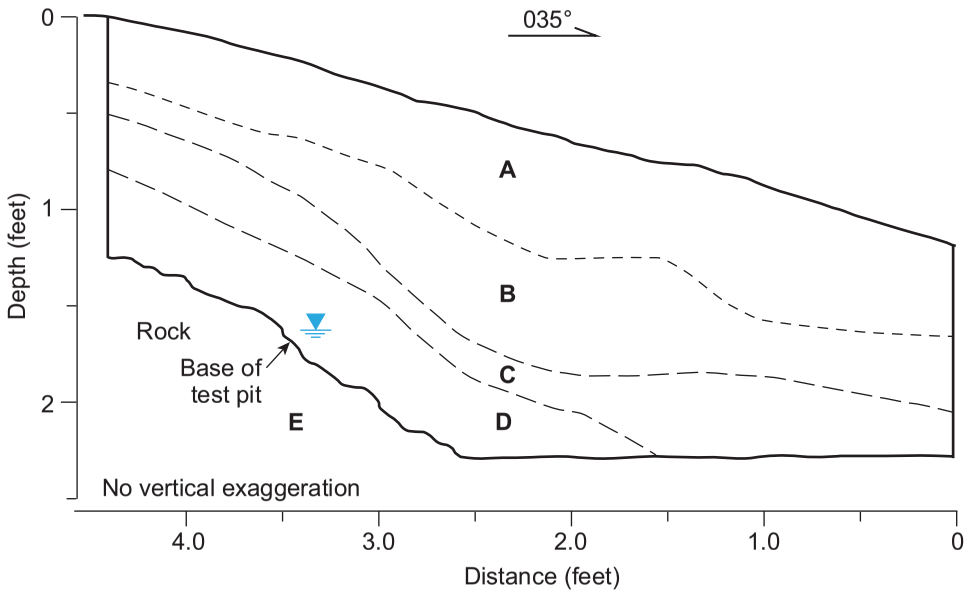
Test pit TP-5, view south

Test pit TP-5 location

Test pit TP-5, view east

PLATE D-4

Test Pit TP-5



Unit Descriptions

Unit A: Root mat with humus and silt (Pt-OH); dark reddish brown (5YR 2.5/2); moist; soft; estimated 25-50% partially humified organic material and organic silt; lower contact wavy and clear over 3 to 5 cm.

Unit B: Organic silt (OH); black (5YR 2.5/1); wet; very soft; estimated 50-75% partially to fully humified organic material; lower contact wavy and clear over 2 to 5 cm.

Unit C: Very fine sandy silt (ML) (residual soil); very dark grey (10YR 3/1); moist to wet; very soft; lower contact wavy and sharp to clear over 1 to 5 cm.

Unit D: Silty sand (saprolite with very weak relict bedrock fabric); grayish brown with tan mottles; wet; medium dense; lower contact wavy and clear over 1 to 3 cm.

Unit E: Phyllite/phyllitic shale, tan to dark grayish brown, R0-R2, highly weathered—foliation planes difficult to identify confidently; prominent joint sets oriented 266°/62° and 227°/77°.

Notes: 1. Ground cover consists of small trees and moss.
2. Ground surface slopes 15°.
3. Excavated July 17, 2013, logged July 18, 2013.

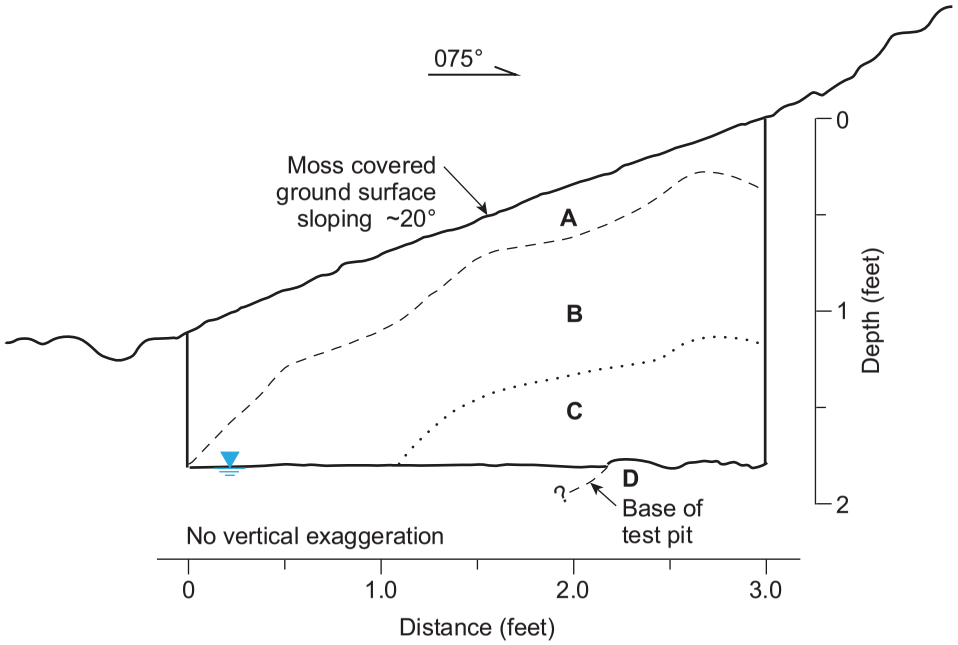
Test pit TP-6, view southwest

Test pit TP-6 location

Test pit TP-6, view northwest

Test Pit TP-6

PLATE D-5



Unit Descriptions

Unit A: Root mat with humus and silt (Pt-OH); very dark brown (10YR 2/2); wet; soft; estimated 25-50% partially humified organic material and organic silt; lower contact wavy and clear over 3 to 5 cm.

Unit B: Organic silt (OH); very dark grayish brown (10YR 3/2); wet; very soft; estimated 50-75% partially to fully humified organic material; lower contact wavy and clear over 2 to 5 cm.

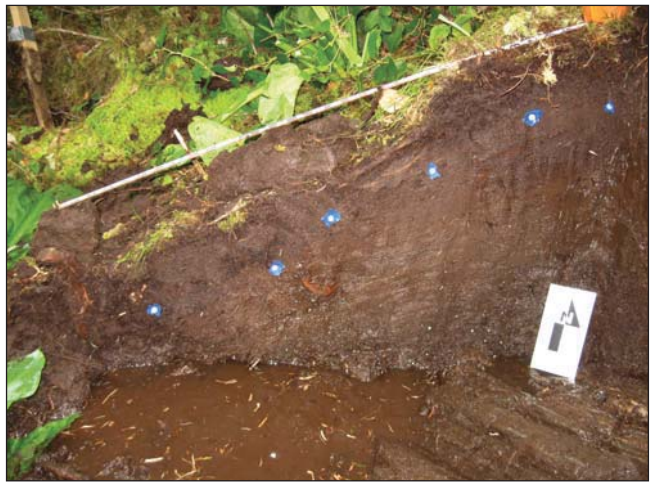
Unit C: Very fine sandy silt (ML) (residual soil); very dark greyish brown (10YR 3/2); moist to wet; very soft; lower contact wavy sharp over 1 cm.

Unit D: Phylittic schist/phyllite with thin quartz veins, tan to dark grayish brown, R0-R2, foliation strikes 290° to 330°, dips 40° northeast.

Notes: 1. Ground cover consists of small trees and moss.
2. Ground surface slopes 20°.
3. Excavated July 17, 2013, logged July 18, 2013.

Test pit TP-7, view southwest

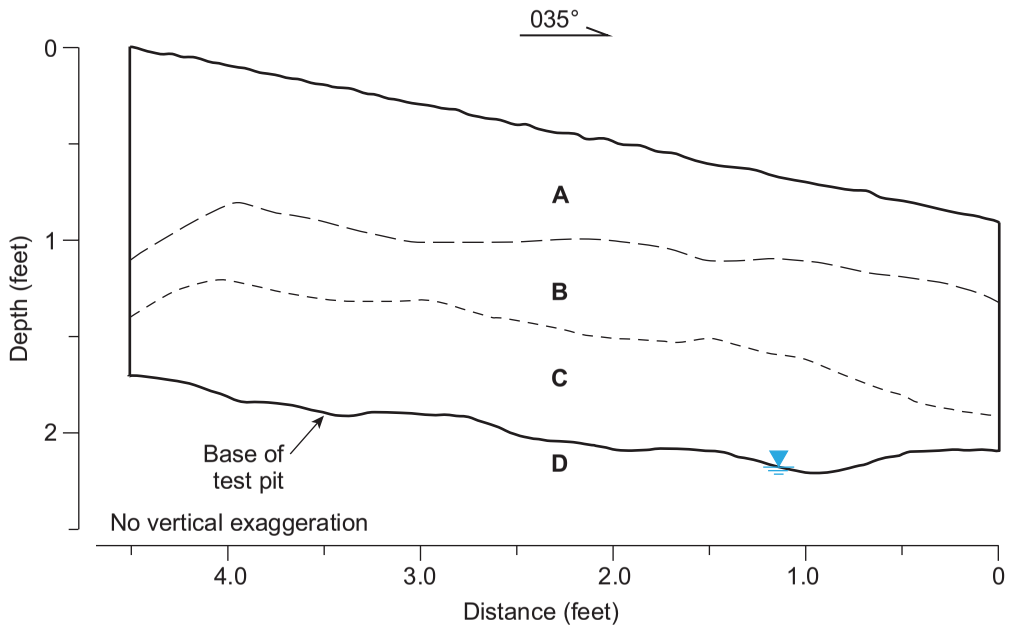
Test pit TP-7 location



Test pit TP-7, view northwest

Test Pit TP-7

PLATE D-6



Unit Descriptions

Unit A: Root mat with humus and silt (Pt-OH); reddish black (2.5YR 2.5/1); moist; very soft; estimated 25-50% partially humified organic material and organic silt; lower contact wavy and clear over 2 to 3 cm.

Unit B: Organic silt (OH); brownish yellow (10YR 6/6) with very dark brown (10YR 2/2) mottles; wet to moist; very soft; estimated 50-75% partially to fully humified organic material; lower contact wavy and clear over 2 to 3 cm.

Unit C: Very fine sand and silt (saprolite with relict bedrock fabric); very dark greyish brown (10YR 3/2) with tan mottling; moist; medium dense; lower contact wavy and sharp over 1 cm.

Unit D: Phyllite/phylittic schist (bedrock), tan to grayish brown, R0-R1, foliation orientation 304°/34°.

Notes: 1. Ground cover consists of low brush and moss.
2. Ground surface slopes 11°.
3. Excavated July 18, 2013, logged July 19, 2013.

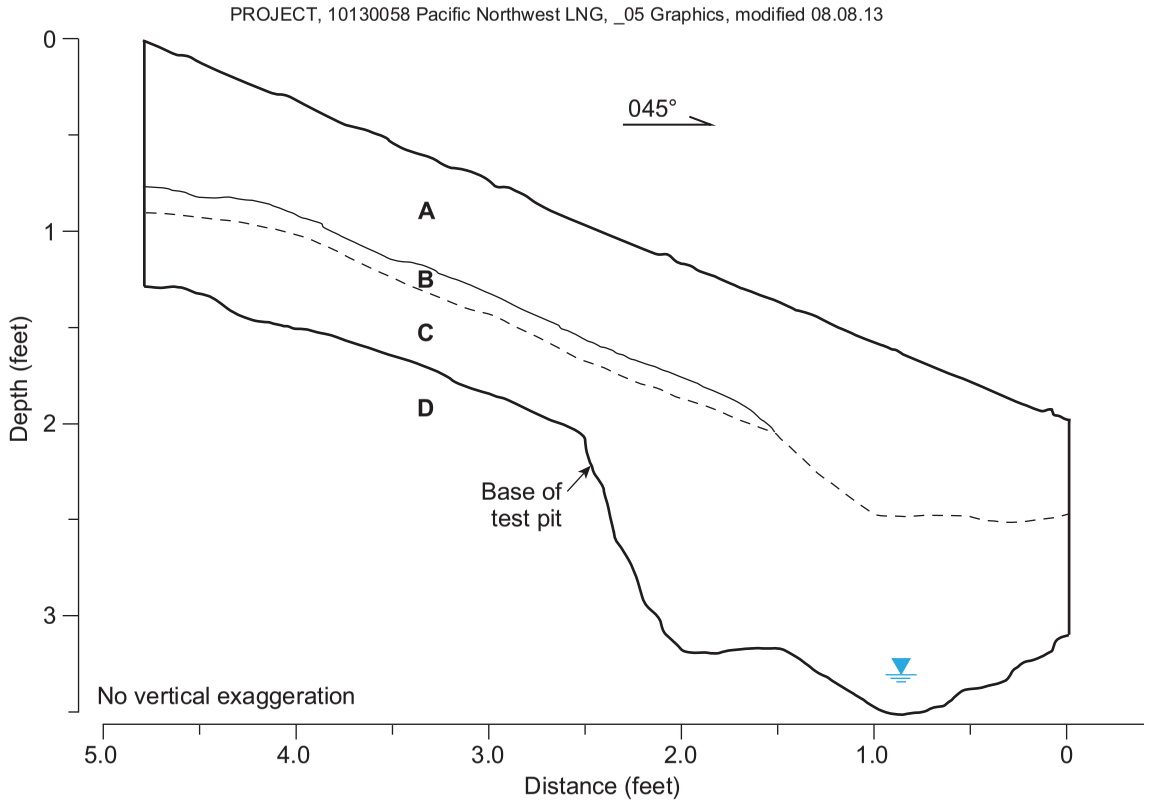
Test pit TP-9, view southwest

Test pit TP-9, location

Test pit TP-9, view northwest

Test Pit TP-9

PLATE D-7



Unit Descriptions

Unit A: Root mat with humus and silt (Pt-OH); dark red (2.5YR 2.5/1); moist; soft; estimated 25-50% partially humified organic material and organic silt; lower contact wavy and sharp over 1 to 2 cm.

Unit B: Very fine sandy silt (ML) (residual soil); very dark grey (10YR 3/1); moist; very soft; common fine sand- to silt-sized detrital mica indicates local schistose/phyllitic bedrock as parent material; lower contact wavy and clear over 2 to 3 cm.

Unit C: Very fine sand and silt (saprolite with relict bedrock fabric); black (5YR 2.5/1) with tan mottling; damp; medium dense/soft; lower contact wavy and sharp over 1 cm.

Unit D: Phyllite (bedrock), mottled tan to grayish brown, R0-R2, foliation orientation 307°/32°; prominent joint sets oriented 310°/90° and 295°/90°.

Notes: 1. Ground cover consists of trees and thick brush.
2. Ground surface slopes 22°.
3. Excavated July 17, 2013, logged July 17, 2013.

Test pit TP-10, view southwest

Test pit TP-10 location

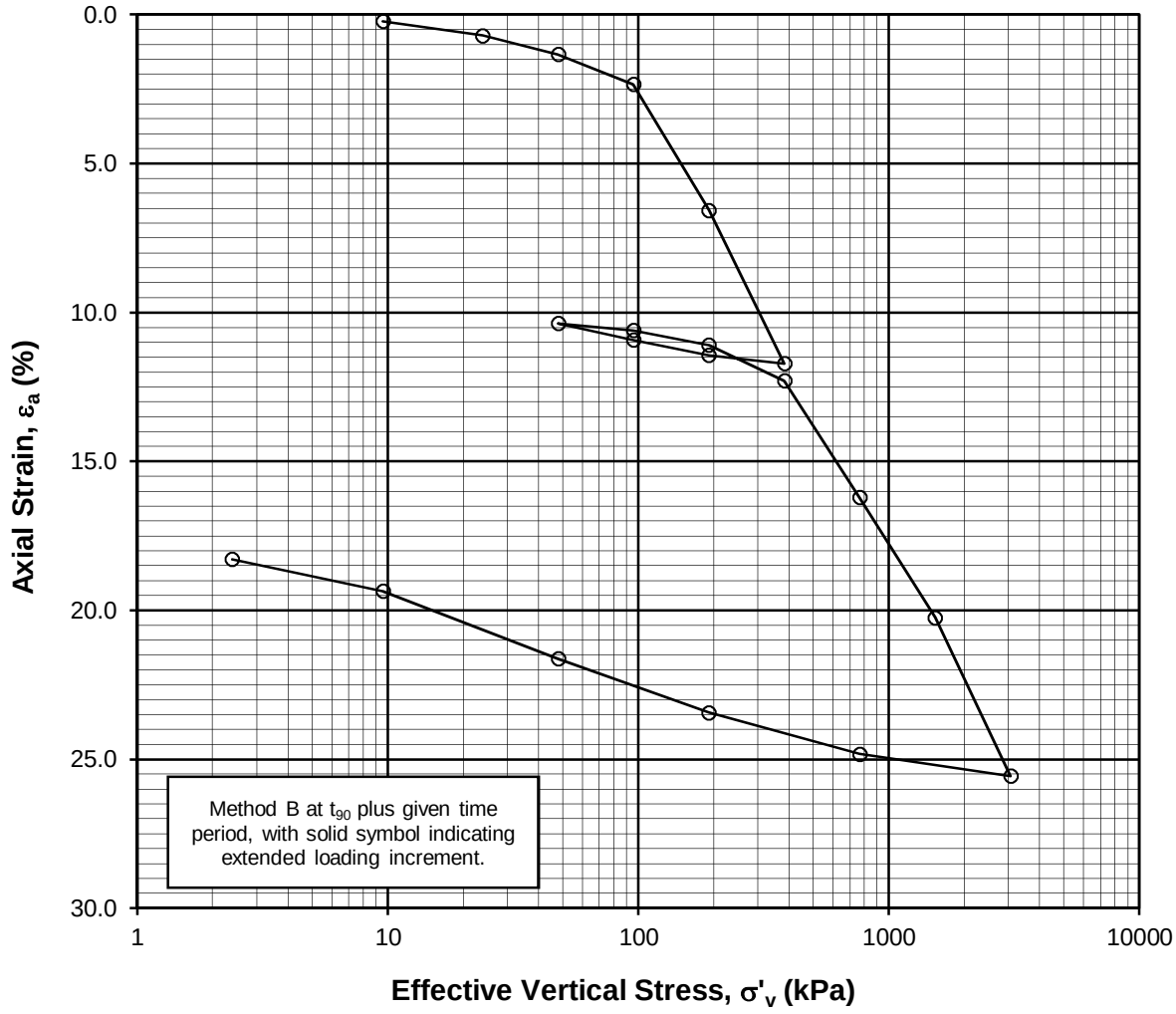
Test pit TP-10, view southeast

Test Pit TP-10

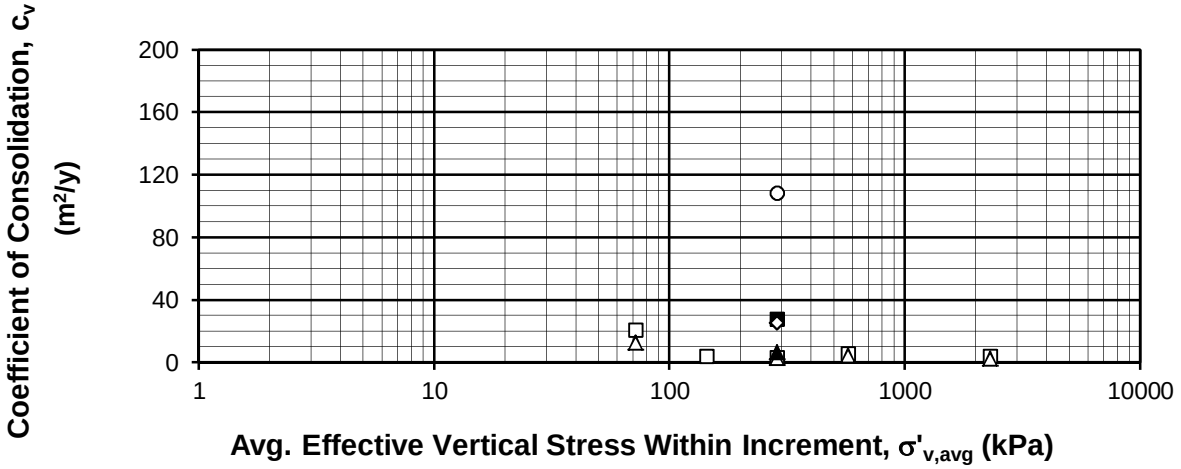
PLATE D-8

APPENDIX E

Laboratory Test Results



Fitting Methods: - Sqr. Rt. Time: □ - Loading ○ - Unloading
- Log of Time: Δ - Loading ◊- Unloading
with solid symbols indicating reloading increments

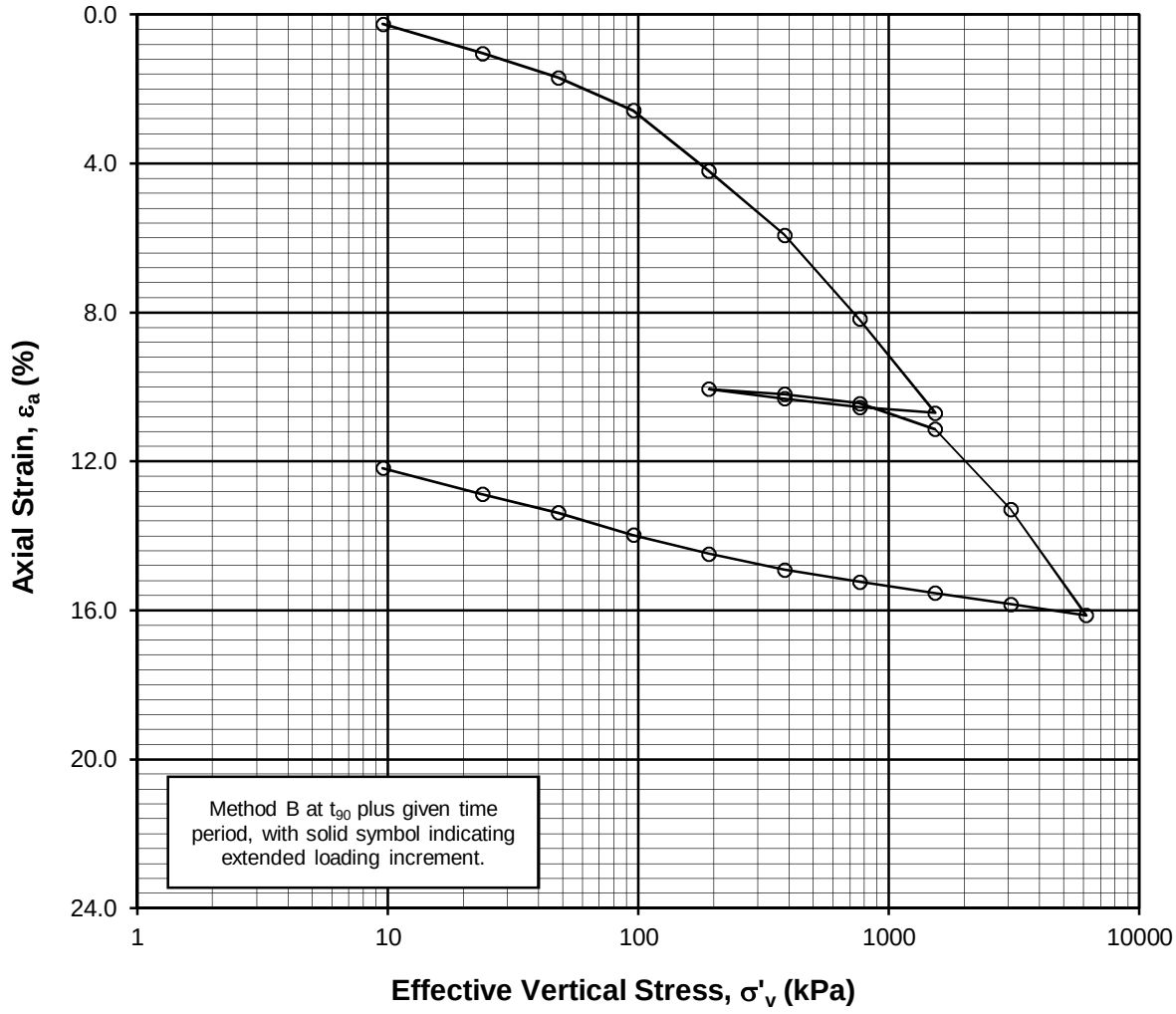


1-D CONSOLIDATION TEST: INC

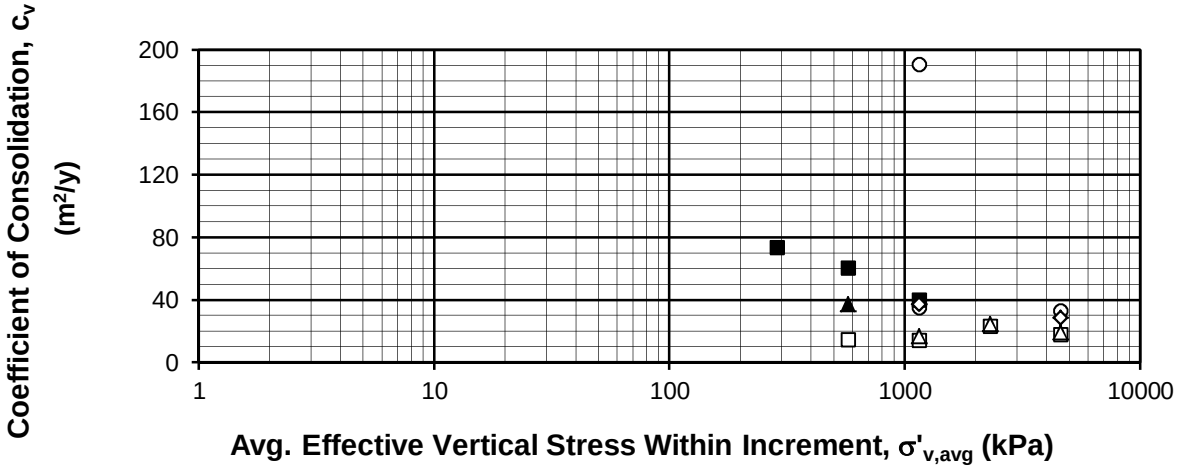
Sample 9a - Depth: 6.34 m

Boring BH-11

PLATE E-1



Fitting Methods: - Sqr. Rt. Time: □ - Loading ○ - Unloading
- Log of Time: Δ - Loading ◊- Unloading
with solid symbols indicating reloading increments

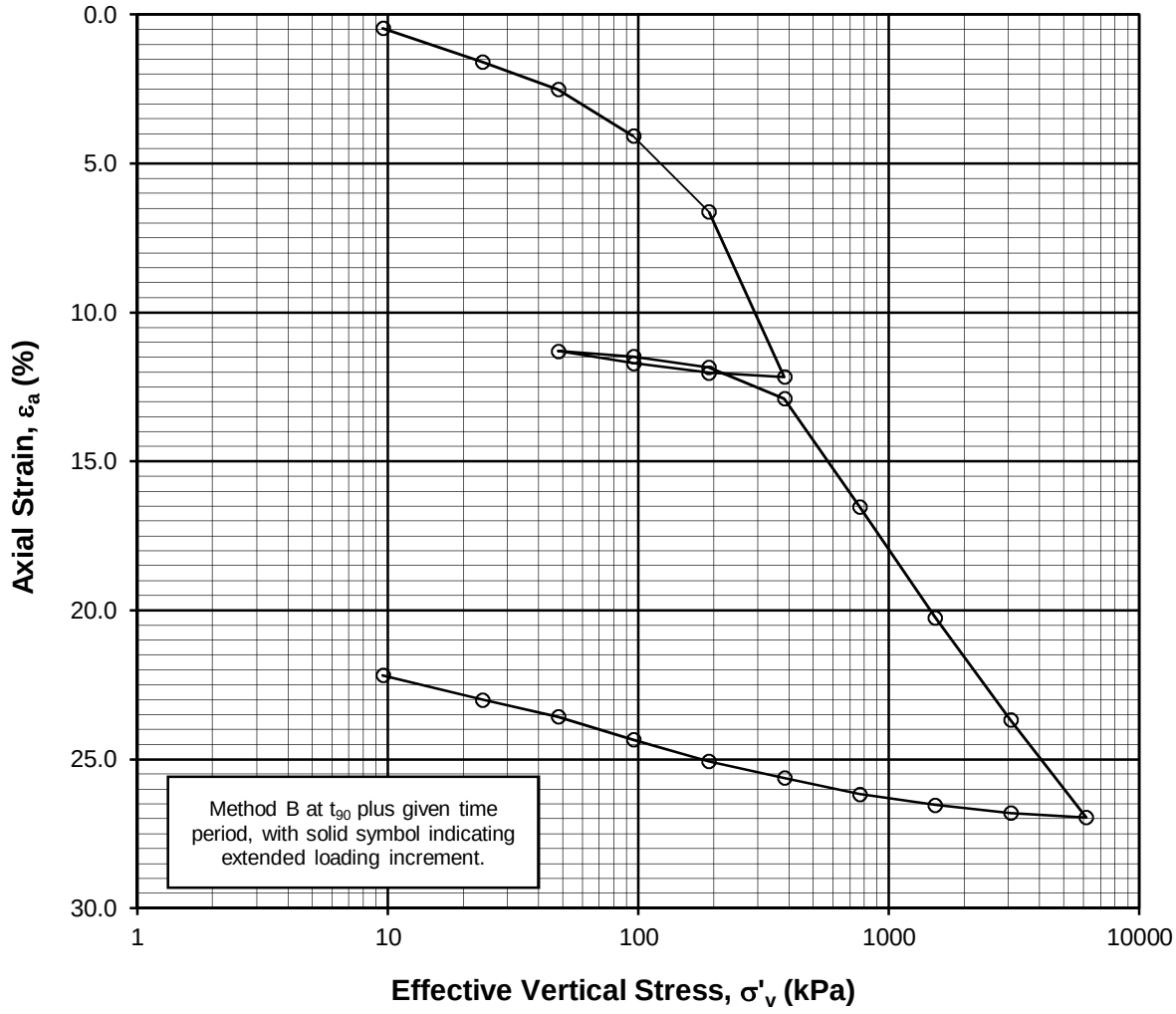


1-D CONSOLIDATION TEST: INC

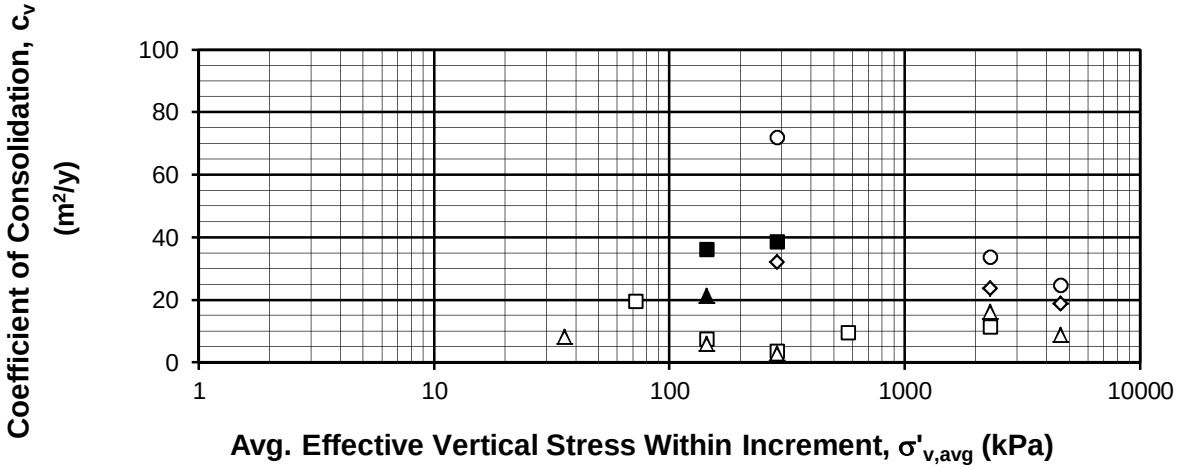
Sample 8a - Depth: 4.27 m

Boring BH-16

PLATE E-2



Fitting Methods: - Sqr. Rt. Time: □ - Loading ○ - Unloading
- Log of Time: Δ - Loading ◊- Unloading
with solid symbols indicating reloading increments

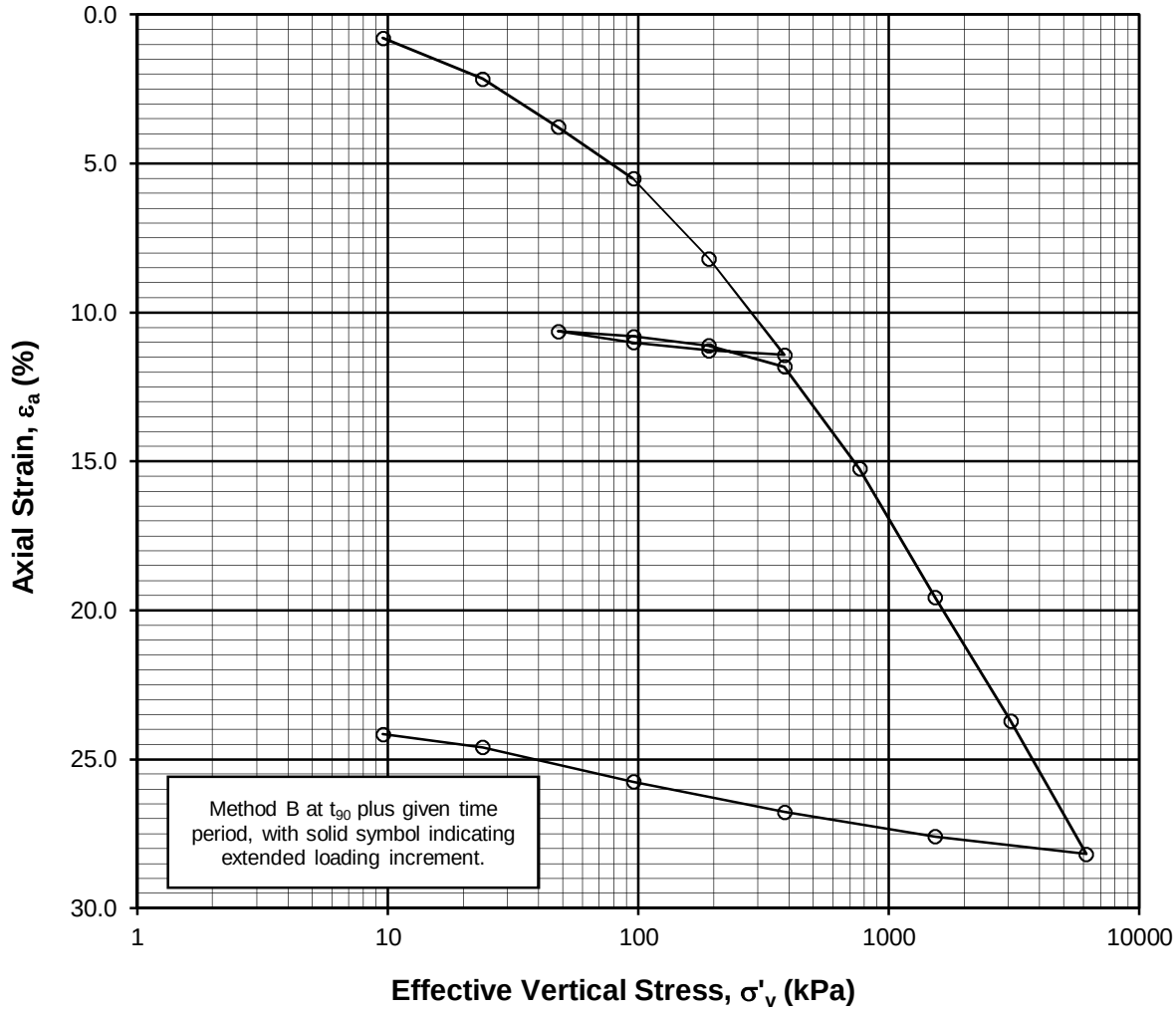


1-D CONSOLIDATION TEST: INC

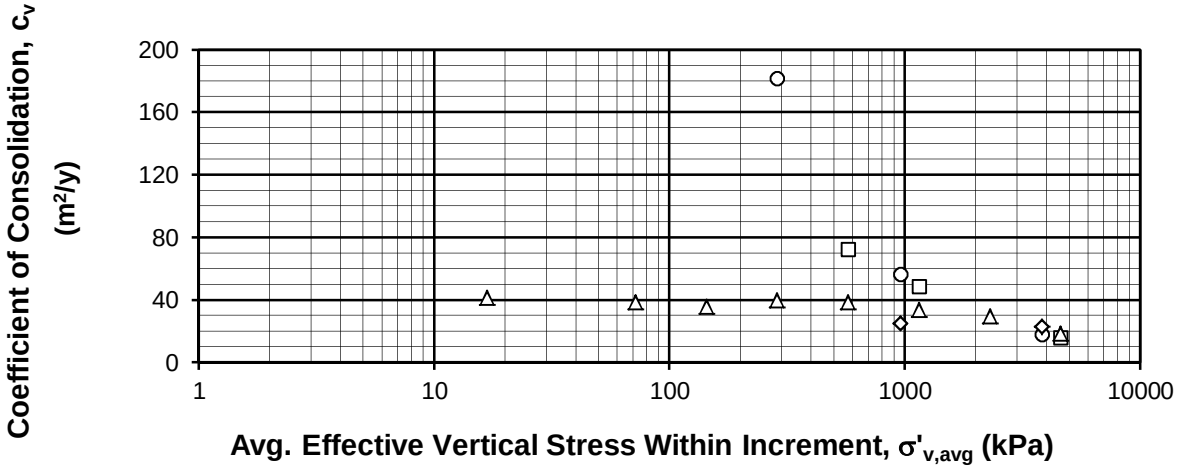
Sample 13a - Depth: 11.28 m

Boring BH-16

PLATE E-3



Fitting Methods: - Sqr. Rt. Time: □ - Loading ○ - Unloading
- Log of Time: Δ - Loading ◊- Unloading
with solid symbols indicating reloading increments

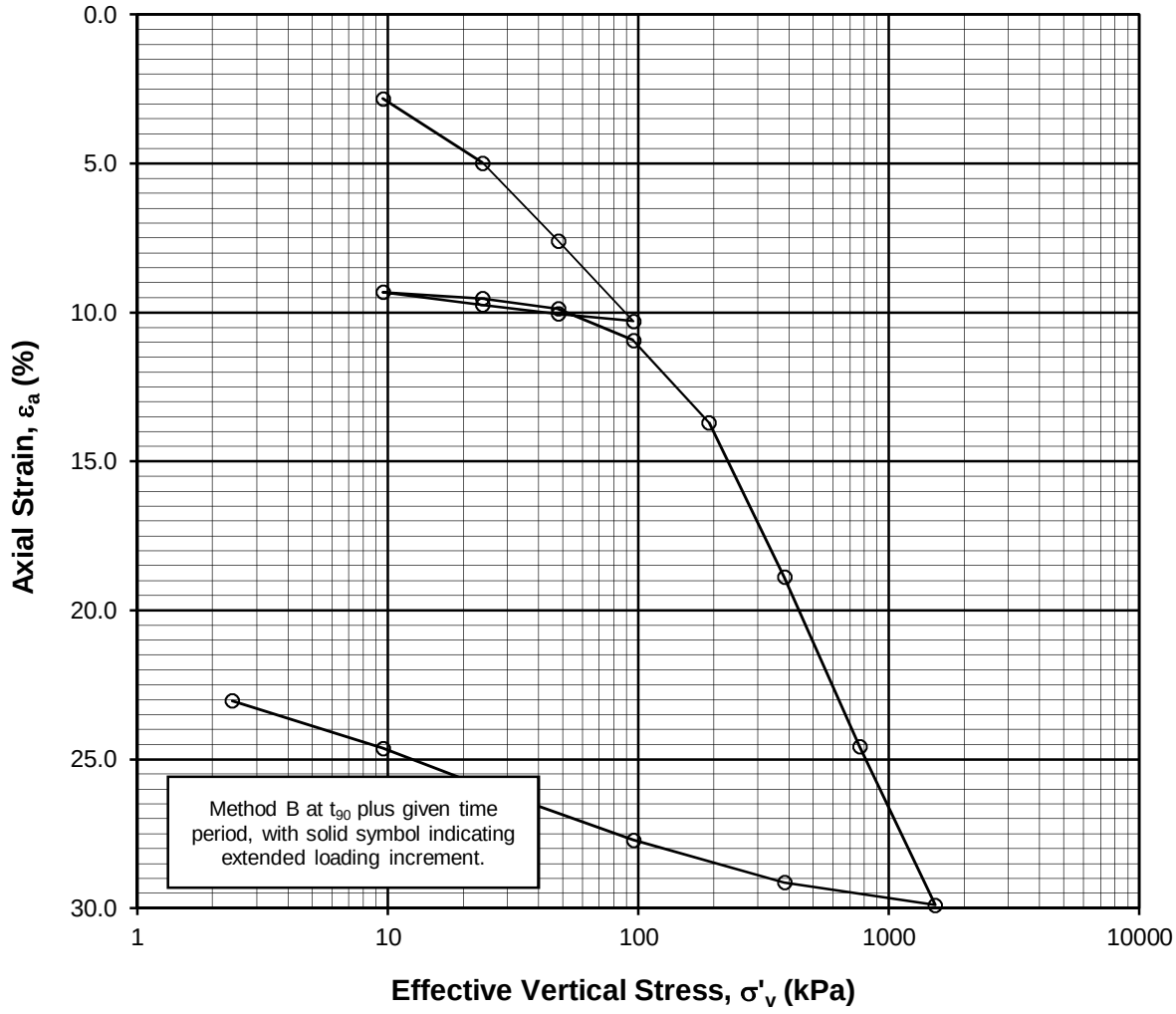


1-D CONSOLIDATION TEST: INC

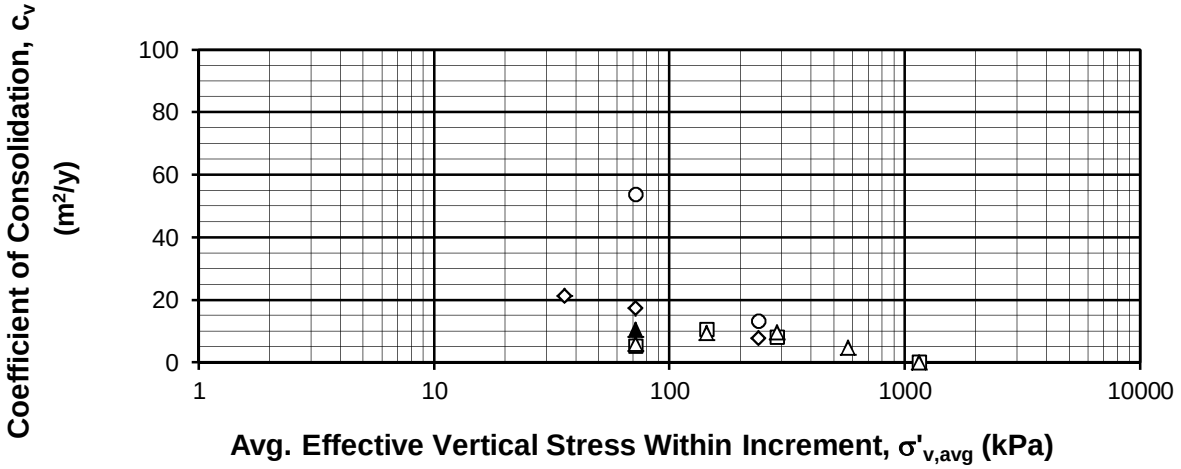
Sample 10a - Depth: 10.39 m

Boring BH-32

PLATE E-4



Fitting Methods: - Sqr. Rt. Time: □ - Loading ○ - Unloading
- Log of Time: Δ - Loading ◊- Unloading
with solid symbols indicating reloading increments

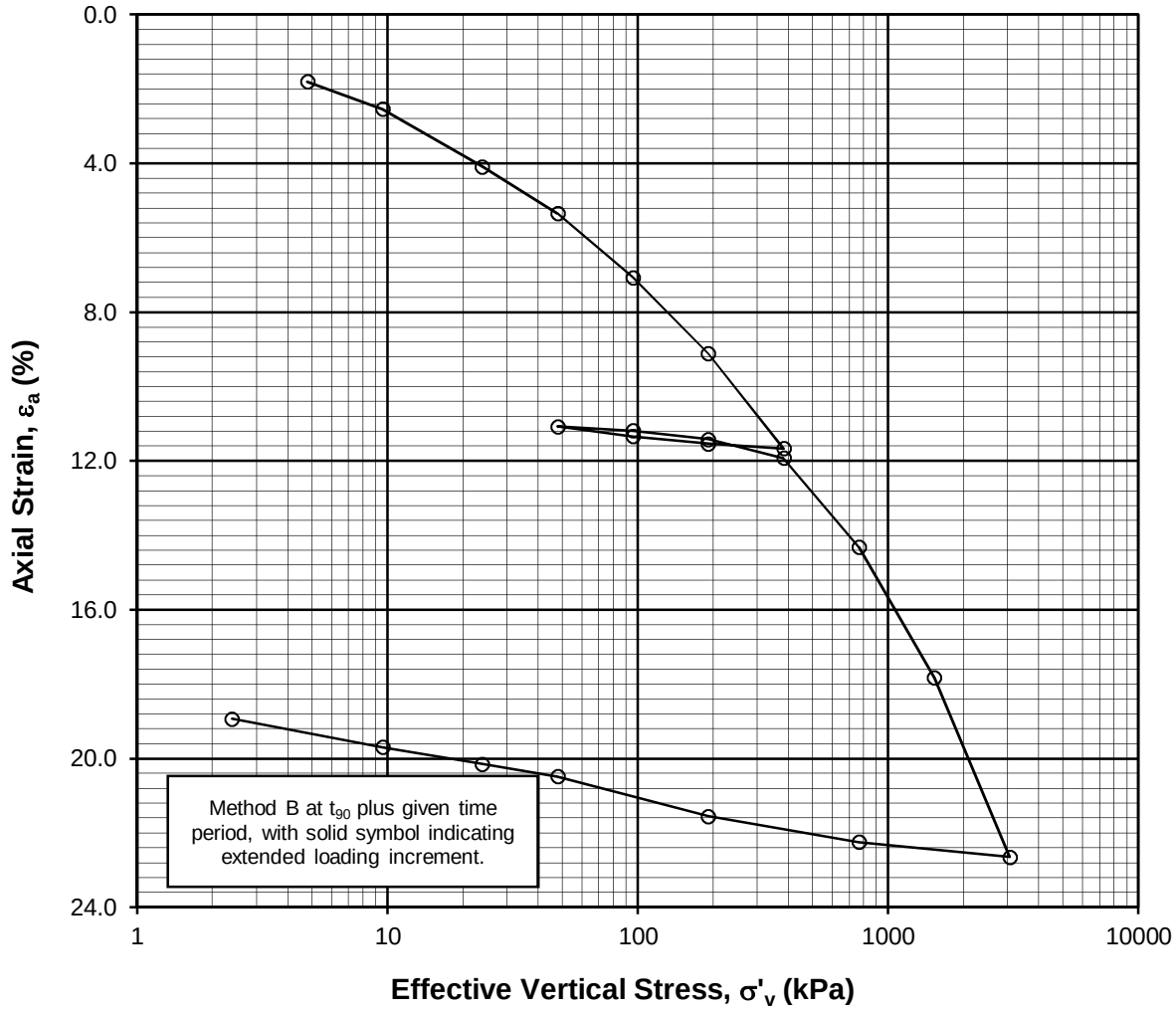


1-D CONSOLIDATION TEST: INC

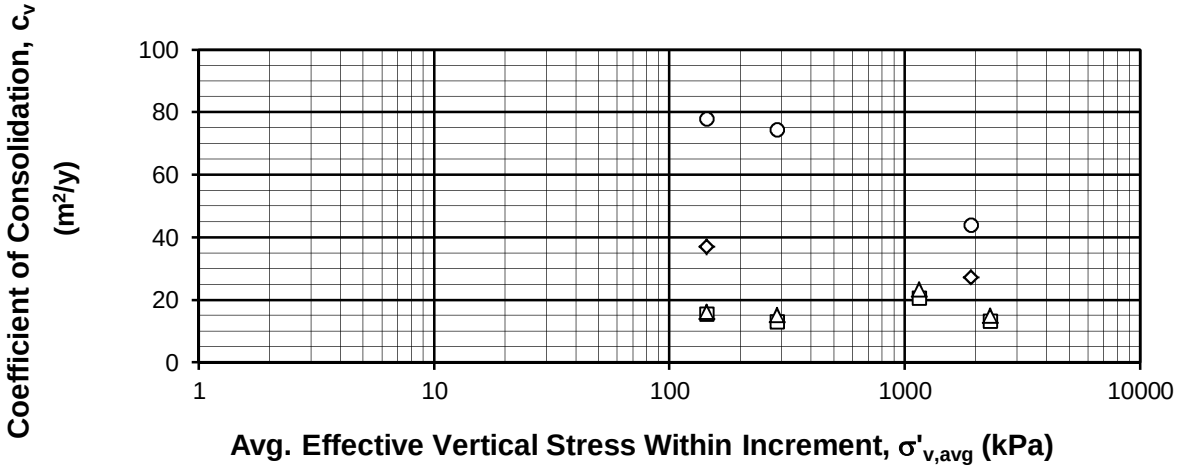
Sample 28a - Depth: 37.25 m

Boring BH-32

PLATE E-5



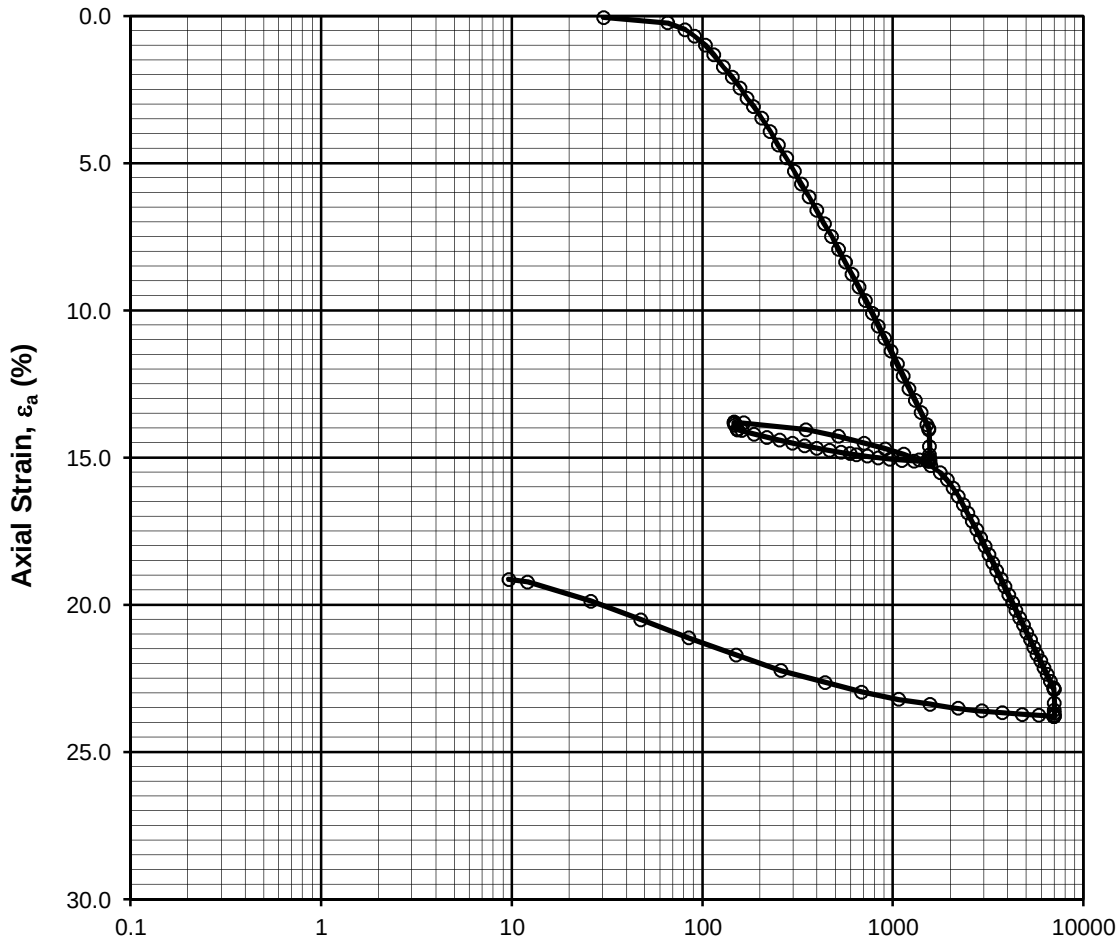
Fitting Methods: - Sqr. Rt. Time: □ - Loading ○ - Unloading
- Log of Time: Δ - Loading ◊- Unloading
with solid symbols indicating reloading increments

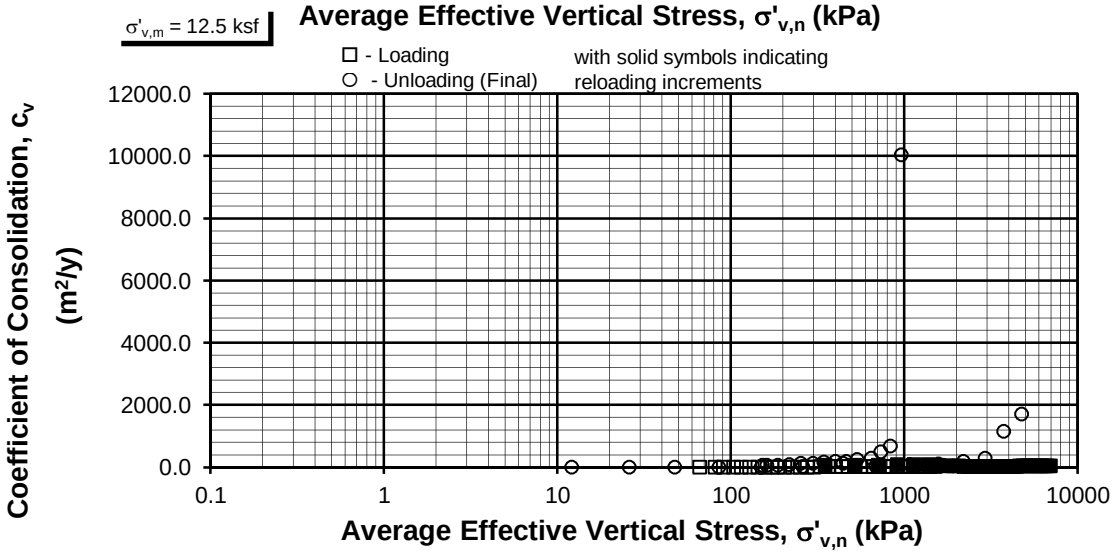


1-D CONSOLIDATION TEST: INC

Sample 15a - Depth: 14.84 m

Boring BH-33

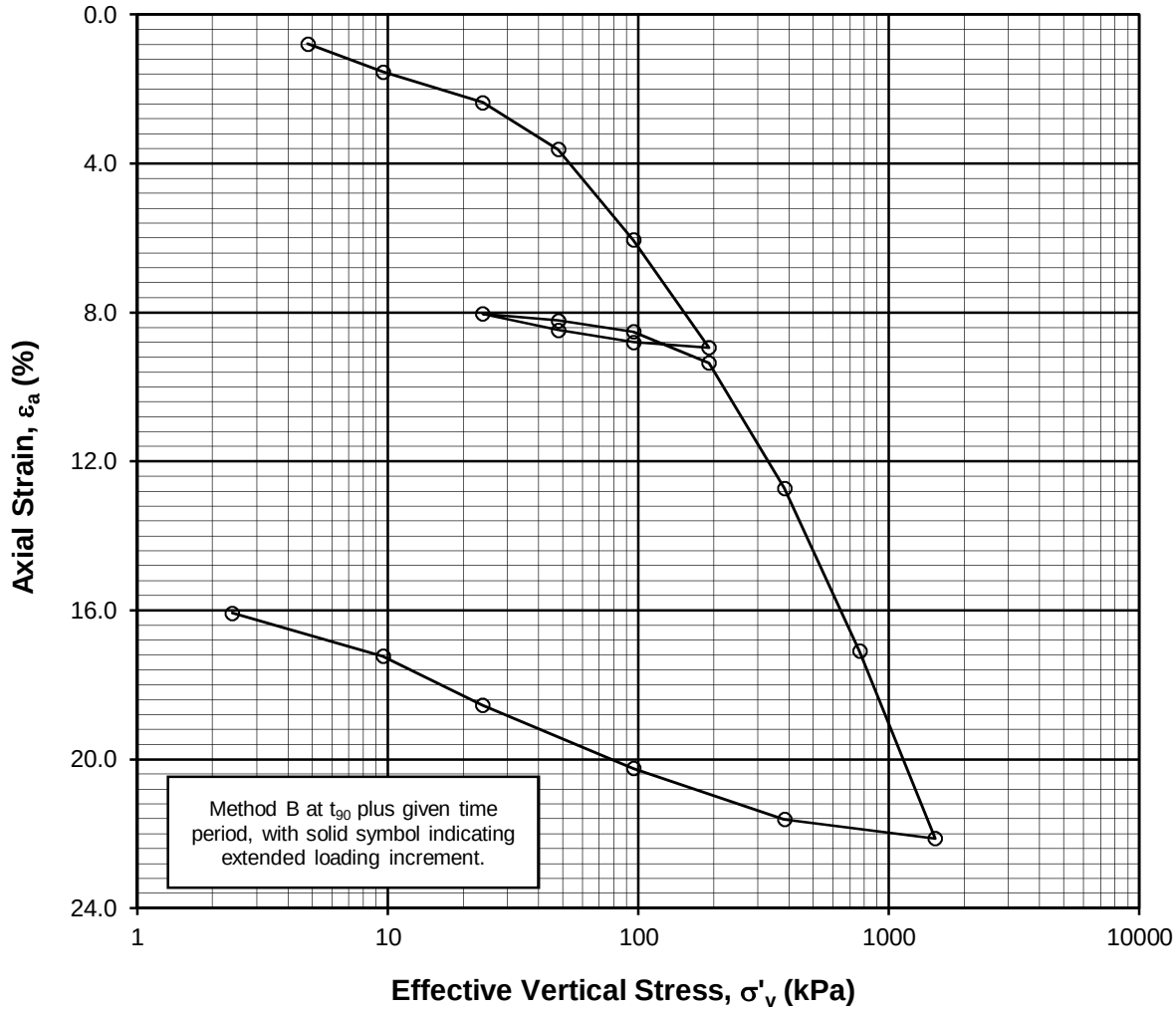




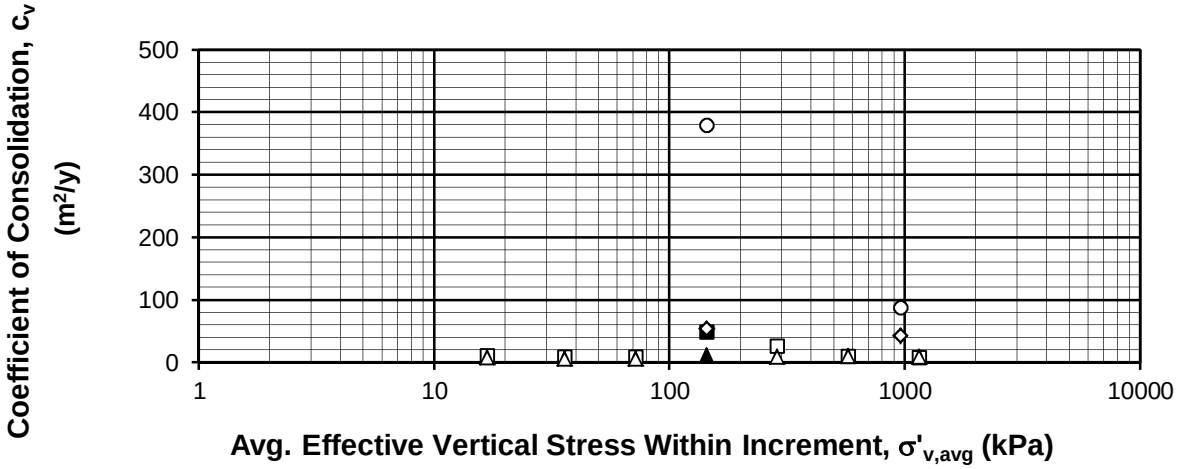
1-D CONSOLIDATION TEST: CRS

Sample No. 21a Depth 23.88 m

Boring BH-33



Fitting Methods: - Sqr. Rt. Time: □ - Loading ○ - Unloading
- Log of Time: Δ - Loading ◊- Unloading
with solid symbols indicating reloading increments

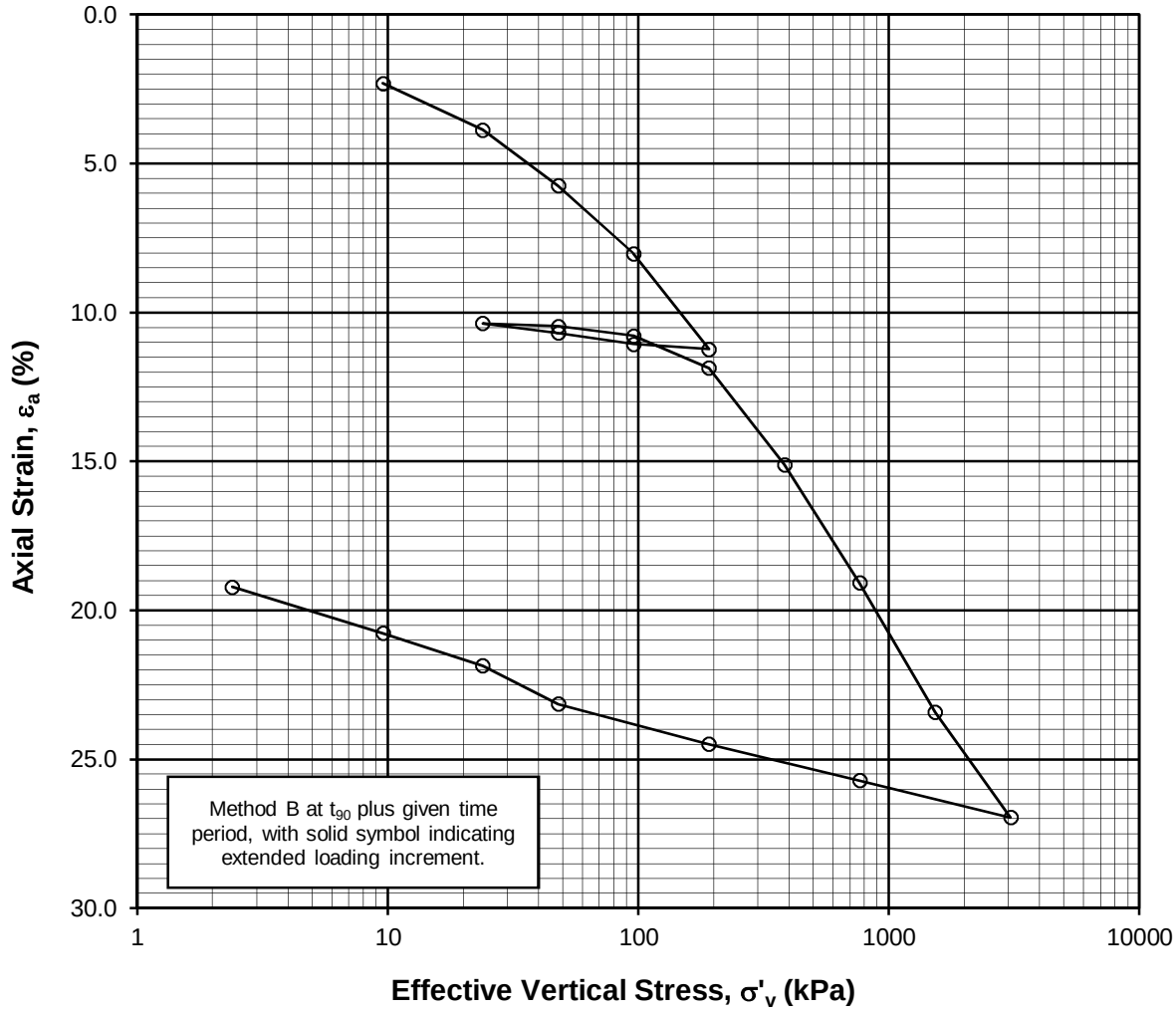


1-D CONSOLIDATION TEST: INC

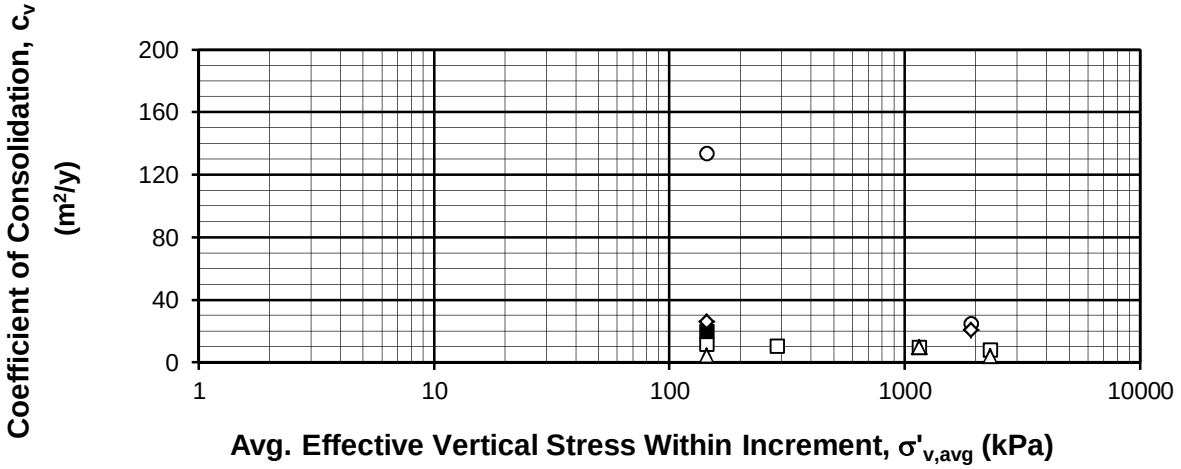
Sample 23a - Depth: 26.88 m

Boring BH-33

PLATE E-8



Fitting Methods: - Sqr. Rt. Time: □ - Loading ○ - Unloading
- Log of Time: Δ - Loading ◊- Unloading
with solid symbols indicating reloading increments

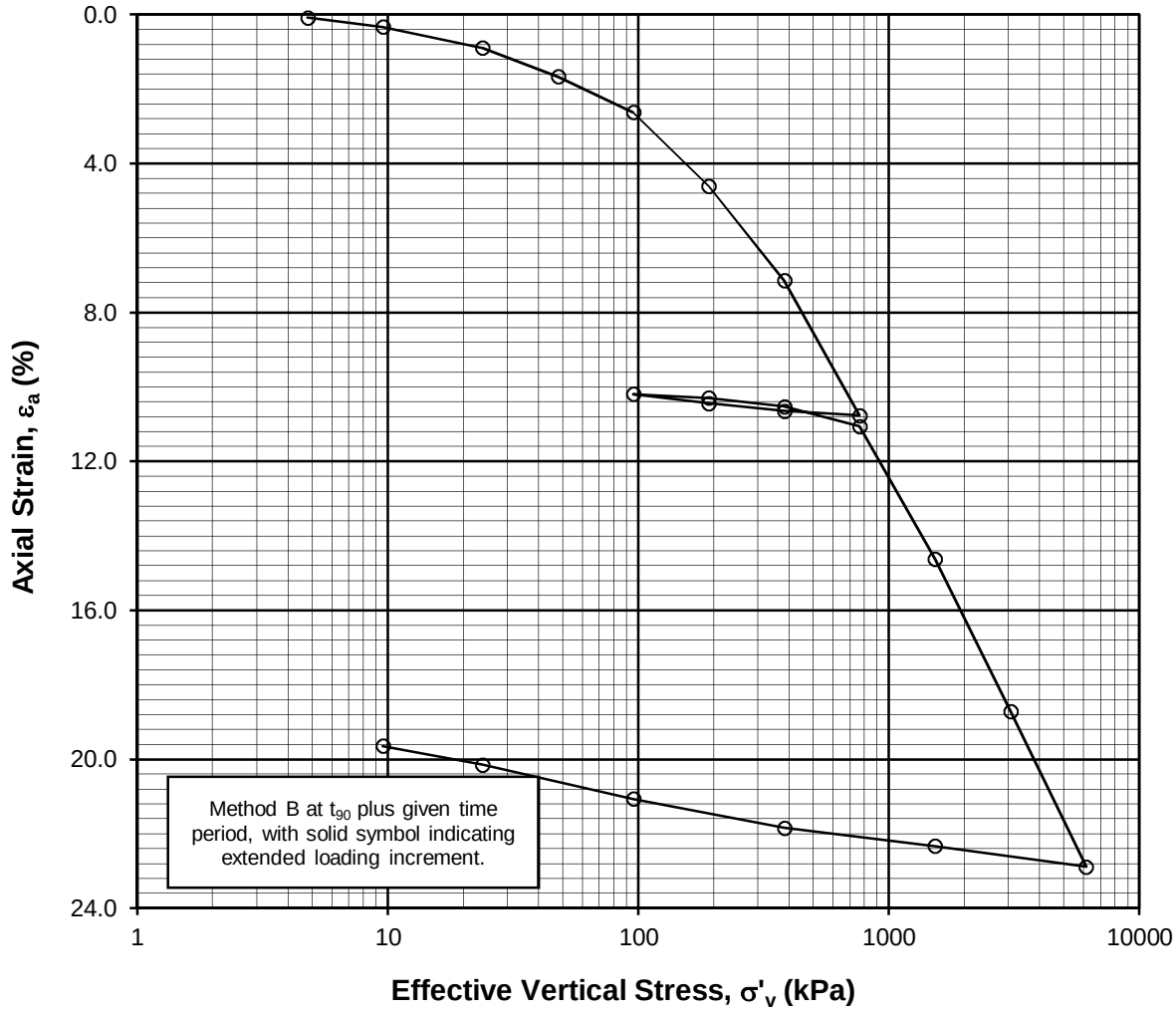


1-D CONSOLIDATION TEST: INC

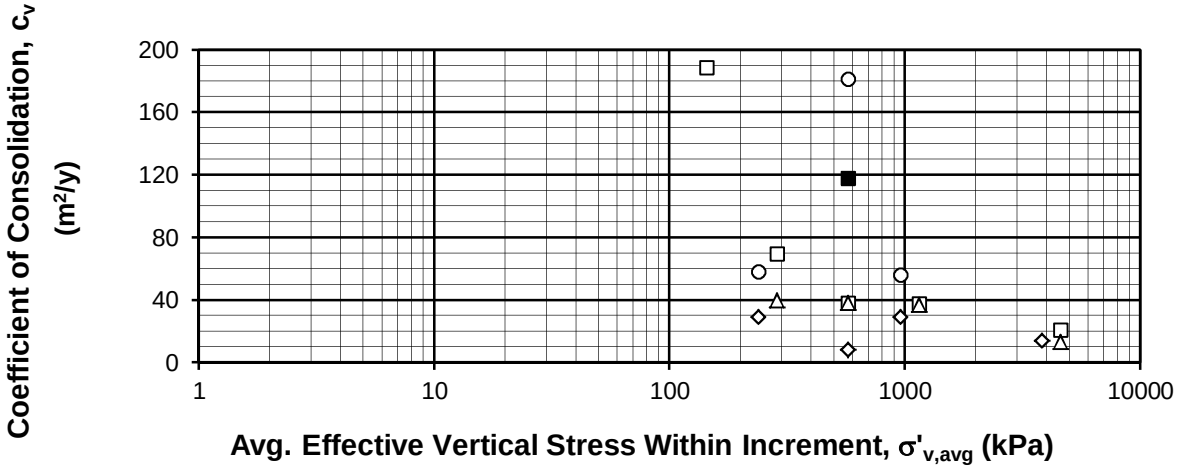
Sample 35a - Depth: 44.38 m

Boring BH-33

PLATE E-9



Fitting Methods: - Sqr. Rt. Time: □ - Loading ○ - Unloading
- Log of Time: Δ - Loading ◊- Unloading
with solid symbols indicating reloading increments

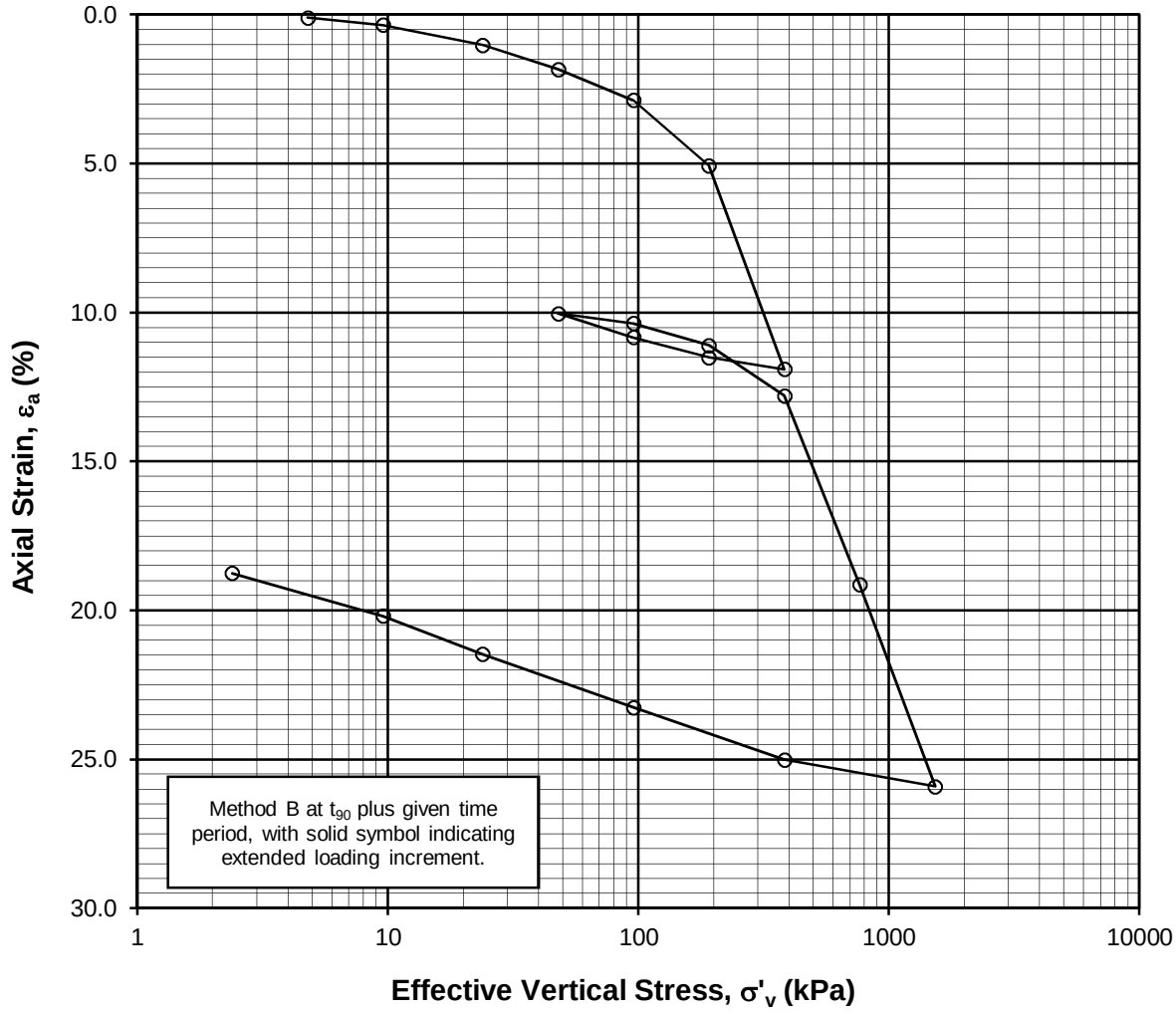


1-D CONSOLIDATION TEST: INC

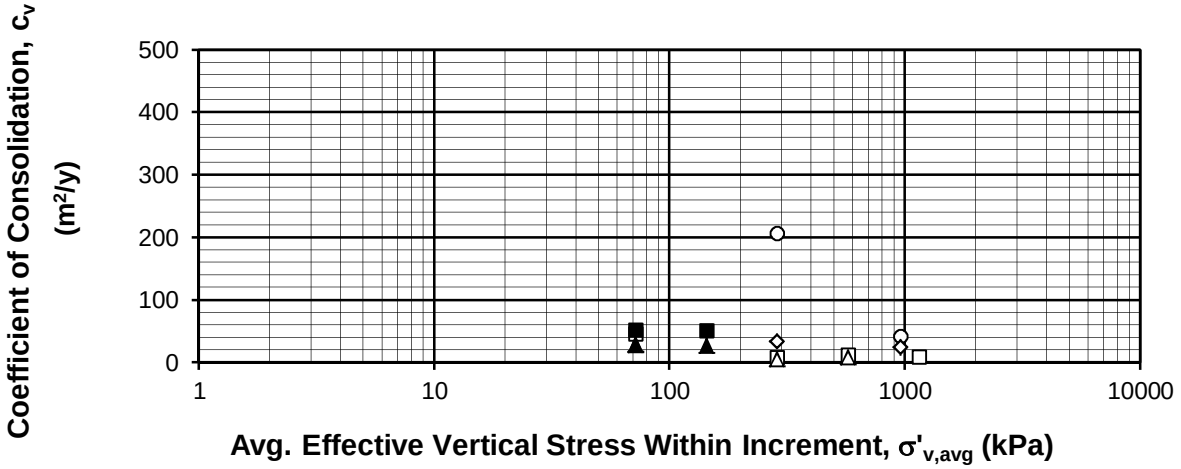
Sample 17a - Depth: 13.9 m

Boring BH-34

PLATE E-10



Fitting Methods: - Sqr. Rt. Time: □ - Loading ○ - Unloading
- Log of Time: Δ - Loading ◊- Unloading
with solid symbols indicating reloading increments

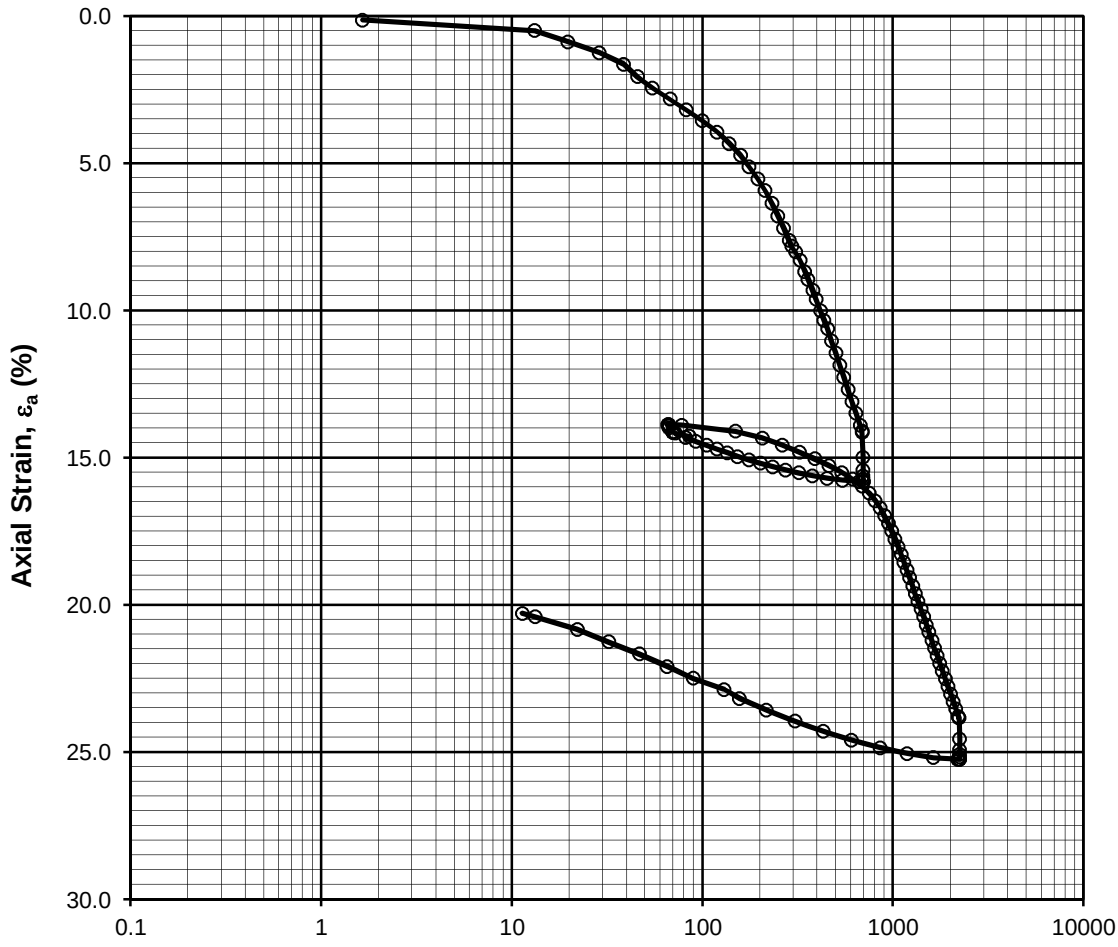


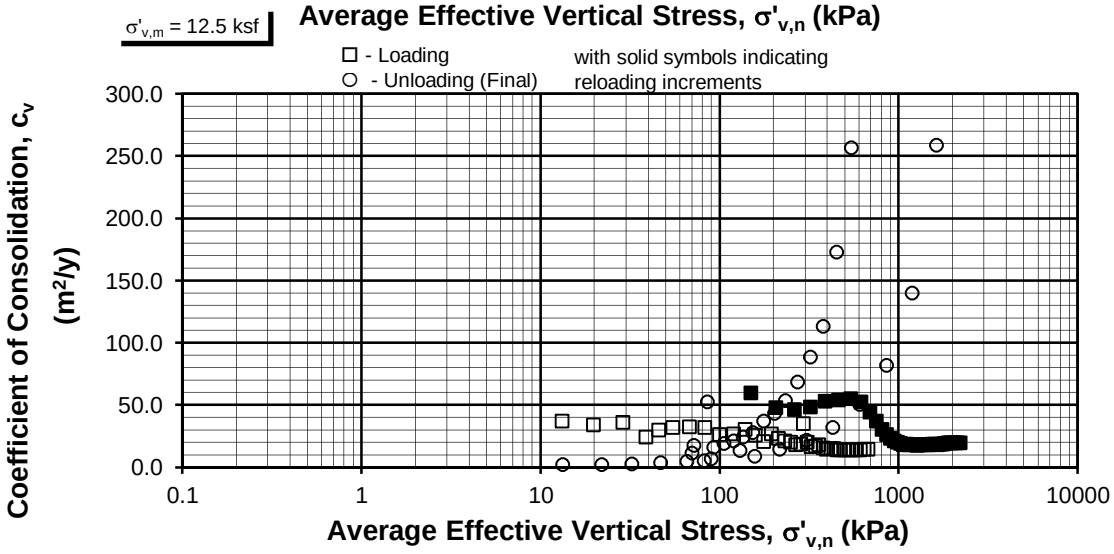
1-D CONSOLIDATION TEST: INC

Sample 25a - Depth: 25.89 m

Boring BH-34

PLATE E-11

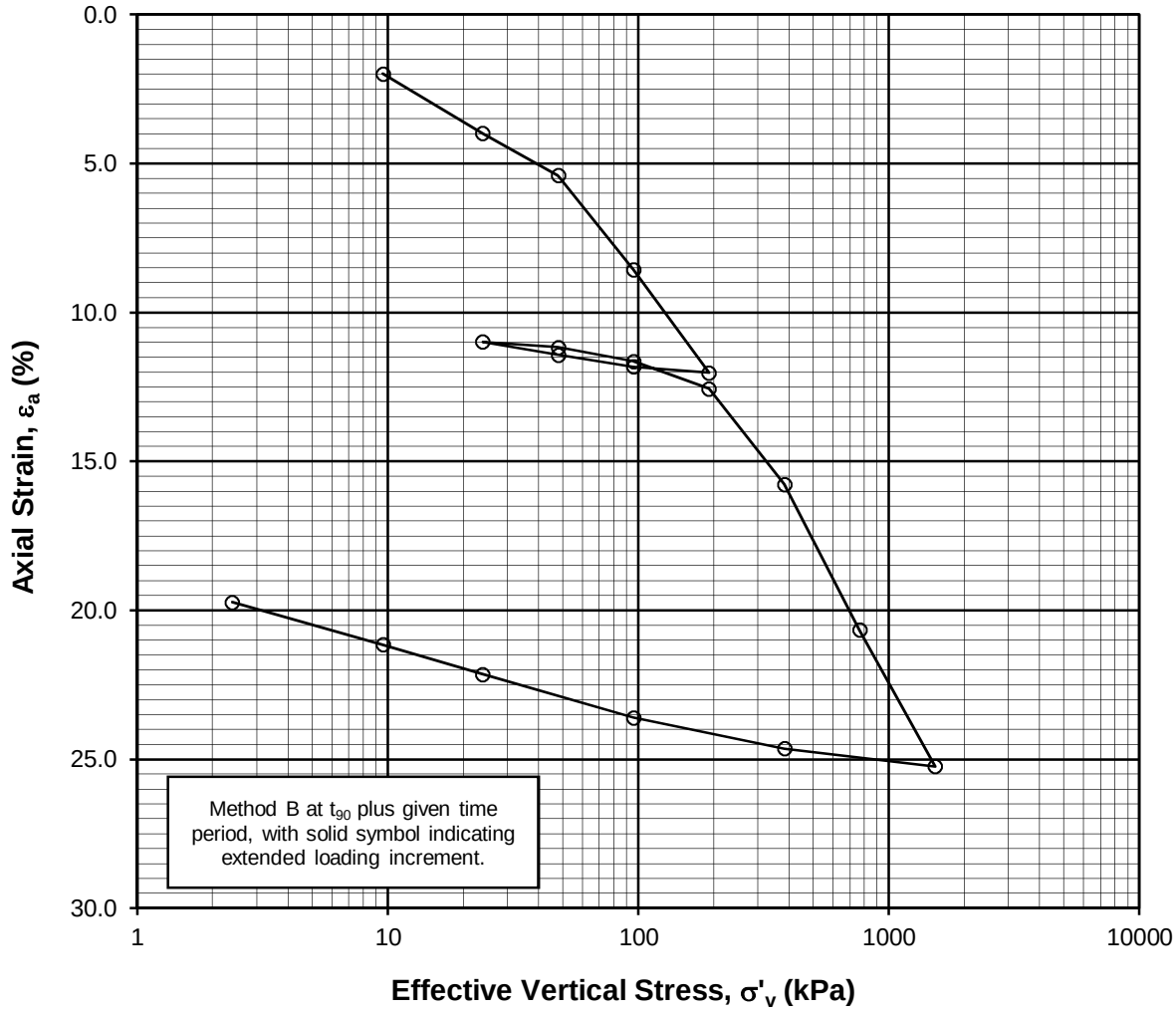




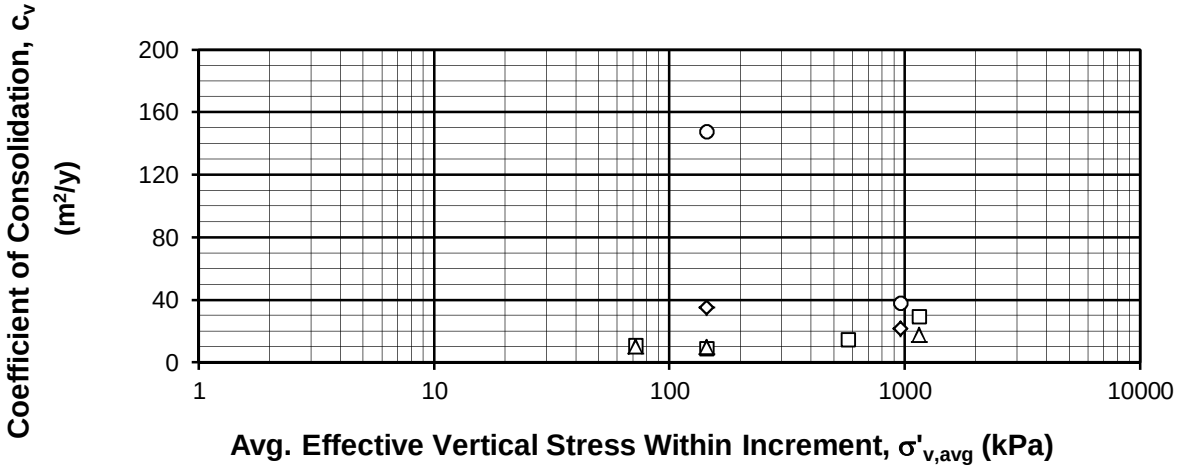
1-D CONSOLIDATION TEST: CRS

Sample No. 31a Depth 34.7 m

Boring BH-34



Fitting Methods: - Sqr. Rt. Time: □ - Loading ○ - Unloading
- Log of Time: Δ - Loading ◊- Unloading
with solid symbols indicating reloading increments

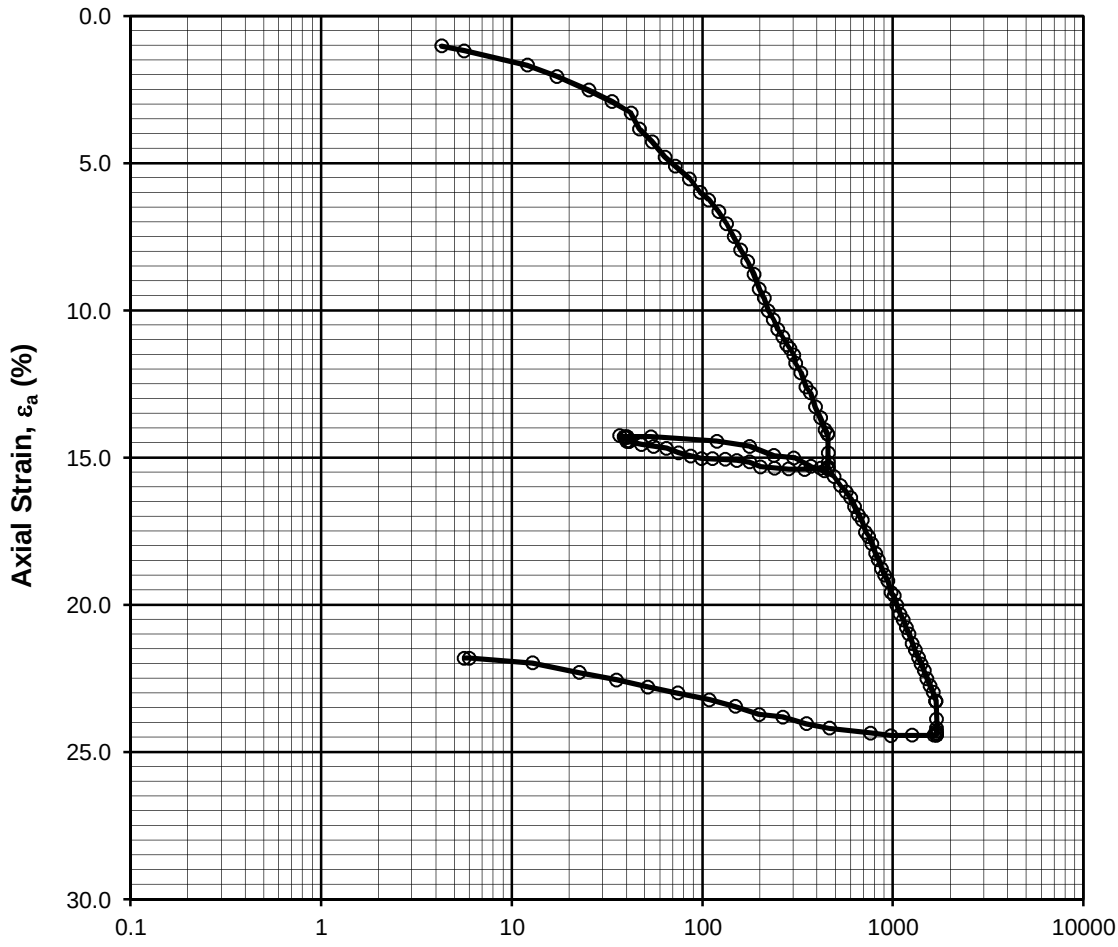


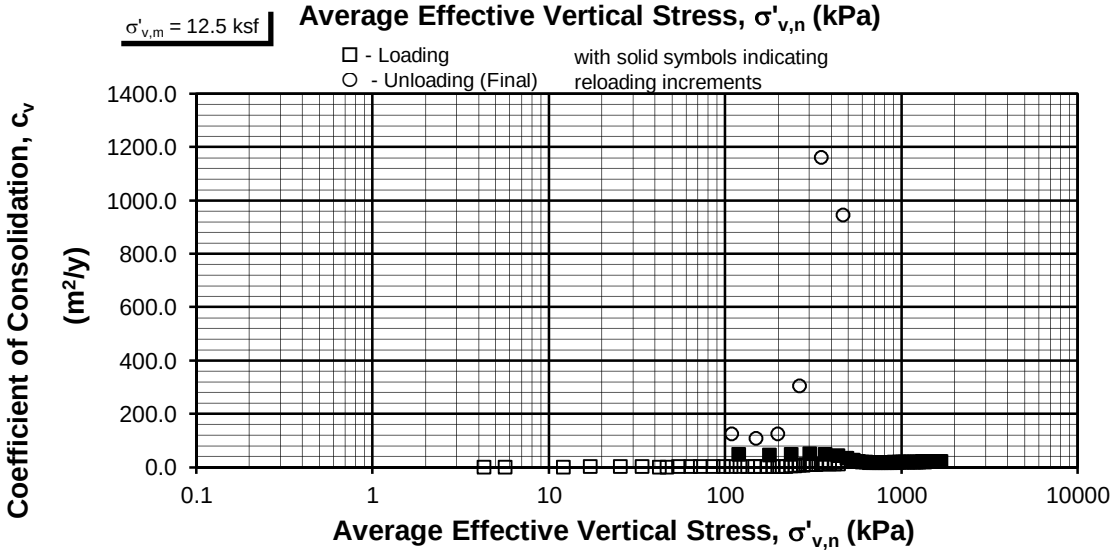
1-D CONSOLIDATION TEST: INC

Sample 13a - Depth: 8.9 m

Boring BH-35

PLATE E-13

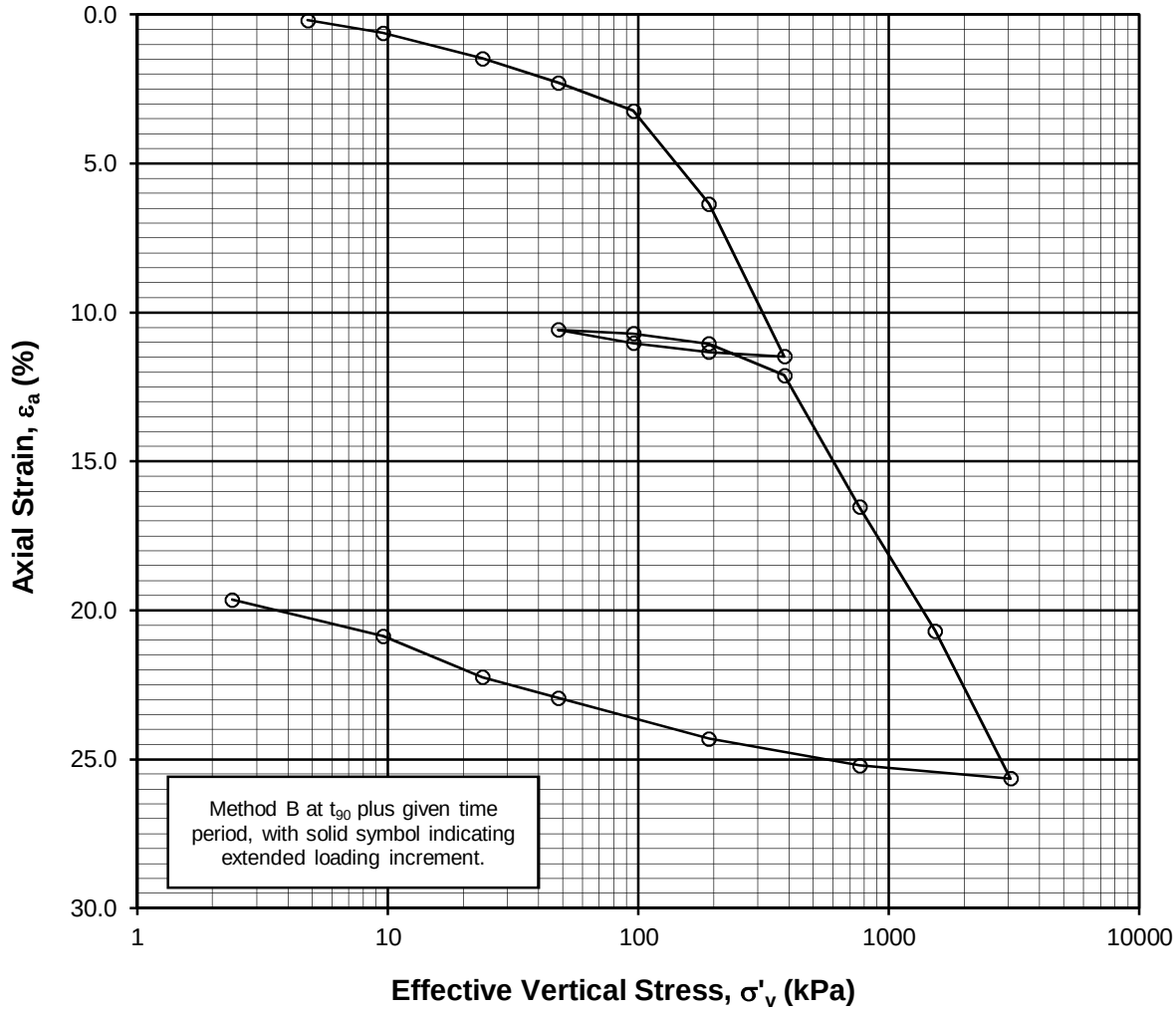




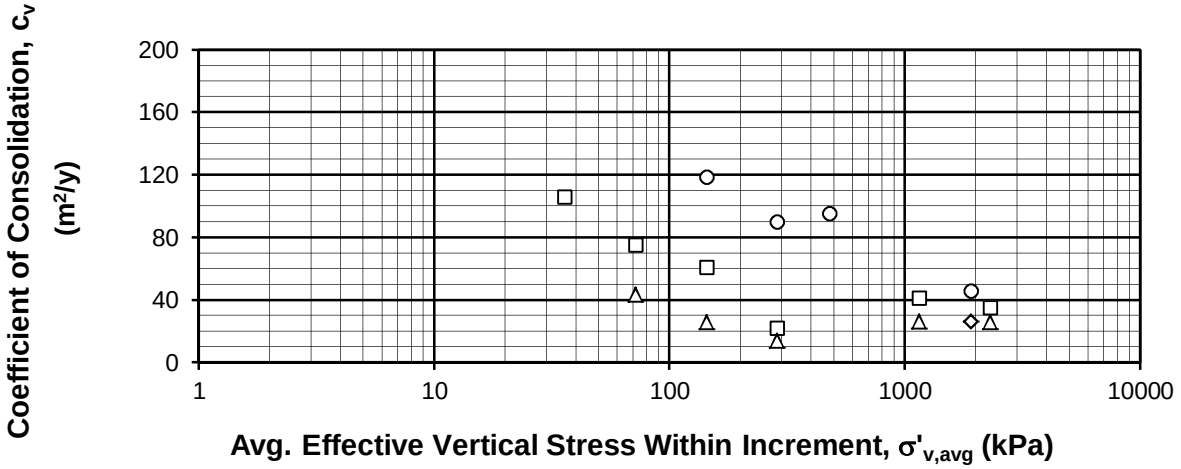
1-D CONSOLIDATION TEST: CRS

Sample No. 17a Depth 14.87 m

Boring BH-35



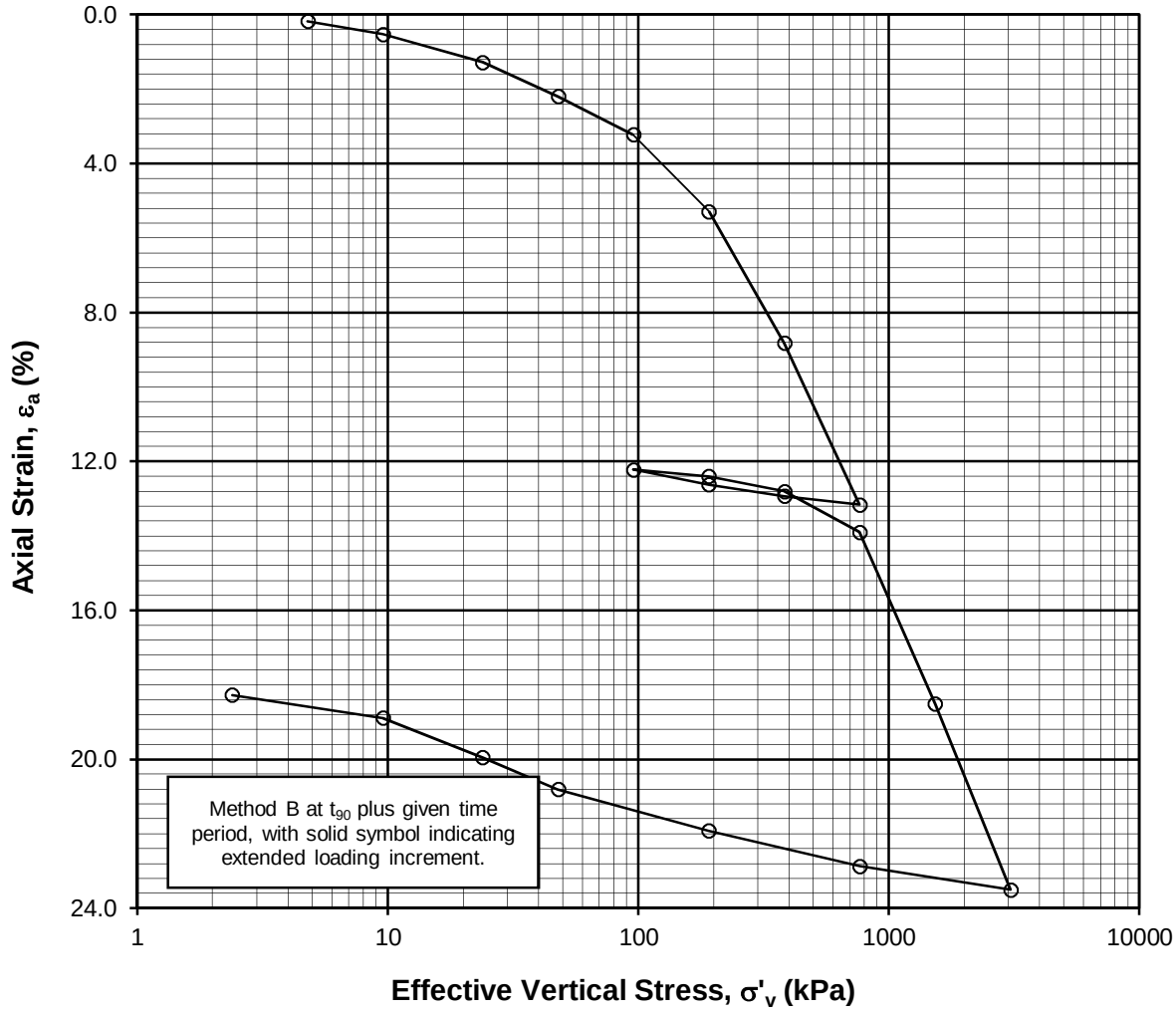
Fitting Methods: - Sqr. Rt. Time: □ - Loading ○ - Unloading
- Log of Time: Δ - Loading ◊- Unloading
with solid symbols indicating reloading increments



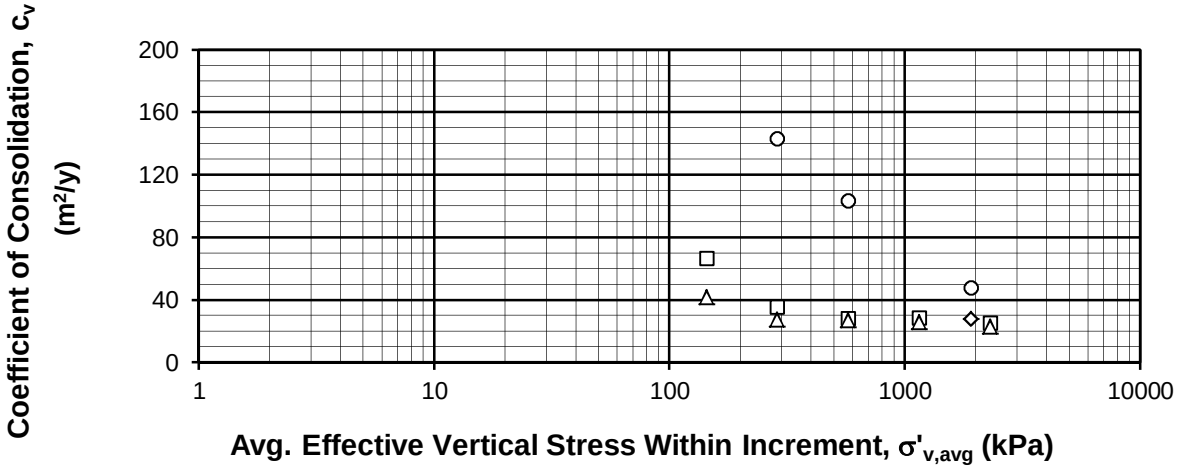
1-D CONSOLIDATION TEST: INC

Sample 21a - Depth: 20.88 m

Boring BH-35



Fitting Methods: - Sqr. Rt. Time: □ - Loading ○ - Unloading
- Log of Time: Δ - Loading ◊- Unloading
with solid symbols indicating reloading increments

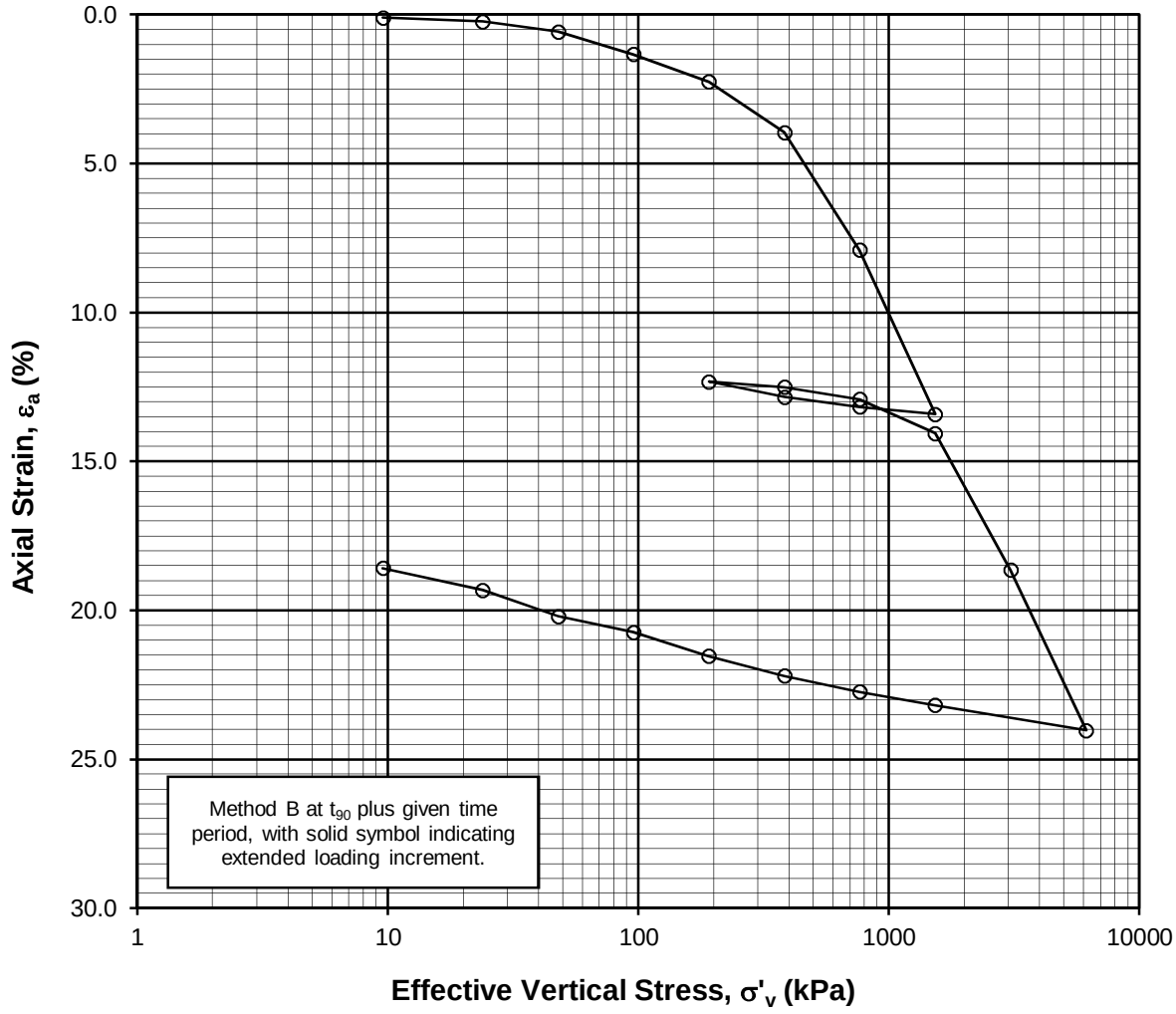


1-D CONSOLIDATION TEST: INC

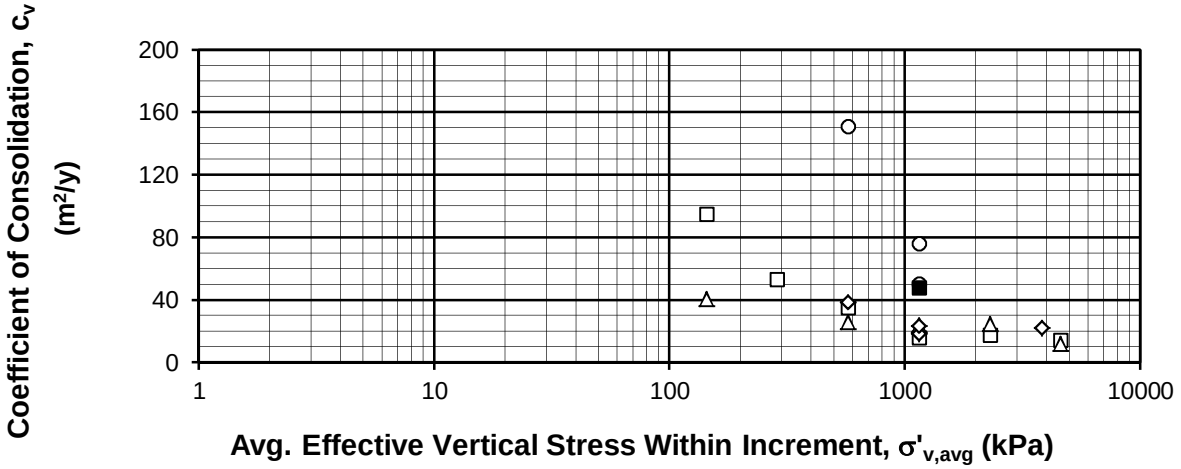
Sample 27a - Depth: 29.9 m

Boring BH-35

PLATE E-16



Fitting Methods: - Sqr. Rt. Time: □ - Loading ○ - Unloading
- Log of Time: Δ - Loading ◊- Unloading
with solid symbols indicating reloading increments

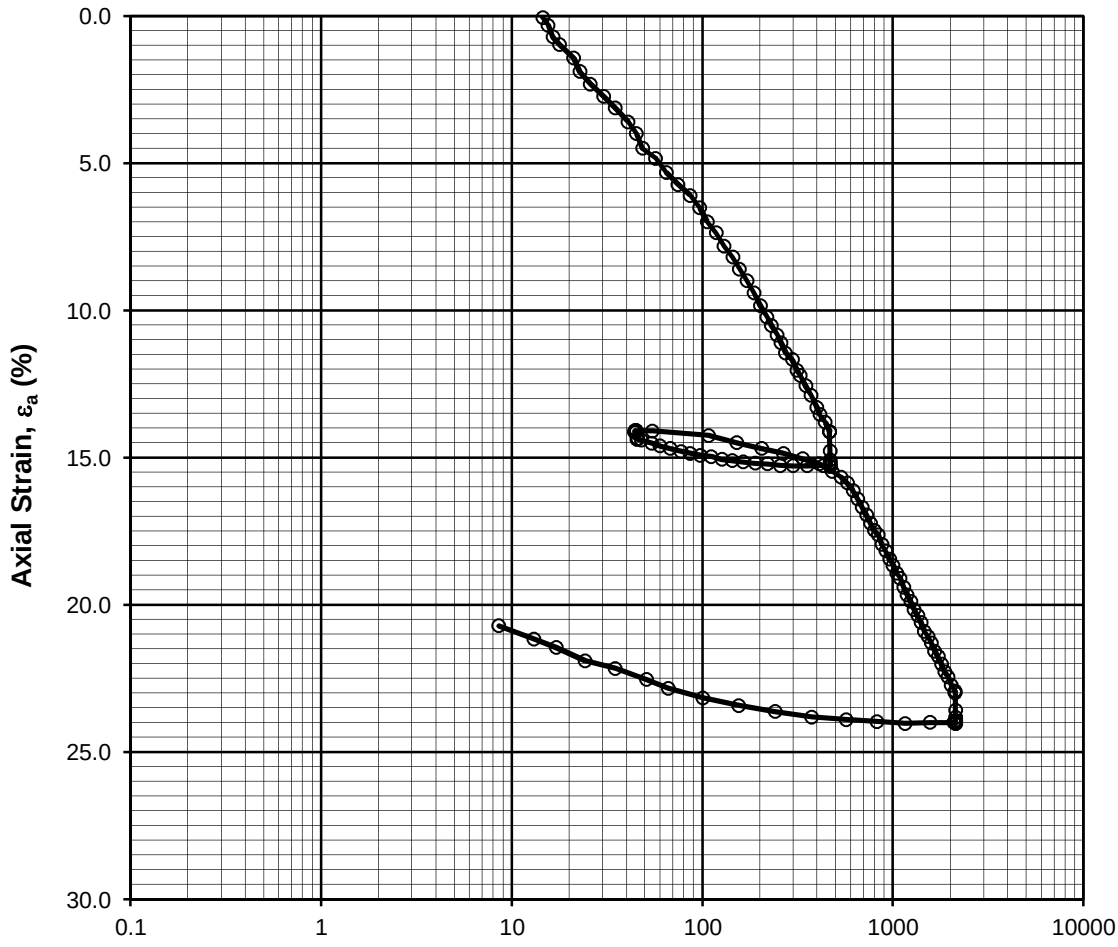


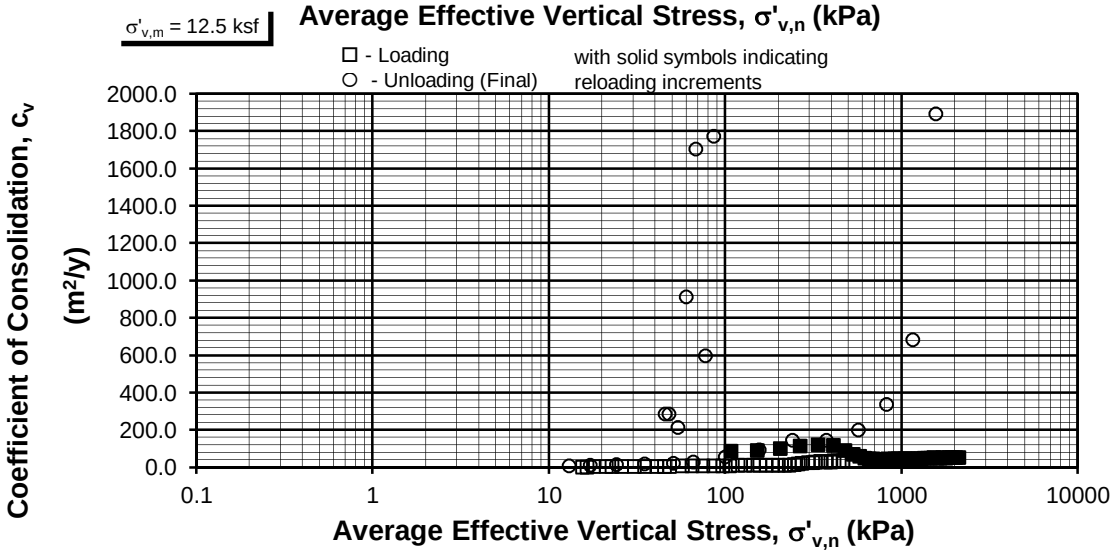
1-D CONSOLIDATION TEST: INC

Sample 50a - Depth: 66.87 m

Boring BH-35

PLATE E-17

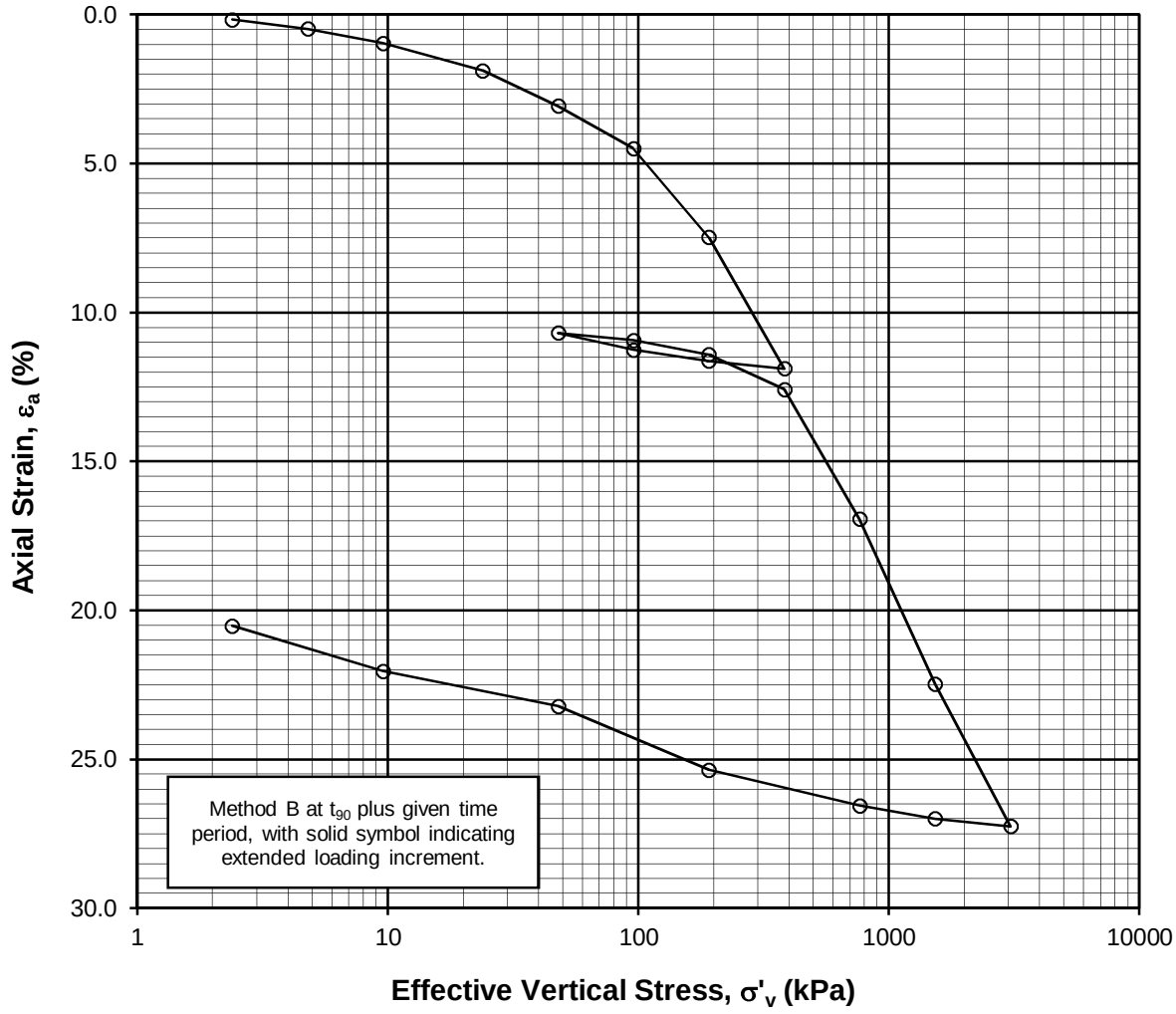




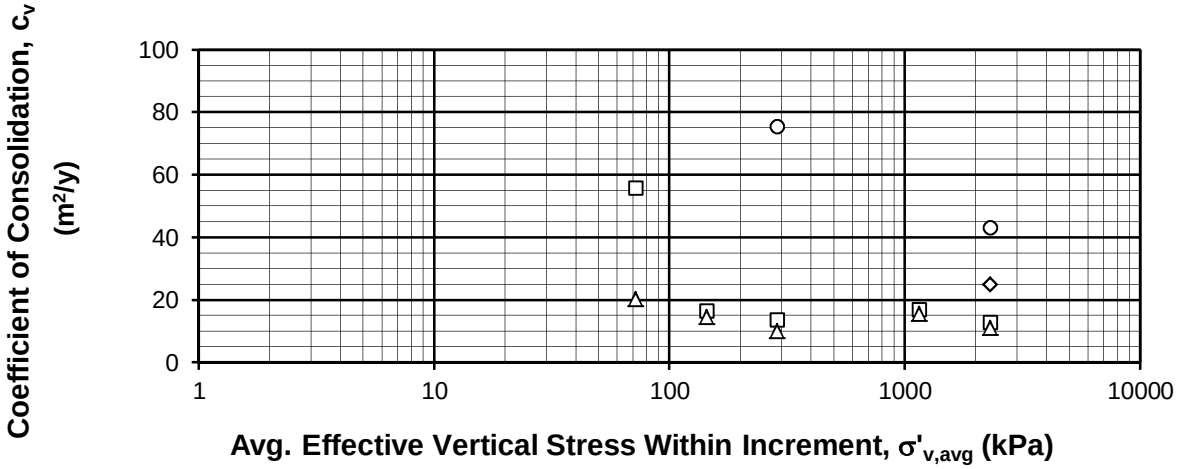
1-D CONSOLIDATION TEST: CRS

Sample No. 10a Depth 9.37 m

Boring BH-36



Fitting Methods: - Sqr. Rt. Time: □ - Loading ○ - Unloading
- Log of Time: Δ - Loading ◊- Unloading
with solid symbols indicating reloading increments

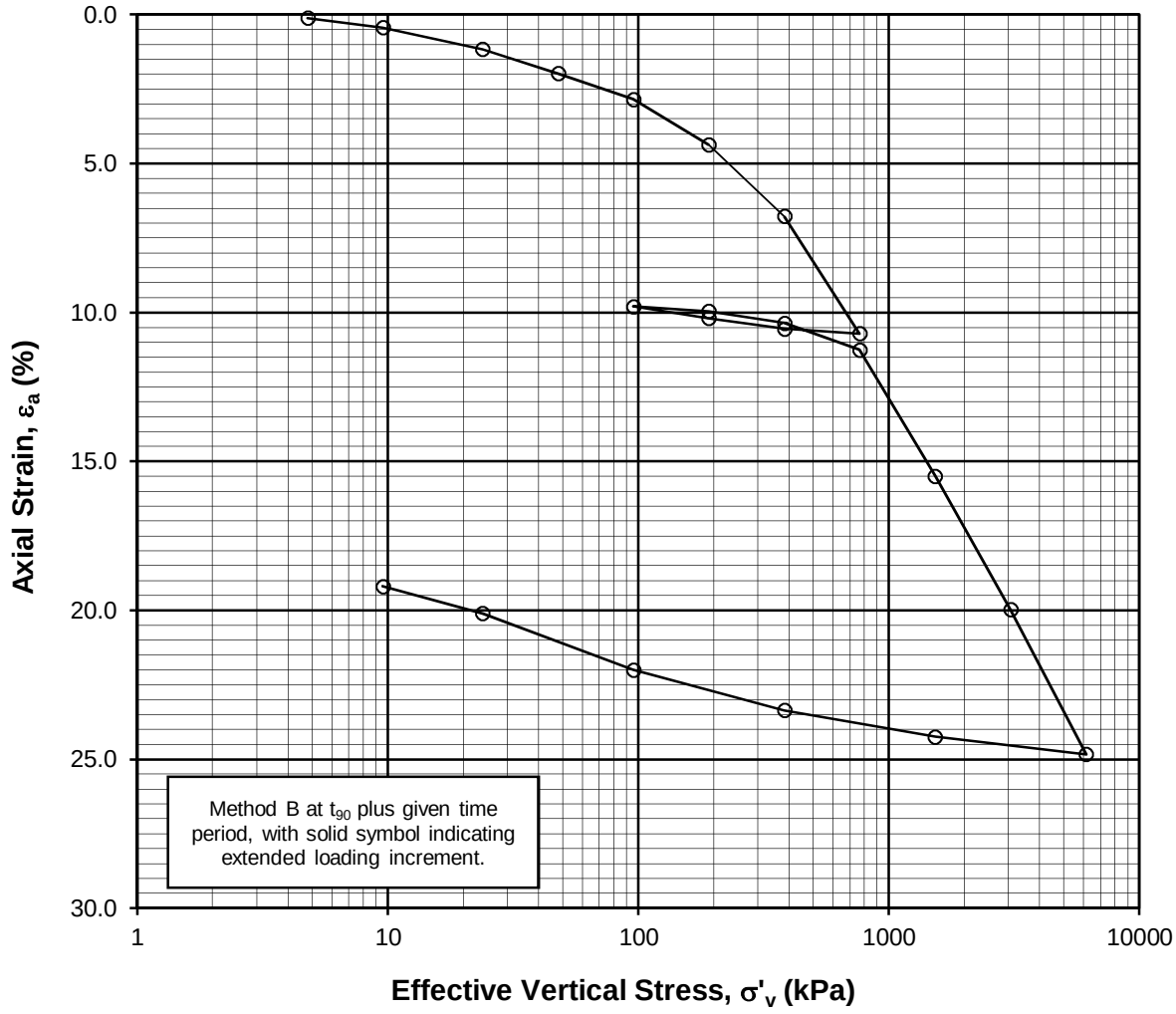


1-D CONSOLIDATION TEST: INC

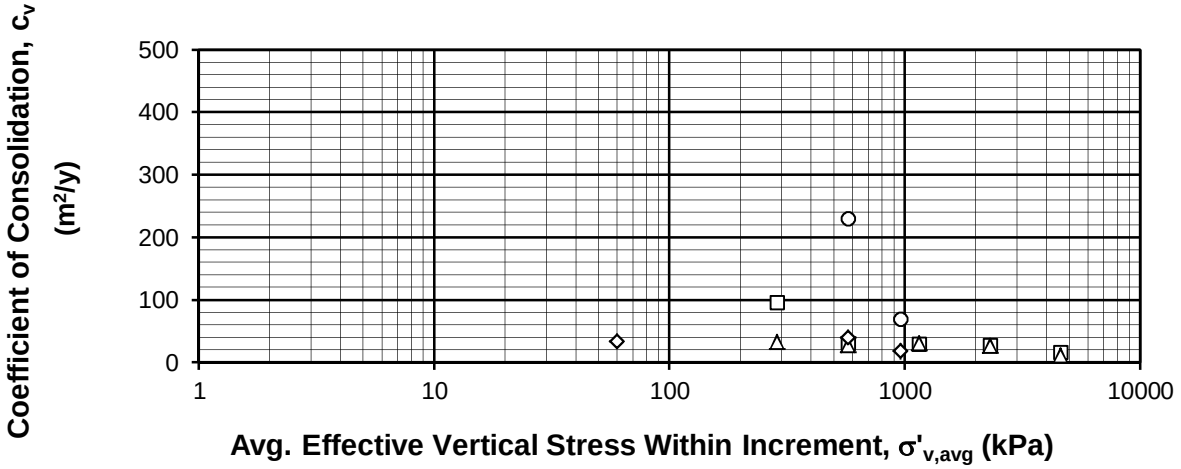
Sample 16a - Depth: 18.39 m

Boring BH-36

PLATE E-19



Fitting Methods: - Sqr. Rt. Time: □ - Loading ○ - Unloading
- Log of Time: Δ - Loading ◊- Unloading
with solid symbols indicating reloading increments

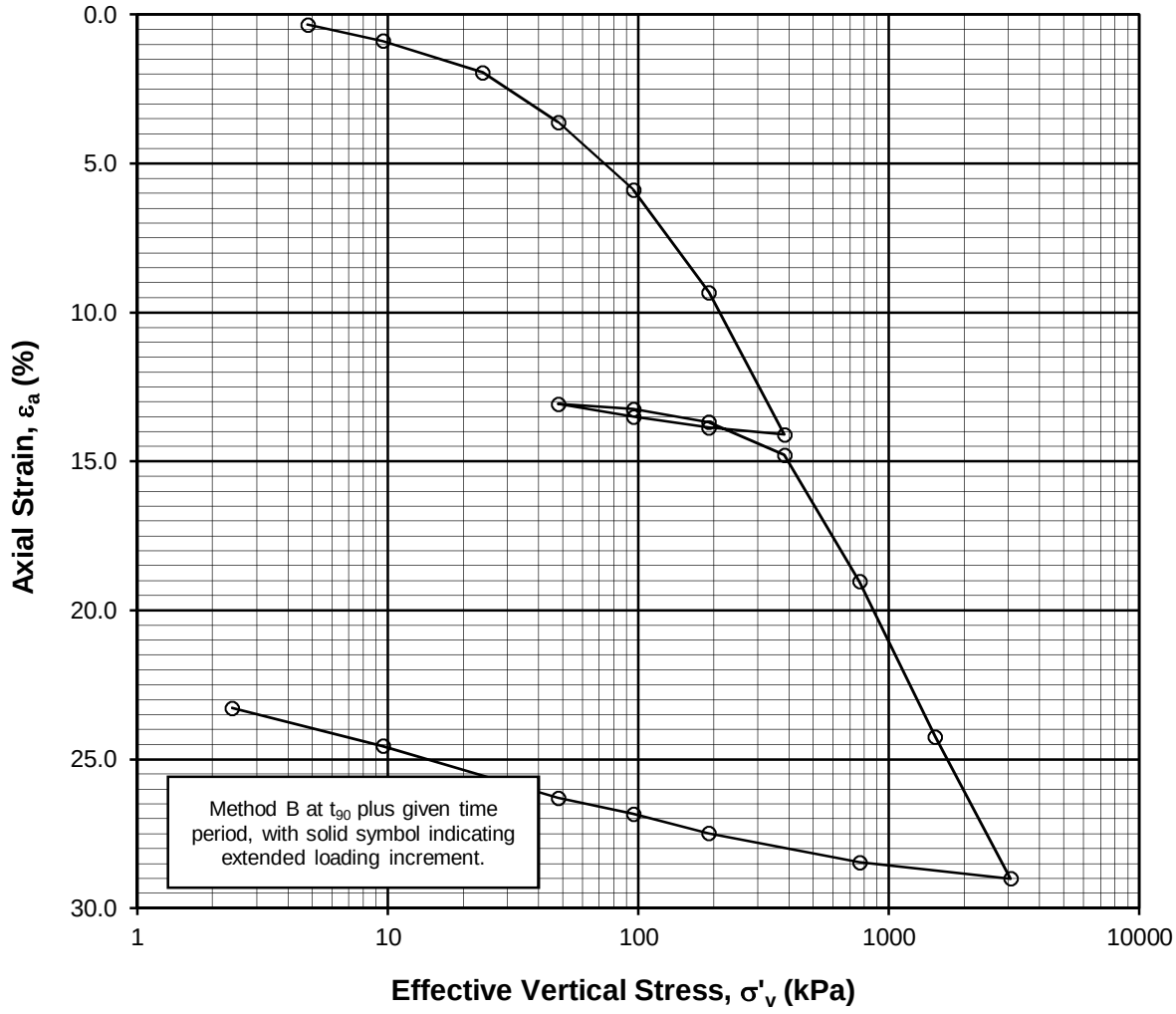


1-D CONSOLIDATION TEST: INC

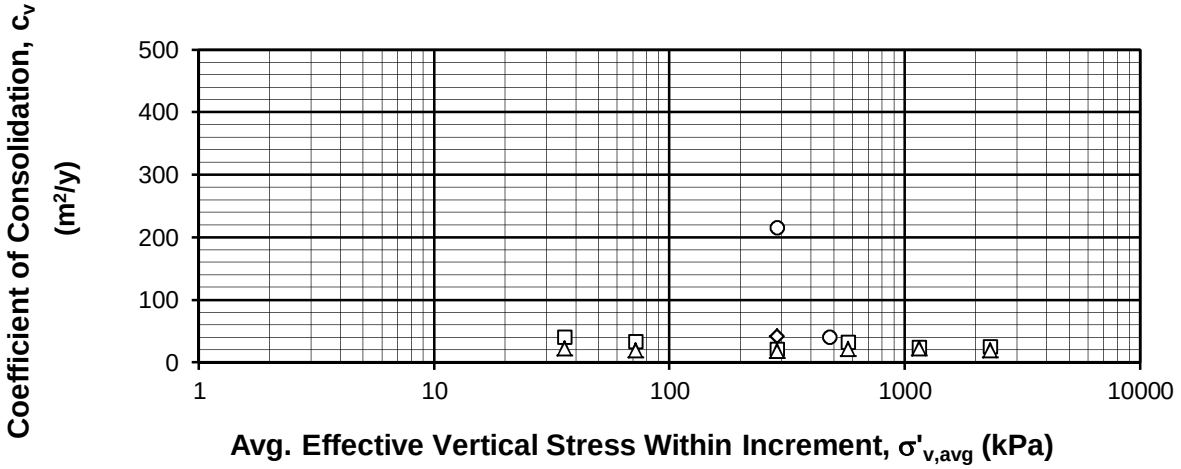
Sample 30a - Depth: 39.23 m

Boring BH-36

PLATE E-20



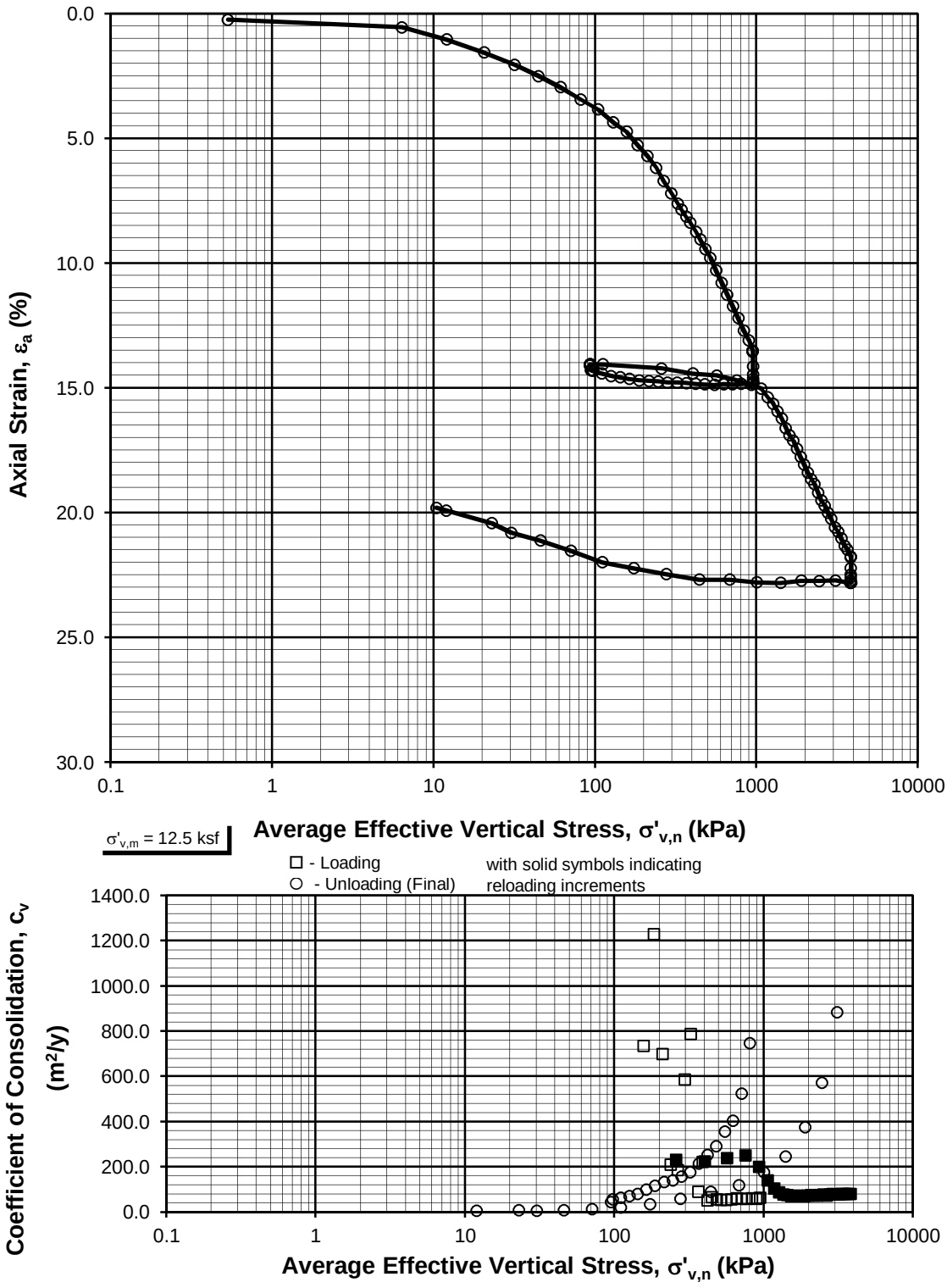
Fitting Methods: - Sqr. Rt. Time: □ - Loading ○ - Unloading
- Log of Time: Δ - Loading ◊- Unloading
with solid symbols indicating reloading increments



1-D CONSOLIDATION TEST: INC

Sample 11a - Depth: 12.89 m

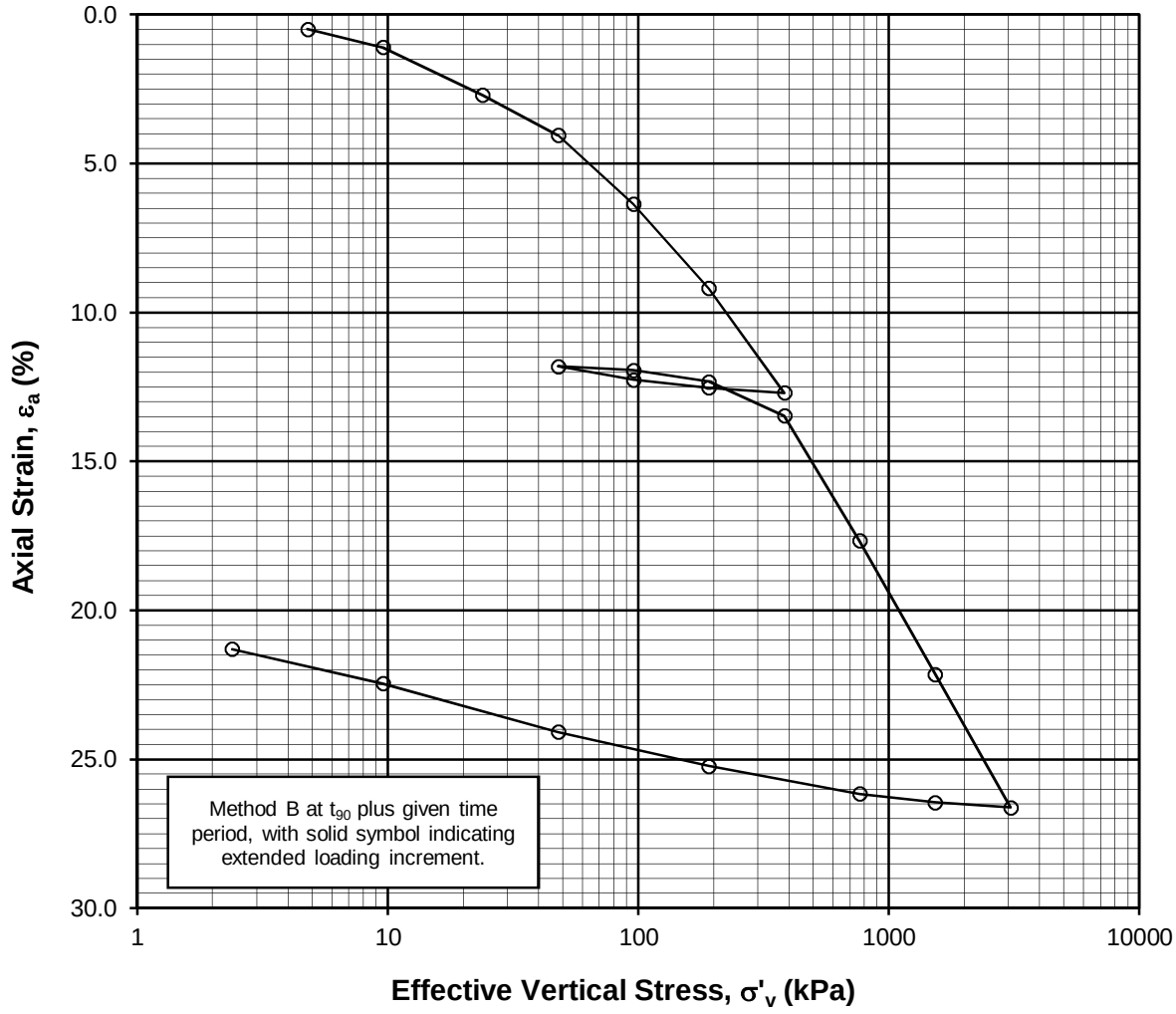
Boring BH-37



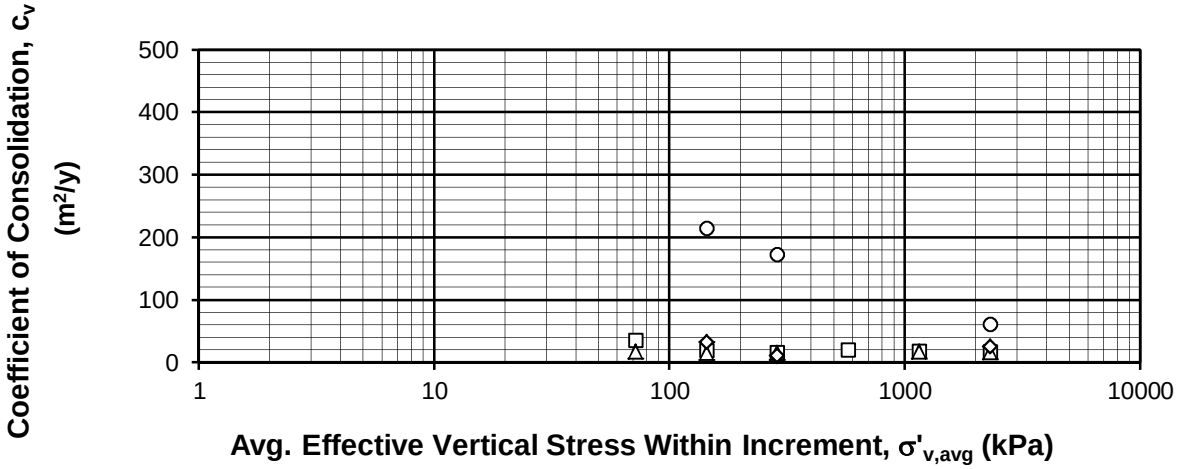
1-D CONSOLIDATION TEST: CRS

Sample No. 21a Depth 27.86 m

Boring BH-37



Fitting Methods: - Sqr. Rt. Time: □ - Loading ○ - Unloading
- Log of Time: Δ - Loading ◊- Unloading
with solid symbols indicating reloading increments

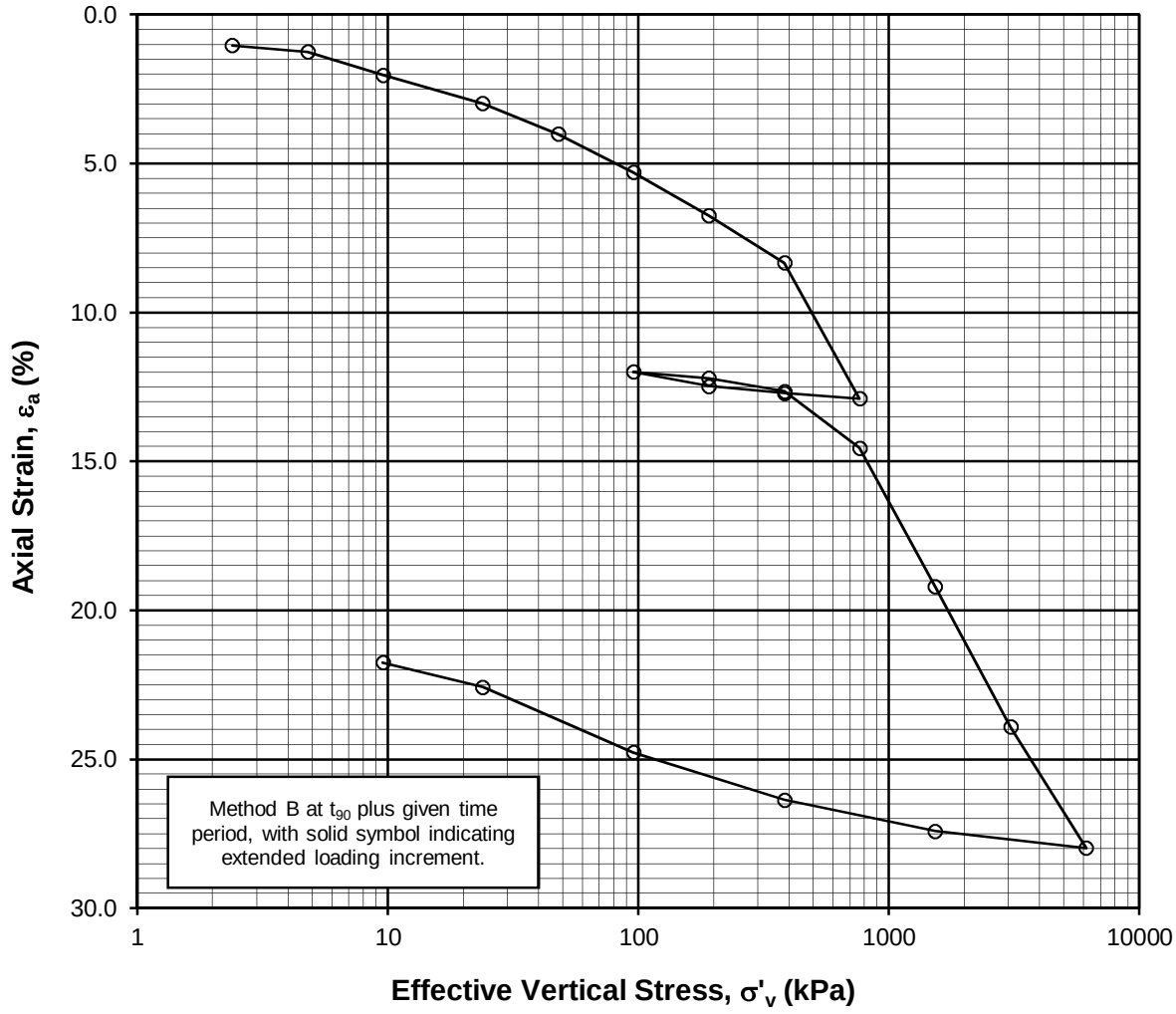


1-D CONSOLIDATION TEST: INC

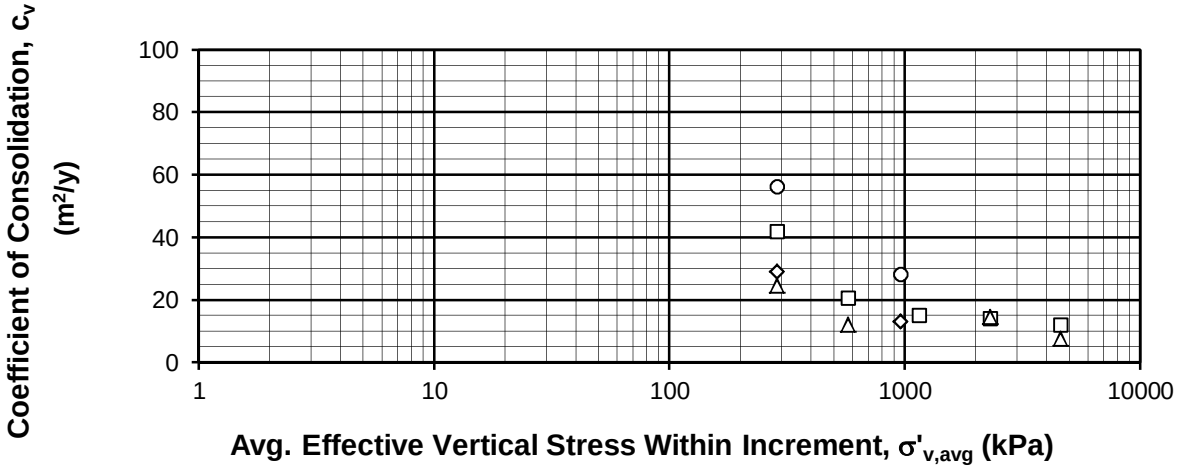
Sample 17a - Depth: 21.88 m

Boring BH-37A

PLATE E-23



Fitting Methods: - Sqr. Rt. Time: □ - Loading ○ - Unloading
- Log of Time: Δ - Loading ◊- Unloading
with solid symbols indicating reloading increments

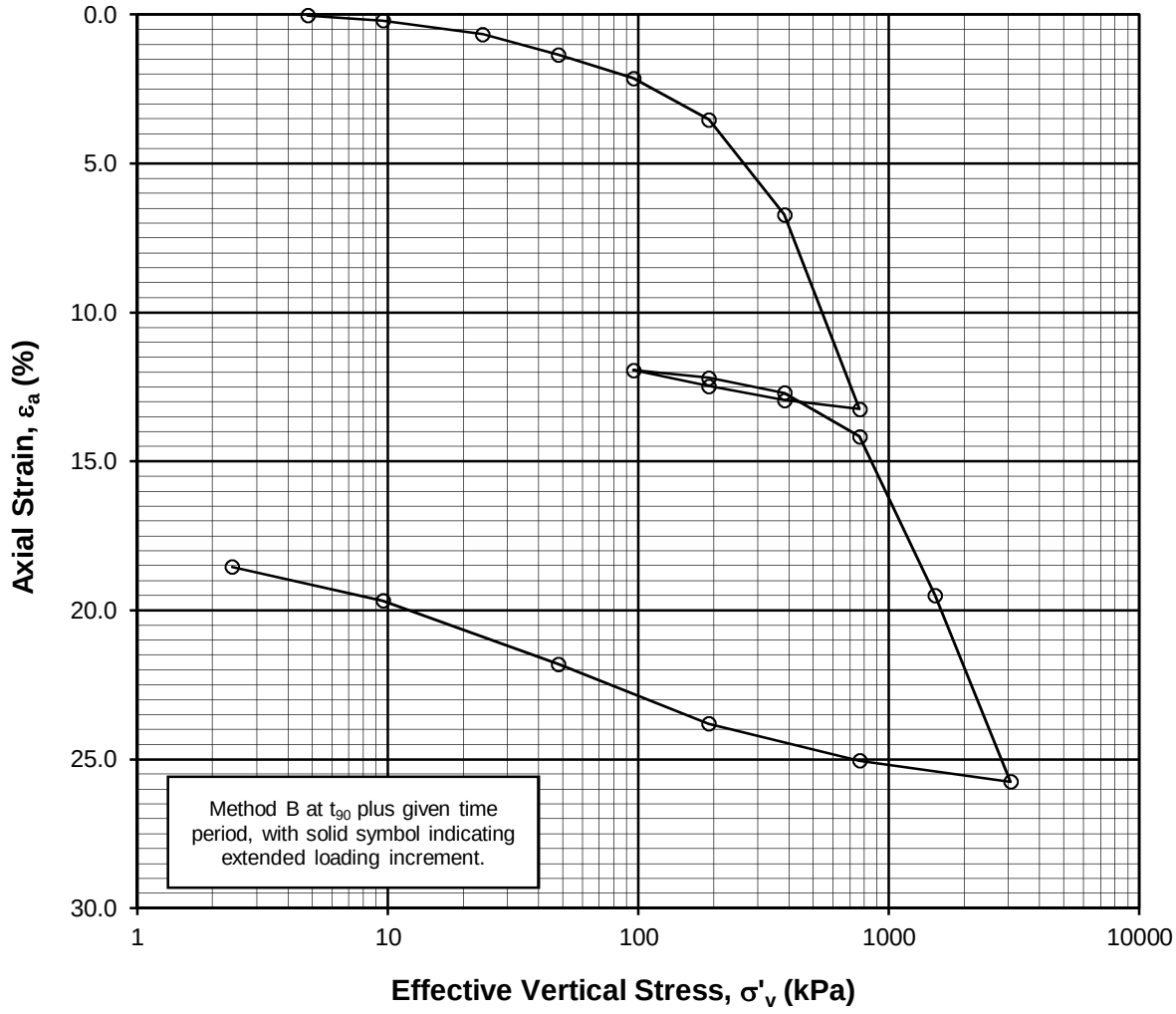


1-D CONSOLIDATION TEST: INC

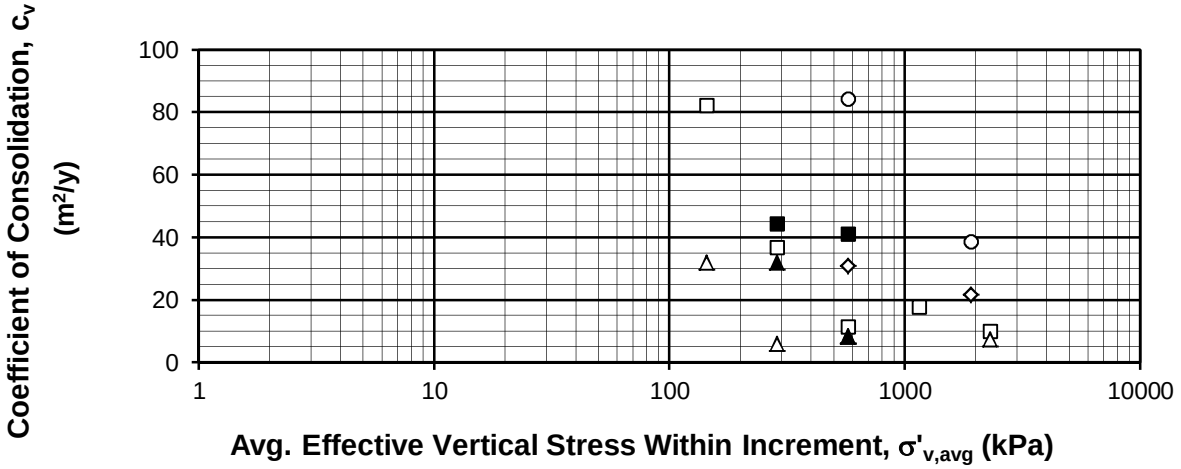
Sample 27a - Depth: 36.9 m

Boring BH-37A

PLATE E-24



Fitting Methods: - Sqr. Rt. Time: □ - Loading ○ - Unloading
- Log of Time: Δ - Loading ◊- Unloading
with solid symbols indicating reloading increments

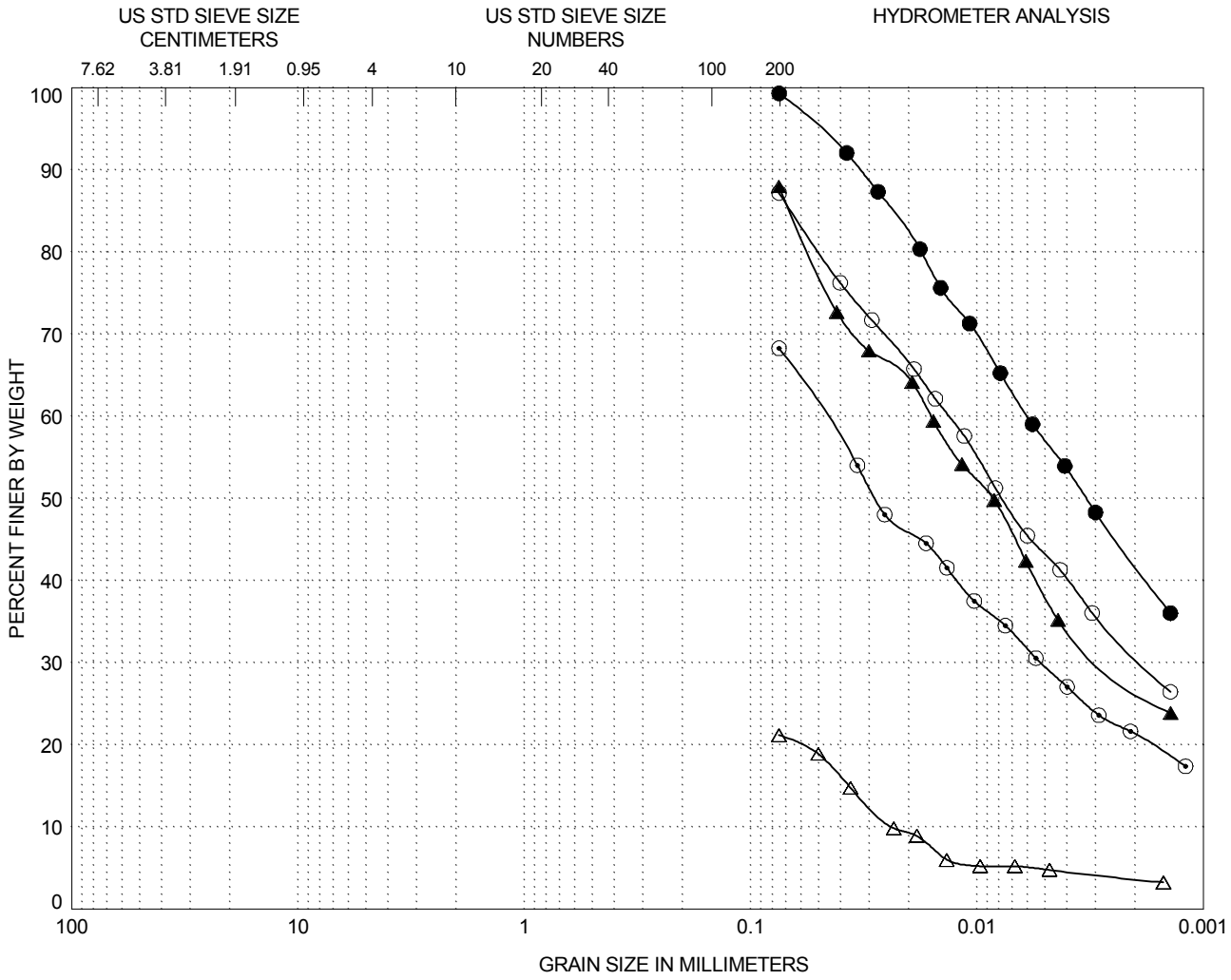


1-D CONSOLIDATION TEST: INC

Sample 39a - Depth: 54.89 m

Boring BH-37A

PLATE E-25

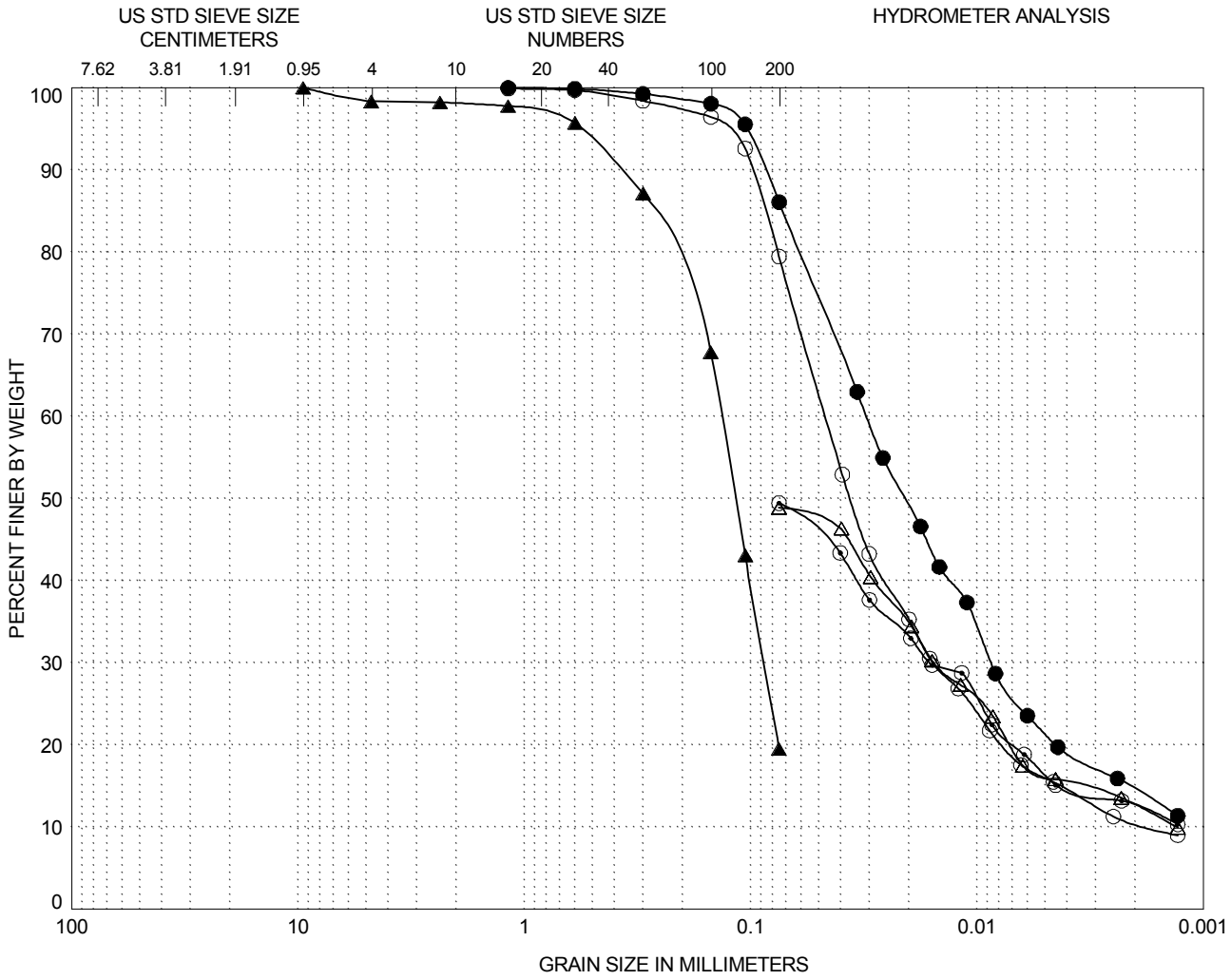


GRAVEL		SAND			SILT or CLAY
Coarse	Fine	Coarse	Medium	Fine	

LEGEND	(location)	(depth,m)		Cc	Cu
○	BH-12	2.7	Peat (PT)		
●	BH-12	5.8	Lean CLAY (CL)		
△	BH-13	1.9	Peat (PT)		
▲	BH-16	8.2	Lean CLAY (CL)		
⊙	BH-30	2.4	Sandy Lean CLAY (CL)		

GRAIN SIZE CURVES
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE E-26

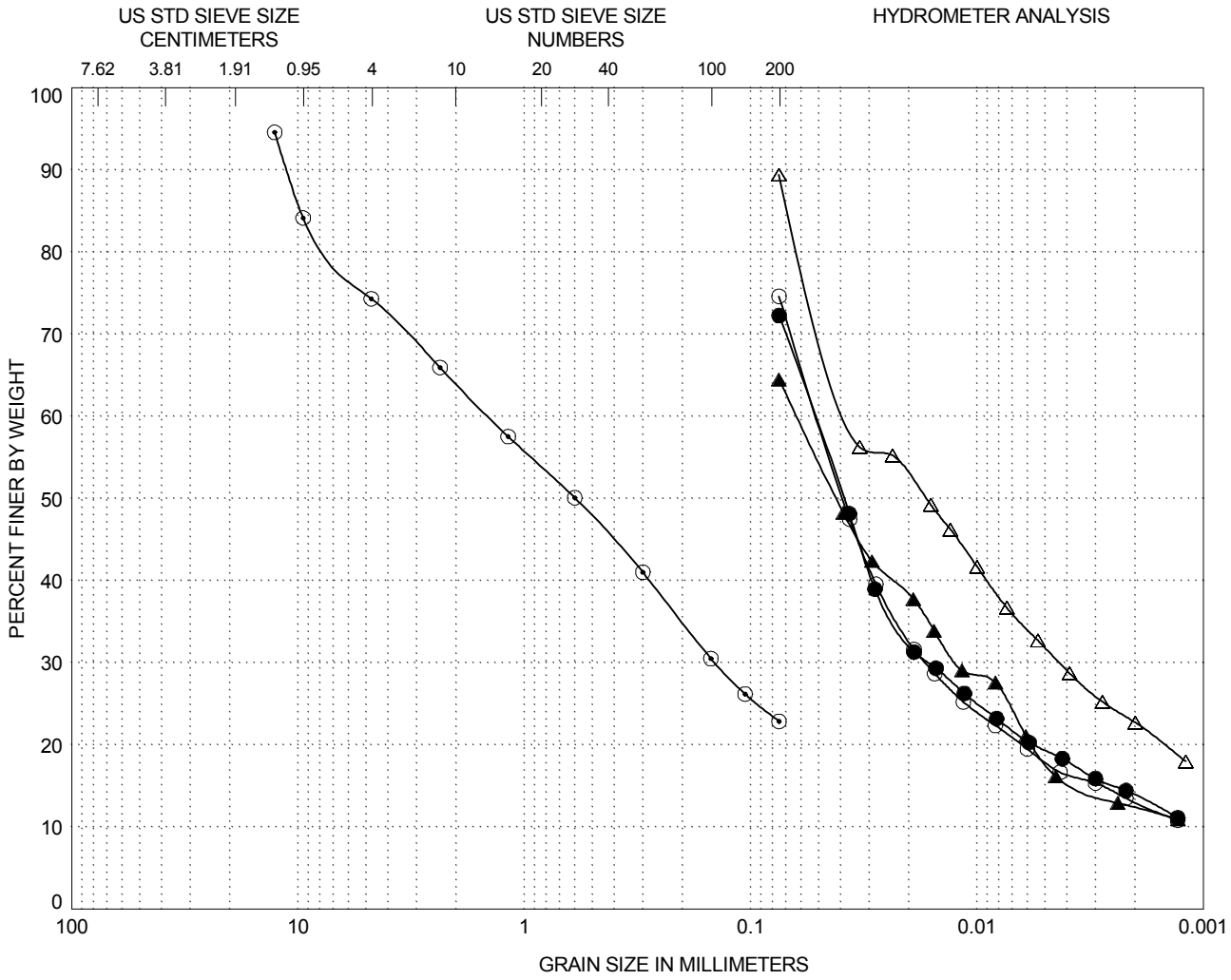


GRAVEL		SAND			SILT or CLAY
Coarse	Fine	Coarse	Medium	Fine	

LEGEND	(location)	(depth,m)		Cc	Cu
○	BH-32	6.5	Sandy SILT (ML)	3.0	26.9
●	BH-32	16.5	Silt (ML)		
△	BH-33	1.0	SILT (ML)		
▲	BH-33	4.0	Silty Fine SAND (SM)		
⊙	BH-34	2.0	Silty SAND (SM)		

GRAIN SIZE CURVES
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE E-27

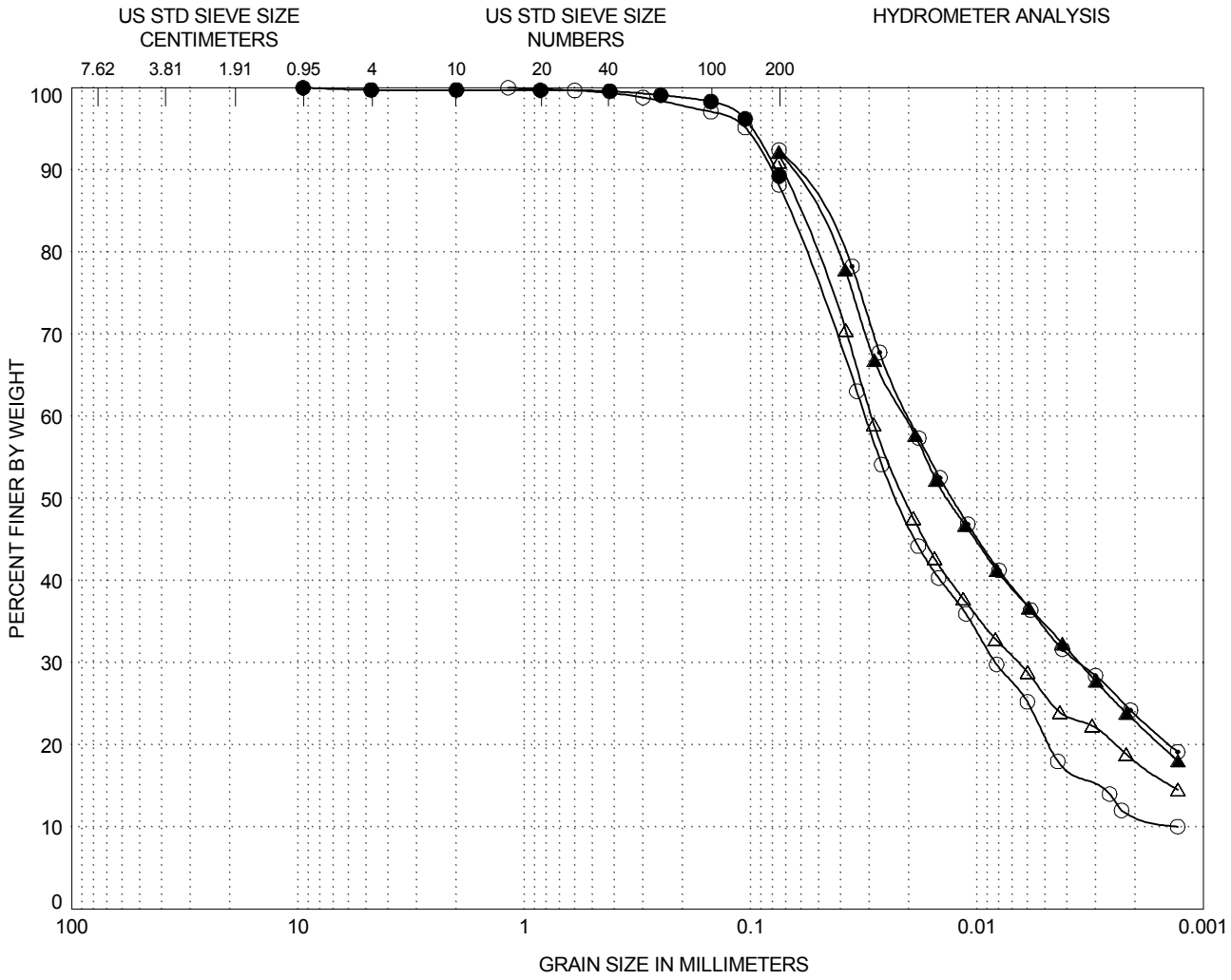


GRAVEL		SAND			SILT or CLAY
Coarse	Fine	Coarse	Medium	Fine	

LEGEND	(location)	(depth,m)		Cc	Cu
○	BH-34	3.4	Silty SAND (SM)		
●	BH-34	4.3	Silty SAND (SM)		
△	BH-34	5.2	Silty SAND (SM)		
▲	BH-34	5.5	Silty SAND (SM)		
⊙	BH-34	42.2	Clayey SAND (SC)		

GRAIN SIZE CURVES
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE E-28



GRAVEL		SAND			SILT or CLAY
Coarse	Fine	Coarse	Medium	Fine	

LEGEND	(location)	(depth,m)		Cc	Cu
○	BH-35	0.5	SILT (ML)		
●	BH-36	21.4	Lean CLAY (CL)		
△	BH-36	27.4	Lean CLAY (CL)		
▲	BH-36	33.4	Lean CLAY (CL)		
⊙	BH-36	45.2	Fat CLAY (CH)		

GRAIN SIZE CURVES
PACIFIC NORTHWEST LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE E-29

APPENDIX F

Corrosion Potential Test Results

FUGRO CONSULTANTS, INC.

6100 HILLCROFT
PHONE (713) 369-5400

HOUSTON, TEXAS 77081
FAX (713) 369-5518

RESULTS OF TESTS

PROJECT: BH-4, S-1, 0-0.7m

FOR: FUGRO CONSULTANTS, INC.
HOUSTON, TEXAS

REPORTED TO: YASSER KOOHI

LAB NUMBER: 1024030

REPORT DATE: 10-29-13
CLIENT NUMBER:
JOB NUMBER: 1013-0058
REPORT NUMBER:
DATE SAMPLED:
TIME SAMPLED:
SAMPLED BY: CLIENT
DATE RECEIVED: 10-24-13
TIME RECEIVED: 0823
RECEIVED BY: SD

PARAMETER	RESULTS	UNITS	METHOD	TIME/DATE	ANALYST
pH (As received)	3.6	SU	ASTM G 51	1100/10-25-13	KD
Sulfate	< 100 *	mg/kg	EPA 9038	1230/10-28-13	KD
Chloride	< 100 *	mg/kg	EPA 9253	1230/10-28-13	KD
Electrical Resistivity @ 15.5°C	QNS¥	ohm-cm	ASTM G 57		

¥ QUANTITY NON SUFFICIENT

SO4CL 072-13

Respectfully submitted,

*** Dry weight basis**

Steve DeGregorio
Chemist

SD

EPA 9038 and EPA 9253 are the soil matrix methods for ASTM D-516 and D-512. The EPA and ASTM methods are the same with the exception of a water extraction which in not included in the ASTM methods.

THE RESULTS RELATE AS TO THE LOCATION TESTED AND NO OTHER REFERENCE SHALL BE MADE.
THIS REPORT SHALL NOT BE REPRODUCED EXCEPT IN FULL WITHOUT THE WRITTEN APPROVAL OF THE LABORATORY.

FUGRO CONSULTANTS, INC.

NELAP CERTIFICATE T104704401-09-1

6100 HILLCROFT **HOUSTON, TEXAS 77081**
PHONE (713) 369-5400 **FAX (713) 369-5518**

RESULTS OF TESTS

PROJECT: **BH-10, S-8, 3.9-4.6m**

FOR: **FUGRO CONSULTANTS, INC.**
HOUSTON, TEXAS

REPORTED TO: **YASSER KOOHI**

LAB NUMBER: **0828103**

REPORT DATE: **09-03-2013**
CLIENT NUMBER:
JOB NUMBER: **1013-0058**
REPORT NUMBER:
DATE SAMPLED:
TIME SAMPLED:
SAMPLED BY: **CLIENT**
DATE RECEIVED: **08-28-13**
TIME RECEIVED: **0800**
RECEIVED BY: **SD**

PARAMETER	RESULTS	UNITS	METHOD	TIME/DATE	ANALYST
pH	7.9	SU	ASTM G 51**	1100/8-29-13	SD
Sulfate	139*	mg/kg	EPA 9038	1300/8-30-13	KD
Chloride	<100*	mg/kg	EPA 9253	1300/8-30-13	KD
Electrical Resistivity @ 15.5°C	2,315	ohm-cm	ASTM G 57	0900/8-30-13	KD/SD

SO4CL 59-13

Respectfully submitted,

*** Dry weight basis**

**** MODIFIED FROM SW846 9045D**

Steve DeGregorio
Chemist

SD

EPA 9038 and EPA 9253 are the soil matrix methods for ASTM D-516 and D-512. The EPA and ASTM methods are the same with the exception of a water extraction which in not included in the ASTM methods.

THE RESULTS RELATE AS TO THE LOCATION TESTED AND NO OTHER REFERENCE SHALL BE MADE.
THIS REPORT SHALL NOT BE REPRODUCED EXCEPT IN FULL WITHOUT THE WRITTEN APPROVAL OF THE LABORATORY.

FUGRO CONSULTANTS, INC.

6100 HILLCROFT
PHONE (713) 369-5400

HOUSTON, TEXAS 77081
FAX (713) 369-5518

RESULTS OF TESTS

PROJECT: BH-11, S-2, 0.9 – 1.4m

FOR: FUGRO CONSULTANTS, INC.
HOUSTON, TEXAS

REPORTED TO: YASSER KOOHI

LAB NUMBER: 1024031

REPORT DATE: 10-29-13
CLIENT NUMBER:
JOB NUMBER: 1013-0058
REPORT NUMBER:
DATE SAMPLED:
TIME SAMPLED:
SAMPLED BY: CLIENT
DATE RECEIVED: 10-24-13
TIME RECEIVED: 0823
RECEIVED BY: SD

PARAMETER	RESULTS	UNITS	METHOD	TIME/DATE	ANALYST
pH (As received)	3.8	SU	ASTM G 51**	1100/10-25-13	KD
Sulfate	148 *	mg/kg	EPA 9038	1230/10-28-13	KD
Chloride	< 100 *	mg/kg	EPA 9253	1230/10-28-13	KD
Electrical Resistivity @ 15.5°C	QNS¥	ohm-cm	ASTM G 57		

¥ QUANTITY NON SUFFICIENT

SO4CL 072-13

Respectfully submitted,

*** Dry weight basis**

Steve DeGregorio
Chemist

SD

EPA 9038 and EPA 9253 are the soil matrix methods for ASTM D-516 and D-512. The EPA and ASTM methods are the same with the exception of a water extraction which in not included in the ASTM methods.

THE RESULTS RELATE AS TO THE LOCATION TESTED AND NO OTHER REFERENCE SHALL BE MADE.
THIS REPORT SHALL NOT BE REPRODUCED EXCEPT IN FULL WITHOUT THE WRITTEN APPROVAL OF THE LABORATORY.

FUGRO CONSULTANTS, INC.

6100 HILLCROFT
PHONE (713) 369-5400

HOUSTON, TEXAS 77081
FAX (713) 369-5518

RESULTS OF TESTS

PROJECT: BH-11, S-3, 1.4 – 1.8m

FOR: FUGRO CONSULTANTS, INC.
HOUSTON, TEXAS

REPORTED TO: YASSER KOOHI

LAB NUMBER: 1024032

REPORT DATE: 10-29-13
CLIENT NUMBER:
JOB NUMBER: 1013-0058
REPORT NUMBER:
DATE SAMPLED:
TIME SAMPLED:
SAMPLED BY: CLIENT
DATE RECEIVED: 10-24-13
TIME RECEIVED: 0823
RECEIVED BY: SD

PARAMETER	RESULTS	UNITS	METHOD	TIME/DATE	ANALYST
pH (As received)	4.1	SU	ASTM G 51**	1100/10-25-13	KD
Sulfate	272 *	mg/kg	EPA 9038	1230/10-28-13	KD
Chloride	< 100 *	mg/kg	EPA 9253	1230/10-28-13	KD
Electrical Resistivity @ 15.5°C	QNS¥	ohm-cm	ASTM G 57		

¥ QUANTITY NON SUFFICIENT

SO4CL 072-13

Respectfully submitted,

*** Dry weight basis**

Steve DeGregorio
Chemist

SD

EPA 9038 and EPA 9253 are the soil matrix methods for ASTM D-516 and D-512. The EPA and ASTM methods are the same with the exception of a water extraction which in not included in the ASTM methods.

THE RESULTS RELATE AS TO THE LOCATION TESTED AND NO OTHER REFERENCE SHALL BE MADE.
THIS REPORT SHALL NOT BE REPRODUCED EXCEPT IN FULL WITHOUT THE WRITTEN APPROVAL OF THE LABORATORY.

FUGRO CONSULTANTS, INC.

NELAP CERTIFICATE T104704401-09-1

6100 HILLCROFT **HOUSTON, TEXAS 77081**
PHONE (713) 369-5400 **FAX (713) 369-5518**

RESULTS OF TESTS

PROJECT: **BH-11, S-7, 3.9-4.5m**

FOR: **FUGRO CONSULTANTS, INC.**
HOUSTON, TEXAS

REPORTED TO: **YASSER KOOHI**

LAB NUMBER: **0828102**

REPORT DATE: **09-03-2013**
CLIENT NUMBER:
JOB NUMBER: **1013-0058**
REPORT NUMBER:
DATE SAMPLED:
TIME SAMPLED:
SAMPLED BY: **CLIENT**
DATE RECEIVED: **08-28-13**
TIME RECEIVED: **0800**
RECEIVED BY: **SD**

PARAMETER	RESULTS	UNITS	METHOD	TIME/DATE	ANALYST
pH	8.0	SU	ASTM G 51**	1100/8-29-13	SD
Sulfate	117*	mg/kg	EPA 9038	1300/8-30-13	KD
Chloride	<100*	mg/kg	EPA 9253	1300/8-30-13	KD
Electrical Resistivity @ 15.5°C	2,513	ohm-cm	ASTM G 57	0900/8-30-13	KD/SD

SO4CL 59-13

Respectfully submitted,

*** Dry weight basis**

**** MODIFIED FROM SW846 9045D**

Steve DeGregorio
Chemist

SD

EPA 9038 and EPA 9253 are the soil matrix methods for ASTM D-516 and D-512. The EPA and ASTM methods are the same with the exception of a water extraction which in not included in the ASTM methods.

THE RESULTS RELATE AS TO THE LOCATION TESTED AND NO OTHER REFERENCE SHALL BE MADE.
THIS REPORT SHALL NOT BE REPRODUCED EXCEPT IN FULL WITHOUT THE WRITTEN APPROVAL OF THE LABORATORY.

FUGRO CONSULTANTS, INC.

NELAP CERTIFICATE T104704401-09-1

6100 HILLCROFT **HOUSTON, TEXAS 77081**
PHONE (713) 369-5400 **FAX (713) 369-5518**

RESULTS OF TESTS

PROJECT: **BH-16, S-8, 4.2-4.8m**

FOR: **FUGRO CONSULTANTS, INC.**
HOUSTON, TEXAS

REPORTED TO: **YASSER KOOHI**

LAB NUMBER: **0828104**

REPORT DATE: **09-03-2013**
CLIENT NUMBER:
JOB NUMBER: **1013-0058**
REPORT NUMBER:
DATE SAMPLED:
TIME SAMPLED:
SAMPLED BY: **CLIENT**
DATE RECEIVED: **08-28-13**
TIME RECEIVED: **0800**
RECEIVED BY: **SD**

PARAMETER	RESULTS	UNITS	METHOD	TIME/DATE	ANALYST
pH	7.9	SU	ASTM G 51**	1100/8-29-13	SD
Sulfate	221*	mg/kg	EPA 9038	1300/8-30-13	KD
Chloride	<100*	mg/kg	EPA 9253	1300/8-30-13	KD
Electrical Resistivity @ 15.5°C	2,640	ohm-cm	ASTM G 57	0900/8-30-13	KD/SD

SO4CL 59-13

Respectfully submitted,

*** Dry weight basis**

**** MODIFIED FROM SW846 9045D**

Steve DeGregorio
Chemist

SD

EPA 9038 and EPA 9253 are the soil matrix methods for ASTM D-516 and D-512. The EPA and ASTM methods are the same with the exception of a water extraction which in not included in the ASTM methods.

THE RESULTS RELATE AS TO THE LOCATION TESTED AND NO OTHER REFERENCE SHALL BE MADE.
THIS REPORT SHALL NOT BE REPRODUCED EXCEPT IN FULL WITHOUT THE WRITTEN APPROVAL OF THE LABORATORY.

FUGRO CONSULTANTS, INC.

6100 HILLCROFT
PHONE (713) 369-5400

HOUSTON, TEXAS 77081
FAX (713) 369-5518

RESULTS OF TESTS

PROJECT: BH-20, S-1, 0-0.6m

FOR: FUGRO CONSULTANTS, INC.
HOUSTON, TEXAS

REPORTED TO: YASSER KOOHI

LAB NUMBER: 1024033

REPORT DATE: 10-29-13
CLIENT NUMBER:
JOB NUMBER: 1013-0058
REPORT NUMBER:
DATE SAMPLED:
TIME SAMPLED:
SAMPLED BY: CLIENT
DATE RECEIVED: 10-24-13
TIME RECEIVED: 0823
RECEIVED BY: SD

PARAMETER	RESULTS	UNITS	METHOD	TIME/DATE	ANALYST
pH (As received)	4.5	SU	ASTM G 51**	1100/10-25-13	KD
Sulfate	< 100 *	mg/kg	EPA 9038	1230/10-28-13	KD
Chloride	< 100 *	mg/kg	EPA 9253	1230/10-28-13	KD
Electrical Resistivity @ 15.5°C	QNS¥	ohm-cm	ASTM G 57		

¥ QUANTITY NON SUFFICIENT

SO4CL 072-13

Respectfully submitted,

*** Dry weight basis**

Steve DeGregorio
Chemist

SD

EPA 9038 and EPA 9253 are the soil matrix methods for ASTM D-516 and D-512. The EPA and ASTM methods are the same with the exception of a water extraction which in not included in the ASTM methods.

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THIS REPORT SHALL NOT BE REPRODUCED EXCEPT IN FULL WITHOUT THE WRITTEN APPROVAL OF THE LABORATORY.

FUGRO CONSULTANTS, INC.

NELAP CERTIFICATE T104704401-09-1

6100 HILLCROFT **HOUSTON, TEXAS 77081**
PHONE (713) 369-5400 **FAX (713) 369-5518**

RESULTS OF TESTS

PROJECT: **BH-27, S-9, 3.9-4.6m**

FOR: **FUGRO CONSULTANTS, INC.**
HOUSTON, TEXAS

REPORTED TO: **YASSER KOOHI**

LAB NUMBER: **0913007**

REPORT DATE: **09-17-2013**
CLIENT NUMBER:
JOB NUMBER: **1013-0058**
REPORT NUMBER:
DATE SAMPLED:
TIME SAMPLED:
SAMPLED BY: **CLIENT**
DATE RECEIVED: **09-13-13**
TIME RECEIVED: **0800**
RECEIVED BY: **KD**

PARAMETER	RESULTS	UNITS	METHOD	TIME/DATE	ANALYST
pH	8.2	SU	ASTM G 51**	1230/9-16-13	KD
Sulfate	< 100 *	mg/kg	EPA 9038	1100/9-17-13	KD
Chloride	< 100 *	mg/kg	EPA 9253	1230/9-17-13	KD
Electrical Resistivity @ 15.5°C	2,806	ohm-cm	ASTM G 57	0800/9-17-13	KD

SO4CL 062-13

Respectfully submitted,

*** Dry weight basis**

**** MODIFIED FROM SW846 9045D**

Steve DeGregorio
Chemist

SD

EPA 9038 and EPA 9253 are the soil matrix methods for ASTM D-516 and D-512. The EPA and ASTM methods are the same with the exception of a water extraction which in not included in the ASTM methods.

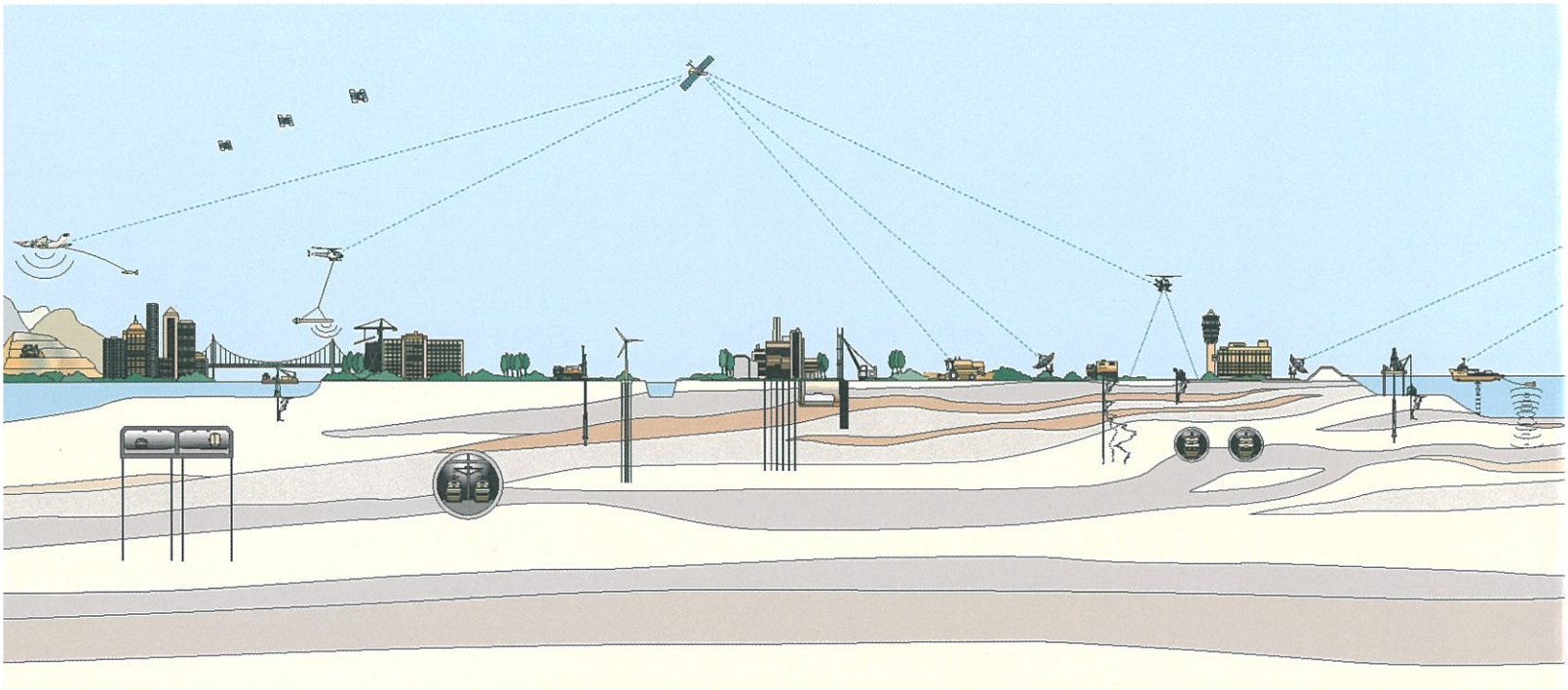
THE RESULTS RELATE AS TO THE LOCATION TESTED AND NO OTHER REFERENCE SHALL BE MADE.
THIS REPORT SHALL NOT BE REPRODUCED EXCEPT IN FULL WITHOUT THE WRITTEN APPROVAL OF THE LABORATORY.

APPENDIX G

Seismic Hazard Analyses – Onshore

PRE FEED-LEVEL SEISMIC HAZARD STUDY
LNG TANK, ISBL, & OSBL AREAS
PNW LNG PROJECT
LELU ISLAND, BRISITISH COLUMBIA, CANADA

REPORT NO. 04.10130058
KBR
HOUSTON, TEXAS



REVISION TABLE

Rev. #	Date	Approved By:	Description of Change:
0	10/16/2013	TT	Draft Issued for Review
1	12/20/2013	TT	Final version addressing comments from Client and Owner.

FUGRO CONSULTANTS, INC.

1000 Broadway, Suite 440
Oakland, California 94607
Tel: (510) 268-0461
Fax: (510) 268-0137

Report No. 04.10130058
December 20, 2013

KBR
601 Jefferson Avenue
Houston, Texas 77002

Attention: Mr. Nathan Chesley (nate.chesley@kbr.com)
Project Manager

Pre FEED-Level Seismic Hazard Study
LNG Tank, ISBL, & OSBL Areas
PNW LNG Project
Lelu Island, British Columbia, Canada

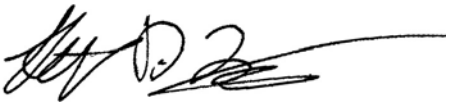
Fugro Consultants, Inc. (Fugro) is pleased to present this report of our pre FEED-Level seismic hazard analyses for the onshore facilities planned in LNG tank, ISBL, & OSBL areas of the PNW LNG project (PNW LNG) located in Lelu Island, British Columbia, Canada. Fugro Consultants, Inc. has been contracted by KBR under a Master Services Contract No. 4600002309 to perform geotechnical investigation for the proposed PNW LNG Project. Our services were performed in general accordance with our proposal No. 05.2012G031, dated January 16, 2013.

PNW LNG project consists of construction of both onshore and marine facilities. The land-based facilities are anticipated to include LNG storage tanks, LNG trains, flare stacks, processing facilities, workshops, administration buildings, pipe racks and pipelines, a construction camp, future fractionation/common facilities, and a bridged site access across the northern channel from/to the mainland. The marine facilities are anticipated to include a turning basin, berthing facility, materials off-loading facilities (MOF), a trestle, and a mooring facility. This report presents our the findings and recommendations from the seismic hazard analyses conducted for the onshore facilities, planned within the LNG tank, ISBL, and OSBL areas of the project only. Seismic hazard analyses for nearshore locations will be presented in a separate subsequent report.

We appreciate the opportunity to be of service to KBR and PNW LNG. Please call us at (713) 369-5400 if you have any questions or comments concerning this report, or when we may be of further assistance.

Sincerely,

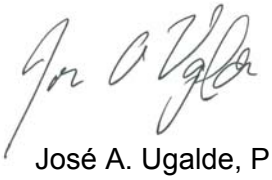
FUGRO CONSULTANTS, INC.
TBPE Firm Registration No. 299



Kate D. Krug, P.G.
Senior Geologist

Dimitra Tsiaousi
Staff Engineer

Zach D. Mayo
Staff Geologist



José A. Ugalde, P.E.
Senior Engineer

Roland LaForge
Associate Geophysicist

Thaleia Travasarou, Ph.D., P.E.
Principal Engineer

Copies Submitted: PDF

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LIST OF SYMBOLS AND ABBREVIATIONS

ALE	Aftershock Level Earthquake
CSA	Canadian Standards Association
CSZ	Coastal Shear Zone
DSHA	Deterministic Seismic Hazard Analysis
GMPE	Ground Motion Prediction Equation (a.k.a. Attenuation Relationship)
GSC	Geologic Survey of Canada
LNG	Liquefied Natural Gas
Mb, m_b	Earthquake Body Wave Magnitude
Ms	Earthquake Surface Wave Magnitude
Ml	Earthquake Richter Local Magnitude
Mw	Earthquake Moment Magnitude
Mmax	Maximum Magnitude modeled in seismic source
Mchar	Characteristic Magnitude of fault sources
NBCC	National Building Code of Canada
NGA	Next Generation Attenuation Relationships
OBE	Operating Basis Earthquake
PDF	Probability Density Function
PGA	Peak Ground Acceleration
PSHA	Probabilistic Seismic Hazard Analysis
QCF	Queen Charlotte Transform Fault
QCN	Queen Charlotte North
QCS	Queen Charlotte South
QCU	Queen Charlotte Underthrust
Sa	Pseudo Spectral Acceleration
SSE	Safe Shutdown Earthquake
UHS	Uniform Hazard Spectrum
Vs30	Average shear-wave velocity in upper 30 meters

SECTION 1.0

1.0 INTRODUCTION

1.1 Project Description

PNW LNG is a proposed liquefied natural gas (LNG) liquefaction and export facility on Lelu Island within the District of Port Edward on land administered by the Port of Prince Rupert, in British Columbia, Canada. The project comprises both onshore and nearshore facilities. This report presents the findings and recommendations from the seismic hazard studies conducted for the onshore facilities including the LNG Tank, ISBL, and OSBL areas. Recommendations for the nearshore facilities will be presented in a separate report.

The Lelu Island Site Region is located within western British Columbia, south of Alaska, along the Coastal Mountain physiographic province near Prince Rupert (Figure 1-1). Lelu Island is approximately 150-200 km east of the Queen Charlotte Transform Fault, a major plate tectonic feature that delineates the boundary between the Pacific and North American Plates (Figure 1-2; Mazzotti et al., 2008b). The region is characterized by moderate to high levels of seismic activity. The main source of earthquakes is the Queen Charlotte Transform Fault (QCF). The north-south trending QCF has experienced a multitude of Mw >7.0 earthquakes in the past including Canada's largest event in recorded history, a Mw 8.1 strike-slip event in 1949 (Bostwick, 1984).

Relative plate motion rates observed along the Pacific-North American plate boundary are moderately high relative to other active tectonic regions of the world. Comparable rates of deformation are observed along some of the lesser active faults in California, New Zealand, Japan, the Middle East, and other active plate boundaries around the world. The relative plate motions are sufficient to produce moderately high rates of earthquake activity, and a geologically dynamic environment that is susceptible to a wide range of geological hazards.

Fugro's earthquake engineering work for the project includes the development of a seismic source model for the region, performing Probabilistic Seismic Hazard Analyses (PSHA), developing design acceleration response spectra, and assessing the liquefaction triggering hazard for the proposed project site. This report presents the development of ground motion recommendations in terms of acceleration response spectra for the onshore facilities. These recommendations supersede any preliminary Peak Ground Acceleration (PGA) values reported by Fugro in previous submittals for this project.

1.2 Work Authorization

Fugro is providing engineering services to KBR for conducting a probabilistic seismic hazard analyses for the Lelu Island Development Project located in Lelu Island, British Columbia. The work was performed in general accordance with the scope of work outlined in our Proposal, dated January 23, 2013.

1.3 Scope and Organization

The approved seismic scope of services is as follows:

- Task 1 – Review and Integration of Available Data;
- Task 2 – Development of Seismotectonic Model;
- Task 3 – Seismic Hazard Analyses and Development of Design Spectra;
- Task 4 – Meetings and Communications; and
- Task 5 – Reporting and Further Recommendations.

Following this introductory section, Section 2.0 provides an overview of the regional geologic and seismotectonic setting around the project area. Section 3.0 provides an outline of the PSHA methodology which includes development of a seismic source model (described in Section 4.0) and PSHA analyses and presentation of results (Sections 5.1 through 5.6). A comparison of the results of this PSHA study to previous regional studies is provided in Section 5.7. The remaining sections of Section 5 (Sections 5.8) describe the use of the PSHA results as a basis for developing target horizontal and vertical acceleration response spectra per the governing design code, CSA Z276-11 (CSA, 2011). Additionally, horizontal design spectra are provided per the values provided in the 2010 NBCC. Target spectra are developed for various site classes and damping levels for use in future structural or geotechnical analyses (liquefaction, site response, etc.). Based on the target horizontal spectra for soil site classes a liquefaction triggering assessment is performed (and described in Section 6.0).

Additional information is provided in three Appendices: Appendix G1 presents the earthquake catalog assembled for this study before (G1.1) and after (G1.2) declustering; Appendix G2 provides the mean annual hazard curves in tabular format; and Appendix G3 contains response to comments on the draft report (Fugro, 2013a), which has been superseded by this report.

The target rock spectra described in Section 5.8.1 (Table 5-4) are also used as input to site response analyses performed for the deep soft soil sites located in the nearshore areas. The site response analyses and development of design spectra for the nearshore areas are described in a separate report (Fugro, 2013b)

1.4 Summary and Findings

A summary of the work performed and findings of analyses is provided below.

Probabilistic seismic hazard analyses were conducted to develop design ground motions for the onshore facilities. The study included the following:

- Developing a seismic source model which characterizes the various seismic sources that may impact the project site. This process involved delineating the geometry and

seismicity rate characteristics of potential seismogenic sources within 350 kilometers (km) of the project area. The model included eight (8) areal and three (3) shallow crustal sources (faults).

- Selecting strong ground motion prediction equations (GMPE) appropriate for the regional tectonic setting. The Next Generation Attenuation (NGA) relationships (Power et al., 2008) recently developed for shallow crustal seismic regions were used to model all seismic sources.
- Incorporating uncertainties in the input parameters using a logic tree approach. The logic tree considered variations in the parameters used to define the seismogenic sources as well as alternative GMPE that are applicable to the region.
- Assigning appropriate Site Class to the different locations using the available site investigation data and anticipated site preparation (Fugro, 2013c).
- Developing design spectra per the requirements of the Canadian Standards Association document for LNG production, storage and handling, CSA Z276-11 (CSA, 2011). Per this standard the seismic design levels correspond to the Safe Shutdown Earthquake (SSE), the Operating Basis Earthquake (OBE), and the Aftershock Level Earthquake (ALE). The SSE and OBE design levels are based on the mean ground motion return periods of 2475 and 475 years, respectively. The ALE design level is defined as ½ the SSE. The horizontal design spectra described in the 2010 NBCC is also provided in the case that some structures are governed by that code.
- Performing PSHA and DSHA (Probabilistic and Deterministic Seismic Hazard Analyses) to develop horizontal design acceleration response spectra. The probabilistic response spectra were estimated for the mean hazard for the two design return periods of 475 and 2475 years. The deterministic response spectra were developed for the median and median plus one standard deviation (84th percentile) for the Cascadia Subduction zone for use in development of SSE design spectra per CSA Z276-11 (CSA, 2011).
- Deaggregating the seismic hazard to evaluate the primary contributions in terms of magnitude, distance and epsilon (number of standard deviations in the ground motion) to the earthquake ground motions for each of the return periods at each site location.
- Developing Vertical-to-Horizontal (V/H) spectral ratios to develop the vertical design spectra.

The primary results from this study are summarized in the following:

- Onshore locations were classified as either Site Class A, C, or E (per NBCC 2010) based on the review of boring data and in-situ shear wave velocity measurements. For the purpose of seismic hazard analyses, an average shear-wave velocity in the top 30 m (Vs30) of 1500, 520, and 180 m/s was selected as representative of Site Classes A, C, and E respectively.

- Peak Ground Acceleration (PGA) values for design developed in this study are provided in Table 1-1.

Table 1-1. Horizontal Design Peak Ground Acceleration per Site Class

Site Class	Representative Subsurface Conditions	PGA (g) per Return Period	
		475-year	2475-year
A	Shallow Rock (Phyllite)	0.079	0.146
C	Locations with up to 15 m of Crushed Rock Backfill	0.118	0.216
E	Locations with up to 11 m of soft surficial sediments	0.163	0.271

- The Graham Island seismic source located approximately 50 km from the site, and the farther away Queen Charlotte seismic sources contribute almost equally to the ground motion hazard at short structural periods (e.g., PGA). At longer structural periods (i.e. 1 second) the primary seismic source contributing to the hazard is the Queen Charlotte fault and surrounding areal source.
- For short structural periods, the seismic hazard at the project site is controlled by two types of scenarios: large magnitudes between 7.5 to 8.5 at distances larger than 150 km associated with the Queen Charlotte fault and surrounding areal source; and intermediate magnitude events (i.e., 6 to 7) at distances between about 50 km to 100 km associated primarily with the Graham Island areal source (i.e., Zone C). For longer structural periods (i.e., period of 1 second), the relative contribution from large magnitude (i.e., 7.5 to 8.5) events increases. These scenarios are associated with the Queen Charlotte fault and surrounding areal source.
- Liquefaction triggering evaluation for coarse-grained soils and a liquefaction susceptibility evaluation of fine-grained soils has been performed for onshore borings on Lelu Island. Overall, liquefaction triggering hazard is negligible in the onshore areas. The potential for liquefaction has been identified over limited, isolated seams and thin strata (< ~1meter) encountered above the final grade of +25 meters. Borings BH10, 16, and 37 show presence of soft clays (CL) and silts (ML) potentially liquefiable clay (CL) or silt (ML) at shallow depths of less than 3 meters below the proposed final grade (elevation +25 m). It is recommended (Fugro, 2013c) that these soils be removed and replaced as they may be prone to cyclic softening and degradation which can result in large ground deformations and pose similar hazard to that of liquefaction of coarse-grained soils.

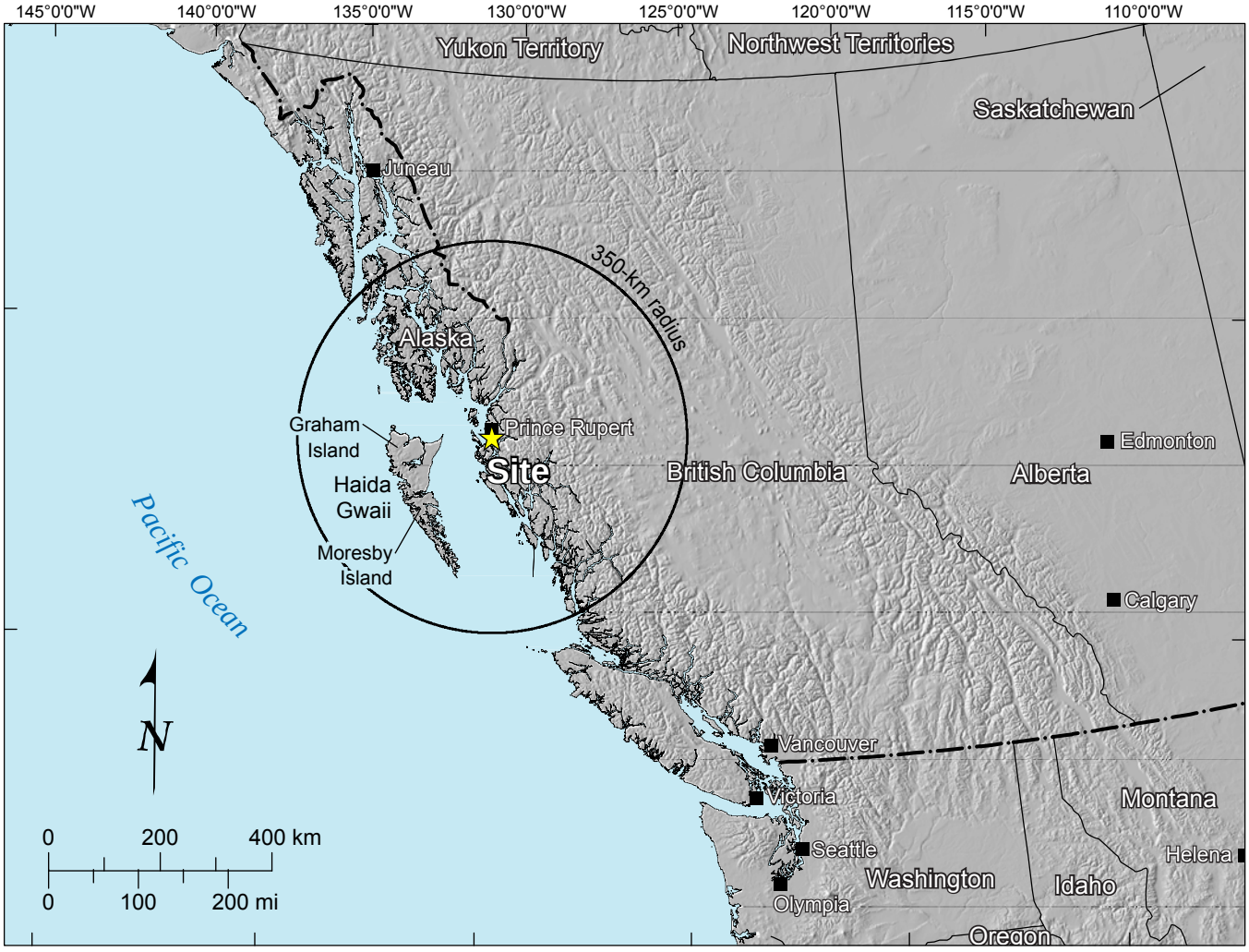
1.5 Limitations of this Study

This report has been prepared solely to assist KBR with seismic design of the onshore facilities at the Lelu Island Development Project. The results herein apply to the specific location mentioned and are not applicable to other locations.

Seismic hazard analysis is a dynamic, rapidly evolving field of earthquake engineering. It is likely that the standard of practice in the project region for these services will evolve over the next few years. Additionally, the analyses were conducted using the geological and geotechnical information available to the date of issue of this report. Consequently, the results presented in this study should be reviewed if new standard of practice or data are available during the design of the project.

This report has been prepared for the exclusive use of KBR and their agents for the specific application to the Lelu Island Development Project located in Lelu Island, British Columbia. In our opinion, the findings, conclusions, professional opinions, and recommendations presented herein were prepared in accordance with generally accepted geotechnical earthquake engineering practice of the project region.

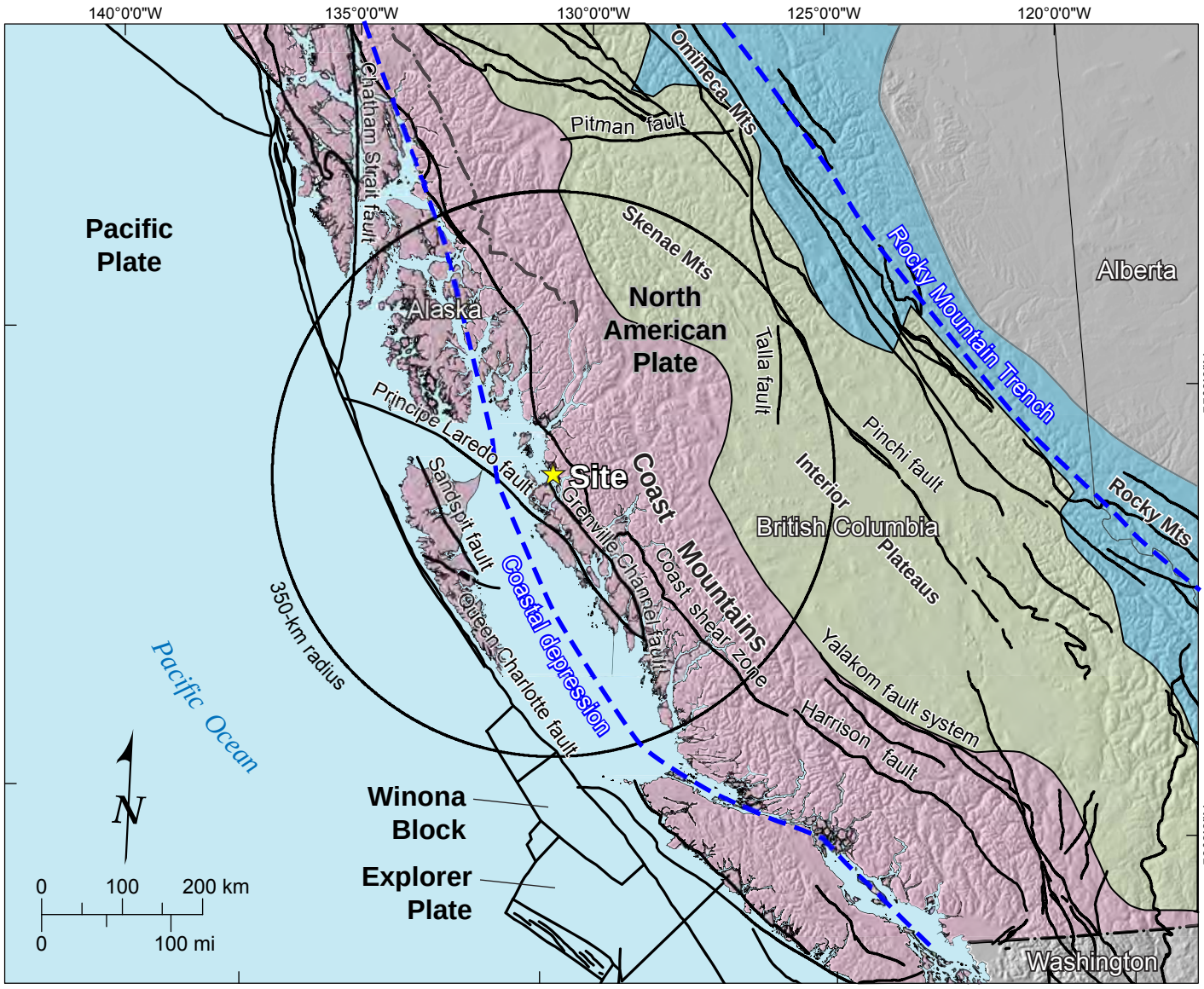
Although information contained in this report may be of some use for other purposes, it may not contain sufficient information for other parties or uses. If any changes are made to the project as described in this report, the conclusions and recommendations in this report shall not be considered valid unless the changes are reviewed and the conclusions and recommendations of this report are modified or validated in writing by Fugro.



SITE LOCATION MAP
PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

FIGURE 1-1

PROJECT, 10130058 Pacific Northwest LNG, _05 Graphics, modified 12.18.13



Note: Physiographic provinces from Monger, 2008

Explanation

Fault (active or inactive)

Orientation of major structural element

Physiographic Provinces

Eastern system

Interior system

Western system

REGIONAL TECTONICS
PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

FIGURE 1-2

PROJECT, 10130058 Pacific Northwest LNG, _05 Graphics, modified 12.18.13

SECTION 2.0

2.0 SEISMOTECTONIC SETTING

The geological, tectonic, and seismological setting of the west coast of British Columbia was used to develop a seismic source model for estimating strong ground motion hazards at proposed site facilities adjacent to Prince Rupert on Lelu Island in British Columbia, herein referred to as the Lelu Island Site Region.

Our approach identifies seismotectonic elements that represent potential earthquake sources in the Lelu Island Site Region. We define the site region as the area extending 350 kilometers (km) from the proposed site locations (Figure 1-1). Available data considered in delineating seismotectonic elements include: (1) peer-reviewed literature, (2) published geologic maps, (3) historical seismicity, (4) geospatial data (e.g., topography and bathymetry), (5) unpublished reports, previous internal reports, and (6) proprietary data provided by the client.

The seismic source model developed for this study identifies two types of seismic sources in the site region. These source types are: (1) shallow crustal faulting associated with transform plate motion between the Pacific and North American plates, as well as an underthrusting fault adjacent to Haida Gwaii and (2) seismic events within the site region. These seismic sources are represented in the seismic source model (Section 4.0) as “line” and “areal” sources. Line sources represent active faults capable of producing earthquakes that can be characterized in terms of earthquake magnitude and recurrence. Areal sources represent portions, or zones, of the site region that have similar tectonic and seismologic characteristics, and are inferred to have similar earthquake magnitude and recurrence.

Below is an introduction to the regional tectonic setting and historical seismicity of the site region (Sections 2.1 and 2.2). These sections are followed by a detailed discussion of each of the seismotectonic elements used to develop the seismic source model (Section 2.3). Section 4.0 describes the model of the seismotectonic setting (development of Seismic Source Model) for use in PSHA.

2.1 Tectonic Setting

The Lelu Island development project lies approximately 150-200 km east of the seismically active Queen Charlotte Transform Fault (QCF) which defines the boundary between the Pacific and North American plates (Bufe, 2005). This boundary is purely right-lateral strike slip along the northern portion of the QCF, and makes a slight left-stepping bend adjacent to Haida Gwaii (formerly Queen Charlotte Islands) at Moresby Island, then terminates into the eastward subducting Winona Block/Explorer Plate to the south (Figures 2-1 and 2-2a; Lay et al., 2013). The northern portion of the QCF takes a slight right step toward Alaska and becomes the Fairweather Fault (FF) which truncates into the Alaskan Subduction (Figure 2-2b; Mazzotti et al., 2008b). The proposed site is located within the Coastal Mountain physiographic province along the Coastal Depression in

northwestern British Columbia (Figure 2-2a, Monger, 2008). As with the QCF boundary, the Coastal Mountain physiographic province is defined by NNW-SSE striking right-lateral faults (Figure 2.2a).

2.1.1 Line and Areal Source Zones

The Queen Charlotte Transform Fault accommodates approximately 49 mm/yr of predominately right-lateral north-directed Pacific-North America plate motion (Bustin et al., 2007 and Lay et al., 2013). The southern portion of the QCF, where the left step occurs, accommodates approximately 20% of oblique convergence along the plate boundary (Lay et al., 2013). Lay et al. (2013) observed oblique thrusting beneath a 25-30 km wide terrace west of the QCF during the M_w 7.8 Haida Gwaii earthquake on October 28, 2012. As with the 2012 event the Queen Charlotte transform fault has produced many large events, such as the M_w 8.1 1949 event, and has the potential to produce high rates of earthquake activity.

Within the 350 km radius of the Site Region, active crustal deformation and seismicity is concentrated along the Queen Charlotte Fault (QCF). Based on recent publications regarding the style of faulting and for the purpose of this study the QCF has been separated into two segments, the Queen Charlotte North (QCN) and the Queen Charlotte South (QCS) (Bostwick, 1984; Smith et al., 2003; Lay et al., 2013). East of the QCF another active tectonic feature is the Queen Charlotte Underthrust (QCU) (Smith et al., 2003; Lay et al., 2013) (Figure 2-4). The bedrock within the Lelu Island Site Region consists of Ordovician and Triassic accreted forearc deposits of the Alexander Terrane emplaced in the late Cretaceous with no geomorphic evidence of quaternary activity (Monger, 2008). With the exception of the QCF and QCU there is no indication of Quaternary faulting along the mapped faults within the 350 km radius of the site region (Figure 2-1).

Mapped inactive and active faults within the site region are shown as thick black lines on Figure 2-1. The faults shown were compiled from recent publications (Bostwick, 1984; Journeay et al., 2000), internal reports, and previous PSHA models within the region developed by Fugro Consultants. Although these figures illustrate several active seismogenic fault zones, many fault traces are present throughout the region that lack quantitative estimates of slip rate or confirmation of Quaternary activity based on field evidence, do not establish sense of slip, or slip rate. Thus, these poorly constrained faults are of limited use for defining discrete fault sources in the seismic source model and the seismic hazard contribution from these sources is incorporated through areal source zones instead of discrete line sources.

There are 8 areal sources (A-H) that have been chosen for specific tectonic, geologic, or seismotectonic reasons. Areal source Zone A encompasses a large portion of the Northern Intermontane area (Figure 2-4). This sparsely populated area has limited data and little is known about the tectonics or deformation rates. Source Zones B, C, and D make up the Northern Coastal Margin. These zones are bounded to the east along the coast range shear zone (Figures 2-1 and

2-4). Areal source Zones E and F encompass the QCN, QCS, and QCU (Figure 2-4). These zones contain a majority of the largest events within the seismic catalog for the Lelu Island Site Region. South of Zones E and F are Zones G and H which also contain a large number of seismic events within the Lelu Island Site Region.

2.2 Historic Seismicity

The QCF and QCU are seismically active and susceptible to geological hazards. Historic seismicity indicates numerous large-magnitude earthquakes with predominantly right lateral focal mechanisms along the northern portion of the QCF and predominantly oblique and reverse focal mechanisms along the southern QCF and QCU (Figure 2-3b); Sella et al., 2002; Kreemer et al., 2003; Braunmiller and Nabelek, 2002; Mazzotti et al., 2003b; and Lay et al., 2013). Several large (defined as moment magnitude [Mw] greater than ~7) earthquakes have occurred in the historical record, which dates back to 1880 (Figure 2-3b, Figure 2-4). The largest earthquakes in the seismicity catalog are a Mw 8.1, a purely strike slip event which occurred in 1949 along the QCN northeast of Haida Gwaii, a Mw 7.9 strike slip event which occurred in 1972, and a Mw 7.8 which was an underthrust earthquake that occurred in 2012 (Bostwick, 1984; Lay et al., 2013).

2.3 Seismotectonic Elements

The seismotectonic elements within a 350-km radius of the site include the QCN, the QCS, and the QCU. All other faults are considered either inactive or not a significant hazard to model as line sources due to no geomorphic evidence of quaternary activity. These faults and the seismic hazards that may be associated with them are therefore represented as areal zones and not as line sources for this model. The tectonic setting and seismicity patterns were used to delineate the seismotectonic elements for the purpose of conducting the seismic hazard analyses. The geometry of the seismic source model is presented on Figure 2-4.

2.3.1 Shallow Crustal (Upper Plate) Tectonics

Within the Lelu Island Site Region, the continental crust is separated into three tectonic blocks: the Pacific plate, the North American plate, and the Winona Block/Explorer plate (Figure 2-2a; Carbotte et al., 1989; Bustin, 2007). Active faulting and seismic hazards within the Lelu Island Site Region are concentrated along the margins of the Pacific and North America transform boundary (Figures 2-1, 2-3, and 2-4). The Queen Charlotte Transform Fault along this boundary is separated into two regions; north and south. The northern portion of the Queen Charlotte Fault (QCN) is purely strike slip whereas the south makes a gradual left step adjacent to Moresby Island of Haida Gwaii and accommodates approximately 20% oblique and reverse motion (Figure 2-2; Bustin et al., 2007; Lay et al., 2013). Paralleling the Queen Charlotte fault to the west is the Queen Charlotte underthrust (QCU) (Figure 2-4). Lay et al. (2013) observed this fault as being a shallowly dipping thrust feature after the Mw 7.8 Haida Gwaii earthquake in 2012. These three tectonic

features are considered the only Quaternary active faults within the 350 km radius of the Lelu Island Site Region.

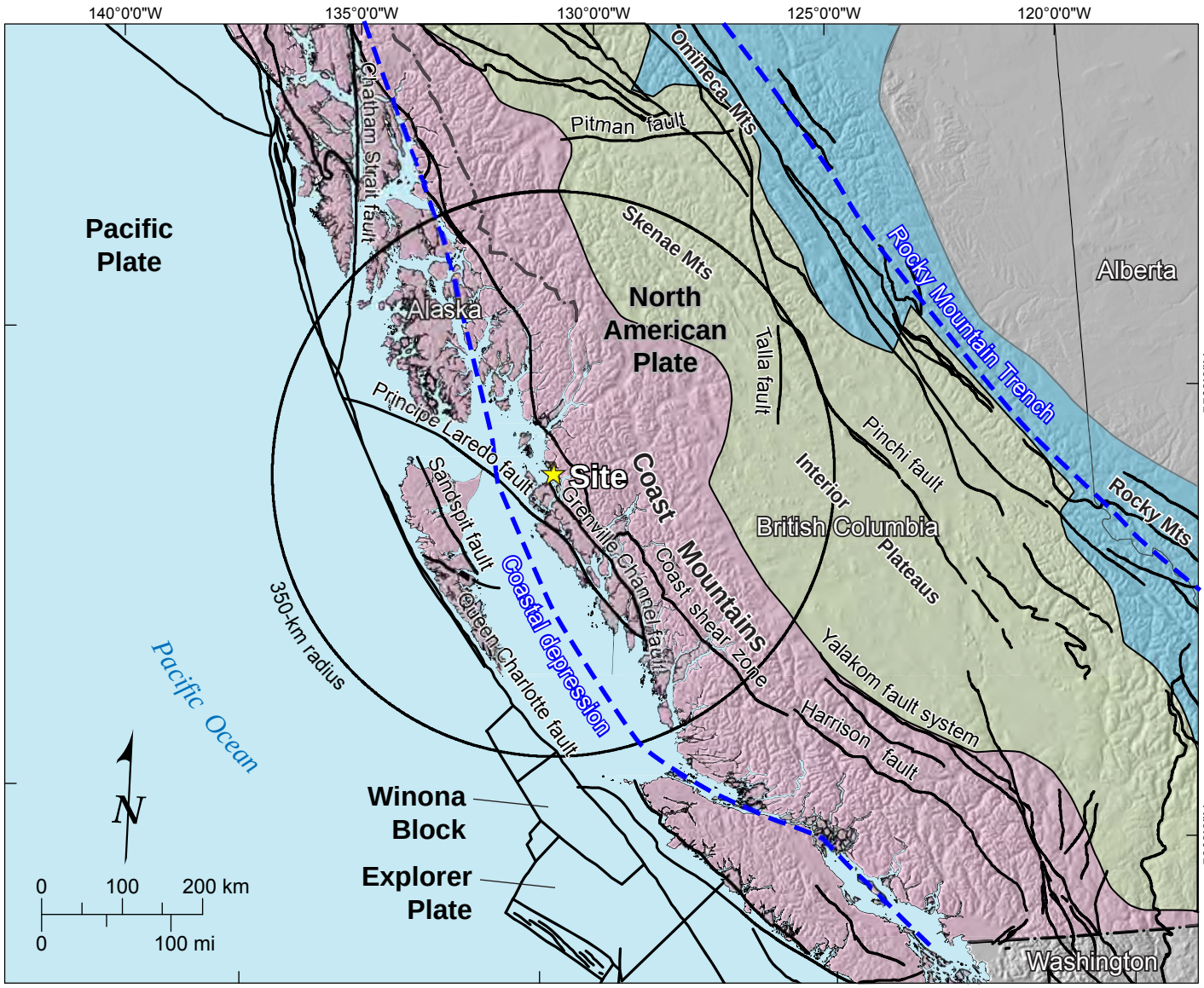
2.3.2 Areal Source Zone Tectonics

We have defined 8 areal sources (A-H) within the Lelu Island Site Region. Areal source Zones A-D are onshore and areal source Zones E-H are located offshore. While line sources within the Lelu Island Site Region reflect the largest magnitude events associated with faulting the areal source zones within the Lelu Island Site Region have seismic events associated with them; however, these events are related to unidentified faults. The assumption that seismic events are not fault related is based on either the seismic event being poorly located and not on or adjacent to a fault, or a lack of known faulting within the area. The areal source zones were chosen to reflect similarities in geology, tectonics, and seismicity rates.

Areal source Zones A-D are onshore source zones. Zone A encompasses a large portion of the Northern Intermontane area. Very little data, published or otherwise, is available for this zone due to the sparse population and low deformation rates. The proximity of Zone A to the right-lateral strike-slip QCF as well as sparse focal mechanisms suggests that this zone exhibits diffuse right-lateral shear (Mazzotti et al., 2008b, Figure 2-3a). The size and shape of Zone A was chosen based on faulting and geology due to a lack of seismicity in this area. The western border, where Zone A borders Zones B-D, is along the Coast Shear Zone (CSZ). The CSZ is a well-foliated complex zone that separates the Western Metamorphic Belt from the Central Gneiss Complex and Mid-Cretaceous Plutons (Davidson et al., 2003). In order to maintain continuity in choosing the north, south, and eastern borders of Zone A, we chose to follow fault and tectonic features (Figures 2-1 and 2-4). The northern boundary of Zone A follows the Pitman Fault, the eastern boundary follows the NNW-SSE trending faults of the Rocky Mountain Trench, and the southern boundary follows the Yalakom Fault System (Figures 2-1 and 2-4) West of Zone A and adjacent to the CSZ are Zones B, C, and D. These zones make up the Northern Coastal Margin and have been separated for geologic, tectonic, or seismological reasons. All three zones that make up the Northern Coastal margin have historic seismicity related to them; however, this seismicity does not appear to occur on known faults. The boundaries for Zone B were chosen to reflect the uncertainty of the region, the east and west boundaries follow the CSZ and Chatham Strait Fault respectively (Figures 2-1 and 2-4). Very little is known about the neotectonics of Zone B as the seismicity within this zone does not appear to be associated with any faults and no focal mechanisms are present for past events (Figure 2-4 and 2-3b; Mazzotti et al., 2008b). The boundaries for Zone C were chosen to encompass the northeast of Haida Gwaii, known as Graham Island, and the small cluster of seismicity in the vicinity (Figures 1-1 and 2-4). The seismic events within this zone do not appear to have fault focal mechanisms associated with them (Figure 2-3; Mazzotti et al., 2008b). Zone D, to the south, is bounded by the CSZ and Zone A to the east and Zones F and H

to the west. As with Zones B, Zone D reflects a large amount of uncertainty due to very limited data including limited seismicity.

Areal source Zones E-H are offshore source zones. Zones E and F are areal source zones that were chosen to encompass the seismicity proximal to the Queen Charlotte Transform Fault (including QCU) that is not related to the faults themselves (Figure 2-4). Figure 2-4 shows the clusters of seismicity that the areal sources are designed to capture. The uncertainty with the seismicity within Zones E and F is most likely attributed to seismic event location and a lack of known faults and structures adjacent and proximal to the QCF. Areal source Zones G and H were chosen to encompass the cluster of seismicity south of the QCF along the Winona-Explorer plate boundaries (Figures 2-4 and 2-3b). These two zones surround a complicated Pacific-North America-Explorer plate triple junction (Carbotte et al., 1989). Although there are few mapped faults within these zones, there are many seismic events with a majority of the focal mechanisms reflecting strike-slip movement (Figure 2-3a; Mazzotti et al., 2008b).



Note: Physiographic provinces from Monger, 2008

Explanation

Fault (active or inactive)

Orientation of major structural element

Physiographic Provinces

Eastern system

Interior system

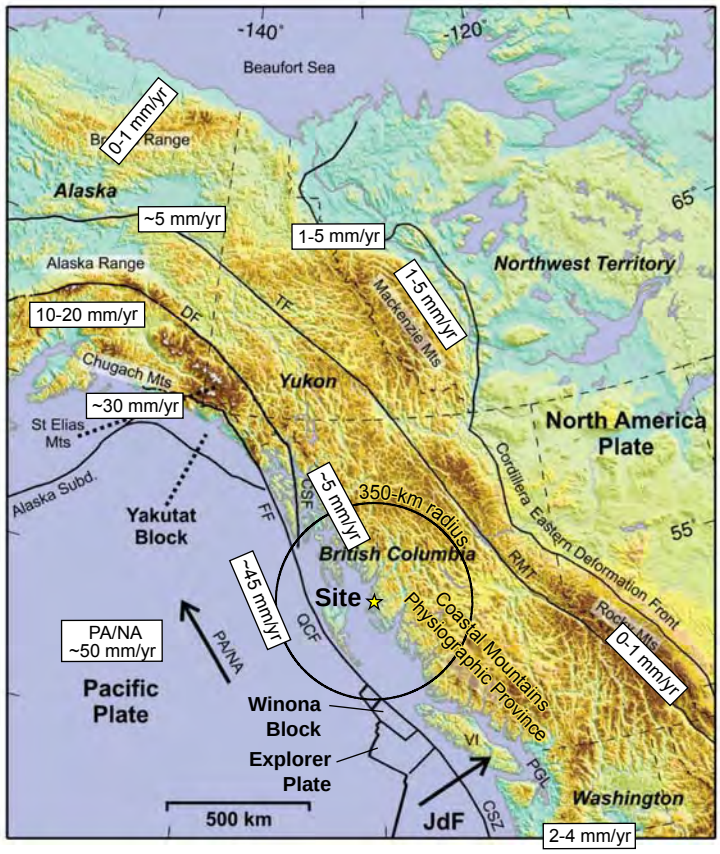
Western system

REGIONAL TECTONICS
PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

FIGURE 2-1

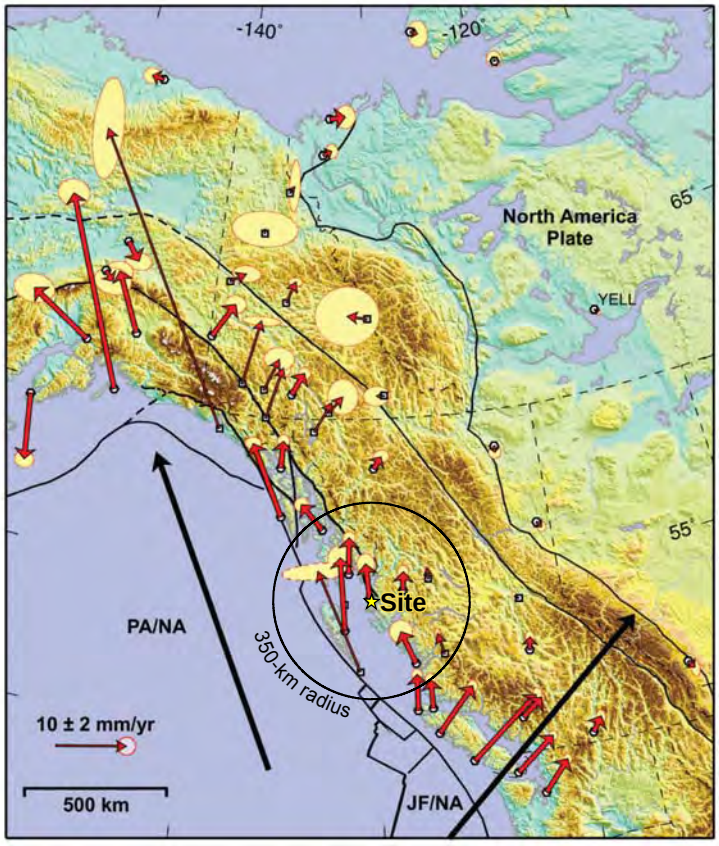
PROJECT, 10130058 Pacific Northwest LNG, _05 Graphics, modified 12.18.13

A)



Modified from Relative Motions of Tectonic Elements by Mazzotti et al., 2008b

B)



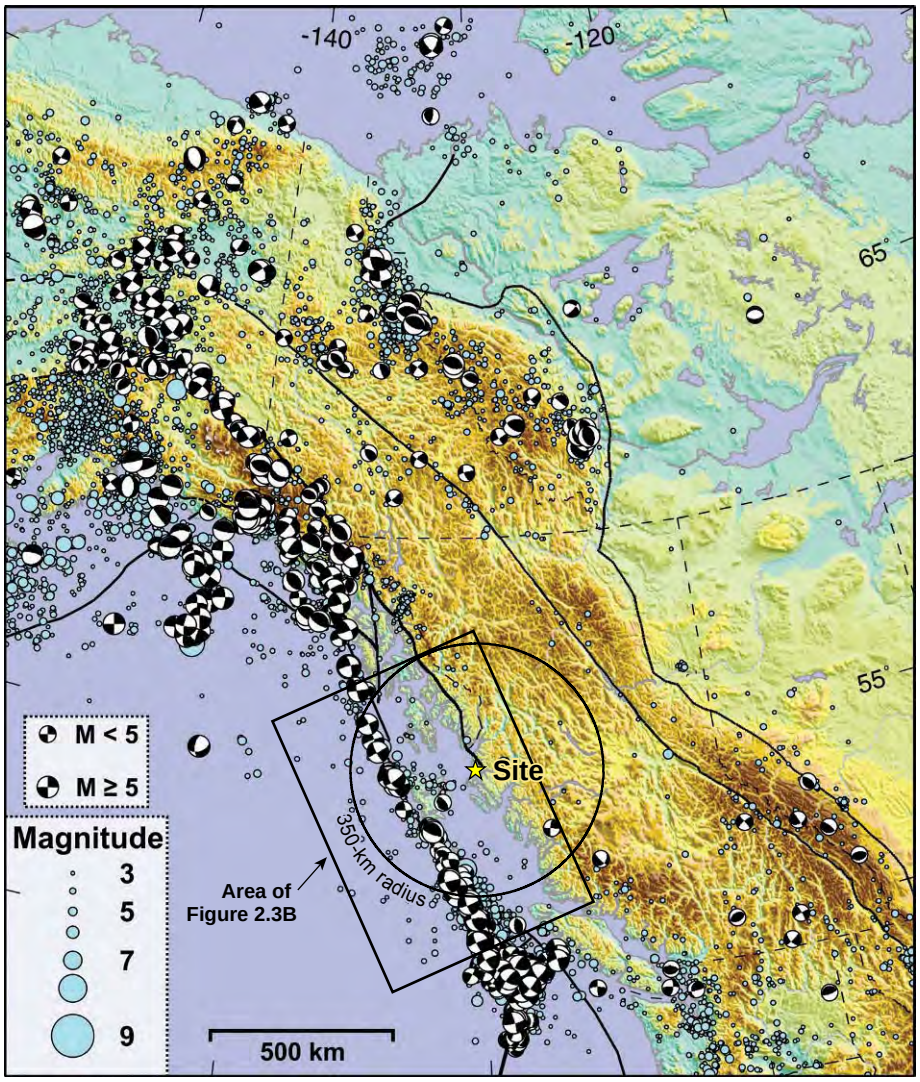
Modified from Plate Velocity by Mazzotti et al., 2008b

PROJECT, 10130058 Pacific Northwest LNG, _05 Graphics, modified 12.18.13

PLATE MOTIONS
PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

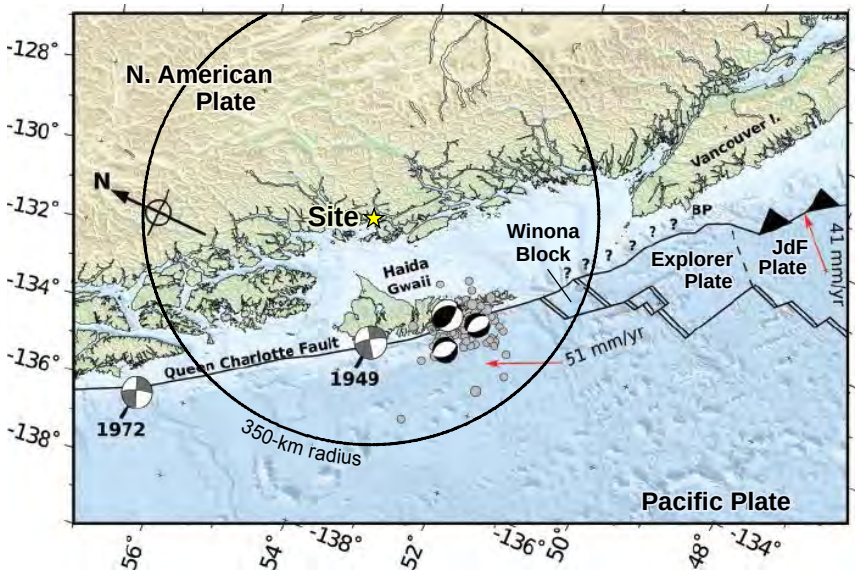
FIGURE 2-2

A)



Modified from Earthquake Focal Mechanisms for NW Coast by Mazzotti et al., 2008b

B)

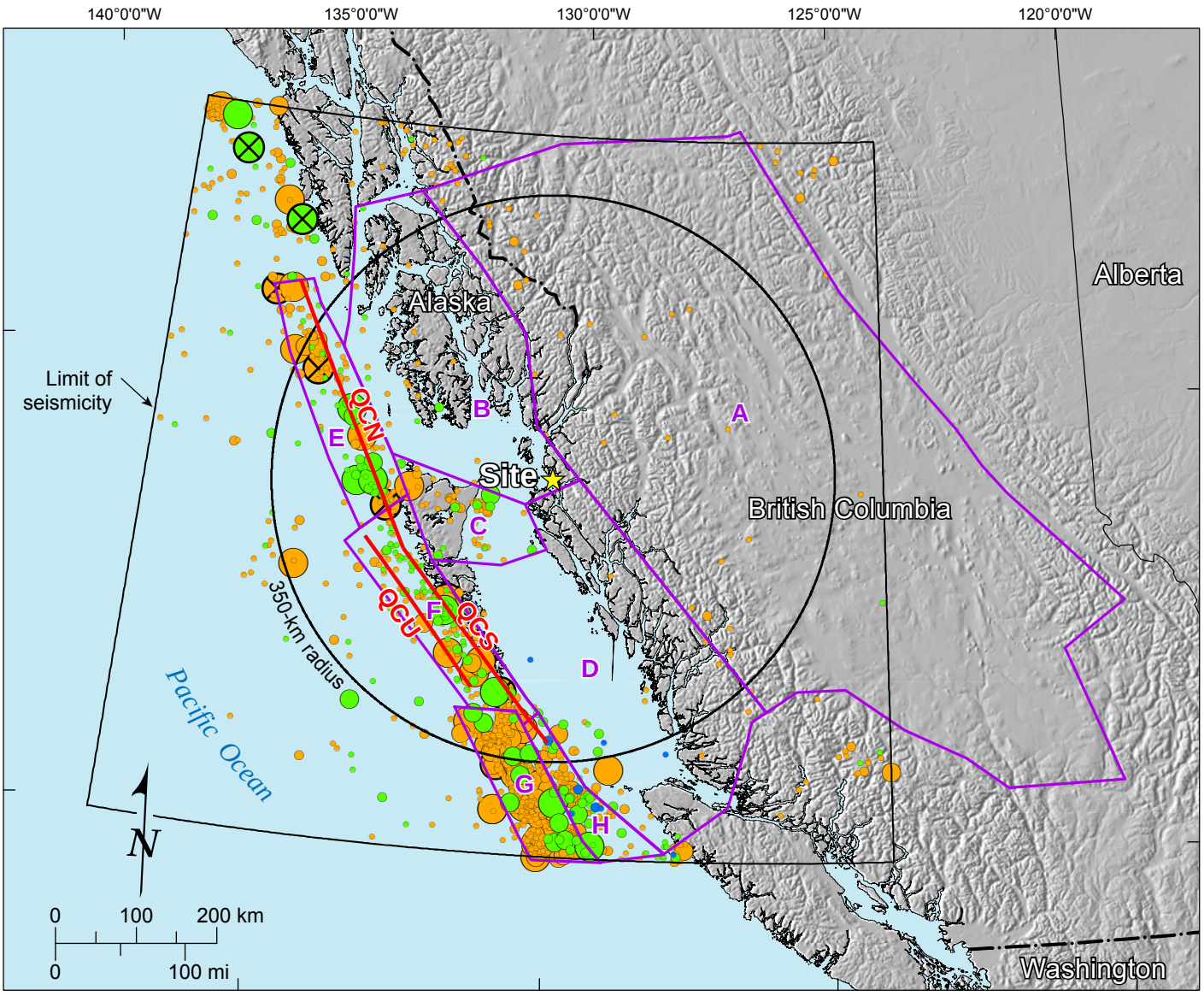


Modified from Earthquake Focal Mechanisms for Site Area by Szeliga, 2013

SEISMICITY AND EARTHQUAKE FOCAL MECHANISMS
PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

FIGURE 2-3

PROJECT, 10130058 Pacific Northwest LNG, _05 Graphics, modified 12.18.13



Explanation

QCU Line source

C Areal source

Seismicity

Magnitude (Mw)	*Depth (km)*
2.0 to 3.9	0 to 20
4.0 to 4.9	20 to 40
5.0 to 5.9	>40
6.0 to 6.9	
7.0 to 8.1	

SEISMIC SOURCE MODEL
PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

FIGURE 2-4

PROJECT, 10130058 Pacific Northwest LNG, _05 Graphics, modified 12.18.13

SECTION 3.0

3.0 PSHA METHODOLOGY

3.1 PSHA Framework

The methodology for Probabilistic Seismic Hazard Analysis (PSHA) is illustrated schematically on Figure 3-1 and includes the following components:

1. Characterization of the seismic sources within a specified radius (typically 100 to 400 km) around the site. This leads to the development of a seismotectonic model for use in subsequent PSHA evaluations. The characterization includes:
   a. Source geometry and location ;
   b. Source type (e.g. shallow crustal, subduction, etc.) and style of faulting (e.g., normal, strike-slip, reverse, etc.);
   c. Magnitude potential (i.e., range of earthquake sizes possible on each source) and magnitude distribution (i.e., typically characterized using a magnitude probability density function);
   d. Earthquake magnitude recurrence: this is a characterization of the annual rate at which earthquakes of a specified magnitude or greater occur in each source. Depending on the source type, the magnitude recurrence is estimated based on: i) the long term slip rate (e.g., for planar fault sources) or ii) regression on the historic seismicity (e.g., for aerial sources). These will be discussed in greater detail in Section 4.4.
2. Characterization of ground motion attenuation in each source based on the geologic environment and source types: This is described by a Ground Motion Prediction Equation, or GMPE (a.k.a “Attenuation Relationship” or “Attenuation Model”). This is later discussed in Section 5.3.
3. Performing PSHA using as input the seismotectonic model developed in the previous step in combination with the GMPEs selected for the specific environment, to estimate the ground motion hazard at the site. This is expressed in terms of the annual frequency of exceeding a given spectral acceleration at the project site (i.e., annual hazard curves). This information can also be shown in the form of uniform hazard spectra (UHS) which correspond to spectral acceleration having the same probability of exceedance across all structural periods. The UHS are typically used by different design codes to define the design spectra.
4. Deaggregation of seismic hazard in terms of magnitude, distance, number of standard deviations, seismic source, etc. to compute the relative contribution of different earthquake scenarios to the hazard at the site.

3.1.1 PSHA Calculations

Computation of the seismic hazard (Step 3 described above) involves the combination of uncertainties in earthquake size, location, frequency, and resulting ground motions. The estimated annual rate at which the ground motion, *A*, will exceed a particular value, a, is computed by (Cornell, 1968):

$$\lambda[A > a] = \sum_{i=1}^{Nsource} N(M_{\min}) \iint P[A > a | m, r]\, f_M(m)\, f_R(r)\, dm\, dr \qquad (3\text{-}1)$$

where N_{source} is the total number of fault and areal sources, $N(M_{min})$ is the annual rate of earthquakes with magnitude greater than or equal to M_{min}, $P[A > a|m,r]$ is the probability of the ground motion, A, exceeding the threshold value, a, given the earthquake magnitude and distance from the fault, and $f_M(m)$ and $f_R(r)$ are probability density functions describing the variability in magnitude and distance.

The computation of this integral is carried out numerically. By assuming that earthquake occurrence can be modeled as a Poisson process, the probability of exceedance in a specified exposure period (typically corresponding to the useful life of a project) may be estimated as follows (Yegian, 1979):

$$P[A > a, t] = 1 - e^{-[\lambda(a)t]} \qquad (3\text{-}2)$$

where P[A>a,t] is the conditional probability of the spectral acceleration (A) exceeding a specified acceleration (a) during a time interval (t) given that an earthquake will occur, and λ (a) is the mean annual rate of exceedance of the specified acceleration level.

3.2 Treatment of Uncertainty

When performing PSHA, there exists uncertainty with regards to the seismic source characterization (earthquake size, type, and distribution in space in time) as well as ground motion amplitude at the project site resulting from a given earthquake scenario. This uncertainty is in part due to inherent randomness in the natural process (Aleatory Variability) and in part due to uncertainty in the modeling of the process (Epistemic Uncertainty).

Aleatory variability is accounted for in the probability density function (PDF) of continuous random variables such as spectral acceleration given a magnitude and distance, or earthquake magnitude given a rupture dimension.

Epistemic uncertainty is accounted for through a logic tree approach. This approach is used to take into consideration uncertainty with respect to parameters that are used in the seismic hazard analyses. Such parameters may be the maximum magnitude on a fault, the long-term slip rate, the

median ground motion given an earthquake scenario, and the magnitude probability density function.

In the current study, epistemic uncertainty was considered with respect to parameters which are illustrated in the examples logic tree shown on Figure 3-2. This figure provides a general overview of the treatment of epistemic uncertainty in the PSHA performed for this project. The development of weights and values for the alternative models is later described in Sections 4 and 5. The following list describes the parameters for which epistemic uncertainty is described in the logic tree (moving from left to right on Figure 3-2):

- Fault segmentation. Multi-segment rupture was considered along the Queen Charlotte Fault (Section 4.3 and 4.4.4).
- Dip angle of the planar fault sources. Up to three different dip angles were considered for the planar fault sources. These were weighted according to the relative confidence in the estimates (Table 4-3a).
- Seismogenic thickness of the shallow crustal areal sources. Three different seismogenic depths were considered for the shallow crustal areal sources. These were weighted according to the relative confidence in the estimates (Table 3-2c).
- Style of Faulting. Up to two styles of faulting were considered for both areal and planar fault sources (Tables 4-3a and 4-3c).
- Maximum/characteristic magnitude on the areal and planar fault sources. Three different maximum or characteristic magnitudes were considered for each seismic zone, as discussed in Section 4.0. The magnitudes were weighted according to the relative confidence in their potential occurrence (Section 4.3, Tables 4-3a and 4-3c).
- Slip rate on the planar fault sources. Three different slip rates were considered for the planar fault sources. These were weighted according to the relative confidence in the estimates (Section 4.3, Table 4-3a).
- Ground motion prediction equation (GMPE). Four relationships with equal weights were used to model all shallow crustal sources (including areal zones and planar fault sources). The GMPEs adopted are described in Section 5.3.

Additionally, sensitivity analyses were performed for other model input parameters such as b-value (Section 4.4.4.1) and maximum distance of contributing sources (Section 5.4) to explore the sensitivity of the seismic hazard at the site on different input parameters.

3.3 Implementation

Probabilistic seismic hazard analyses were carried out using the computer program HAZ38 (Abrahamson, 2007). HAZ38 was developed by Dr. Abrahamson, and along with other public and proprietary seismic hazard codes, it has been extensively validated as part of the PSHA Validation

Project performed by the Pacific Earthquake Engineering Research (PEER) Center's Lifelines Program (Thomas et al., 2010).

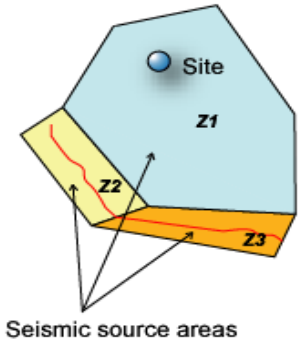
The hazard calculation described by Equation 3-1 is carried by discretizing the distribution on earthquake Magnitude, location, and shaking amplitude with the following assumptions: 1) The magnitude distribution per source is sampled at intervals of 0.05 magnitude units; 2) The location of earthquakes on areal sources are discretize in a grid of 1 km in the zone where the site is located and 5 km in other zones; 3) The variability in ground motion amplitude for a given earthquake scenario is truncated at ± 3 standard deviations.

3.4 Near Source and Directivity Effects

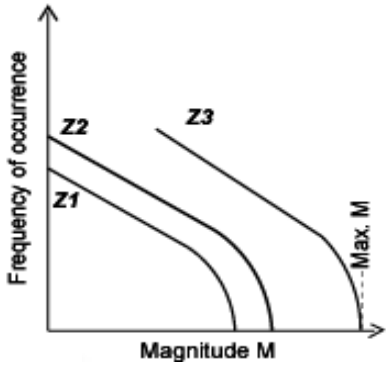
Near-source effects for relatively large magnitude earthquakes are typically considered for distances from the fault of about 15 km or less. They are usually referred to as forward, neutral, and backward directivity conditions. In general forward directivity is associated with the fault rupturing towards the project site, and backward directivity conditions with the fault rupturing away from the project site. Near-source effects are typically accounted for by using the model proposed by Somerville et al. (1997) as modified by Abrahamson (2000). The calculation of near-source effects is implemented probabilistically by randomizing the location of the earthquake hypocenter given a rupture area.

For this project, the closest distance from the site to an identified seismogenic fault is approximately 200 kilometers (Figure 2-4). Hence, near-source effects were not considered in the analyses.

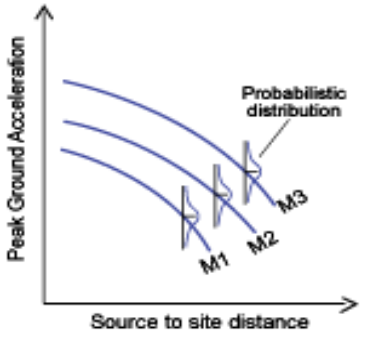
1. Define Seismic Sources



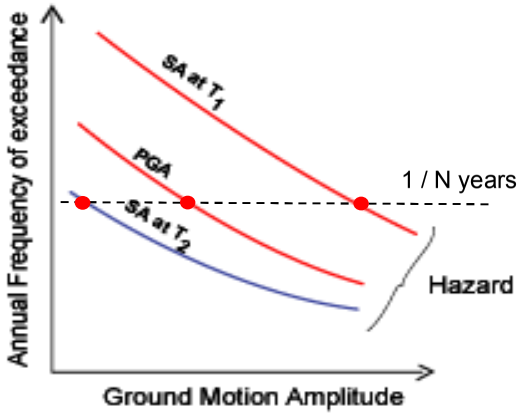
2. Characterize Magnitude Reccurence

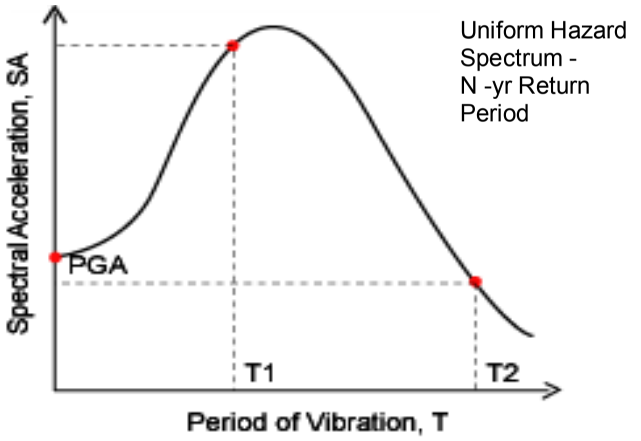


3. Characterize amplitude of ground motions for given eqk. scenario (GMPE)



4. Perform PSHA





5. Deaggregation

PROBABILISTIC SEISMIC HAZARD ANALYSES COMPONENTS

PNW LNG PROJECT

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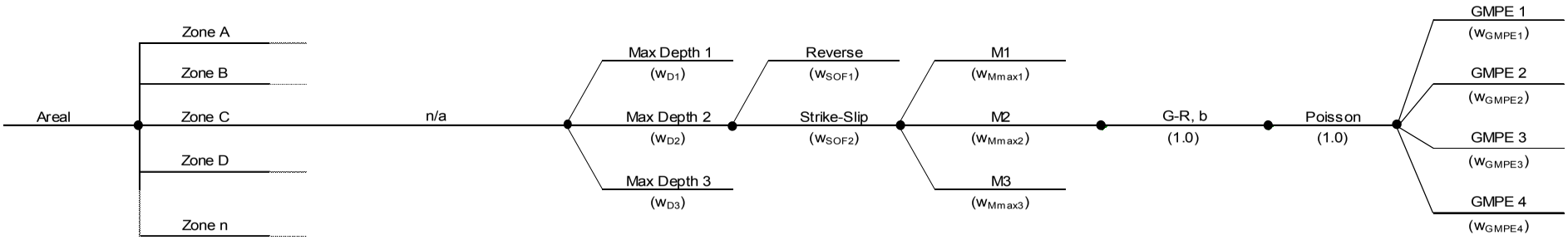
FIGURE 3-1

1. Source Type, Location, and Geometry					2. Earthquake Magnitude Distribution and Frequency			3. Ground Motion Prediction Equation
Source Type	Source	Segmentation	Source Geometry	Style of Faulting	Maximum Magnitude	Magnitude Recurrence	Time Dependence	



NOTE: This logic tree illustrates the modeling of epistemic uncertainty modeled in this project. Values and weights for specific seismic sources and sources of uncertainty are described in Section 4.3.

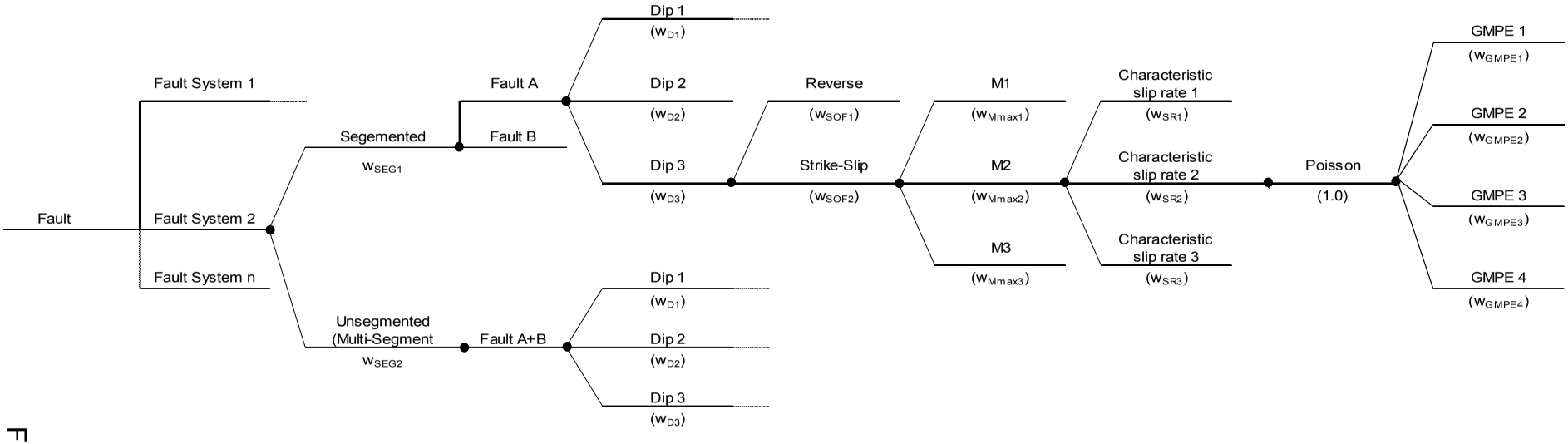


FIGURE 3-2

EXAMPLE LOGIC TREE FOR TREATMENT OF EPISTEMIC UNCERTAINTIES

PNW LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

SECTION 4.0

4.0 SEISMIC SOURCE MODEL

4.1 Introduction

All seismic sources which intersect a 350 km radius around the project site were characterized in terms of geometry, magnitude potential, and earthquake magnitude recurrence. The characterization of these sources is based on 1) peer-reviewed literature, 2) published geologic maps, 3) historical seismicity, 4) geospatial data (e.g., topography and bathymetry), 5) unpublished reports, 6) previous internal reports, and 7) proprietary data provided by the client.

The seismic source model (Figure 4-1) includes 8 shallow areal source zones and 3 fault segments that characterize shallow faulting within the crust at ≤ 40 km depth for calculation of probabilistic earthquake ground motions within the Lelu Island Site Region.

The seismic source model, shown in plan on Figure 4-1 includes two types of seismic sources, each representing a part of the seismotectonic setting that requires a different characterization of seismic source parameters. The first type of seismic sources are the planar faults (sources Queen Charlotte North, Queen Charlotte South and Queen Charlotte Underthrust), and their potential multiple segment ruptures, representing seismogenic faults within the upper crust of the Pacific and North American plates. The second type is the areal source and shallow crustal zones (sources A to H). Areal sources represent seismogenic faulting from both mapped faults that are incompletely characterized and unmapped faults within the upper crust.

All of the seismic sources in the model are characterized in terms of geometry and fault activity parameters and the characterization is given for alternate models in order to account for epistemic uncertainty in the characterization (as described in Section 3.2, Figure 3-2) for input to probabilistic seismic hazard analyses.

Section 4.2 provides a description of the earthquake catalog used in the characterization of seismic sources. Section 4.3 provides a detailed description of the characterization of seismic source geometry, magnitude potential, and slip rates. Section 4.4 describes the development of rates of recurrence of earthquakes on each source.

4.2 Earthquake Catalog

4.2.1 Data Compilation

A historical catalog of earthquakes was assembled and processed for use in characterization of sources geometry and magnitude potential. The seismicity catalog used for this project was prepared by Dr. Lowell Whiteside (Whiteside, 2013). Appendix G1.1 contains the complete catalog from Dr. Whiteside. The catalog covers the earliest known earthquakes up until August 2013 over the region of the Northern British Columbia, Canada and surrounding areas (50.0°N - 58.0°N and

124°W - 138°W) with all listed events was compiled from a number of sources including the following:

- ABE Abe, K. 1981 Magnitudes of large Shallow Earthquakes.
- AEI Alaska Earthquake Information Center.
- BCI Bureau Central International de Seismologie, Strasbourg, France..
- BDA M. Bath and S. Duda (1979).
- BJI Beijing, China.
- BRK Berkeley, Haviland, California, USA.
- DNG Decade of North American Geology (DNAG project).
- EQH Earthquake history of the United States (Coffman and others 1982).
- GCM Menlo Park, California.
- GIA Geophysical Institute, University of Alaska, Fairbanks, USA.
- GS United States Geological Survey, Denver, Colorado.
- GS0 United States Geological Survey, Denver, Colorado.
- HRV Harvard University, Massachusetts, USA.
- ISC International Seismological Centre, Newbury, UK.
- ISS International Seismological Summary, UK.
- MOS Moscow, USSR.
- NRC Natural Resources of Canada, Ottawa, Canada.
- OTT Ottawa, Canada.
- PAL Palisades, New York, USA.
- PAS Pasadena, California, USA.
- PDE Preliminary Determination of Epicenters, NOAA/USGS/CGS.
- PEK Peking, (Chiufeng) China.
- PGC Pacific Geoscience Centre, Sydney, British Columbia, Canada.
- PMR Palmer, Alaska, USA.
- RMT Moar Alm, Germany.
- ROT Rothe, J.P. ,The Seismicity of the Earth, 1953-1965, UNESCO, 1969.
- SCA South Central Alaska.
- SIG Catalog of Significant Earthquakes (Dunbar, Lockridge, Whiteside, 1993).

- UCM University of California, Menlo Park.
- USC University of Southern California.
- USE United States Earthquakes (Publication, 1935 - 1985).
- USN US Network Catalog (Hays and others, 1975).

After compiling a combined catalog from multiple agencies and sources, duplicate events were removed based on similarities in time, location, and magnitude. Removal of duplicates is performed through a prioritization of the reporting agencies. International or global data collection agencies that provide their own locations often use a global velocity model to determine locations. While this may be satisfactory on a global scale, it may lead to serious location errors on a local scale. In this case local network distribution and integrity is reviewed in keeping some events and not others. Once the automated system is run, a manual check is performed insure that duplicates are removed. In general data from ISC, PDE, NGDC (National Geophysical Data Center, NOAA) are highest priority in that order followed by regional earthquake center data.

4.2.2 Magnitude Conversion

The original raw catalog received from Dr. Whiteside contained 22,226 events, with magnitudes ranging from M_w 0.0 to M_w 8.1. Events in the seismicity catalog range from December 1843 through August 28, 2013. The catalog was compiled using multiple international catalog sources including the International Seismological Center (ISC) and the National Earthquake Information Center (NEIC). The catalog contained events listed with multiple magnitude types. Dr. Whiteside converted all events to M_w using a series of magnitude relationships developed for the project region ($M_w = 0.95M_s+0.2$ (based on 198 regional data points) and $M_w = 0.98*M_B+0.12$ (based on 237 regional data points), $M_w = M_B$, $M_w = M$, $M_w = M_D$, $M_W = M_L$).

4.2.3 Declustering

The raw catalog was declustered using the Gardner-Knopoff time-space windows shown in Table 4-1 below. The Gardner and Knopoff (1974) method uses declustering windows for magnitude (M_w), distance (km), and time (days) to remove dependent events (duplicate events, foreshocks, and aftershocks) from the undeclustered catalog. The windows were extended to capture a smaller and larger set of magnitudes, distances, and time. Each entry in the catalog, initially flagged as "independent" was searched for subsequent events satisfying the time-distance criteria, with linear magnitude interpolation for the time-space parameters. Once these "dependent" events were collected, a check was made to see if any of the "dependent" events had a larger magnitude than the initial "independent" event. If so, the largest dependent event was flagged as independent and the initial event as dependent. In this manner foreshocks, and the largest event of a sequence, were identified. The raw undeclustered catalog contains 22,226 events ranging from

Mw 0.0 to Mw 8.1. The final declustered catalog contains 1109 events ranging from M_w 2.9 to M_w 8.1.

Appendix G1.2 contains the declustered catalog which was used in development of earthquake recurrence rates described in Section 4.4.2.

Table 4-1. Gardner-Knopoff Time-Space Windows used for Declustering*

Magnitude (Mw)	Distance (km)	Time (days)
0.5	15	3
1.0	15	3
1.5	15	3
2.0	15	5
2.5	19.5	6
3.0	22.5	11.5
3.5	26	22
4.0	30	42
4.5	35	8.
5.0	40	155
5.5	47	290
6.0	54	510
6.5	61	790
7.0	70	915
7.5	81	960
8.0	94	985
8.5	300	1500
9.0	500	2000
9.5	500	2000

* Windows were extended to capture smaller and larger set of magnitudes, distances, and times. Windows are linearly interpolated for unlisted magnitudes.

4.3 Seismic Source Parameters

4.3.1 Planar Fault Sources

We characterized 3 individual fault segments within 350 km of the project locations as potential sources of strong ground motion (Figure 4-1). Parameters included to characterize these faults as line sources include geometry, seismogenic depth, style of faulting, slip rate, and magnitude. The 3 line sources are:

- QCN: Queen Charlotte Transform Fault-North;
- QCS: Queen Charlotte Transform Fault-South;

- QCU: Queen Charlotte Transform Fault-Underthrust;

The multi-segment rupture scenario is:

- Queen Charlotte Transform Fault-North and South;

Geodetic rates derived from previous studies of the Queen Charlotte Transform Fault (Bostwick, 1984; Sella et al., 2002; Leonard et al., 2012; Lay et al., 2013; Figures 2-2a and 2-2b) and fault dips inferred from field, seismic, and gravity studies (Bostwick, 1984; Buffe, 2005; Bustin, 2007; Lay et al., 2013) were used to estimate slip rates given a range of fault dips throughout the 350-km Lelu Island Site Region. Magnitudes for scenario earthquakes on these faults are evaluated by: (1) interpreting compiled published literature and geologic mapping to estimate potential source dimensions, and (2) applying the empirical relations of Wells and Coppersmith (1994) or Hanks and Bakun (2002) to estimate maximum magnitudes associated with the source dimensions (equations listed below).

Table 4-2: Empirical Relationships correlating Maximum Magnitudes with the Source Dimensions

Reference	Source Dimension	Empirical Relationship
Wells and Coppersmith, 1994 M-A, Strike-Slip	(A)=Rupture area	Mw = 3.98 + 1.02 * log(A)
Wells and Coppersmith, 1994 M-A, Reverse	(A)=Rupture area	Mw = 4.33 + 0.90 * log(A)
Hanks & Bakun, 2002 Transform	(A)=Rupture area	Mw = 3.07 + 4 / 3 * log(A)
Wells and Coppersmith, 1994 M-L Strike-Slip	(L)=Rupture length	Mw = 5.16 + 1.12 * log(L)
Wells and Coppersmith, 1994 M-A, All Slip Types Slip	(A)=Rupture area	Mw = 4.07 + 0.98 * log(A)

4.3.1.1 Fault Geometry and Sense of Slip

The trace for each fault source is shown in Figure 4-1. For all line sources, the trace coincides with the land surface trace and the up-dip limit of faulting (Table 4-3a). Our fault source model assumes that line sources rupture independently except in the event that the QCF ruptures along both the northern and southern segments.

Line sources QCN and QCS represent the northern and southern segments of the Queen Charlotte Transform Fault, which is the transform boundary between the Pacific and North American plates. The boundaries between each section are based on qualitative assessments of step over morphology as well as seismic clustering along the fault escarpment (Figure 4-1). The modeled geometry and sense of slip for these faults is generally steeply-dipping (60-90°), with

predominantly right-lateral strike-slip sense of motion on all segments. A component of reverse motion is modeled along faults in the Queen Charlotte Transform Fault Underthrust (QCU) based on published literature for the region, discussed in Section 4.3.1.2 (Leonard et al., 2012; Lay et al., 2013).

A combined rupture of segments QCN and QCS is modeled based on published literature indicating that the potential for plate boundary faults such as the QCF to rupture over lengths of ≥500 km as in the case of the Mw 9.0 Tohoku earthquake in 2011 and the Mw7.8 San Andreas earthquake in 1906 (Bostwick, 1984; Song et al.,2008; Ammon et al., 2011). The cumulative rupture length, of QCN and QCS is 500 km in the multi-segment rupture model (Bostwick, 1984). The weight for a multi-segment rupture scenario (0.2, described below) is based on our judgment of the expected likelihood of a 500 km long rupture. Additionally, a check was performed (Section 4.4.4, Figure 4-4a) on the compatibility between historic seismicity, geodetic slip rates, geologic maximum magnitudes which support such a distribution of the moment budget to rare large multi-segment events.

A summary of the scenarios modeled along the Queen Charlotte North and South are described in the Logic Tree shown in Table 4-3b. A combined (or multi-segment) rupture scenario was given a weight of 0.2 while the segmented model (QCN and QCS separately rupture) was given a weight of 0.8 based on the historic Mw8.1 event which ruptured all of the QCN and a portion of the QCS. The first rupture scenario of combined fault rupture on the north and south segment was given a weight of 0.6; this weighting models a scenario of a purely strike slip event (90° dip), with slip rate of 10 mm/yr, and rupture length of 500 km (Table 4-3a). The second scenario assumes a combined fault rupture of the QCN and QCS with a weight of 0.2; this weighting models a dip-slip event of 60°, slip rate of 25 mm/yr, and rupture length of 500 km. The third scenario assumed a combined fault rupture of the QCN and QCS with a weight of 0.2. This scenario has been included for completeness purposes and has been given a low weighted value due to recently published data that suggests this type of event is unfavorable (Szeliga, 2013). The weighting models a dip-slip event of 60°, slip rate of 49 mm/yr, and rupture length of 490 km.

Line source QCU represents the underthrust portion of the QCF that parallels the QCF to the west (Figure 4-1). The boundary of this line source is based on previous studies and published literature (Lay et al., 2013; Szeliga, 2013). The modeled geometry and sense of slip for this fault is moderately to shallowly-dipping (18.5°-60°); with reverse sense of motion along the segment.

4.3.1.2 Seismogenic Slip Rate

Estimates of fault slip rates are provided for the faults within the Lelu Island Site Region based on geodetic studies of the Pacific-North American plate boundary (Sella et al., 2002; Lay et al., 2013). Published literature indicates a northward trend in plate motion of approximately 49 mm/yr with 20% transpressional convergence at Moresby Island (Figure 1-1; Molnar and Dayem, 2010; Lay et

al., 2013). G iven the northward trend of the plate motion, recent models and publications by Leonard et al. (2012), and the approximately 20% oblique-reverse convergence, slip rates along the Queen Charlotte Underthrust are estimated to be approximately 5-18 mm/yr (Lay et al., 2013).

Slip-rates on any given fault within the Lelu Island Site region vary dependent on the range of fault-dips identified for the fault. Slip rates for faults with reverse or oblique motion in the source model were determined by projecting the relative portion of the published geodetic rate for the region onto a dipping fault plane, inferred from a range of sources including published literature, seismic data, and gravity data.

Additionally geodetic and seismic studies for the Queen Charlotte Transform Fault (our 3 line sources) indicate that nearly all of the plate motion is being accommodated along this transform boundary due to the plate motion vector being parallel to nearly parallel along the length of the fault (Molnar et al., 2010, Lay et al., 2013). As such, a range of estimates were utilized for the study to model strike-slip motion along the QCN and QCS, strike-slip and reverse along the QCS, as well as reverse motion along the QCU. The range of strike-slip slip rates (30.0, 40.0, and 49.0 mm/yr) used in the source model reflect an interpreted estimate of the relative amount of purely strike-slip motion that could occur on the QCN. The range of strike-slip and reverse rates (10.0, 25.0, and 40.0 mm/yr) used in the source model reflect an interpreted estimate of the relative amount of both strike-slip or reverse motion that could occur on the QCS. The range of reverse slip rates (5.0, 8.0, and 18 mm/yr) used in the source model reflect an interpreted estimate of the relative amount of reverse motion that could occur on the QCU. We believe that these values best characterize the average rate for each fault segment based on plate motion vectors and geodetic data from published literature.

The slip rates were also checked against the geologic constraints on the characteristic magnitude in combination with historic seismicity rates.

4.3.1.3 Characteristic Magnitude

In this section the term Mean Characteristic Magnitude (M_{char}) is applied to the fault sources while “Maximum Magnitude” (M_{max}) is used to refer to the absolute maximum magnitude modeled in areal sources. The difference in notation stems from the different magnitude probability density functions applied to the two types of sources (Section 4.4.3) where planar fault sources include aleatory variability about the characteristic magnitude (derived from maximum fault dimensions). Because of the additional variability in magnitude, the actual maximum magnitude modeled on fault sources is 0.24 magnitude units above the assigned characteristic value (Section 4.4.3).

The characteristic earthquake magnitudes (M_{char}) for the line sources are estimated based on fault dimensions. As stated previously, the documented maximum magnitude in the Lelu Island Site Region includes an historic 8.1 M_w event northeast of Haida Gwaii along the Queen Charlotte Transform Fault. Table 4-3a shows M_{char} values with corresponding weights for the 3 line sources.

The calculations for M_{char} and the ranges shown consider the uncertainties in both fault length and width. For each line source, we used the Hanks and Bakun (2002) empirical magnitude-area relationship for strike-slip or the Wells and Coppersmith (1994) empirical magnitude-area relation for either strike-slip or reverse to derive estimated maximum magnitudes.

The assigned M_{char} distributions (and assigned weights) for line source QCN, are 7.3 (0.2), 7.9 (0.2), and 8.3 (0.6). These values represent rupture lengths of 100, 200, and 356 km, with the total fault area based on the fault-dips (90°) and depth extent of the potential rupture (15-25 km).

For line source QCS, we assigned M_{char} values (and assigned weights) of 7.6 (0.3), 7.8 (0.4), and 8.1 (0.3). These M_{char} values represent rupture lengths of 100, 200, and 300 km, with fault-dips ranging from 60-90°, and rupture depths varying from 15-25 km.

For line source QCU we assigned M_{char} values (and assigned weights) of 7.8 (0.3), 8.0 (0.4), and 8.1 (0.3). These values represent rupture lengths of 75, 125, and 230 km, with fault-dips ranging from 18.5-60°, and rupture depths varying from 15-22 km.

The combined rupture of QCN and QCS we assigned M_{char} values (and assigned weights) of 8.1 (0.3), 8.3 (0.4) and 8.5 (0.3). These M_{char} values represent rupture lengths of 490-500 km, with fault dips ranging from 60-90°, and a rupture depth of 22 km. Szeliga (2013) observed that in parts of the world that are tectonically similar to the Queen Charlotte Transform and Underthrust fault, that either pure strike slip or pure reverse events occur and rarely a combination of the two.

4.3.2 Shallow Areal Source Zones

The site source model includes the characterization of 8 shallow areal source zones within the 350-km Site region that are potential sources of seismic activity and strong ground shaking (Figure 4-1). These areal zones are defined based on similarities in topography and tectonic province, pattern of faulting, and pattern of historical seismicity. The areal source zones are:

- A: Northern Intermontane;
- B: Northern Coastal Margin;
- C: Graham Island;
- D: Coastal Shear Zone;
- E: Queen Charlotte Transform Fault Zone-North;
- F: Queen Charlotte Transform Fault Zone- South;
- G: Revere-Dellwood-Wilson Zone; and
- H: Winona-Explorer Margin.

Each areal zone is characterized by expected earthquake type, top and bottom of the seismogenic zone, and maximum magnitude (M_{max}) (Table 4-3a). Because of the large uncertainty in M_{max}, we use a logic-tree approach and assign a distribution of magnitudes and corresponding weights. Rates of seismicity within the areal source zones are determine by a truncated Gutenberg-Richter relation, whereby declustered historical seismicity located within the areal source zone polygons is evaluated to determine rates of earthquakes up to the M_{max} values.

4.3.2.1 Earthquake Type and Geometry

The expected earthquake types in the areal source zones reflect the high degree of uncertainty in the current state of stress within the crust of the Lelu Island Site Region. Although focal mechanisms, fault geometry, and slip type are known along the QCF many of the events within the Lelu Island Site Region either occur on unmapped faults or faults with unknown geometry. Due to this lack of data and uncertainty the areal source zones have been modeled to reflect all slip types (Table 4-3b).

There is very little known about the style or history of deformation as well as the tectonics in zone A. With few seismic events, few focal mechanism, and very low deformation rate, Zone A appears to have earthquake types that are diffuse dextral strike-slip (Figure 2-3a, Mazzotti et al., 2008b). The assumed seismogenic thickness for these zones is between 18.0, 20.0, and 22.0 km depth with a weighting of 0.3, 0.4, and 0.3.

For Zones B, C, and D the expected earthquake types are strike-slip and reverse-oblique, with predominantly right-lateral motion (Table 4-3c). These types reflect the location of the source zone along the western margin of the Coastal Mountain Physiographic province and available public data on focal mechanisms (Mazzotti et al., 2008b; Monger, 2008 Figures 2-2a and 4-1). The assumed seismogenic thickness for these zones is between 15.0, 20.0, and 25.0 km depth with a weighting of 0.2, 0.7, and 0.1.

For Zones E and F, the expected earthquake types are strike-slip and reverse (Table 4-3c). These types reflect the location of the source zone within the Queen Charlotte Transform Fault zone (Figures 2-1 and 4-1). The assumed seismogenic thickness of Zones E and F is between 15.0 and 25.0 km depth with a weighting of 0.7 and 0.3. Our weighting reflects our preference for the shallow depth value.

For Zones G and H, the expected earthquake types are strike-slip in Zone G and reverse oblique in Zone H (Table 4-3c). These types reflect the location of the source zone along the northern margin of the Winona block/Explorer Plate and the southern extent of the Queen Charlotte Transform Fault (Figures 2-1, 2-2a, and 4-1). The assumed seismogenic thickness for Zone G is between 3.0, 6.0, and 12 km depth with a weighting of 0.4, 0.3, 0.3. Our weighting reflects our

preference for the shallow depth value. The assumed seismogenic thickness for Zone H is between 3.0, 9.0, and 13.0 km depth with a weighting of 0.3, 0.4, and 0.3.

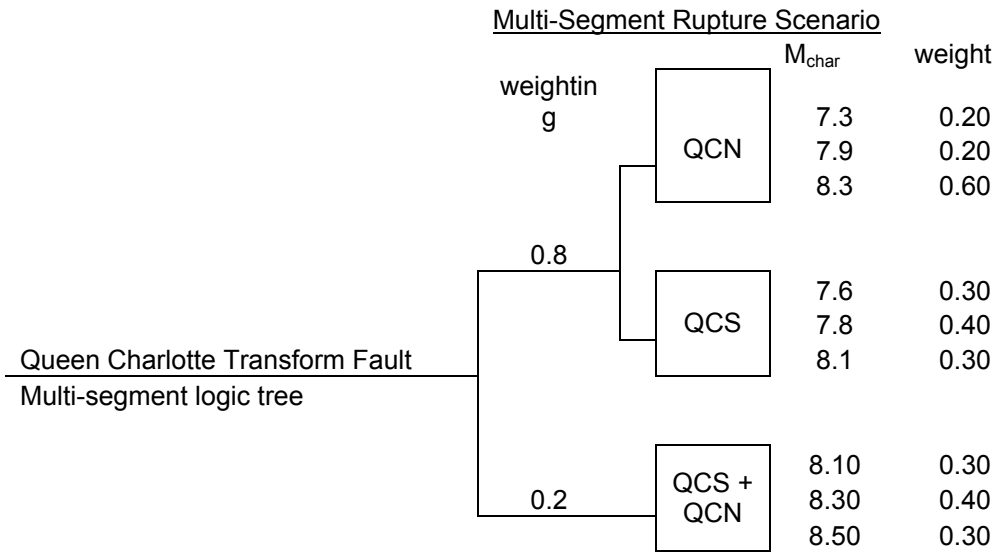
4.3.2.2 Maximum Magnitudes

Maximum magnitudes within the areal source zones are based on historical seismicity and qualitative assessment of geomorphic features in the delineated area. The maximum magnitudes in Table 4-3c generally span approximately one-third to one-half of a magnitude range, reflecting the high degree of uncertainty in this parameter. In all cases, the minimum value in the M_{max} distribution is greater than the historical maximum earthquake in the seismicity catalog. The M_{max} distributions listed in Table 4-3c are derived from empirical relationships of magnitude and rupture-length established by Hanks and Bakun (2002) and Wells and Coppersmith (1994). A range of potential rupture-lengths were used in each source zone to reflect the lengths of geomorphic features with possible tectonic origins. Table 4-3c lists assigned M_{max} distribution (and corresponding weights) for each defined areal source zone.

Table 4-3a. Summary of Seismic Source Parameters for Fault (Line) Sources

Source	Source Name	Style of Faulting	Dip Distribution		Characteristic Magnitude Distribution		Slip Rate Distribution		b-value
			Dip (degrees), Direction	Weights	M_{char}	Weights	Slip Rate (mm/yr)	Weights	
QCN	Queen Charlotte Fault-North	Strike-Slip	90°	1.0	7.3 7.9 8.3	0.2 0.2 0.6	30 40 49	0.3 0.4 0.3	NA
QCS	Queen Charlotte Fault- South	Strike-Slip/ Reverse	90° 60° E 60° W	0.4 0.3 0.3	7.6 7.8 8.1	0.3 0.4 0.3	10 25 40	0.3 0.4 0.3	NA
QCU	Queen Charlotte Underthrust	Reverse	18.5° E 30° E 60° E	0.6 0.2 0.2	7.8 8.0 8.1	0.3 0.4 0.3	5 8 18	0.3 0.4 0.3	NA
QCF (N+S)	Queen Charlotte Multi-segment (N+S)	Strike-Slip/ Reverse	90° 60° E 60° W	0.6 0.2 0.2	8.1 8.3 8.5	0.3 0.4 0.3	10 25 49	0.5 0.35 0.15	NA

Table 4-3b . Multiple Segment Rupture Logic Tree (Before Moment Balancing)



NOTE: Final moment-balanced weights described in Section 4.4.2, Table 4-7c.

Table 4-3c. Summary of Seismic Source Parameters for Shallow Crustal Areal Sources

Source	Source Location	Tectonic Setting	Style of Faulting	Maximum Magnitude Distribution[1]		Seismogenic Depth Distribution[1]		N(M>5)/year[2]	b-value[2]
				M_{max}	Weight	Depth (km)	Weight		
A	Northern Intermontane	Craton	Strike-Slip	6.8 7.3 7.6	0.3 0.4 0.3	18 20 22	0.3 0.4 0.3	0.014	0.74
B	Northern Coastal Margin	Oceanic Basin	Strike-Slip	7.0 7.2 7.5	0.3 0.4 0.3	15 20 25	0.2 0.7 0.1	0.009	0.74
C	Graham Island	Oceanic Basin	Strike-Slip	7.0 7.2 7.5	0.3 0.4 0.3	15 20 25	0.2 0.7 0.1	0.066	0.65
D	Coast Shear Zone	Oceanic Basin	Strike-Slip/Reverse-Oblique	7.0 7.2 7.5	0.3 0.4 0.3	15 20 25	0.2 0.7 0.1	0.013	0.74
E	Queen Charlotte Transform Fault-North	Transform Boundary (N.A. Plate)	Strike-Slip	7.8 8.0 8.4	0.2 0.5 0.3	15 15 25	0.4 0.3 0.3	0.198	0.54
F	Queen Charlotte Transform Fault-South	Transform Boundary (N.A. Plate)	Strike-Slip/Reverse	7.8 8.0 8.4	0.2 0.5 0.3	15 15 25	0.4 0.3 0.3	0.168	0.6
G	Wilson Ridge	Oceanic	Strike-Slip	7.0 7.3	0.6 0.4	3 6 12	0.4 0.3 0.3	1.054	0.92
H	Winona/Explorer Plate Margin	Oceanic Transform	Strike-Slip/Reverse-Oblique	6.0 7.0 8.5	0.1 0.1 0.8	3 9 13	0.3 0.4 0.3	0.066	0.76

[1] Model parameters developed in Section 4.3.2
[2] Model parameters developed in Section 4.4

4.3.3 Grenville Channel Fault

The Grenville Channel Fault (GCF) has been mapped in close proximity to the project site (Nelson, et. al., 2011; Proprietary Fugro data, Figure 2-1). However, this fault and other identified faults (Principe Laredo Fault, etc.) either do not have sufficient information to allow them to be modeled as discrete line sources or have not been identified as active and is cited as being of mid-Cetaceous age in the available literature (Nelson, et al., 2011). As described in Section 4.3.1, a

model of a line sources must include geometry, seismogenic depth, style of faulting, slip rate, and magnitude. For the GCF there is no geologic or geodetic information available for which a slip rate can be inferred. Additionally there are no seismicity clusters along the GCF to suggest that is active. Therefore, areal sources have been used to account for the earthquakes occurring in the area of these faults (Section 4.3.2).

4.3.4 Cascadia Subduction Zone

The Cascadia subduction zone, which lies approximately 500 km to the south of the project site, was not characterized or included in the PSHA. Although the Cascadia Subduction Zone is a major source of earthquakes in the Pacific Northwest, it was not considered because the governing design standard, CSA Z276, explicitly states that it should not be included in PSHA calculations. The treatment of the Cascadia Subduction Zone for the purposes of a deterministic lower limit scenario on design spectra per CSA Z276 is discussed in Section 5.8.2.

4.4 Earthquake Recurrence Rates

4.4.1 Approach

The recurrence of earthquakes in a region is modeled by means of magnitude recurrence relationships, *N(M)*. Those relationships describe the annual rate at which earthquakes with magnitudes equal to or greater than M occur on a given source or region and may be estimated through the following equation:

$$N(M) = N(M_{\min}) \cdot \int_{M}^{M_{\max}} f_m(m) \cdot dm$$

As suggested by this equation, the following information is required for each areal or fault source to develop its magnitude recurrence relationship:

- The magnitude probability density function, *f(m)*, which describes the relative number of large, moderate and small magnitude earthquakes occurring on the source.
- The activity rate, $N(M_{min})$ which describes the annual number of earthquakes on a source larger than a minimum magnitude of engineering interest, M_{min}.

Different magnitude distributions are typically used for areal sources compared to fault sources which have been observed to generate earthquakes in a preferred magnitude range. This preferred earthquake magnitude is known as the “mean characteristic magnitude” of a fault source. By contrast, areal sources generate a larger range of earthquakes up to the “maximum” magnitude.

Different earthquake recurrence models were used to characterize the various shallow crustal areal zones and planar fault sources in the seismic source model.

- The seismicity rate of the shallow crustal areal zones were modeled by fitting a Gutenberg-Richter truncated exponential curve to the historical seismicity data. The magnitude frequency distribution is truncated at a maximum magnitude representative of the tectonic environment of the zone.
- The activities of the planar fault sources were modeled by means of the fault slip rate in combination with the “pure characteristic” or “maximum magnitude” model which is based on a truncated normal magnitude distribution. This was intended to model the large magnitude, characteristic-type events generated on these faults.

The selection of magnitude probability density functions and development of source activity rates are described in the following sections. The subsequent section discusses the historical seismicity catalog used to develop the source parameters and the methodology employed to derive those parameters for the different source types.

4.4.2 Historic Rates of Earthquake Occurrence

An evaluation of catalog completeness for different magnitudes was conducted. The completeness interval is the number of years before present time for which the catalog can be considered to have recorded all earthquakes in the magnitude ranges of interest.

Figures 4-3a through 4-3c show historic rates of earthquake occurrence and illustrate the evaluation of completeness intervals. The completeness has been evaluated using the slope method where the cumulative number of earthquakes is plotted with time and the year the rate of recorded earthquakes shows a significant reduction is taken to be the year the catalog is complete for the magnitude range of interest

The estimated completeness intervals as a function of magnitude are shown in Table 4-4. In computing the annual frequency of earthquakes using the entire data set, the completeness intervals reported in Tables 4-4 were adopted.

Table 4-4. Completeness Interval of Seismicity Catalog

Magnitude Range	Completeness Interval (years before present)	Reference Date
3-3.4	35	1978
3.5-3.9	38	1975
4-4.4	38	1975
4.5-4.9	38	1975
5-5.4	38	1975
5.5-5.9	38	1975
6-6.4	93	1920
6.5-6.9	93	1920
7-7.4	93	1920
7.5-7.9	93	1920

Table 4-5 presents the number of independent (declustered) events per zone, per magnitude bin, recorded within the time intervals presented in Table 4-4.

Table 4-5. Number of Mainshocks per Zone within Catalog Completeness Intervals

Magnitude Range	Zone A	Zone B	Zone C	Zone D	Zone E	Zone F	Zone G	Zone H
3-3.4	16	14	18	11	52	76	116	26
3.5-3.9	6	5	13	5	21	34	50	14
4-4.4	3	1	8	2	10	8	39	13
4.5-4.9	0	0	2	0	9	5	31	5
5-5.4	0	0	1	1	4	2	24	1
5.5-5.9	0	0	0	0	1	1	10	0
6-6.4	0	0	1	1	2	3	8	1
6.5-6.9	0	0	0	0	3	2	3	0
7-7.4	0	0	0	0	0	0	1	0
7.5-7.9	0	0	0	0	2	2	0	0
8-8.1	0	0	0	0	1	0	0	0

4.4.3 Magnitude Probability Density Functions

Two different magnitude probability density functions (PDF) were used to model the relative rate of occurrence of different magnitudes on each seismogenic source, as shown in Table 4-6.

Table 4-6. Magnitude Probability Density Functions

Sources	Source Type	Magnitude PDF	
		Designation	Mathematical Model
Zones A to H	Shallow Crustal Areal Sources	Gutenberg Richter	Truncated Exponential
Faults QCN, QCS, QCU and QCN+QCS	Planar Fault Sources	Pure Characteristic/ Maximum Magnitude	Truncated Normal

In general:

- The truncated exponential model was used for all shallow crustal areal sources.
- A truncated normal model was used for all the planar fault sources to model the characteristic events on these faults. Events of smaller magnitudes were accommodated within the surrounding areal source zones.

Example probability density functions (PDF) and cumulative probability density functions for the truncated exponential and characteristic models are shown on Figures 4-4a and 4-4b, respectively. For this comparison, a characteristic magnitude of 7.75 was assumed. This magnitude was also used as the maximum magnitude in the truncated exponential model. The characteristic model was assumed to have a truncated normal distribution with maximum and minimum magnitudes of +/-0.24 units about the characteristic magnitude and a standard deviation of 0.12. This distribution represents the aleatory variability in the magnitude potential of any given source. The pure characteristic model has the highest probability density around the characteristic magnitude while zero density is assigned to smaller magnitudes. The characteristic model (truncated normal) is consistent with the modeling of major faults in California by the Working Group on California Earthquakes (2008). The differences in the probability density between the two models translate to significantly different recurrence relationships. Figure 4-4b shows the annual recurrence predicted using the two models in combination with a slip rate of 1.0 mm/year, a fault area of 100,000 km^2 and a b-value of 1.0. The truncated exponential model estimates the occurrence of earthquakes for a range of magnitudes, with the smaller magnitude earthquakes occurring more frequently compared to the larger ones. Conversely, the pure characteristic model estimates larger frequency of occurrence for the characteristic magnitude earthquake.

It is important to note that the areal sources overlap the planar fault sources. In this way, the majority of characteristic earthquakes are concentrated along the fault plane while smaller and moderate magnitude earthquakes are distributed evenly over a broader zone. This model has been found to be consistent with observations in nature (Shwartz, 2010).

In general, the appropriateness of the model is judged based on a regional comparison of the model's magnitude recurrence to historical seismicity for small to intermediate magnitudes given

the constraints from geodetic slip rates and geologically estimated maximum magnitudes. This comparison is described in the following section (Section 4.4.4).

4.4.4 Recurrence Parameters

4.4.4.1 Shallow Crustal Areal Sources

The activity rate and the slope of the truncated exponential model were estimated by performing a regression analysis of the Gutenberg-Richter (1954) relationship on the historical seismicity data. The model estimates the annual number of earthquakes larger than a given magnitude as:

$$\log N = a - b M$$

where: N = cumulative number of earthquakes with magnitude greater or equal to M;

a = log of the rate of earthquakes above magnitude 0; and

b = the slope of the semi-log plot (referred to as b-value).

The regressions were performed using the maximum likelihood estimator per the procedure proposed by Weichert (1980). The seismicity grouped per seismic zone is shown on Figure 4-2. Regressions to estimate the activity rate, a, and b-value were performed separately for each of the areal sources, with the exception of sources A, B, and D, which are associated with low rates of seismicity and were grouped together for the purpose of developing a and b-value.

Figures 4-5a to Figure 4-5f present the fit of the Gutenberg-Richter model on the historic seismic for Zones A-B-D, C, E, F, G, H, respectively. These figures also show, the historical seismicity per source, including 5%-95% confidence intervals calculated per the procedure outlined by Weichert (1980). On Figures 4-5, seismicity is shown for M greater than the minimum magnitude of completeness. The estimated activity rates, N(M>5.0) and b-values per zone are summarized in Table 4-3c.

Due to the limited amount of historical seismicity data for Zones A, B, and D, a more stable estimate of the slope of the Gutenberg-Richter relationship (i.e., b-value) is obtained by a simultaneous regression on data from these 3 zone sources together. Activity rates for each areal source were estimated based on the number of events greater than M 3.5 recorded within each of those sources. Sensitivity analyses were performed using activity rates and b-values for Zones A, B, and D regressed independently based on seismicity within each zone. The effect on the mean hazard was negligible with on average 2% difference on resulting design spectra.

For all other zones the activity rate and b-value were estimated independently by regression of seismicity in each zone. The b-values computed from the regressions shown on Figures 4-5a to 4-5f are tabulated in Table 4-3c.

4.4.4.2 Planar Fault Sources

The relative distribution of magnitudes on the planar fault sources was described using a pure characteristic model (truncated normal PDF) as described in Section 4.4.3. The activity of the fault was represented by its slip rate as shown in Table 4-3a. The probabilities of activity of various combinations of fault segments were generated by moment balancing the scenarios presented in Section 4.3.2. The moment-balancing procedure is briefly discussed in the following paragraphs.

Relative scenario weights were developed as part of the seismic source model summarized in Section 4.3. However, these were based on a frequency approach where each fault rupture scenario is given a certain percentage of the number of events that would occur in that system. This was based on the confidence in the corresponding segmentation model, the fault rupture mechanism, historical seismicity, in addition to the geologists' judgment. Since the individual rupture sources typically have different areas, using the scenario weights in hazard calculations may not be moment-balanced, i.e. may generate a different moment rate than the overall fault is capable, thus over predicting or under predicting the seismic activity of a fault. While the moment rate is proportional to the area, the seismic moment is related exponentially to the area. As a result, a procedure was used to obtain rupture weights (probability of activity) for each fault segment that are both moment balanced and preserve the relative seismicity rates specified by the geologists.

The relative rupture weight per fault segment is obtained by summing the weights of the scenarios that include the particular segment (note that although scenario weights add up to 1, segment rupture weights do not). The relative seismicity of each fault segment is the ratio between the relative rupture weight of the segment and the sum of the rupture weights of all the segments of a fault system (relative seismicities of all the segments of a fault add up to 1). Table 4-7a illustrates the rupture weights and the relative seismicities of the segments of the Queen Charlotte Transform Fault prior to moment balancing (as derived from the scenario weights provided in Section 4.3).

Table 4-7a Queen Charlotte Transform Fault Relative Seismicity prior to Moment Balancing

Fault Rupture Source	Relative Fault Rupture Source Weight	Geologist Relative Seismicity
QCN	0.8	0.80/1.80=0.444
QCS	0.8	0.80/1.80=0.444
QCN+QCS	0.2	0.20/1.80=0.112
Total	**1.80**	**1.0**

The next step involves moment balancing the rupture source weights. This involves calculating new fault scenario weights (*f*) to replace values presented in Section 4.3, which minimize the difference between the geologist relative seismicities and the moment balanced relative seismicities.

Table 4-7b illustrates the moment balancing procedure. First, the activity rate was estimated (column 3 of Table 4-7b) through the fault slip rate, area, and magnitude distribution function *f(m)* for each of the individual rupture sources using the following relationship relating annual geologic seismic moment rate to the cumulative moment rate given the magnitude probability density function on the source:

$$N(M_{\min}) = \frac{\mu \cdot A \cdot s}{\int_{M_{\min}}^{M_{\max}} 10^{1.5m+16.05} f_m(m) \cdot dm}$$

where: μ : the rigidity of the earth's crust taken as equal to 3.0×10^{11} dyn/cm^2;
A : the area of the fault; and
s : long term slip rate on the fault
f_m: magnitude probability density function
$10^{1.5m+16.05}$: seismic moment given magnitude (Hanks and Kanamori, 1979)

To simplify the above calculation, a Dirac delta function is used to model the characteristic earthquake and the faults are characterized with mean values of slip rate, fault rupture length and fault rupture width.

The seismic moment of each segment is then multiplied with the new (unknown) fault scenario weights (column 4 of Table 4-7b). The moment balanced relative seismicities for each segment are then calculated (column 5) as the ratio of the moment balanced rate of exceedance to the total rate of exceedance. The moment balanced fault scenario weights are then obtained by equating Columns 2 and 5. However, since the number of individual fault segments (e.g. 3 in the case of the Queen Charlotte Transform Fault) exceeds the number of fault rupture scenarios (e.g. 2 in the case of Queen Charlotte Transform Fault), this results in an over-determined set of equations. To solve this problem a 'least squares regression' is performed to calculate scenario weights that minimize the difference between the relative seismicities computed for each rupture source based on the seismic source model (column 2) and the moment-balanced relative seismicities (column 5).

Table 4-7b Moment Balancing Illustration (Queen Charlotte Transform Fault)

Fault Rupture Source	Geologist Relative Seismicity (rs)	Mean Annual Rate of Exceedance (Ni)	Moment Balanced Rate of Exceedance (fjNi)	Moment Balanced Relative Seismicity (rsm)
QCN	0.444	N_1=0.0071066	f_1N_1	$f_1N/\Sigma f_jN_i$
QCS	0.444	N_2=0.0077279	f_1N_2	$f_1N/\Sigma f_jN_i$
QCN+QCS	0.111	N_3=0.0033200	f_2N_3	$f_2N/\Sigma f_iN_i$
Total	**1.0**	**ΣN_i = 0.0181545**	**Σf_jN_i**	**1.0**

j = the number of rupture scenarios,

i = the number of individual segments,

f_1 and f_2 are the moment balanced scenario weights and $f_1+f_2 =1$.

The resulting moment balanced rupture weights and relative seismicities for each segment of each multi-segment fault in the model are summarized in Table 4-7c.

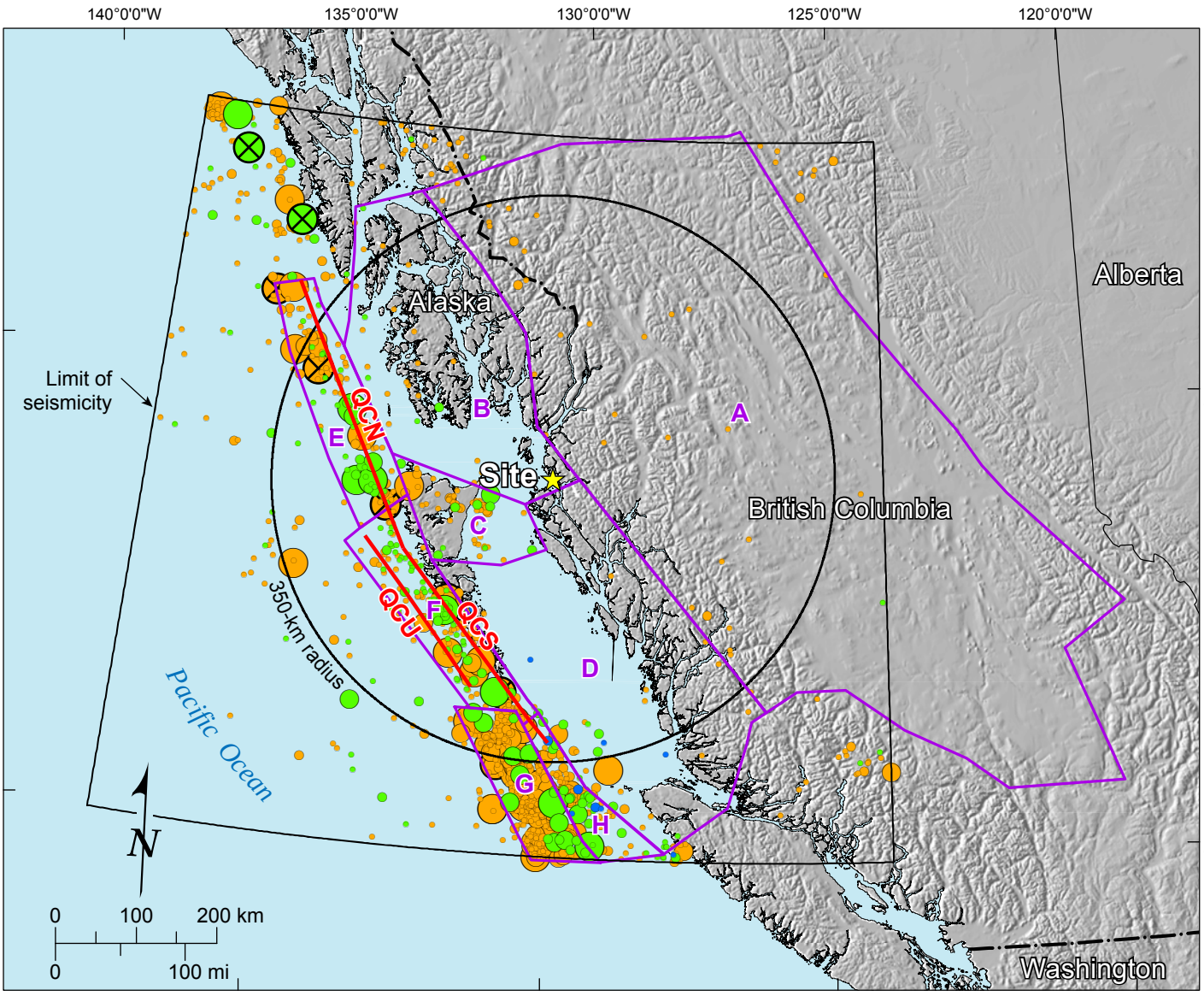
Table 4-7c Fault Rupture Scenario Weights

Fault Rupture Source	Moment Balanced Rupture Weight	Moment Balanced Rupture Seismicity
Queen Charlotte Transform Fault		
QCN	0.64	0.426
QCS	0.64	0.463
QCN+QCS	0.36	0.111

Figures 4-6a to 4-6e show the idealized magnitude earthquake recurrence for each of the seismic sources in the seismic source model: the Queen Charlotte Faults and Seismic Source Zones (Faults QCN, QCS, QCU and Zones E and F), Seismic Source Zones A-B-D, Zone C, Zone G and Zone H, respectively, superimposed on the historical seismicity records in these respective areal source zones. These figures show that the idealized magnitude earthquake recurrence for each seismic source (shown with the black line) which will be input to the PSHA calculations agrees well with the historic seismic city data shown with the red dots over the magnitude range of available data.

4.5 Summary of Seismic Source Parameters

As described in the previous sections, a detailed source model was developed for the project area. The parameters required for probabilistic seismic hazard analyses and the characteristics of those source zones are summarized in Tables 4-3 (a to c). The idealized magnitude recurrence used in the subsequent Probabilistic Seismic Hazard Analyses for each zone is shown on Figures 4-6a to 4-6e. These recurrence plots incorporate the epistemic uncertainty on magnitude potential, and source activity (e.g., slip rate) using a range of values and associated weights as reported in Tables 4-3 (a to c).



Explanation

QCU Line source

C Areal source

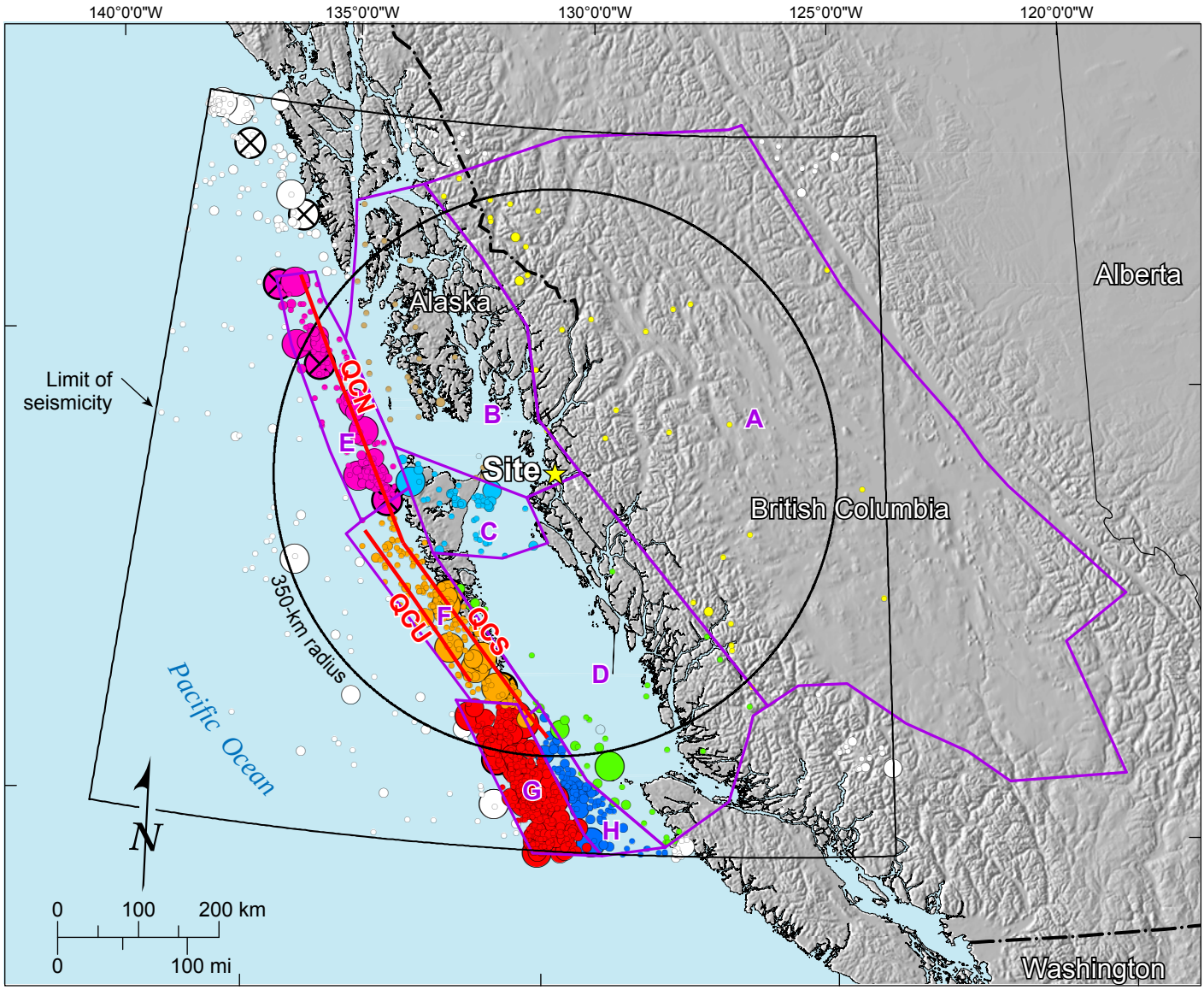
Seismicity

Magnitude (Mw)	*Depth (km)*
2.0 to 3.9	0 to 20
4.0 to 4.9	20 to 40
5.0 to 5.9	>40
6.0 to 6.9	
7.0 to 8.1	

SEISMIC SOURCE MODEL
PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

FIGURE 4-1

PROJECT, 10130058 Pacific Northwest LNG, _05 Graphics, modified 12.18.13



Explanation

QCU Line source

C Areal source

Seismicity Magnitude (Mw)

- 2.0 to 3.9
- 4.0 to 4.9
- 5.0 to 5.9
- 6.0 to 6.9
- 7.0 to 8.1

Seismicity by Areal Zone

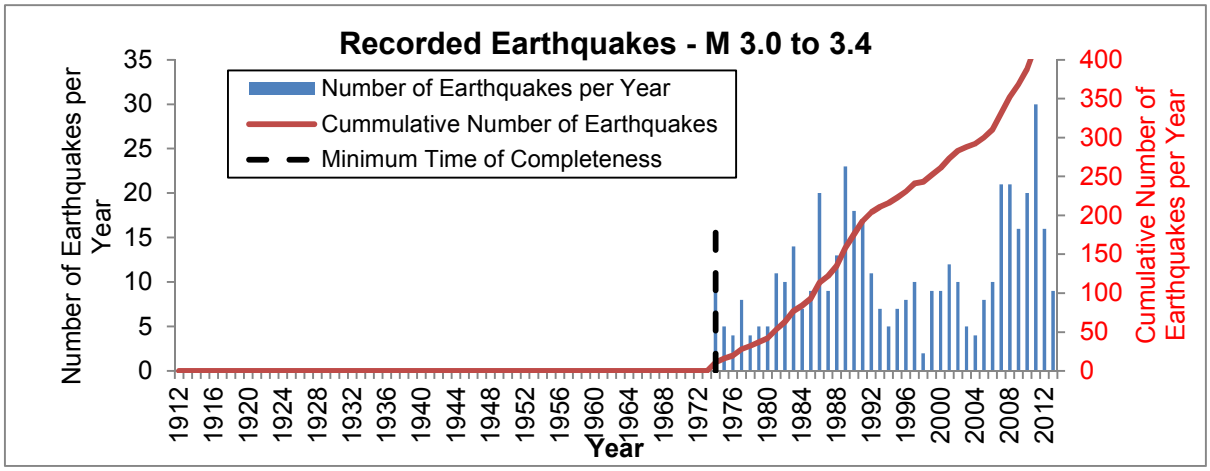
- A
- B
- C
- D
- E
- F
- G
- H
- Outside of areal zone

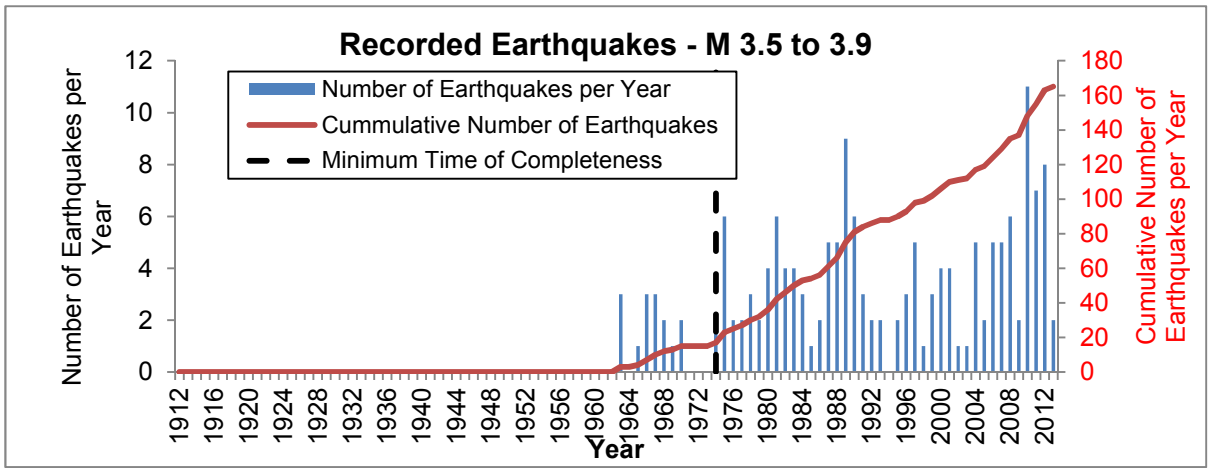
SITE LOCATION AND SEISMICITY BY AREAL AND FAULT SOURCES

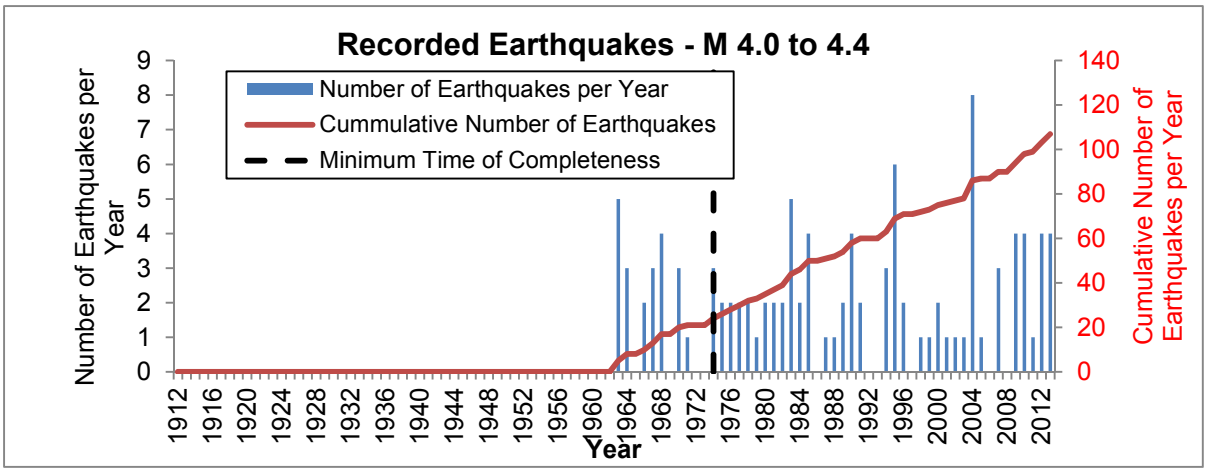
PNW LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA FIGURE 4-2

PROJECT, 10130058 Pacific Northwest LNG, _05 Graphics, modified 12.18.13





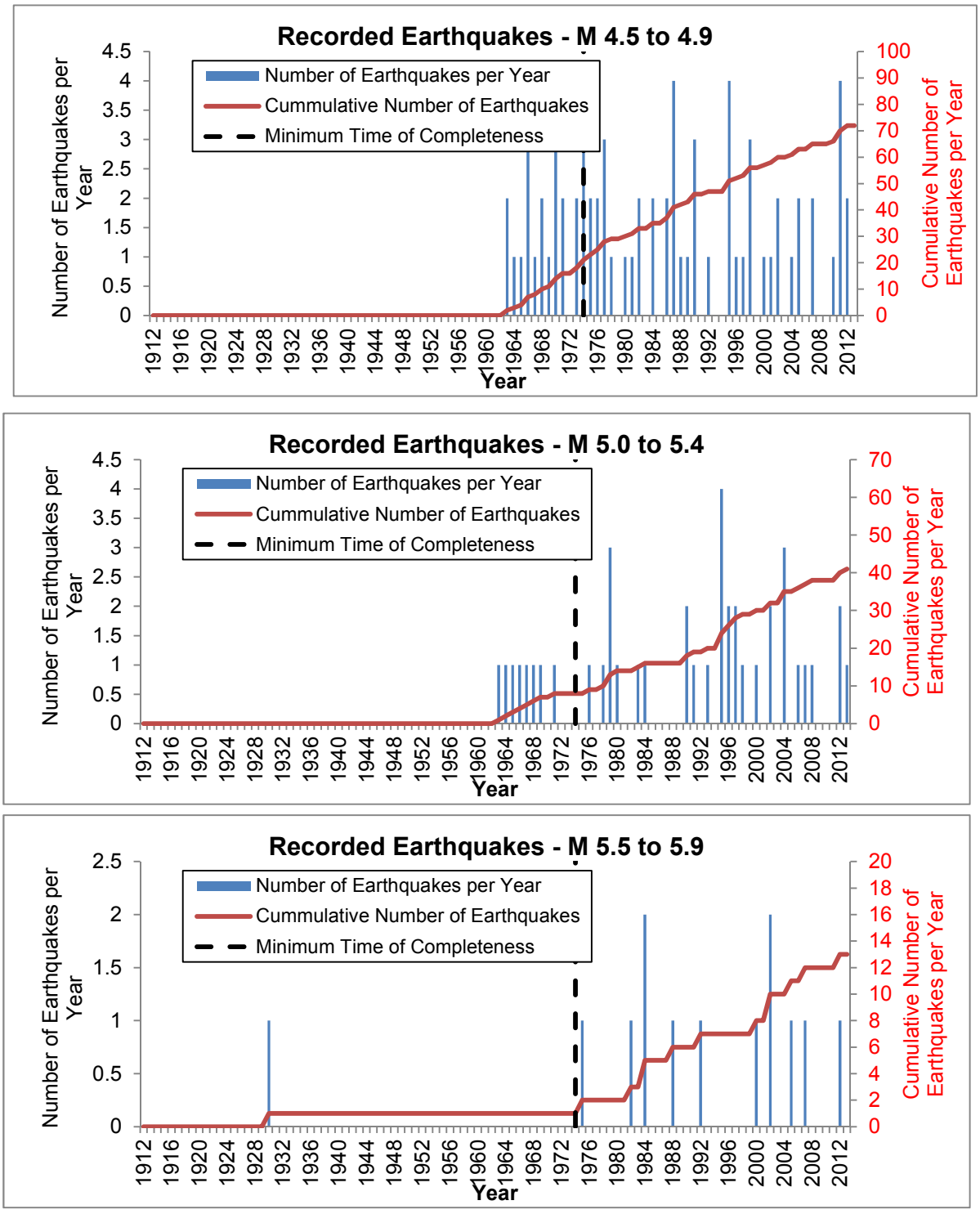


CUMULATIVE NUMBER OF EARTHQUAKES PER YEAR AND MAGNITUDE 3 TO 4.4

PNW LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

FIGURE 4-3a

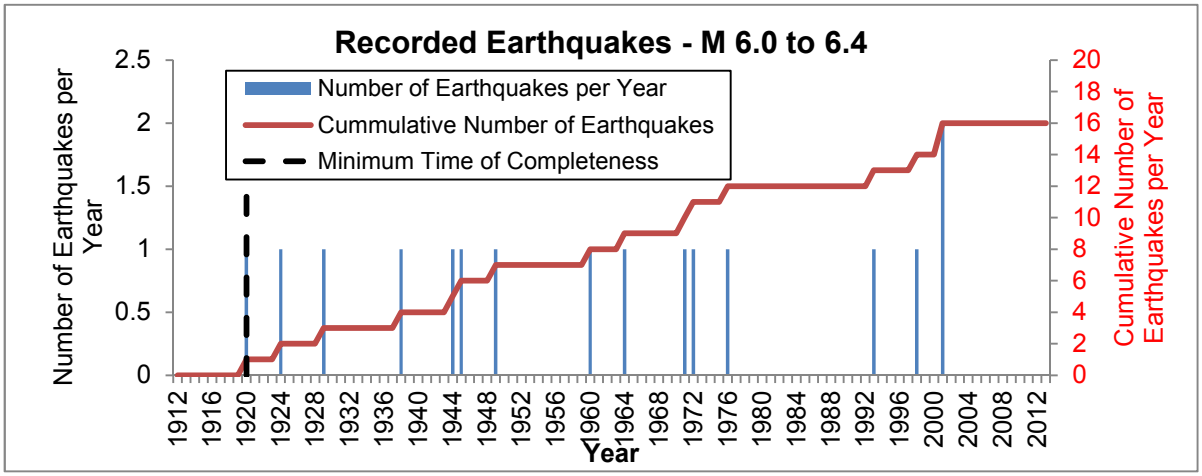


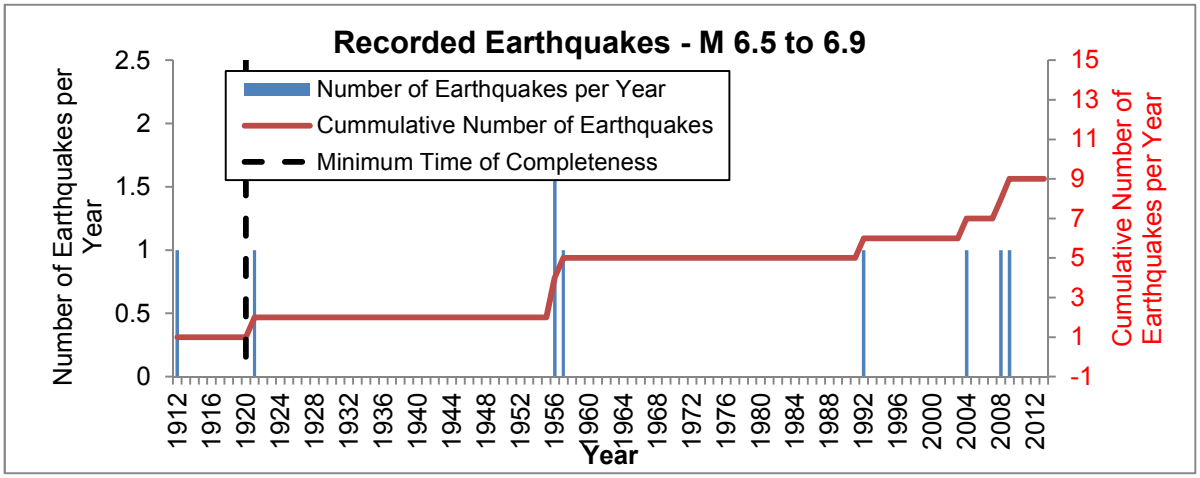
CUMULATIVE NUMBER OF EARTHQUAKES PER YEAR AND MAGNITUDE 4.5 TO 5.9

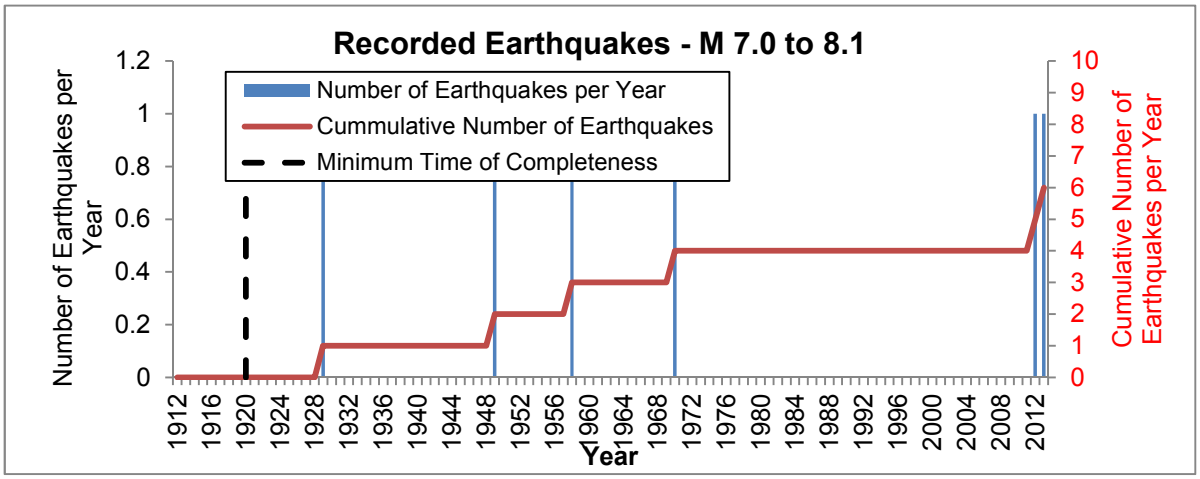
PNW LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

FIGURE 4-3b





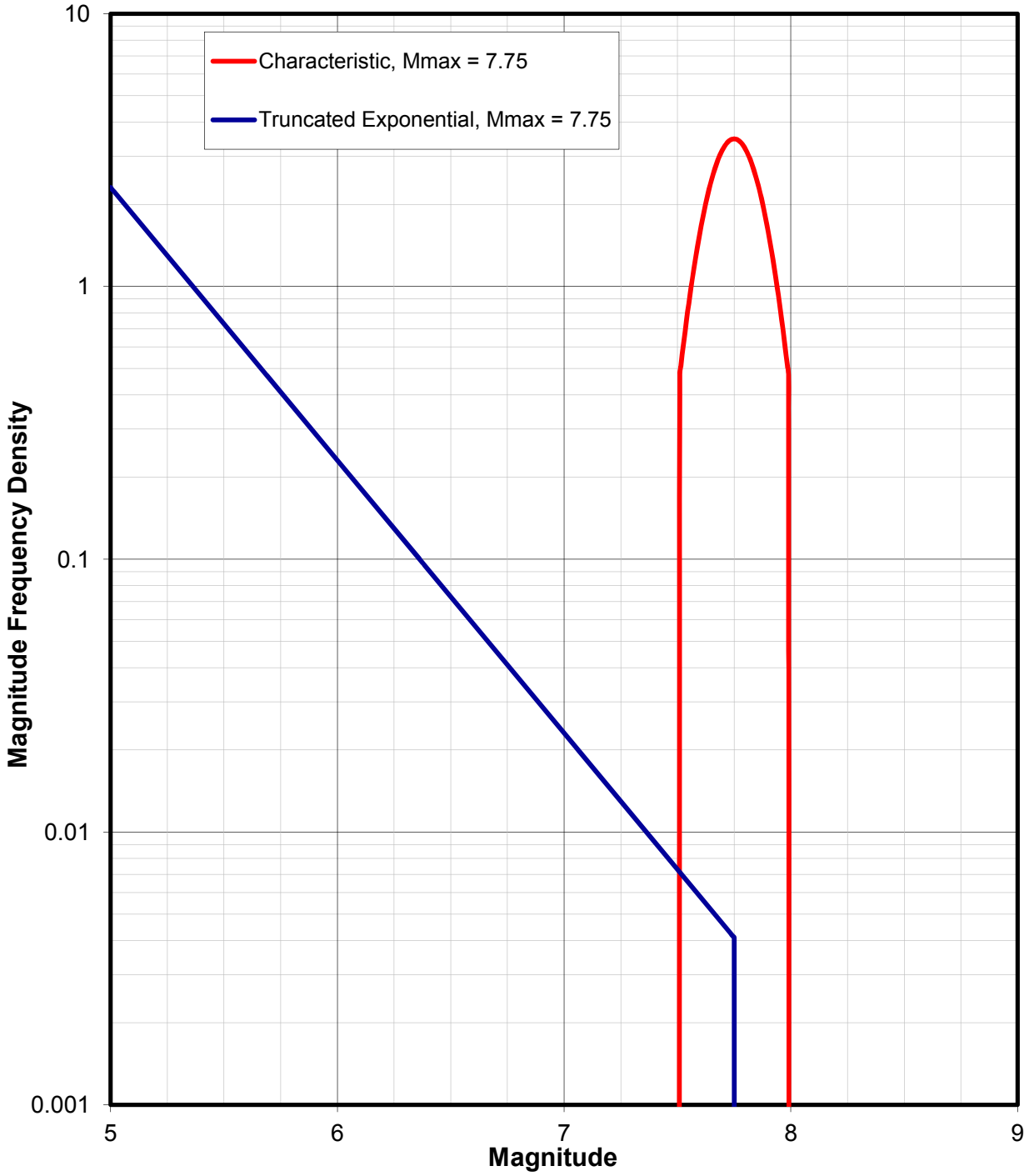


CUMULATIVE NUMBER OF EARTHQUAKES PER YEAR AND MAGNITUDE 6 TO 8.1

PNW LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

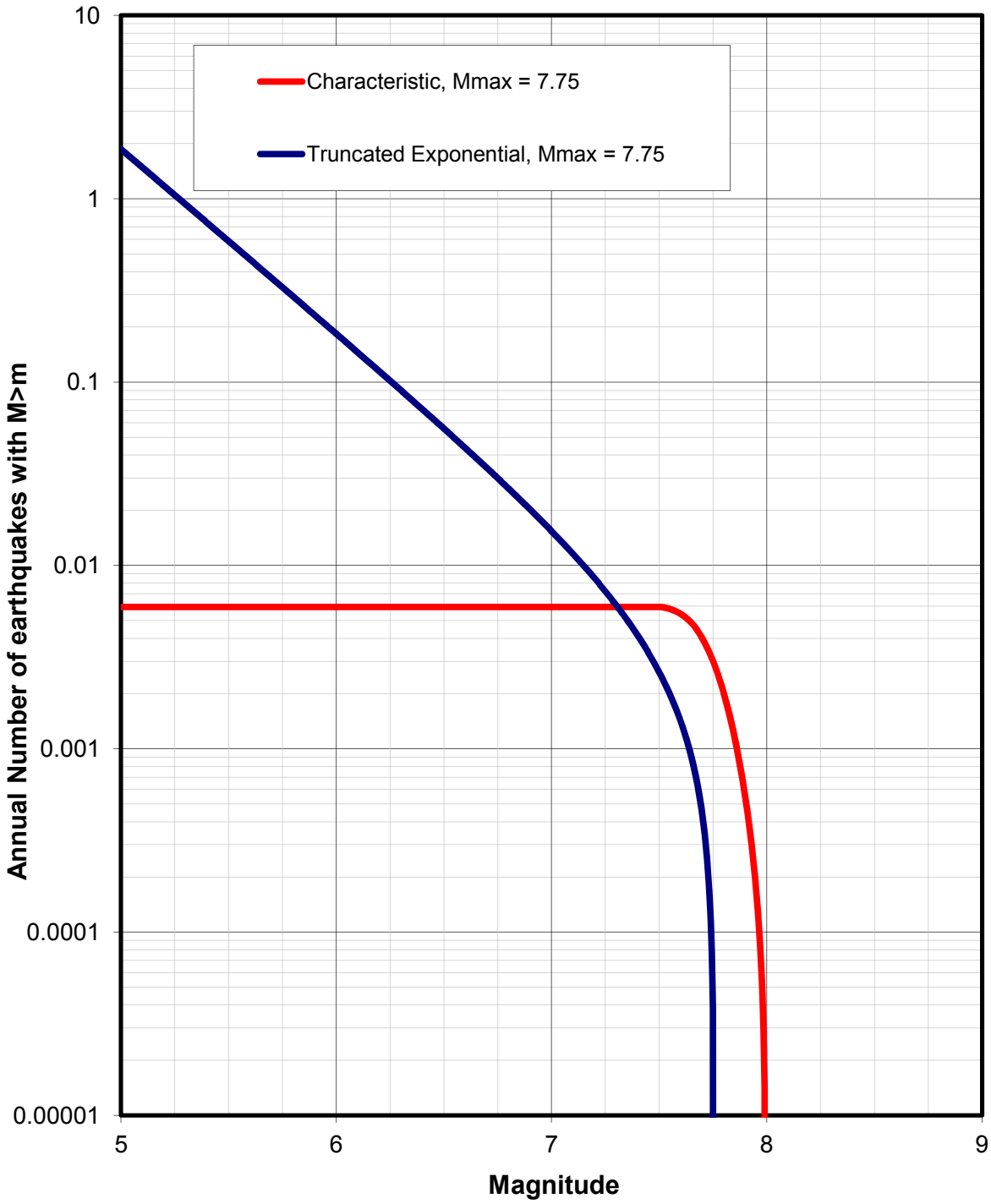
FIGURE 4-3c



EXAMPLE MAGNITUDE PROBABILITY DENSITY FUNCTIONS

PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

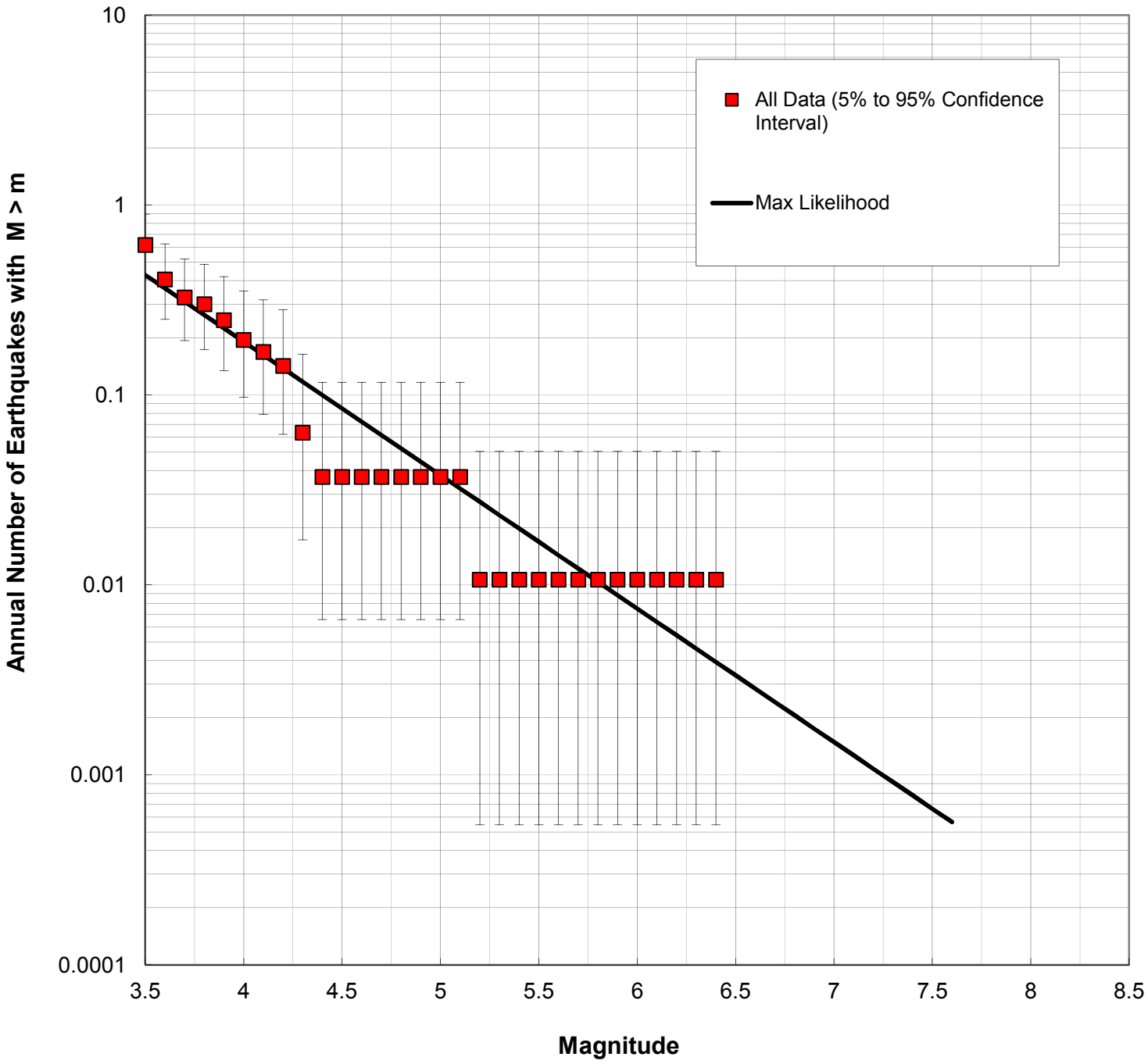
FIGURE 4-4a



EXAMPLE ANNUAL RECURRENCE PREDICTED BY DIFFERENT MAGNITUDE PDF MODELS

PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

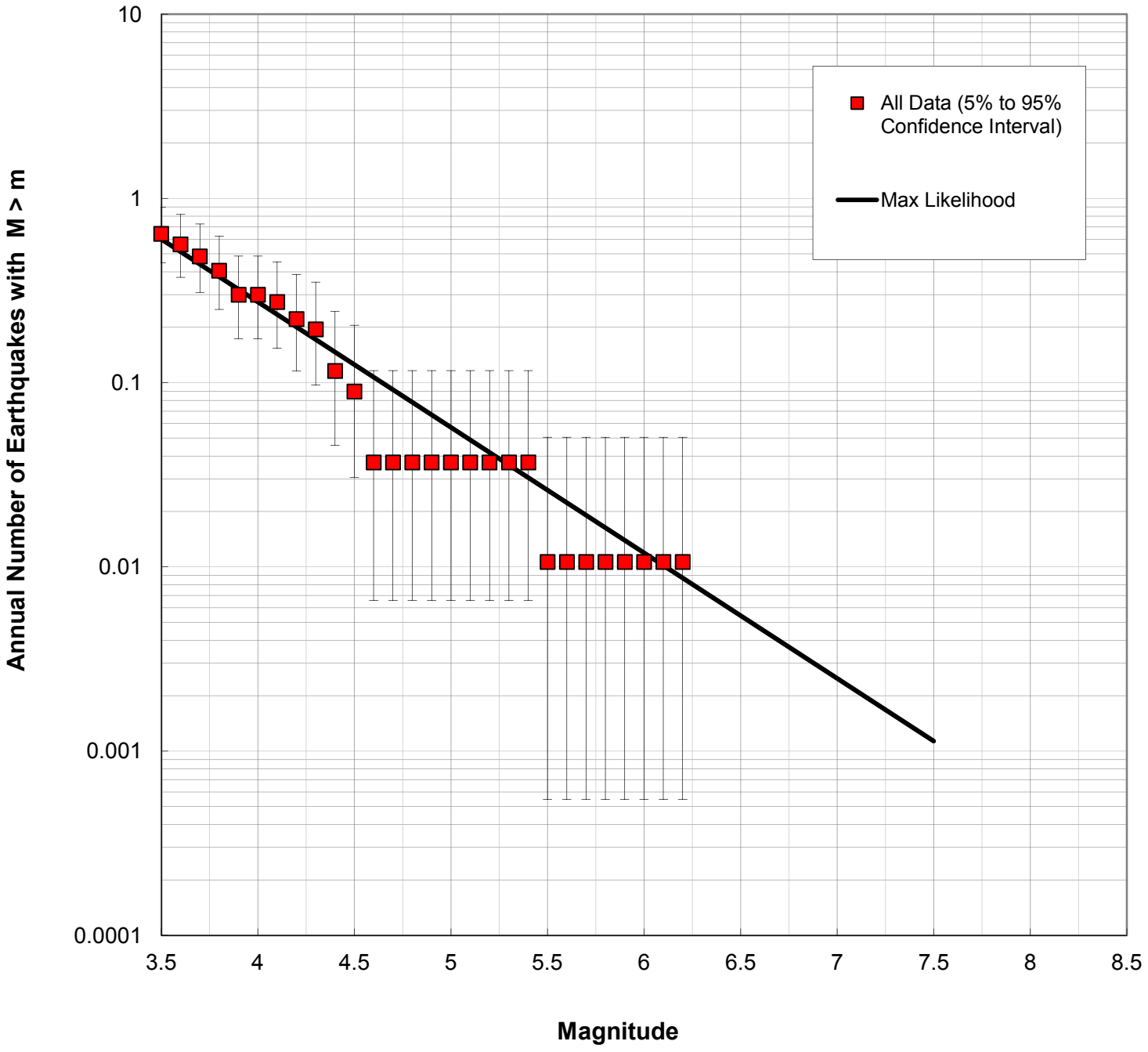
FIGURE 4-4b



FIT OF GUTENBERG-RICHTER MODEL TO HISTORIC SEISMICITY DATA - ZONES A+B+D

PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

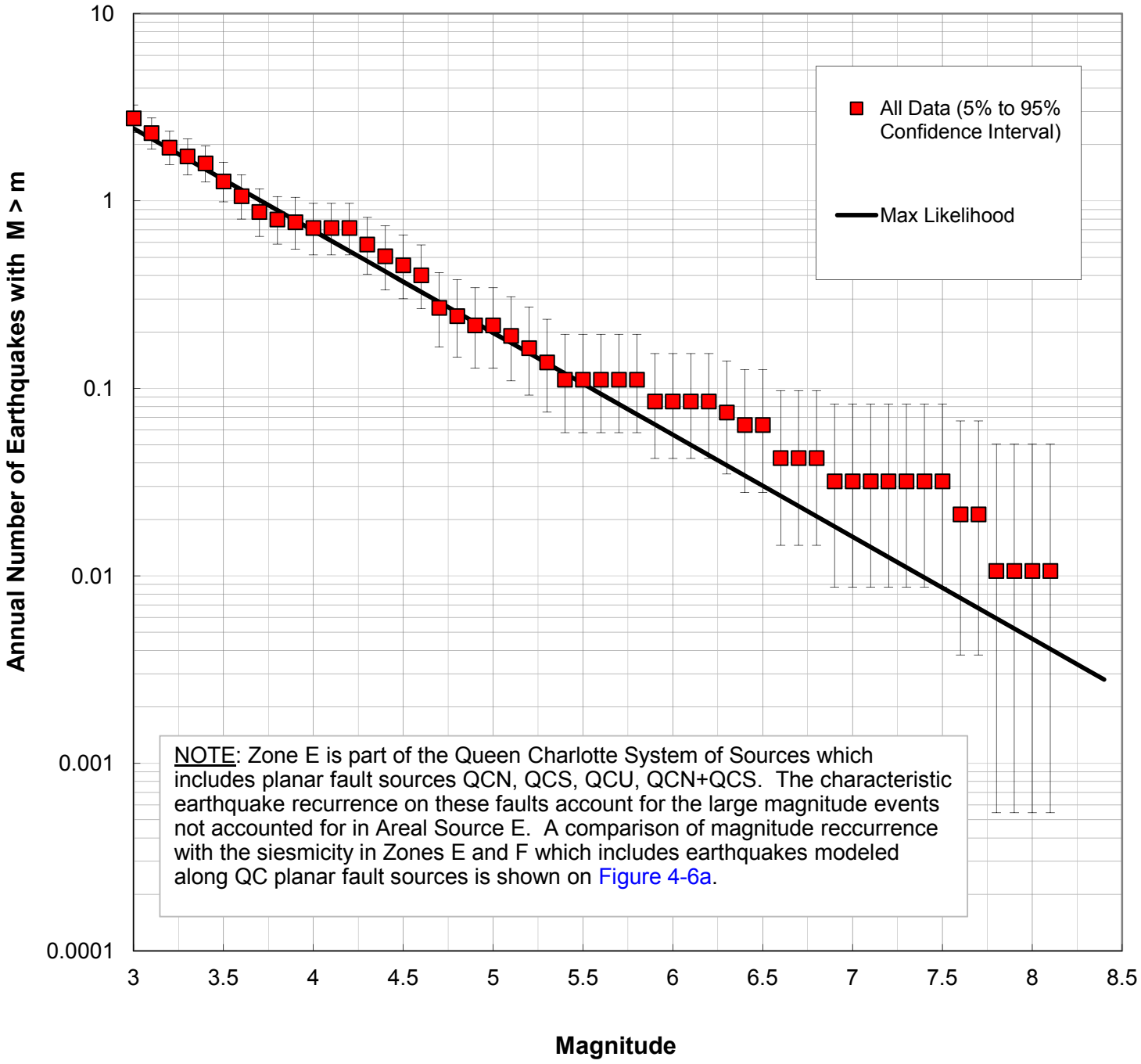
FIGURE 4-5a



FIT OF GUTENBERG-RICHTER MODEL TO HISTORIC SEISMICITY DATA - ZONE C

PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

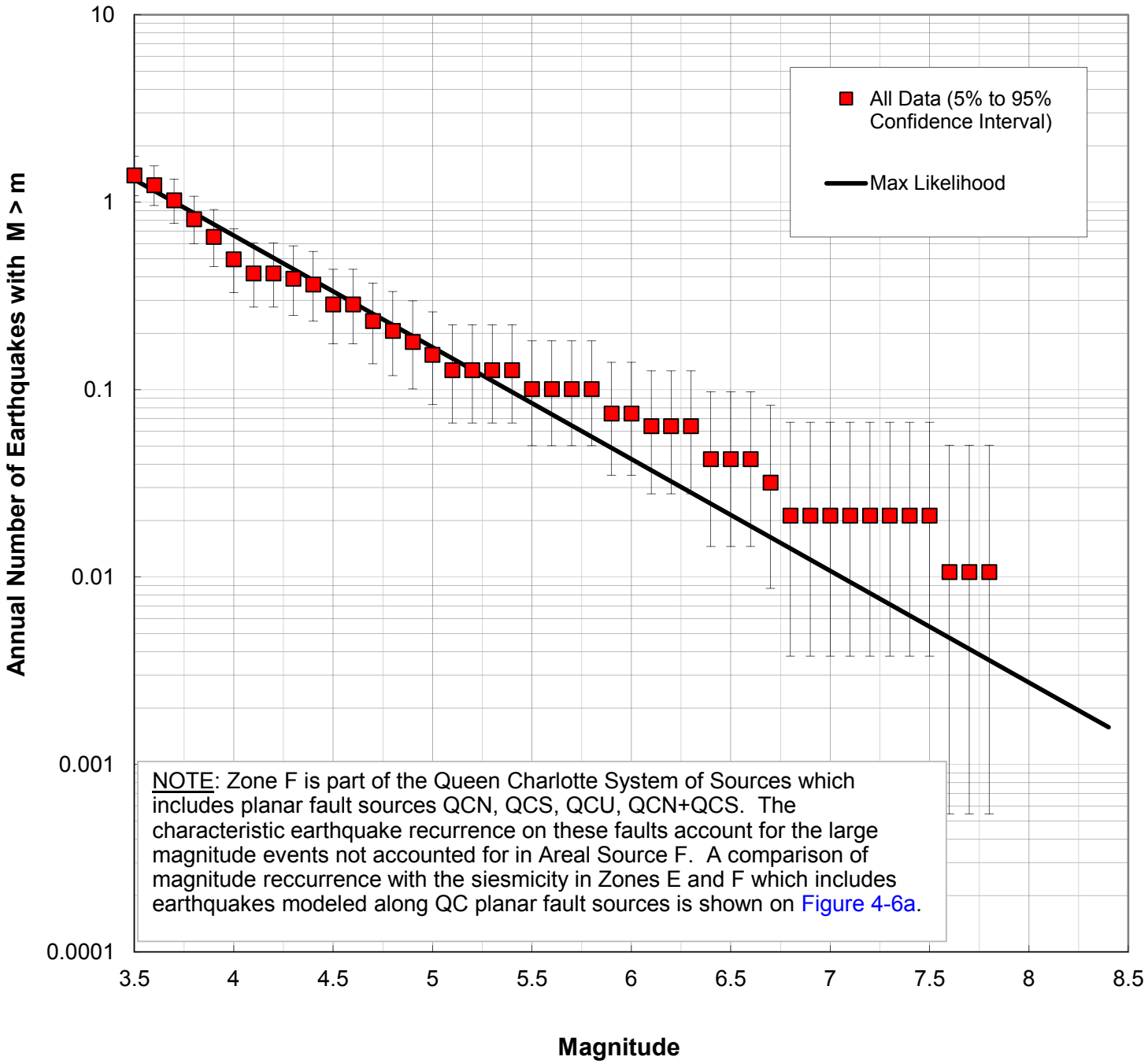
FIGURE 4-5b



FIT OF GUTENBERG-RICHTER MODEL TO HISTORIC SEISMICITY DATA - ZONE E

PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

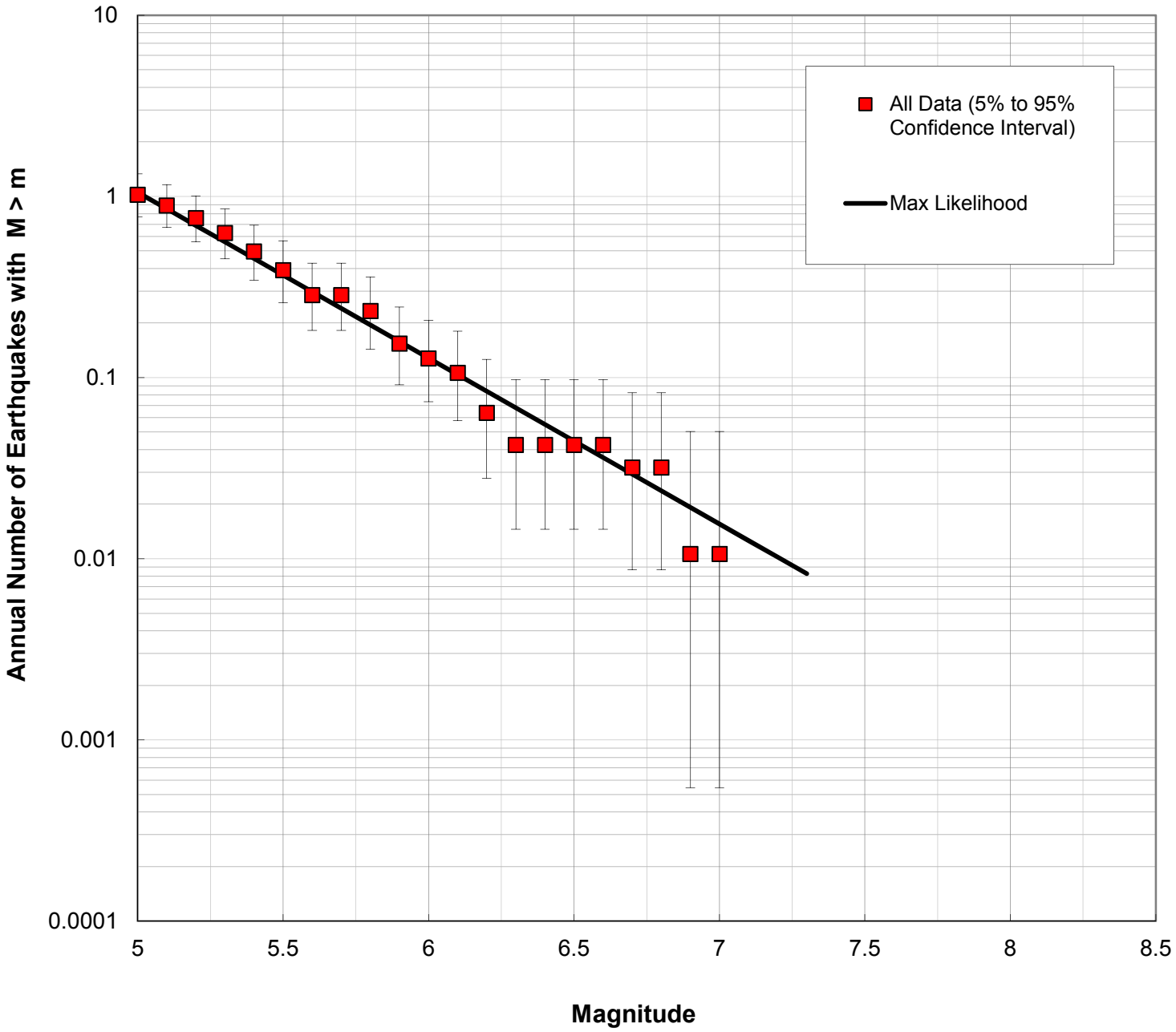
FIGURE 4-5c



FIT OF GUTENBERG-RICHTER MODEL TO HISTORIC SEISMICITY DATA - ZONE F

PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

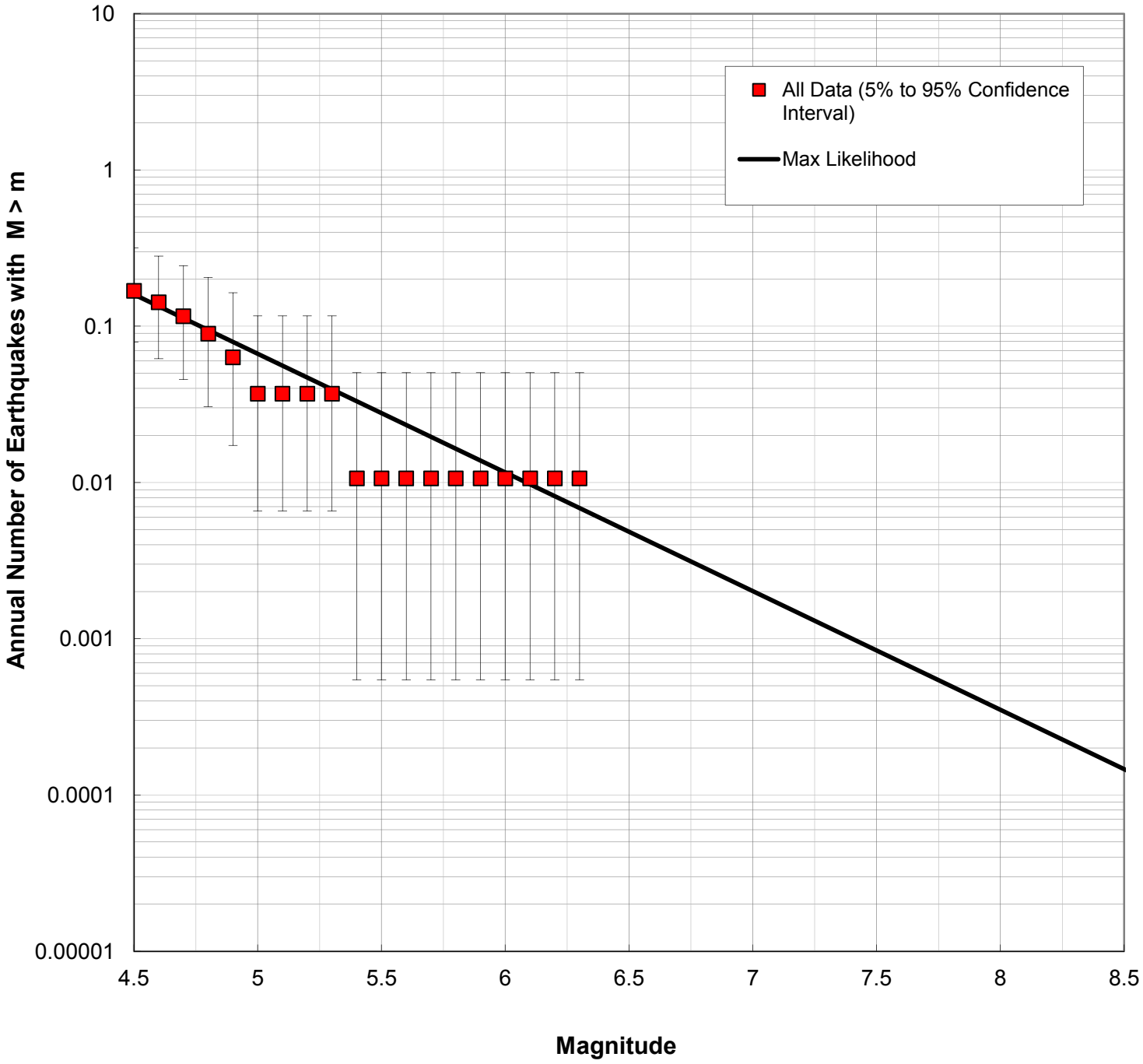
FIGURE 4-5d



FIT OF GUTENBERG-RICHTER MODEL TO HISTORIC SEISMICITY DATA - ZONE G

PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

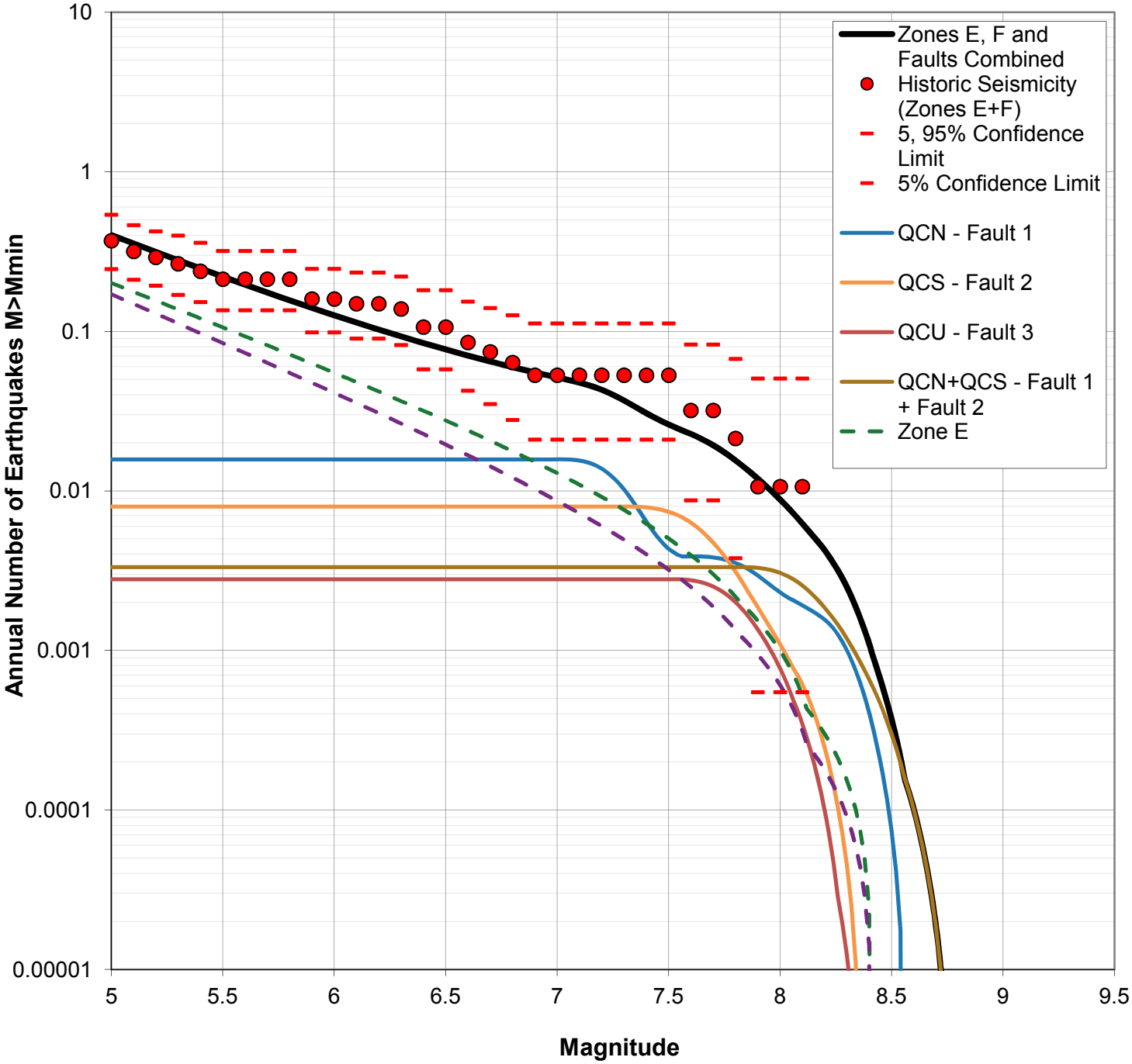
FIGURE 4-5e



FIT OF GUTENBERG-RICHTER MODEL TO HISTORIC SEISMICITY DATA - ZONE H

PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

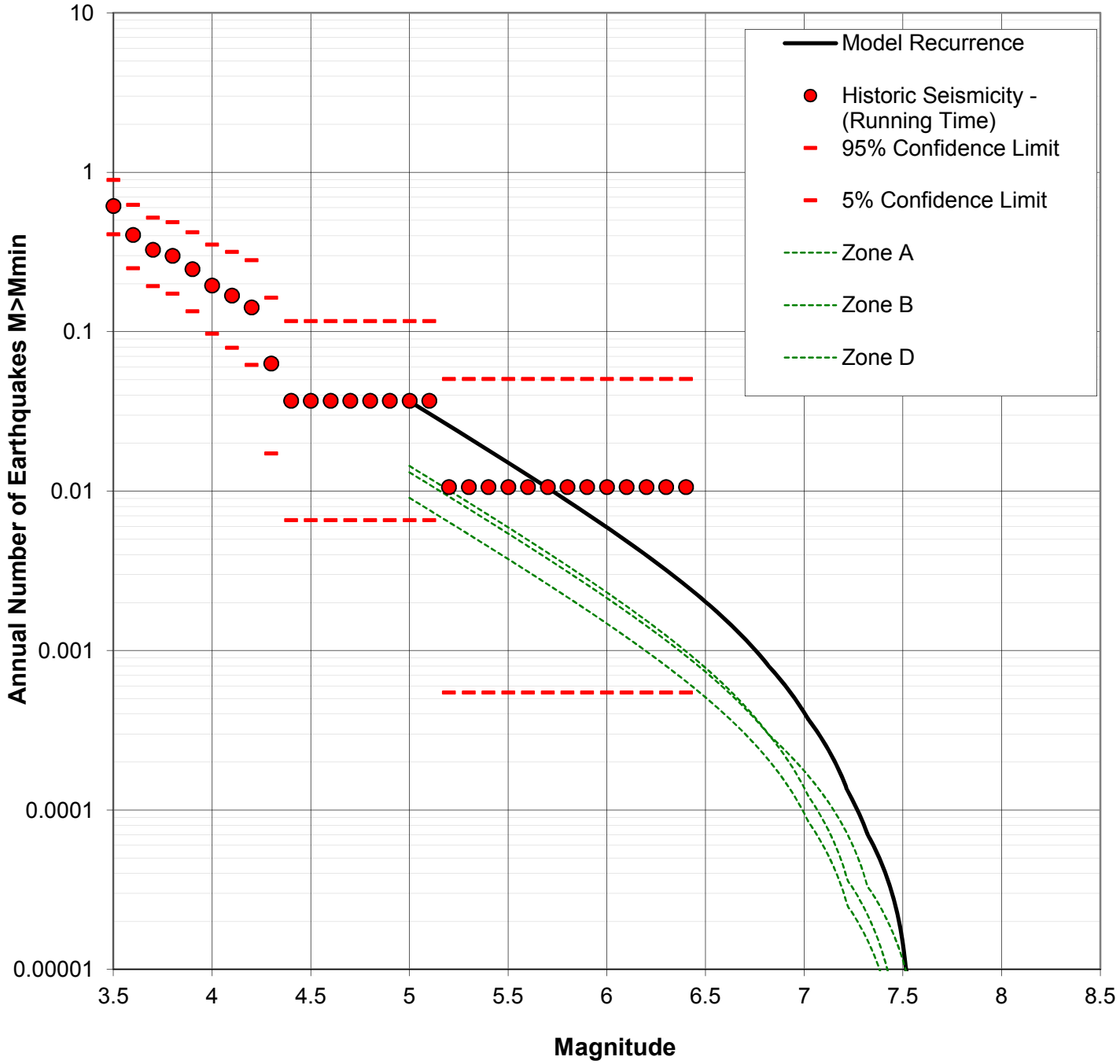
FIGURE 4-5f



CUMULATIVE ANNUAL NUMBER OF EARTHQUAKES FOR QUEEN CHARLOTTE SEISMIC SOURCES ZONES E, F AND FAULTS F1, F2, F3

PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

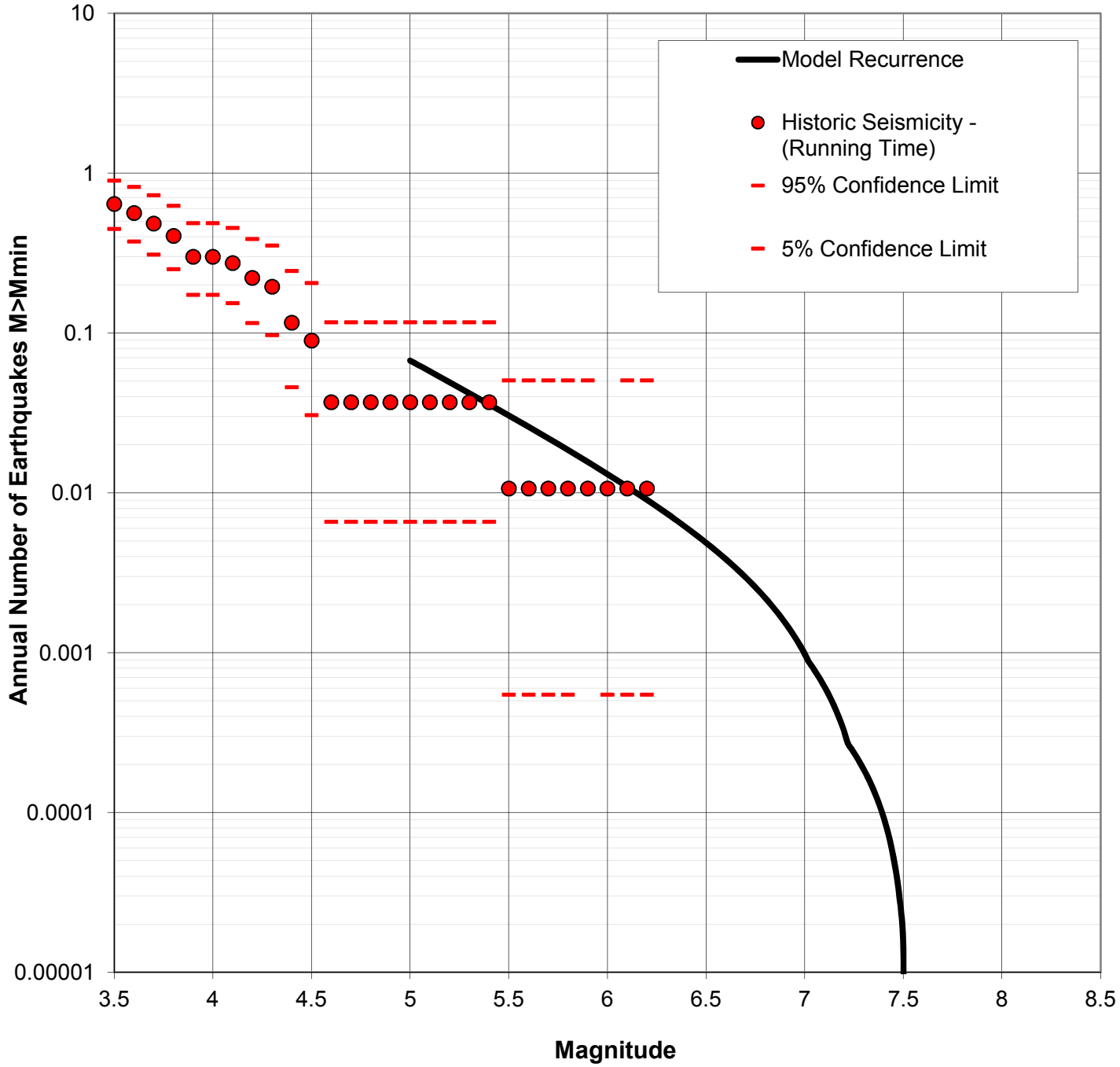
FIGURE 4-6a



CUMULATIVE ANNUAL NUMBER OF EARTHQUAKES SEISMIC SOURCES ZONES A, B AND D

PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

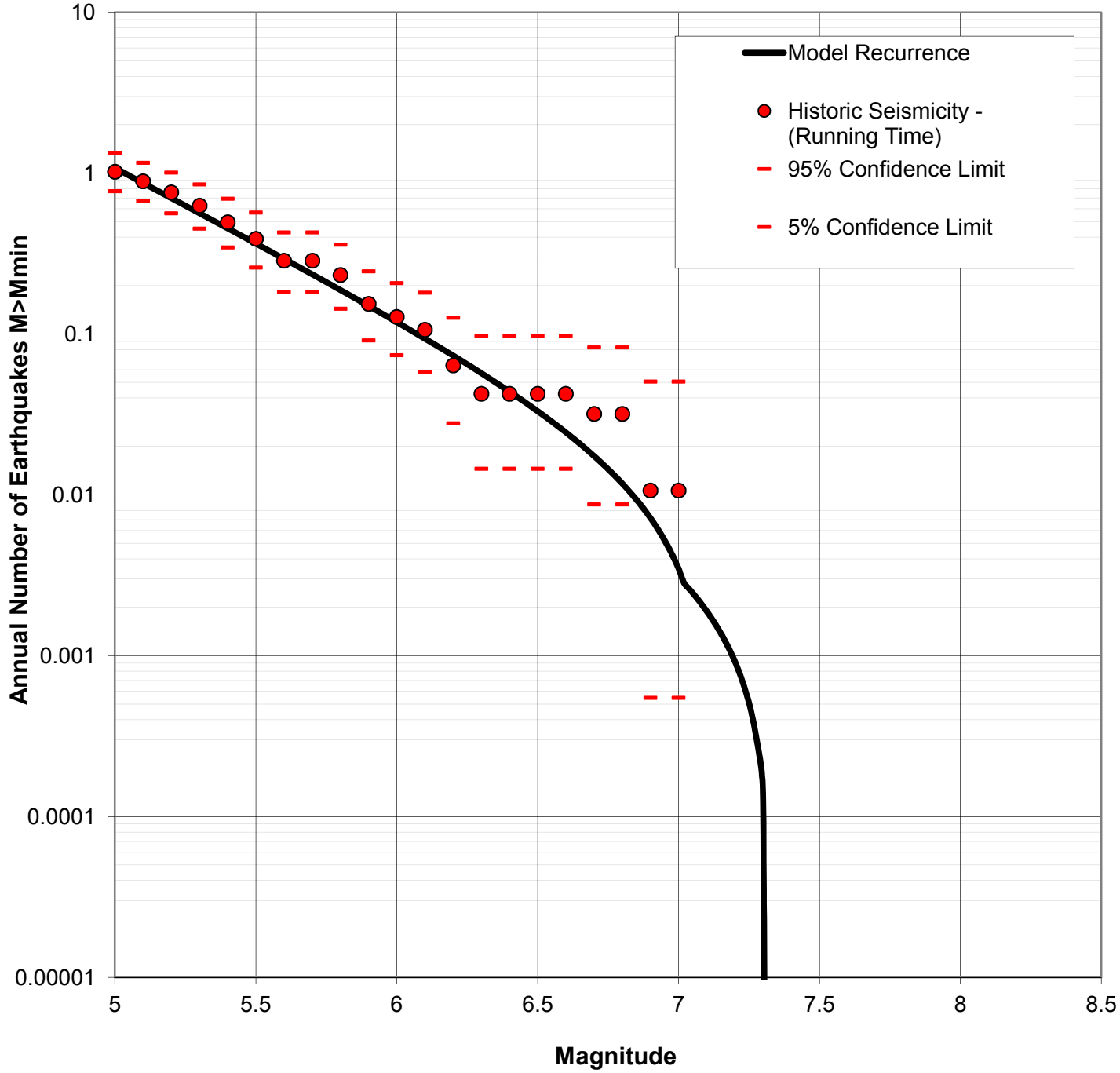
FIGURE 4-6b



CUMULATIVE ANNUAL NUMBER OF EARTHQUAKES SEISMIC SOURCE ZONE C

PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

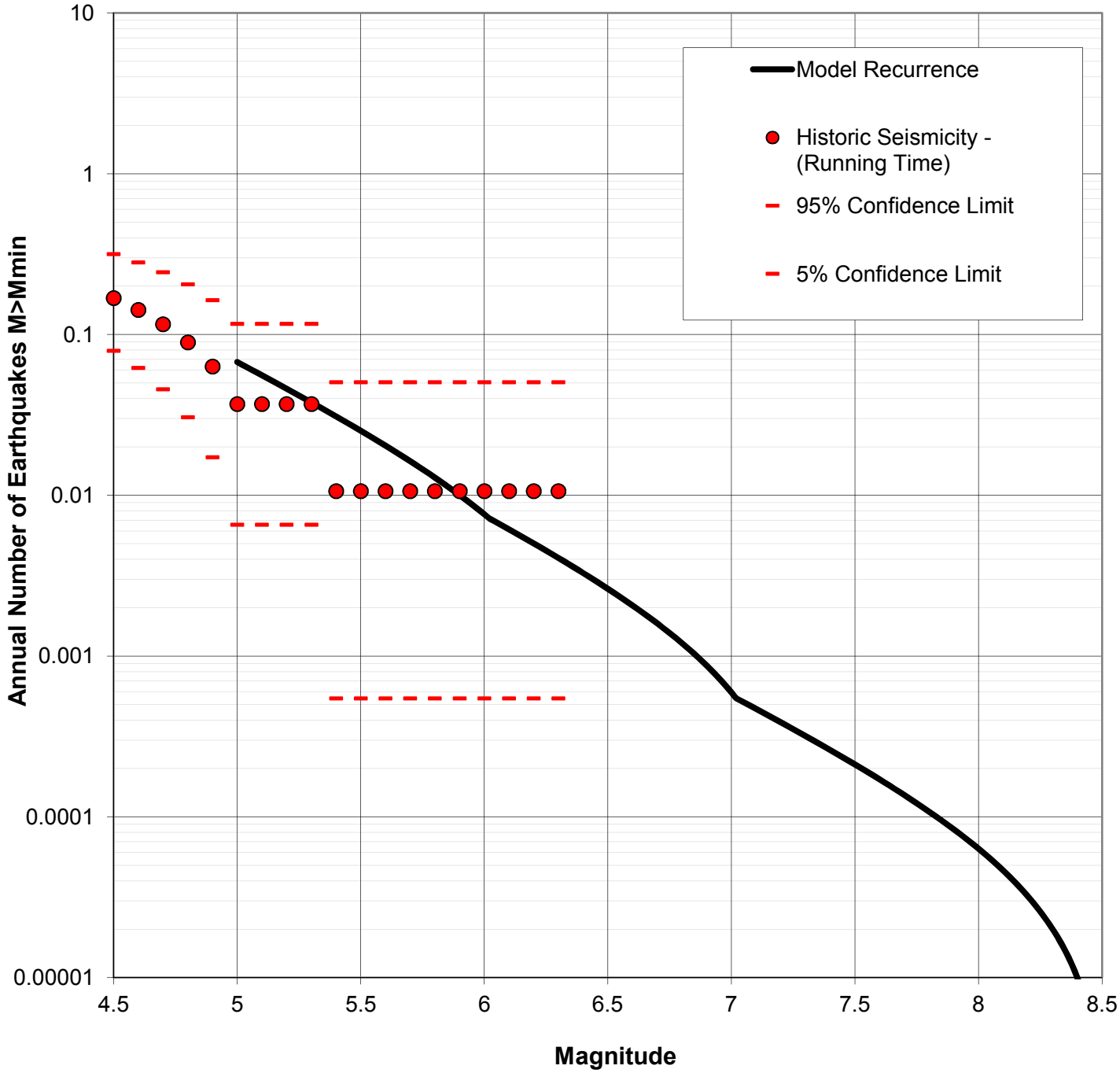
FIGURE 4-6c



CUMULATIVE ANNUAL NUMBER OF EARTHQUAKES SEISMIC SOURCE ZONE G

PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

FIGURE 4-6d



CUMULATIVE ANNUAL NUMBER OF EARTHQUAKES SEISMIC SOURCE ZONE H

PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

FIGURE 4-6e

SECTION 5.0

5.0 SEISMIC HAZARD ANALYSES AND DESIGN SPECTRA DEVELOPMENT

5.1 Project Location

Probabilistic (PSHA) and deterministic (DSHA) seismic hazard analyses were conducted for one representative onshore location on Lelu Island. Selecting one location was considered appropriate because of the large distance of the controlling seismic sources from the project site. It should be noted that spectral values computed for an additional location in the nearshore area (presented in Fugro 2013b) are within 3% of the onshore values, suggesting negligible ground motion variability across the project site for the same subsurface conditions.

The geographical coordinates of the location used for the seismic hazard analyses is shown in Table 5-1. The closest distance from the project site to the seismic sources described in Section 4 are summarized in Table 5-2.

Table 5-1. Coordinates of Representative Location

Latitude (degrees)	Longitude (degrees)
54.201	-130.289

Geographical coordinates are referenced to datum WGS 84 - World Geodetic System

Table 5-2. Closest Distance to Seismic Sources

Source	Closest Distance (km)
Zone A	28
Zone B	0
Zone C	48
Zone D	18
Zone E	183
Zone F	178
Zone G	293
Zone H	293
QCN	202
QCS	188
QCU	168

5.2 Seismic Site Classification

Subsurface conditions were characterized by means of 22 onshore borings, including PS suspension logging data. A detailed description of subsurface conditions in the onshore areas is provided in the draft geotechnical report (Fugro 2013c). In general, subsurface conditions are variable across the site with variable thickness of overburden soils above rock (phyllite and moderately metamorphosed schistose rock). Figure 5-1 shows a map with the thickness of soft soils encountered across the onshore project area below the final grade of +25 meters. Figure 5-2a presents results from the PS suspension logging conducted in boring BH-14 near the middle LNG tank location. Figure 5-2b presents the boring log for BH-14. The measured shear wave velocities in rock are generally greater than 1500m/s. Based on the recommendations in the draft geotechnical report, some structures may be supported on engineered fill material.

For the purpose of developing design ground motions for the onshore locations three idealized profiles were considered, representative of: a) rock conditions, b) engineered fill, and c) up to 10 meters of soft soils. Shear wave velocity values of 1500m/s, 520 m/s and 180 m/s were selected to model the three idealized conditions in the PSHA. Shear wave velocities of 1500 m/s (Site Class A) represent the undivided metamorphic rock outcrop, consisting mainly of undivided phyllite, encountered at many different onshore locations across the site. Shear wave velocities of 520 m/s (Soil Class C) represent the artificial fill consisting mainly of clayey sand with gravel. Shear wave velocities of 180 m/s represent the peat or soft clayey deposits which overly the metamorphic rock at the project area. A maximum thickness of soft soils equal to 11 meters was assumed in these analyses, based on the available boring data.

5.3 Horizontal Ground Motion Prediction Equations

The attenuation of seismic waves from a seismogenic source to the site was modeled using horizontal ground motion prediction equations (GMPE). These empirical relationships should model the type of rupture mechanism as well as the regional geology to properly estimate site-specific strong ground motion. For this study the assumption was made that shallow crustal earthquakes in and around Lelu Island are similar to comparable events in active plate margin areas such as California.

For all shallow crustal sources (fault and areal sources), four of the GMPE's developed as part of the Next Generation Attenuation (NGA-West 1) project (Power et al., 2008) were used with equal weights. Those relationships include Abrahamson and Silva (2008), Boore and Atkinson (2008), Campbell and Bozorgnia (2008), and Chiou and Youngs (2008). Table 5-3 presents the characteristics and recommended range of applicability of the selected GMPE's. It is recognized that magnitude range for some scenarios exceeds the magnitude range for which the Boore and Atkinson (2008) model is deemed applicable. During the FEED-level studies the NGA-West 2 models (which were recently developed and currently under review), which are applicable at larger

magnitudes, should be adopted. Similar concerns over distance applicability of existing GMPE are discussed in the following Section 5.4.

Table 5-3. Characteristics and Recommended Range of Applicability of the Selected GMPE's

No.	Model	Seismotectonic Regime	No. of Earthquake Records in Database	Source-to-Site Distance Range (km)	Magnitude Range (M_w)	Vs_{30} Range (m/s)	Spectral Periods Range (sec)
1	Abrahamson and Silva (2008)	Shallow crustal, active tectonic regions	2754	0 - 200	5.0 - 8.5	160 - 1500	0 - 10
2	Boore and Atkinson (2008)	Shallow crustal, active tectonic regions	1574	0 - 200	5.0 - 8.0	180 - 1300	0 - 10
3	Campbell and Bozorgnia (2008)	Shallow crustal, active tectonic regions	1561	0 - 200	4.0 - 8.5	150 - 1500	0 - 10
4	Chiou and Youngs (2008)	Shallow crustal, active tectonic regions	1950	0 - 200	4.0 - 8.5	150 - 1500	0 - 10

5.4 Maximum Distance of Contributing Sources

Seismic sources within a 300 km radius of the project site were considered in the hazard analyses. This distance was selected based on results of PSHA sensitivity analyses and consideration of limitations in current GMPEs. Due to the absence of high activity seismic sources near the project site, seismic sources associated with the Queen Charlotte system control the hazard at the site and the hazard is therefore highly sensitive to limiting considered sources to distances smaller than 200 km. Due to the effect of Queen Charlotte sources on the hazard, it was deemed inappropriate to ignore the source contributions due to limitations in currently available GMPEs.

It is noted that the GMPEs developed as part of the NGA-West 1 project (Power et al., 2008) have only been deemed applicable by the model developers for distances less than 200 km due insufficient data at larger distances. By using these GMPE's at distances up to 300 km there is greater uncertainty in the predicted hazard from distance sources. However, as described above, 200 km West of the project site lies the active Queen Charlotte fault system which was deemed inappropriate to ignore.

To understand any potential bias with the current hazard calculations at long distances, comparisons were made between the median NGA-West 1 model attenuation with distance as compared to the draft NGA-West 2 models. The GMPEs in current development as part of the NGA-West 2 project (e.g. Abrahamson et. al., 2013) have used an expanded ground motion database and in some cases accounted for a large amplitude bias in large distance recordings due to instrument triggering limitations. The resulting GMPEs have been deemed applicable to distances of 300 – 400 km. Comparison of median ground motion amplitude attenuation (for representative Queen Charlotte Scenarios) at distances larger than 200 km show that the preliminary NGA-West2 GMPEs, on average, attenuate faster than 2008 models at a structural Period of 1 second while at PGA some NGA-West 2 models attenuate faster while others attenuate slower than NGA-West 1 models. Therefore, we believe at long periods there may be some conservatism in the NGA-West 1 models used. To address any potential conservatism due to the limitations in current GMPEs, these analyses can be revisited upon publication of the final NGA-West 2 GMPE in a peer-reviewed journal (expected in 2014).

5.5 Definition of Design Levels

The project design levels were defined per the requirements of CSA Z276-11, the seismic hazard assessment for the PNW-LNG project was conducted for three levels of ground motions:

- The SSE (Safe Shutdown Earthquake) defined as the greater of the mean probabilistic ground motions with a 2 percent probability of exceedance within a 50-year period (2,475 year return period) and the deterministic 84th percentile spectral response for the Cascadia subduction zone earthquake scenario.
- The OBE (Operating Basis Earthquake) defined as mean hazard ground motion with a 10 percent probability of exceedance within a 50-year period (475 year return period);
- The ALE (Aftershock Level Earthquake) defined as 50% of the SSE ground motion.

Based on the return periods of interest for SSE and OBE design levels, PSHA results are provided in the following section for 475- and 2475-year return periods.

Additionally, per KBR's request the design spectrum described in the 2010 NBCC is provided although it is not based on the hazard analyses performed by Fugro and is prescribed by the building code in the case that some structures are allowed to be designed per this criteria.

5.6 Probabilistic Seismic Hazard Analyses Results

Results from the PSHA are presented for the selected site coordinates shown in Table 5-1 and for three different site class conditions, referred to as Site Class A ($V_{s,30}$= 1,500 m/s), C ($V_{s,30}$= 520m/s) and E ($V_{s,30}$= 180m/s).

5.6.1 Seismic Hazard Curves

Figures 5-3a, 5-3b and 5-3c present the total mean hazard curves for structural periods ranging from 0.01 to 10 seconds for site class A, C and E, respectively. These hazard curves represent the total mean hazard from combining all seismic sources and GMPE's.

5.6.2 Horizontal Uniform Hazard Response Spectra

Figures 5-4a, 5-4b and 5-4c present the mean horizontal uniform hazard acceleration response spectra (UHRS) for return periods of 475 and 2475 years for site class A, C and E, respectively. These UHRS were computed based on the total mean hazard curves presented on Figures 5-3. The estimated PGA for the 475-year return period for site class A, C and E is approximately 0.08g, 0.12g and 0.16g, respectively. The estimated PGA for the 2475-year return period for site class A, C and E is approximately 0.15g, 0.21g and 0.27g, respectively.

5.6.3 Seismic Hazard Deaggregation by Seismic Source

Figures 5-5a, 5-5b and 5-5c present the seismic source contribution to the total mean hazard for PGA and structural period of 1 second and for site class A, C and E, respectively. For short structural periods (i.e. PGA) the seismic hazard is associated with seismic source Zone C and the Queen Charlotte Faults and Zones (E and F). At longer structural periods (i.e. 1 second) the main seismic sources contributing to the hazard are the Queen Charlotte Faults and Queen Charlotte Zones (E and F).

Figures 5-6a, 5-6b and 5-6c present bar plots illustrating the fractional contribution to the total mean hazard from different seismic sources for 475 and 2475 year return periods. .

5.6.4 Seismic Hazard Deaggregation by Earthquake Magnitude, Distance and Epsilon

Figures 5-7a, 5-7b and 5-7c present the seismic hazard deaggregation with respect to earthquake magnitude, distance, and epsilon for 475 and 2475 year return periods for PGA and structural period of 1 second and for Site Class A, C and E, respectively.

In general, for short structural periods the seismic hazard at the project site is controlled by two types of scenarios: large magnitudes between 7.5 to 8.5 at distances larger than 150 km associated with the Queen Charlotte faults (North, South and Underthrust) and the Queen Charlotte Zones; and intermediate magnitude events (i.e., 6 to 7) at distances between about 50 km to 100 km associated primarily with the Graham Island areal source (i.e., Zone C). For longer structural periods (i.e., period of 1 seconds), the relative contribution from large magnitude (i.e., 7.5 to 8.5) events increases. These scenarios are associated with the Queen Charlotte faults (North, South and Underthrust) and the Queen Charlotte Zones (E and F on Figure 4-1).

Similar trends are observed for the longer return period of 2475 years, with generally larger contributions from larger epsilon (ε) values. Epsilon is the number of standard deviations that the

estimated ground motion amplitude deviates from the estimated median ground motion amplitude. Thus, an epsilon of 1 indicates that the probabilistic value of the ground motion corresponds to a median plus one-standard-deviation value.

Finally, similar observations with respect to the seismic hazard deaggregation are made for all three Site Class cases.

5.6.5 Effects of Soil Profile Type

Figure 5-8 compare the total horizontal mean UHS normalized for Site Class A, C and E for 475 and 2475 year return periods. The change to softer site class (A to C, or C to E) is accompanied by increases in spectral amplitudes at all structural periods. This trend is observed for both 475 and 2475 year return period UHS.

5.7 Comparison with Previous Studies

5.7.1 Comparison with 2010 National Building Code of Canada

Figure 5-9a compares the UHS for Site Class C from this study with the UHS according to 2010 National Building Code of Canada (http://www.earthquakescanada.nrcan.gc.ca/ hazard-alea/interpolat/index_2010-eng.php). The spectral acceleration from this PSHA study are overall larger than NBC. For short periods site-specific spectral values are about 25% larger than NBC values. For intermediate and long structural periods (e.g., Ts > 0.2s) site-specific spectral acceleration are 50% to 100% larger than respective code values. These differences can be attributed to a) differences in seismic source model (slip rates, b-values, activity rates, and maximum magnitudes) and b) differences in GMPE (median estimate of Sa and standard deviation) used to estimate ground motion amplitude for a given earthquake scenario..

At the time of preparation of this report the documentation for the 2010 NBCC maps is not yet available (Open File Report 6761 is listed “in preparation”), however it is understood that the 2010 maps are based on the same source model used in the 2005 maps (GSC, 2003).

5.7.1.1 Differences in the Seismic Source Model

The seismic source model used in Fugro’s study was developed based on the latest available data including: (1) peer-reviewed literature (2) published geologic maps, (3) historical seismicity, (4) geospatial data (e.g., topography and bathymetry), (5) unpublished reports, previous internal reports, and (6) proprietary data provided by the client. The NBCC 2010 seismic hazard model was based on the same seismic hazard model as the NBCC 2005 which is based on information (seismicity, geologic and geodetic information) from the mid-1990s (GSC, 2003). The main differences between the Fugro and the 2010 NBCC seismic source models lie in the earthquake catalog used and the magnitude recurrence relationships used to delineate the seismic sources.

In the Fugro 2013 earthquake catalog, events up to 2013 have been included. The earthquake catalog used for NBCC 2005 only included earthquakes up to 1990 in the east and 1991 in the west (i.e, 22 years of additional earthquake information in Fugro's catalog). The magnitudes in the NBCC catalog were of mixed type whereas region-specific magnitude scale conversions were applied to Ms and Mb in the Fugro catalog. These conversions with an additional two decades of earthquakes (1990-2013) have been implemented in the Fugro, 2013 model allowing a more reliable estimate of the magnitude recurrence on each seismic source. These improvements over the current NBCC model have also recommended by Adams (2011) as possible updates for the 2015 NBCC maps.

Figure 5-9b illustrates the magnitude recurrence for the Queen Charlotte Fault for the NBCC, 2010 model and the Fugro 2013 model. NBCC 2010 uses only truncated exponential magnitude recurrence model which is deficient in the large magnitudes when compared to historic seismicity. Also, the implied seismic moment rate in the area is lower than that estimated from observed geodetic slip rates (on which the recurrence of Fugro's fault sources are based). As presented in Figure 5-9b, the historic seismicity in the Queen Charlotte area is noticeably higher than the seismicity predicted by NBCC 2010 recurrence model used for magnitudes higher than 6.5. The Fugro 2013 model considers characteristic events using a characteristic recurrence model superimposed with truncated exponential as was presented in Section 4.4, and is in agreement with the historic seismicity and geodetic slip rates.

As presented in Figures 5-5a to 5-5c, which show the deaggregation of the hazard by seismic sources, Queen Charlotte Fault is one of the main contributors to the seismic hazard and therefore the magnitude recurrence model used to model this source is important for the estimated seismic hazard.

5.7.1.2 Differences in Ground Motion Prediction Equations

NBCC 2010 seismic source model uses the Boore, Joyner and Fumal (BJF) GMPE published in 1997 (GSC, 2003). The Fugro study uses the Next Generation Attenuation Relationships (NGA) published in 2008. As discussed per Adams (2011), the NGA's represent a major change as the new GMPEs have incorporated a better understanding of scaling of ground motion amplitude based on new earthquake data and fault simulations. The adoption of NGA Relationships has been indicated as a possible model change for 2015 NBCC (Adams, 2011).

Fugro performed sensitivity analyses both deterministically (DSHA) and probabilistically (PSHA) in order to explore the effect of the selected GMPE on the seismic hazard. Figure 5-9c presents a comparison of the deterministic horizontal acceleration response spectra from Boore, Joyner, and Fumal (1997) model and the average of the four 2008 NGA relationships (Abrahamson and Silva (2008), Campell and Bozorgnia (2008), Boor and Atkinson (2008), Chiou and Youngs (2008)) for the median plus 2.1 standard deviation spectrum. These deterministic analyses were conducted

for a magnitude 8 earthquake, with a closest distance of 190 km and epsilon 2.1, which is the mean earthquake scenario from the deaggregation of 1 second structural period and the 2475 year return period event. Figure 5-9d, presents the same comparison for a magnitude 7.2 earthquake, with a closest distance of 120 km and epsilon 2, which is the mean earthquake scenario from the PGA deaggregation and the 2475 year return period event. As presented in Figure 5-9d, the spectral accelerations using the average of the four NGA relationships are significantly higher than the ones using BJF, 1997 relationship with the spectral acceleration for a structural period of 1 second being 50% higher.

Figure 5-9e compares the Uniform Hazard Spectra (UHS) for an average shear wave velocity of 1500m/s and the 2475 year return period event, for the following cases: a) the Fugro 2013 source model and the average of the four NGA relationships and b) Fugro 2013 source model and the BJF, 1997 relationship, c) Fugro's interpretation of the NBCC source model for Queen Charlotte Fault using BJF 1997 relationship, and d) the Site Class A spectrum based on the Canadian Building Code. The NBCC code spectrum is close to the spectrum resulting from the implementation of the NBCC magnitude recurrence relationships for Queen Charlotte Fault in Haz38 using BJF 1997 relationship for periods larger than 0.5 seconds. It appears that changes to the selected GMPEs have a significant effect on the estimated seismic hazard, followed by differences in the modeled magnitude recurrence of the QCF.

Figure 5-9f, present the same spectra for an average shear wave velocity in the first 30 meters of 520m/s (Site Class C).

5.7.2 Comparison with GSHAP

Figure 5-10 presents PGA estimates for the 475-year return period and site class B/C developed by GSHAP (http://www.seismo.ethz.ch/static/gshap/northam/shednh_8col.gif). Based on the GSHAP study, PGA values at the project site for 475-year return period at the Site Class B/C boundary are on the order of 0.08g. GSHAP results are in general agreement with the PSHA results of this study estimating PGA values of 0.08g for 475-year return period and site class C and 0.12 g for 475-year return period and site class A.

5.8 Development of Design Spectra

5.8.1 Horizontal Design Spectra

The NGA Relationships provide estimates of the ground motion for structural periods up to 10 seconds. However, per CSA Z276-11, horizontal acceleration response spectra shall be constructed covering the entire range of anticipated damping ratio for the sloshing (convective) mode of vibration of the contained LNG. Therefore, the spectral acceleration values up to 20 seconds may be required for structural evaluations. In order to extend the spectra to longer periods the following approach was adopted; Uniform hazard spectra (UHS) were first estimated

directly from PSHA up to structural periods of 10 seconds using the full seismic source model (i.e., all sources were modeled), spectral values were estimated for long (>10.0 seconds) structural periods assuming a constant spectral velocity from 10 to 16 seconds and constant displacements from 16 to 20 seconds. The corner period of 16 seconds was selected as a function of the mean deaggregated magnitude from the PSHA, based on Abrahamson and Silva (2008) constant displacement model. A mean magnitude of 8.2 was used for the estimation of the corner period. Horizontal response spectra are developed for 0.5, 2.5 and 5% damping ratios for structural periods up to 20 seconds.

Figures 5-11a and 5-11b present the extended acceleration, velocity and displacement spectra for Site Class A, for 475 and 2475 year return periods, respectively. Figures 5-11c through 5-11f present the extended UHS for Site Class C and E.

Figures 5-12a, 5-12b and 5-12c present the extended uniform hazard acceleration response spectra for OBE (475-years return period), SSE (2475 year return period) and the Aftershock Level Earthquake (ALE), respectively.

Table 5-4 tabulates the spectral acceleration values for periods ranging from 0 to 20 seconds for 2475 years and 475 years return period for Site Class A, C and E.

Table 5-4: Horizontal Design Spectra for Site Class A, C and E per CSA Z276

Period (s)	Horizontal Spectral Acceleration (g)								
	Site Class A			Site Class C			Site Class E		
	475yrs	2475yrs	ALE	475yrs	2475yrs	ALE	475yrs	2475yrs	ALE
0.01	0.079	0.146	0.073	0.118	0.216	0.108	0.163	0.271	0.135
0.05	0.092	0.173	0.086	0.131	0.241	0.121	0.170	0.281	0.140
0.1	0.125	0.240	0.120	0.176	0.332	0.166	0.224	0.375	0.188
0.15	0.152	0.293	0.147	0.226	0.426	0.213	0.293	0.484	0.242
0.2	0.170	0.323	0.161	0.264	0.495	0.247	0.354	0.579	0.290
0.3	0.176	0.338	0.169	0.299	0.574	0.287	0.437	0.738	0.369
0.5	0.160	0.300	0.150	0.255	0.482	0.241	0.363	0.589	0.295
0.75	0.128	0.246	0.123	0.201	0.365	0.182	0.308	0.498	0.249
1	0.109	0.213	0.106	0.158	0.280	0.140	0.266	0.439	0.220
1.5	0.073	0.141	0.070	0.107	0.185	0.092	0.212	0.362	0.181
2	0.051	0.098	0.049	0.079	0.137	0.069	0.169	0.297	0.148
3	0.031	0.058	0.029	0.051	0.089	0.045	0.115	0.208	0.104
4	0.021	0.039	0.020	0.036	0.064	0.032	0.083	0.152	0.076
5	0.016	0.030	0.015	0.028	0.052	0.026	0.066	0.123	0.062
6	0.013	0.025	0.013	0.024	0.045	0.023	0.054	0.106	0.053
7	0.011	0.022	0.011	0.020	0.040	0.020	0.046	0.093	0.046
8	0.010	0.019	0.010	0.018	0.036	0.018	0.038	0.082	0.041
9	0.008	0.017	0.008	0.015	0.032	0.016	0.033	0.075	0.037
10	0.007	0.015	0.008	0.013	0.030	0.015	0.028	0.069	0.035
11	0.006	0.013	0.007	0.012	0.027	0.014	0.025	0.062	0.031
12	0.006	0.012	0.006	0.010	0.025	0.012	0.022	0.056	0.028
13	0.005	0.011	0.005	0.009	0.022	0.011	0.020	0.051	0.025
14	0.005	0.010	0.005	0.009	0.020	0.010	0.018	0.046	0.023
16	0.004	0.008	0.004	0.007	0.016	0.008	0.015	0.036	0.018
18	0.003	0.006	0.003	0.006	0.013	0.006	0.012	0.029	0.014
20	0.002	0.005	0.003	0.004	0.010	0.005	0.010	0.023	0.012

In addition to the site-specific design spectra per CSA Z276 described above, we have provided design spectra based on the NBCC 2010 criteria per the request of the client, as we understand some structures may be designed per this criteria. Table 5-5 below describes design horizontal response spectra as prescribed by Section 4.1.8.4 of the 2010 NBCC. The spectrum below does

not include any importance factor modification. The remainder of the vertical and horizontal spectra (at various damping levels) in this report are developed per the site-specific criteria of CSA Z276 unless noted otherwise.

Table 5-5: Horizontal Design Spectra per 2010 NBCC

Period (s)	Spectral Acceleration (g)		
	Site Class A	Site Class C	Site Class E
0.01	0.265	0.378	0.658
0.2	0.265	0.378	0.658
0.5	0.124	0.248	0.508
1	0.076	0.152	0.312
2	0.044	0.087	0.178
4	0.022	0.044	0.089
20	0.022	0.044	0.089

NOTE: Values of Sa shall be linearly interpolated for intermediate periods

5.8.2 Horizontal Deterministic Response Spectra

Per CSA Z276-11, a deterministic earthquake response spectrum shall be calculated as the 84th percentile spectral response acceleration at each period of interest, with the earthquake magnitude and source geometry for the Cascadia subduction zone. Deterministic analyses for the Cascadia earthquake scenario were conducted using the attenuation relationships of Zhao et al. (2006) and Atkinson and Boore (2003), assuming equal weights of 0.5. The deterministic Cascadia interface subduction scenario assumed a magnitude of 9 earthquake and closest distance to the site of approximately 450 km per USGS Professional paper 1700 (Atwater et al, 2005).

Figure 5-13 presents the deterministic response spectra for Site Class A, C and E. Superimposed on this figure are the probabilistic UHS for the corresponding site classes. The horizontal deterministic response spectra were calculated for the median plus one standard deviation (sigma, σ). The 84th percentile deterministic response spectra are smaller than the corresponding Uniform Hazard Spectra for all structural periods of the ground motion. Hence, the deterministic spectra from a Cascadia subduction scenario have no effect on the design spectra per CSA Z276 and the horizontal design spectra are defined solely based on the probabilistic UHS as summarized on Figures 5-8 and Table 5-4. The atypical shape of the deterministic response spectra is due to the

use of the attenuation relationships for distances much larger than the data used for development of those relationships.

5.8.3 Vertical Design Spectra

The vertical design response spectra were calculated by applying the median values of the vertical-to-horizontal (V/H) ratios proposed by Gulerce and Abrahamson (2011) to the horizontal UHS.

Gulerce and Abrahamson (2011) developed a GMPE for the V/H ratio using the Pacific Earthquake Engineering Research Center's Next Generation of Ground-Motion Attenuation Models (PEER-NGA) database (Chiou et al. 2008). These V/H ratios account for the differences in the nonlinear site-response effects on the horizontal and vertical components.

These V/H ratios are dependent on the earthquake magnitude and distance, site conditions and faulting mechanism. The V/H ratios were chosen. The resulting vertical UHS are consistent with the probabilistic seismic hazard assessment results for the horizontal ground motion component.

According to CSA Z276-11, vertical acceleration response spectra shall be constructed covering the entire range of anticipated damping ratio for the sloshing (convective) mode of vibration of the contained LNG. Therefore, vertical and horizontal response spectra were developed for 0.5, 2.5 and 5% damping ratios for structural periods up to 20 seconds. CSA Z276-11 states that if information is not available to develop a vertical response spectrum, the ordinates of the vertical response spectrum shall not be less than two-thirds of those of the horizontal. If information is available, the corresponding ratio shall not be less than the one-half. For the purpose of this study, where a site-specific seismic source model was developed and geotechnical information is available for the subsurface conditions, the V/H ratios were limited by a lower threshold of one half of the horizontal spectrum.

Vertical-to-Horizontal (V/H) ratios were developed using the Gulerce and Abrahamson (2011) model for each Soil Class and return period separately. For each structural period (PGA, T=1sec and T=10 seconds), Site Class (A, C and E) and return period (475 and 2475 years), the corresponding mean magnitude and distance scenarios from the hazard deaggregation were used to calculate the V/H ratio applied on the horizontal component to estimate the vertical component. The envelope of all the V/H ratios for different structural periods limited to a minimum of 0.5 was used as the final V/H ratio for each Soil Class and return period. Figure 5-14 illustrates the development of V/H Ratios for Site Class A, C and E as well as return periods of 475 and 2475 years. Figure 5-15 presents the final idealized V/H Ratios used in the computation of the vertical design spectra.

Figures 5-16a to 5-16c present the vertical design spectra for Site Class A, C and E, respectively. Table 5-6 presents the tabulated values of the vertical design spectra.

Table 5-6: Vertical Design Spectra for Site Class A, C and E for 475, 2475 years return period and ALE

Period (s)	Vertical Spectral Acceleration (g)								
	Site Class A			Site Class C			Site Class E		
	475yrs	2475yrs	ALE	475yrs	2475yrs	ALE	475yrs	2475yrs	ALE
0.01	0.047	0.091	0.0455	0.062	0.122	0.061	0.089	0.176	0.088
0.05	0.055	0.108	0.054	0.069	0.136	0.068	0.093	0.182	0.091
0.1	0.075	0.15	0.075	0.093	0.187	0.0935	0.123	0.246	0.123
0.15	0.096	0.194	0.097	0.131	0.268	0.134	0.188	0.378	0.189
0.2	0.102	0.205	0.1025	0.154	0.321	0.1605	0.247	0.512	0.256
0.3	0.101	0.207	0.1035	0.175	0.379	0.1895	0.325	0.709	0.3545
0.5	0.09	0.178	0.089	0.145	0.323	0.1615	0.293	0.622	0.311
0.75	0.077	0.153	0.0765	0.115	0.23	0.115	0.228	0.479	0.2395
1	0.067	0.132	0.066	0.088	0.165	0.0825	0.183	0.391	0.1955
1.5	0.049	0.096	0.048	0.061	0.11	0.055	0.135	0.287	0.1435
2	0.037	0.071	0.0355	0.042	0.075	0.0375	0.089	0.19	0.095
3	0.023	0.044	0.022	0.026	0.047	0.0235	0.058	0.119	0.0595
4	0.017	0.032	0.016	0.018	0.033	0.0165	0.042	0.076	0.038
5	0.014	0.026	0.013	0.015	0.027	0.0135	0.033	0.062	0.031
6	0.011	0.021	0.0105	0.013	0.025	0.0125	0.027	0.053	0.0265
7	0.009	0.018	0.009	0.012	0.024	0.012	0.023	0.046	0.023
8	0.008	0.015	0.0075	0.011	0.023	0.0115	0.019	0.041	0.0205
9	0.007	0.013	0.0065	0.01	0.021	0.0105	0.016	0.037	0.0185
10	0.006	0.012	0.006	0.009	0.02	0.01	0.014	0.035	0.0175
11	0.005	0.01	0.005	0.008	0.019	0.0095	0.013	0.031	0.0155
12	0.005	0.009	0.0045	0.007	0.017	0.0085	0.011	0.028	0.014
13	0.004	0.009	0.0045	0.007	0.016	0.008	0.01	0.025	0.0125
14	0.004	0.008	0.004	0.006	0.014	0.007	0.009	0.023	0.0115
16	0.003	0.006	0.003	0.005	0.011	0.0055	0.007	0.018	0.009
18	0.002	0.005	0.0025	0.004	0.009	0.0045	0.006	0.014	0.007
20	0.002	0.004	0.002	0.003	0.007	0.0035	0.005	0.012	0.006

5.8.4 Conversion to Damping Ratios other than 5%

Horizontal design spectra for damping ratios other than 5 percent can be developed by applying period-dependent factors to the 5%-damped horizontal design spectra. Table 1 presents the scaling factors which can be used to adjust design spectra previously provided for a structural damping ratio of 5%. Scaling factors to adjust the 5% damped spectra are provided for damping ratios of 0.5%, 2.5%, 10%, 15%, and 20% damping per Idriss (1993).

$$\text{Damping Scaling Factor} = Sa_{\beta\%} / Sa_{5\%}$$

These ratios can be used to convert the 5%-damped design spectra listed in Table 5-6 to other damping levels.

Table 5-7: Damping Scaling Factors from Sa at Damping Ratio = 5% to Damping Ratio = β

Period	Damping Scaling Factors for β =				
(s)	0.5%	2.5%	10%	15%	20%
0.01	1.00	1.00	1.00	1.00	1.00
0.05	1.16	1.05	0.97	0.95	0.93
0.1	1.70	1.21	0.82	0.71	0.64
0.15	1.83	1.25	0.78	0.66	0.57
0.2	1.88	1.26	0.78	0.64	0.55
0.3	1.88	1.26	0.78	0.64	0.55
0.5	1.83	1.25	0.78	0.66	0.57
0.75	1.74	1.23	0.79	0.67	0.59
1.0	1.68	1.20	0.80	0.68	0.60
1.5	1.63	1.19	0.80	0.68	0.60
2.0	1.60	1.18	0.80	0.68	0.60
3.0	1.58	1.17	0.80	0.68	0.60
4.0	1.58	1.17	0.80	0.68	0.60
5.0	1.58	1.17	0.80	0.68	0.60
6.0	1.58	1.17	0.80	0.68	0.60
7.0	1.58	1.17	0.80	0.68	0.60
8.0	1.58	1.17	0.80	0.68	0.60
9.0	1.58	1.17	0.80	0.68	0.60
>10	1.58	1.17	0.80	0.68	0.60

6008000 6007500 6007000 6006500 6006000 6005500 6005000

417000 416500 416000 415500 415000

N

1:10,000

200 100 0 200

Meters

BRIDGE AREA

OSBL AREA

ISBL AREA

LNG TANK AREA

PORPOISE INLET

TURNING BASIN AREA

TRESTLE AREA

TRESTLE AND BERTHING AREA

0 250 500 Meters

Thickness of Soft Soil Below Final Grade (m)

- 0 - 2
- 2 - 4
- 4 - 6
- 6 - 8
- 8 - 10
- > 10

Soil Thickness (m)

- < 40
- 40 - 50
- 50 - 60
- 60 - 70
- 70 - 80
- > 80

Legend

- LNG Tank and Tank Number
- ISBL Area
- OSBL Area
- Bridge Area
- LNG Tank Area

Notes:

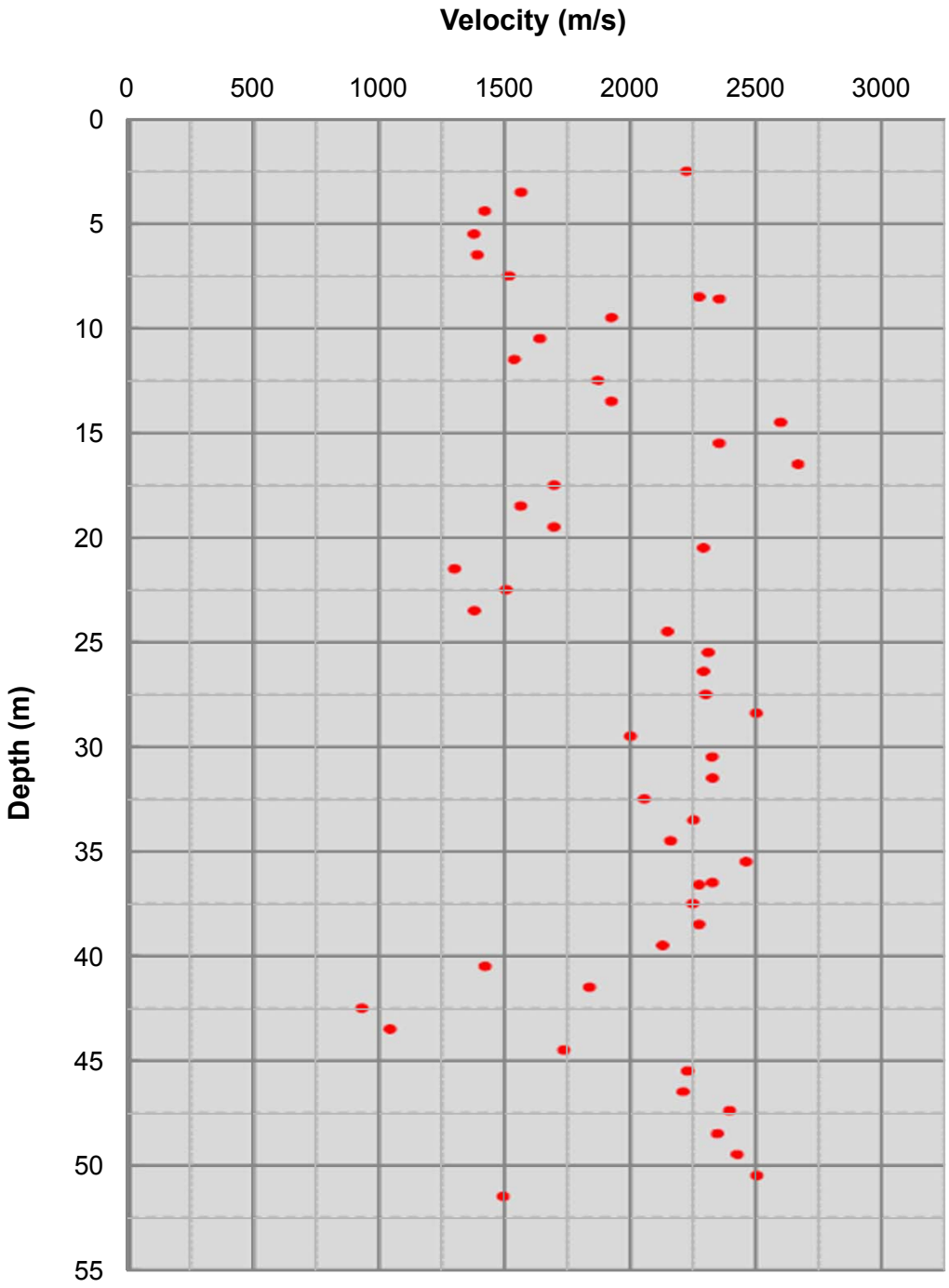
1) Drawing provided by KBR

2) Boring locations are approximate

SOFT SOIL THICKNESS
PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

FIGURE 5-1

N:\Projects\04_2013\04_1013_0068_LeluIsland\Outputs\2013_10_15_DraftOnshoreSeismic\mxd\Figure4-1_SoftSoils.mxd, 10/15/2013, CDean



PS SUSPENSION LOGGING RESULTS - CALCULATED INTERNAL SHEAR WAVE VELOCITIES FROM DATA OF BH-14

PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

FIGURE 5-2a

LOCATION: See Plate 2
COORDINATES: N 6006733m
E 415534m

SURFACE EL. 29.63 m

DEPTH, METERS	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS
0	1	WOH	**PEAT** PEAT (PT): very loose to very soft, dark brown to dark grayish brown, moist, fibrous, organic	29.6
			SILT with gravel (ML): very soft, dark grayish brown, moist, with trace fine sand, intensely weathered to decomposed approximately 2.5cm-angular phyllite gravel-size fragments with oxidized foliation surfaces	29.5
			UNDIVIDED PHYLLITE (OTa) PHYLLITE (Rx): intensely to moderately weathered, hard to very hard, dark gray, intensely to very intensely fractured, thinly foliated to laminated at approximately 50 degrees, planar foliation	
1	C1		- slightly weathered, at 1.37m - moderately to slightly fractured, at 1.52m	
2	C2		- increase in deformation, folded over quartz veins with schist margins, from 1.74 to 1.92m - fresh, at 1.77m - three approximately 45 degree joints, randomly-oriented microjoints, from 2.04 to 2.56m, planar, totally healed	
3	C3			
4	C4		- 75 degree joint, at 3.54m, planar, slightly rough, moderately open, slightly mineralized, sub-parallel microjoints - approximately 70 degree joint, at 7.01m, planar to stepped, moderately rough, slightly open, slightly mineralized (quartz) - 60 degree joint, at 4.42m, planar, slightly rough, slightly open - slightly to very slightly fractured, at 4.57m	
5				
6	C5		- moderately fractured, at 4.91m - 45 degree joint, at 5.79m, planar, stepped, moderately open, slightly mineralized - 50 degree joint, at 5.88m, planar, smooth, partly mineralized - 55 degree joint, at 6.04m, planar, moderately rough, moderately open	
7			- approximately 70 degree joint, at 7.01m, planar to stepped, moderately rough, slightly open, slightly mineralized (quartz)	
8	C6		- sub-vertical to vertical joint, at 7.62m, planar, moderately rough, moderately open to open, slightly mineralized - 75 degree joint, at 7.80m, planar, slightly to moderately rough, slightly open, slightly mineralized	
9	C7		- 65 degree joint, at 8.41m, stepped, slightly rough, slightly open, partly mineralized	
10	C8		- increase in deformation/schistosity, from 9.36 to 10.40m	
11			- 77 degree joint, at 9.74m, planar, slightly rough, slightly to moderately open, slightly mineralized	

CLASSIFICATION

UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
28		0			
		0			
		0			
27					
27					
		0			
		0			

SHEAR STRENGTH / UCS

□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
UCS ✳
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE — Min./m: 10 20 30 40
REC. — SCR - - RQD — %: 20 40 60 80

NOTES:

▽ : Initial Ground Water Depth ▼ : Static Ground Water Depth

1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:

Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 04 July, 2013
TOTAL DEPTH: 59.44m
CAVED DEPTH: N/A
CORING: N/A
WET ROTARY: N/A
BACKFILL: Grout
LOGGER: GEckrich, CEG
DRILLER: Geotech Drilling

N:\PROJECTS\04_2013\04_1013_0058_LELUISLAND\EXPLORATIONS\GINT\2013\04_1013_0058_FE13B.GPJ FUGRO_S_(LAB)_IND GRP_A3_ONSHORE_REV03 12/18/2013

LOG OF BORING BH-14
PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE 5-2bi

LOCATION: See Plate 2
COORDINATES: N 6006733m
E 415534m

SURFACE EL. 29.63 m

DEPTH, METERS	SYMBOL	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS
13		C9		- biotite schist band and quartz veins, bands to 2.5cm, from 10.19 to 12.10m - slightly fractured, at 12.34m - increase in deformation, from 12.37 to 13.50m	
14		C10		- approximately 25 degree joint, at 13.47m, planar, moderately rough, slightly open - approximately 50 to 80 degree microjoints, from 13.90 to 14.48m, stepped, totally healed - increase in deformation, biotite schist bands, from 13.99 to 14.75m	
15		C11		- approximately 70 degree microshears, from 14.48 to 14.72m, stepped, totally healed, with approximately 0.2cm-differential movement - 60 degree joint, at 14.90m, planar, moderately rough to rough, slightly open - 60 degree joint, at 15.09m, planar, moderately rough to rough, slightly open	
16		C12		- increased deformation, from 15.94 to 17.13m - quartz veins, at 16.55m, tabular to amorphous, to approximately 15.2cm-wide	
17				- quartz veins, at 16.86m, tabular to amorphous, to approximately 15.2cm-wide	
18		C13		- increase in deformation, quartz veins/boudins, from 17.59 to 18.11m - intensely fractured, at 18.29m - quartz veins/boudins with biotite schist margins, from 18.38 to 18.59m, to 1.3cm-wide	
19				- 50 degree joint at 19.20m, planar, slightly rough to smooth, moderately open, slightly to partly mineralized - slightly fractured, at 19.42m	
20		C14		- quartz vein/boudin, at 19.93m, approximately 0.6cm-wide - 60 to 65 degree joint, at 20.18m, stepped, totally healed - sub-parallel microjoints, from 20.33 to 20.39m, planar, totally healed	
21		C15		- approximately 65 to 75 degree joint, at 21.21m, planar, smooth, slightly open - gneiss band, from 21.34 to 21.58m - approximately 55 to 85 degree joint, at 21.40m, stepped, rough, moderately open to open, partly to totally mineralized/infilled with chlorite/dark greenish blue lean clay	
22				- approximately 60 degree joint, 75 degree microjoint, at 21.88m, planar, partly to totally healed - intensely to very intensely fractured, from 22.16 to 22.92m - increase in deformation, from 22.31 to 23.56m	
23		C16		- 33 degree joint, at 23.53m, slightly rough to smooth, slightly open to tight - intensely to very intensely fractured, from 23.62 to 24.11m	

CLASSIFICATION

UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
		0			
		0			
		0			
		0			
		0			
		0			

SHEAR STRENGTH / UCS

□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
UCS ✳
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE
Min./m: 10 20 30 40
REC. SCR RQD
%: 20 40 60 80

NOTES:

▽ : Initial Ground Water Depth ▼ : Static Ground Water Depth

1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:

Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 04 July, 2013
TOTAL DEPTH: 59.44m
CAVED DEPTH: N/A
CORING: N/A
WET ROTARY: N/A
BACKFILL: Grout
LOGGER: GEckrich, CEG
DRILLER: Geotech Drilling

N:\PROJECTS\04_2013\04_1013_0058_LELUISLAND\EXPLORATIONS\GINT\2013\04_1013_0058_FE13B.GPJ FUGRO_S_(LAB)_IND GRP_A3_ONSHORE_REV03 12/18/2013

LOG OF BORING BH-14
PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE 5-2bii

LOCATION: See Plate 2
COORDINATES: N 6006733m
E 415534m

SURFACE EL. 29.63 m

DEPTH, METERS	SYMBOL	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS
25		C17		- approximately 75 degree joint, at 23.87m, stepped, moderately open to open - 30 degree joint, at 24.23m, smooth, slightly to moderately open, intersected by 60 to 80 degree microjoints, planar to undulating, totally healed - 45 to 55 degree joint, at 24.38m, stepped, totally healed, with 0.3cm-differential movement, branched microshears along upper margin, totally healed	
26		C18		- 55 and 85 degree intersecting joints, at 25.51m, slightly rough to stepped, slightly to moderately open, slightly to partly mineralized (quartz/chlorite) GNEISS (Rx): fresh, hard to very hard, dark gray to white, very slightly fractured, thinly foliated to laminated at approximately 45 degrees - increased deformation, from 26.46 to 26.79m	4.0
27		C19		PHYLLITE (Rx): intensely to moderately weathered, hard to very hard, dark gray, intensely to very intensely fractured, thinly foliated to laminated at approximately 50 degrees, planar foliation - 60 degree joint, at 27.34m, stepped, slightly to moderately open, slightly mineralized (chlorite) - moderately fractured, at 27.43m	2.8
28				- approximately 70 degree microjoint, at 28.29m, stepped, totally healed	
29		C20		- intensely fractured, at 24.65m - 55 degree joint, at 28.74m, stepped, open - approximately 45 degree joint, at 29.02m, stepped, moderately open to open - increase in deformation, quartz veins/boudins, from 29.02 to 29.72m - approximately 75 degree joint, at 29.35m, stepped, partly to totally healed	
30		C21		- intensely fractured, from 30.57 to 31.30m - approximately 75 degree joint, at 30.57m, rough, slightly open to moderately open, partly mineralized (quartz/pyrite)	
31				- approximately 40 degree fault/shear, at 31.15m, moderately rough to slickensided, approximately 2.5cm-wide, infilled with lean clay gouge/decomposed phyllite - 30 degree joint, at 31.24m, slightly rough to smooth, moderately open, slightly mineralized, intersected by approximately 75 degree sub-vertical microjoints, undulating, totally healed (pyrite) - 40 degree joint, at 31.67m, smooth, slightly open to tight, slightly mineralized (chlorite) - randomly-oriented microjoints, from 31.70 to 32.10m, totally healed - 70 degree joint, at 31.79m, smooth, slightly open to tight - increase in deformation/schistosity, quartz veins/boudins, from 32.11 to 33.01m	
32		C22			
33		C23		- approximately 55 degree to sub-vertical microshears, from 32.89 to 33.07m, totally healed, with approximately 0.2cm-differential movement - quartz veins with biotite schist margins, from 33.19 to 33.44m	
34				- 45 degree joint, at 34.35m, slightly rough to smooth, moderately open	
35		C24		- 55 degree joint, at 35.27m, rough to stepped, moderately open, intersected by approximately 80 degree to sub-vertical joint, stepped, moderately open, partly mineralized (chlorite/pyrite) - sub-vertical microjoints, from 35.63 to 35.69m, totally healed	

CLASSIFICATION

UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
27		0			
		0			
		0			
		0			
		0			

SHEAR STRENGTH / UCS

□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
UCS ✳
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE — Min./m: 10 20 30 40
REC. — SCR · · · RQD — ·
%: 20 40 60 80

NOTES:

▽ : Initial Ground Water Depth ▼ : Static Ground Water Depth

1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:

Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 04 July, 2013
TOTAL DEPTH: 59.44m
CAVED DEPTH: N/A
CORING: N/A
WET ROTARY: N/A
BACKFILL: Grout
LOGGER: GEckrich, CEG
DRILLER: Geotech Drilling

N:\PROJECTS\04_2013\04_1013_0058_LELUISLAND\EXPLORATIONS\GINT\2013\04_1013_0058_FE13B.GPJ FUGRO_S_(LAB)_IND GRP_A3_ONSHORE_REV03 12/18/2013

LOG OF BORING BH-14
PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE 5-2biii

LOCATION: See Plate 2
COORDINATES: N 6006733m
E 415534m

SURFACE EL. 29.63 m

DEPTH, METERS	SYMBOL	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS
37		C25		- 65 degree joint, at 36.24m, slightly rough, moderately open to open, partly mineralized (quartz/pyrite)	
38		C26		- biotite schist bands, from 37.58 to 37.70m - approximately 45 degree microjoint, at 38.22m, slightly rough to smooth, moderately open - quartz vein/boudin, at 38.62m, approximately 2.5cm-wide	-9.1
39		C27		GNEISS (Rx): fresh, hard to very hard, dark gray to white, very slightly fractured, thinly foliated to laminated at approximately 45 degrees - approximately 50 degree joint, at 39.17m, stepped, slightly open	-9.7
40				PHYLLITE (Rx): intensely to moderately weathered, hard to very hard, dark gray, intensely to moderately fractured - quartz vein with pyrite inclusions, from 39.47 to 39.68m, sharp contacts GNEISS (Rx): fresh, hard to very hard, dark gray to white, unfractured	-10.3
41		C28		PHYLLITE (Rx): intensely to moderately weathered, hard to very hard, dark gray, intensely to moderately fractured - 75 degree joint, at 40.33m, stepped, slightly open, slightly mineralized (quartz) - sub-vertical microjoints, from 40.84 to 41.61m, undulating to stepped, totally healed, pyrite inclusions	-10.6
42				- quartz vein, from 41.36 to 41.51m, amorphous - increased deformation, randomly-oriented microjoints/microshears, from 41.39 to 42.09m, discontinuities totally healed, with approximately 2.5cm-differential movement	
43		C29		- increase in deformation, from 42.58 to 42.73m - biotite schist bands, from 42.95 to 45.42m, to approximately 6.4cm-wide	
44		C30		- 45 degree joint, at 44.32m, slightly rough to smooth, slightly open	
45		C31		- 25 degree joint, at 44.87m, rough to stepped, open, slightly mineralized (chlorite) - 40 degree joint, at 44.93m, slightly rough to rough, open, slightly mineralized (chlorite) - approximately 10 degree joint, at 44.96m, rough, open, slightly mineralized (chlorite) - 55 degree joint, at 45.26m, slightly to moderately rough, slightly open to tight, partly mineralized (chlorite)	
46				- very intensely fractured, from 46.66 to 48.01m	
47		C32		- decomposed phyllite with coarse sand clasts and lean clay gouge, possible fault zone, from 46.94 to 47.15m	

CLASSIFICATION: UNIT DRY WT, kN/m³ | PASSING NO. 200 SIEVE, % | WATER CONTENT, % | LIQUID LIMIT | PLASTIC LIMIT | PLASTICITY INDEX (PI)

WATER CONTENT, %: 0 | 0 | 0 | 0 | 1 | 0

SHEAR STRENGTH / UCS
□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
UCS ✳
MPa (◆, ✳): 50 100 150 200 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20 40 60 80 100

CORING RATE — Min./m: 10 20 30 40
REC. SCR RQD
%: 20 40 60 80

NOTES:
▽ : Initial Ground Water Depth ▼ : Static Ground Water Depth
1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:
Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 04 July, 2013
TOTAL DEPTH: 59.44m
CAVED DEPTH: N/A
CORING: N/A
WET ROTARY: N/A
BACKFILL: Grout
LOGGER: GEckrich, CEG
DRILLER: Geotech Drilling

N:\PROJECTS\04_2013\04_1013_0058_LELUISLAND\EXPLORATIONS\GINT\2013\04_1013_0058_FE13B.GPJ FUGRO_S_(LAB)_IND GRP_A3_ONSHORE_REV03 12/18/2013

LOG OF BORING BH-14
PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

PLATE 5-2biv

LOCATION: See Plate 2
COORDINATES: N 6006733m
E 415534m

SURFACE EL. 29.63 m

DEPTH, METERS	SYMBOL	SAMPLES	BLOWS PER 300mm	STRATUM DESCRIPTION	STRATUM ELEV, METERS
49		C33		- quartz vein with pyrite inclusions/margins, at 47.88m approximately 3.8cm-wide - 50 degree joint, at 47.95m, slightly rough, moderately to totally healed - 50 to 60 degree microjoints, from 48.37 to 63.33m, smooth, totally healed - 45 degree joint, at 48.68m, slightly rough to smooth, moderately open to open, moderately mineralized (chlorite) - quartz veins with pyrite margins, from 49.16 to 49.35m	
50		C34		- approximately 50 degree joint, at 49.62m, rough to stepped, moderately open to open - approximately 45 degree joint, at 49.90m, stepped to undulating, open - approximately 45 degree joint, at 49.93m, stepped, moderately open - intersecting 45 and 60 degree joints, at 50.14m, slightly to moderately rough, slightly to moderately open - thinly foliated to laminated at 46 degrees, at 50.29m - approximately 60 degree joint, at 50.57m, stepped, totally healed	
51		C35		- approximately 65 degree to sub-vertical joint, at 51.18m, stepped, slightly open - approximately 55 degree joint, at 51.63m, rough, moderately open to open	
52				- approximately 2.5cm-wide biotite schist band, at 52.09m, approximately 50 degree microjoint, stepped, totally healed - 15 degree joint, at 52.49m, moderately to slightly rough, slightly open to tight, moderately mineralized (pyrite) - 55 degree joint, at 52.79m, slightly rough, slightly open to tight, truncated by foliation at 52.70m	
53		C36			
54				- 78 degree joint, at 54.01m, stepped, slightly to moderately open, moderately mineralized (chlorite) - approximately 60 degree joints, from 54.19 to 54.35m, smooth to planar, totally healed - two sub-vertical joints, at 47.03m, stepped, slightly open to tight, moderately mineralized (chlorite)	
55		C37		- very intensely fractured, from 54.86 to 55.47m	
56		C38		- approximately 35 degree joint, at 55.63m, rough to stepped, open, moderately mineralized (chlorite) - intersection 50 and 65 degree joints, at 55.87m, slightly rough to smooth, moderately open, partly mineralized (chlorite) - biotite schist band, increased deformation/schistosity, from 56.17 to 56.30m - quartz vein, at 56.30m, approximately 3.8cm-wide - 55 degree joint, at 56.35m, slightly rough to smooth, moderately open, partly mineralized (chlorite) - randomly-oriented discontinuities, from 56.57 to 56.91m, stepped, slightly open to tight, partly to totally mineralized (pyrite/chlorite) - 15 degree joint, at 56.91m, slightly rough, moderately mineralized (chlorite) - 50 degree joint, at 57.03m, smooth, slightly open - quartz vein, at 57.12m, approximately 10.2cm-wide	
57		C39			
58		C40		- 60 to 85 degree microjoint, at 58.06m, stepped, totally healed - 45 degree joint truncated by vertical joint, at 58.43m, smooth, planar and stepped respectively, both totally healed	
59				- approximately 80 degree joint, at 58.95m, moderately rough to rough	
				NOTE: Performed acoustic televiewer and PS geophysical logging on 4 July, 2013. **TD = 59.44m**	-29.8

CLASSIFICATION

UNIT DRY WT, kN/m³	PASSING NO. 200 SIEVE, %	WATER CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX (PI)
		0			
		0			
		0			
		0			
		0			
		0			
		0			

SHEAR STRENGTH / UCS

□ Penetrometer ▼ Unconfined
◇ Torvane ● Triaxial
Remold Testing ▲ Miniature Vane
○ △ ▽ ◆ Point Load
UCS ✳
MPa (◆, ✳): 50, 100, 150, 200, 250
kPa (□, ◇, ○, △, ▼, ●, ▲): 20, 40, 60, 80, 100

CORING RATE
Min./m: 10, 20, 30, 40
REC. SCR RQD
%: 20, 40, 60, 80

NOTES:

▽ : Initial Ground Water Depth ▼ : Static Ground Water Depth

1- Correlation values of UCS/Is(50) of phyllites being equal to 10 for Is(50)<=4MPa and 5 for Is(50)>4MPa were selected based on the completed tests.
2- Laboratory and field test results corresponding to rock are converted to Uniaxial Compressive Strength (UCS).
3- Laboratory and field test results corresponding to soil are converted to Undrained Shear Strength.

DRILLING AND SAMPLING TECHNIQUES:

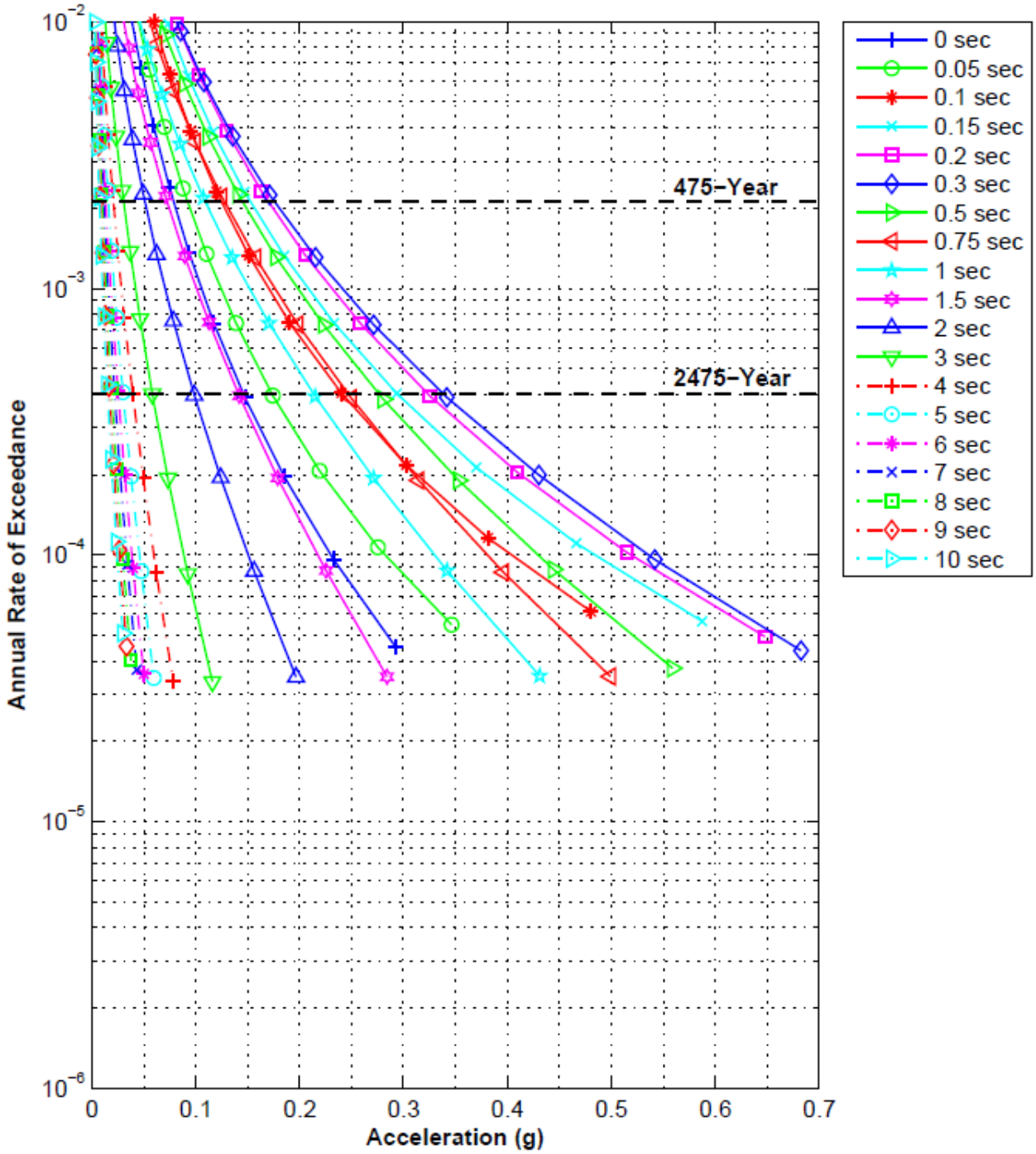
Soil samples (if applicable) were recovered using a combination of bulk, pushed, and/or driven sampling techniques; undisturbed rock samples were obtained using triple-tube wireline coring assemblies.

DATE COMPLETED: 04 July, 2013
TOTAL DEPTH: 59.44m
CAVED DEPTH: N/A
CORING: N/A
WET ROTARY: N/A
BACKFILL: Grout
LOGGER: GEckrich, CEG
DRILLER: Geotech Drilling

N:\PROJECTS\04_2013\04_1013_0058_LELU\ISLAND\EXPLORATIONS\GINT\2013\04_1013_0058_FE13B.GPJ FUGRO_S_(LAB)_IND GRP_A3_ONSHORE_REV03 12/18/2013

LOG OF BORING BH-14
PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

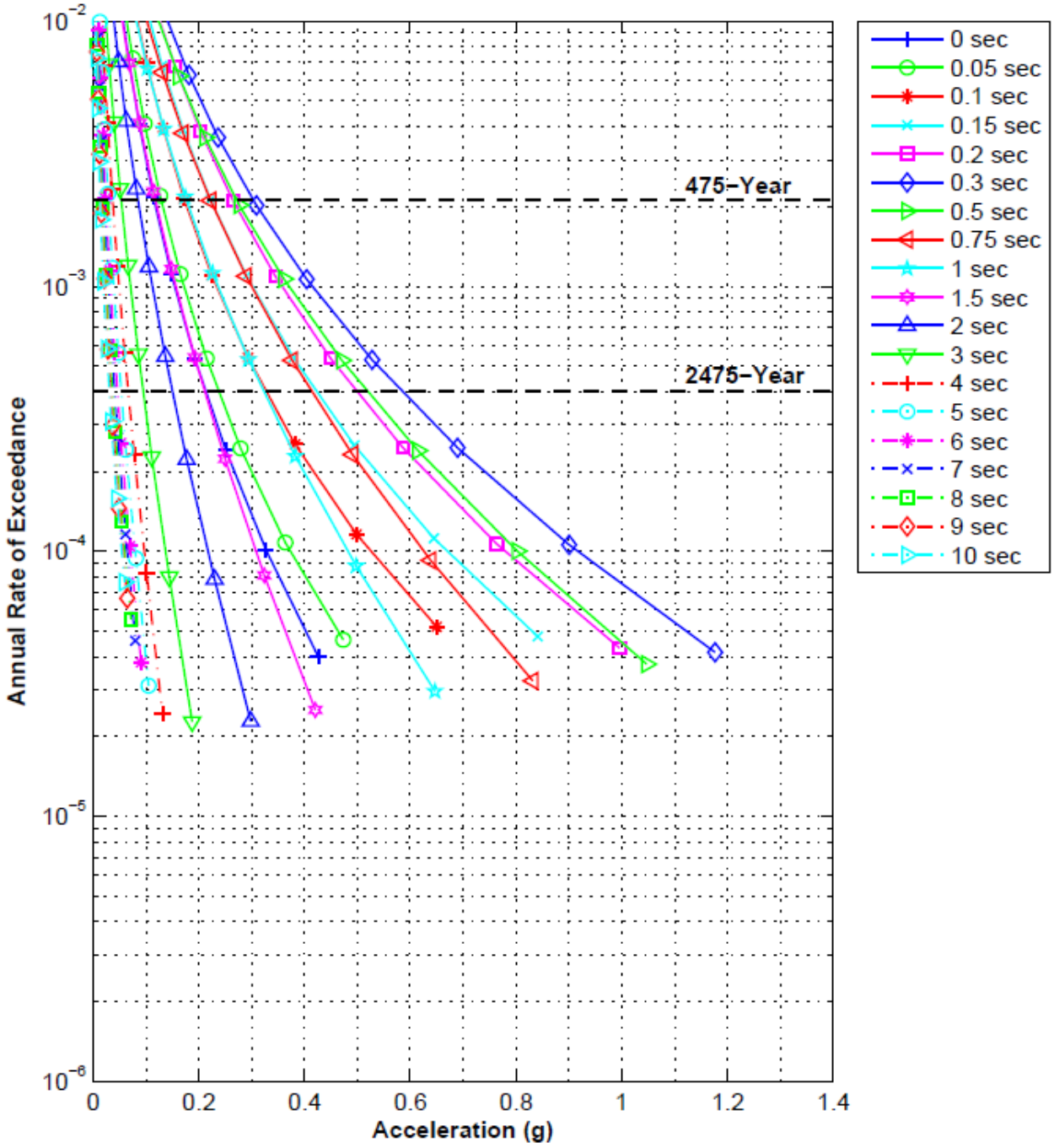
PLATE 5-2bv



ANNUAL HAZARD CURVES AT DIFFERENT STRUCTURAL PERIODS - SITE CLASS A

PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

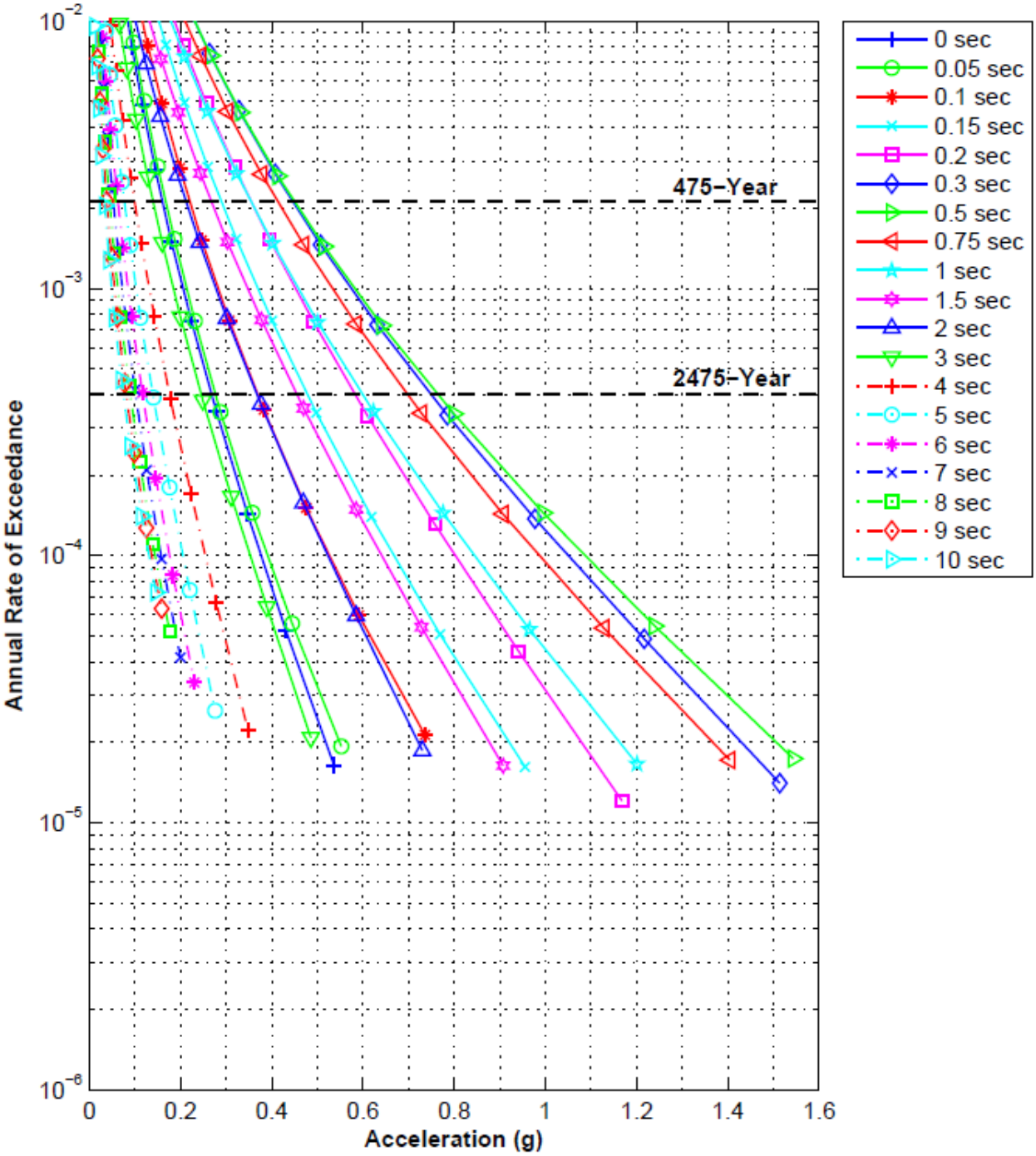
FIGURE 5-3a



ANNUAL HAZARD CURVES AT DIFFERENT STRUCTURAL PERIODS - SITE CLASS C

PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

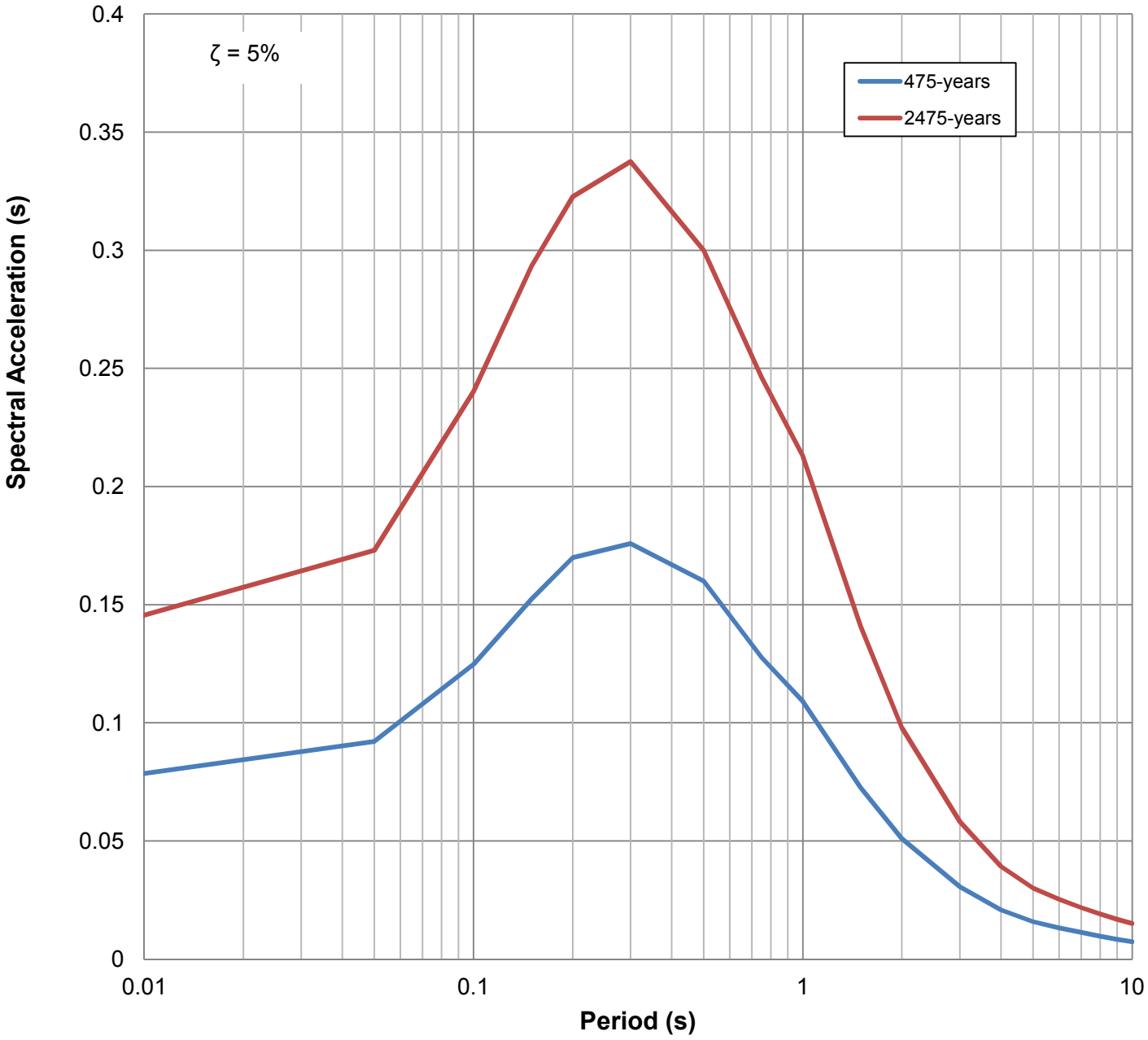
FIGURE 5-3b



ANNUAL HAZARD CURVES AT DIFFERENT STRUCTURAL PERIODS - SITE CLASS E

PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

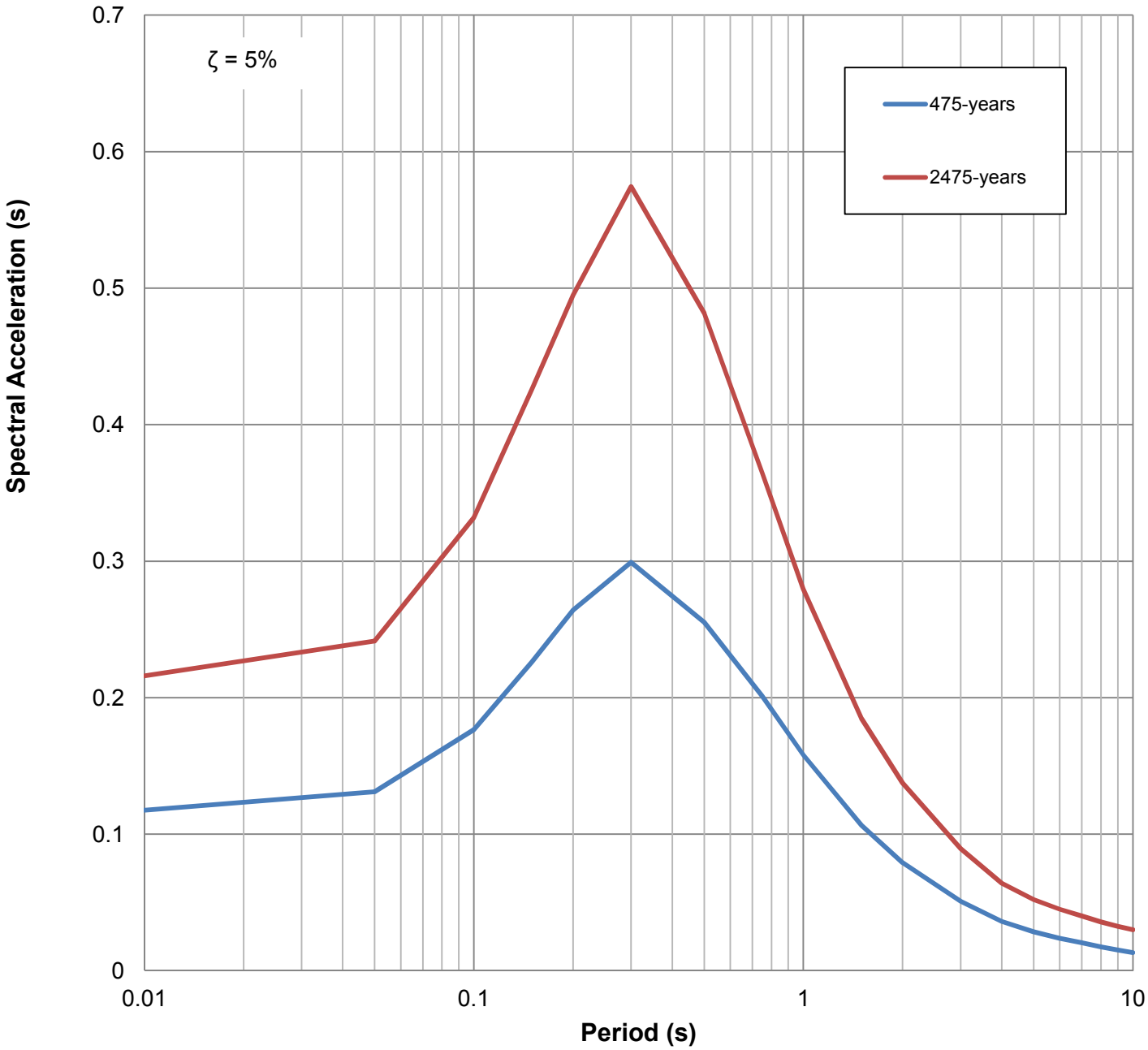
FIGURE 5-3c



SITE SPECIFIC UNIFORM HAZARD SPECTRA AT DIFFERENT RETURN PERIODS - SITE CLASS A

PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

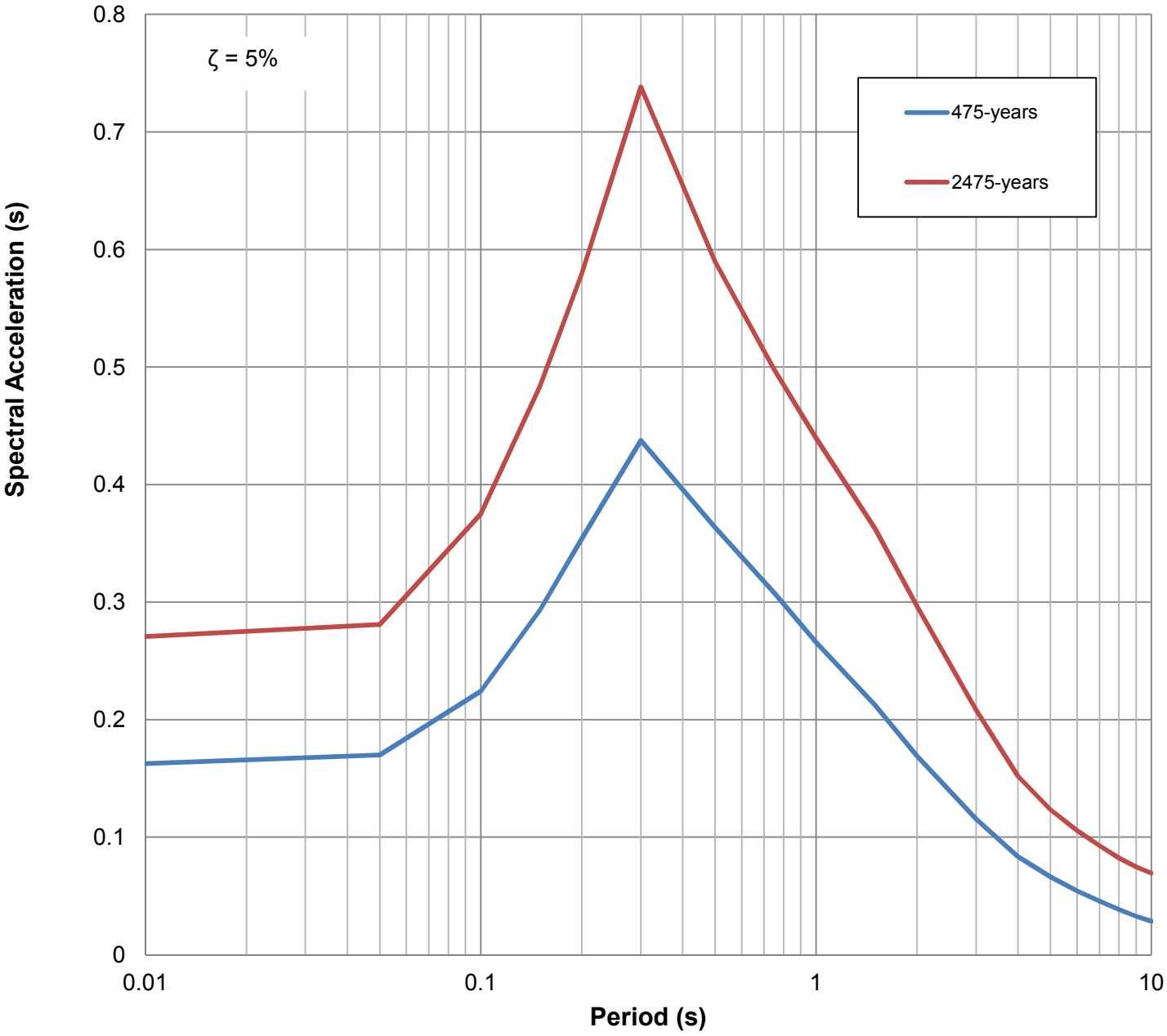
FIGURE 5-4a



SITE SPECIFIC UNIFORM HAZARD SPECTRA AT DIFFERENT RETURN PERIODS - SITE CLASS C

PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

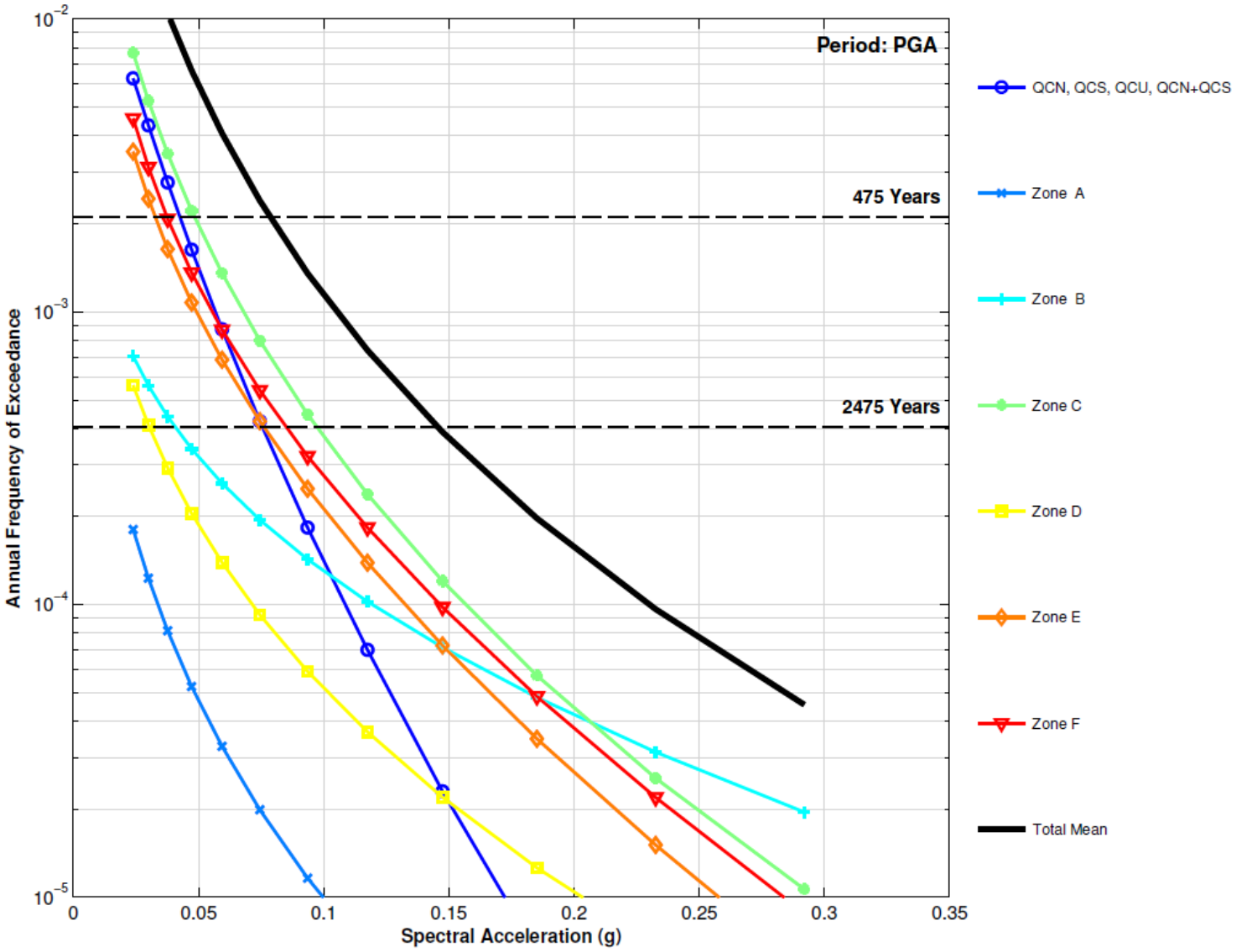
FIGURE 5-4b



SITE SPECIFIC UNIFORM HAZARD SPECTRA AT DIFFERENT RETURN PERIODS - SITE CLASS E

PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

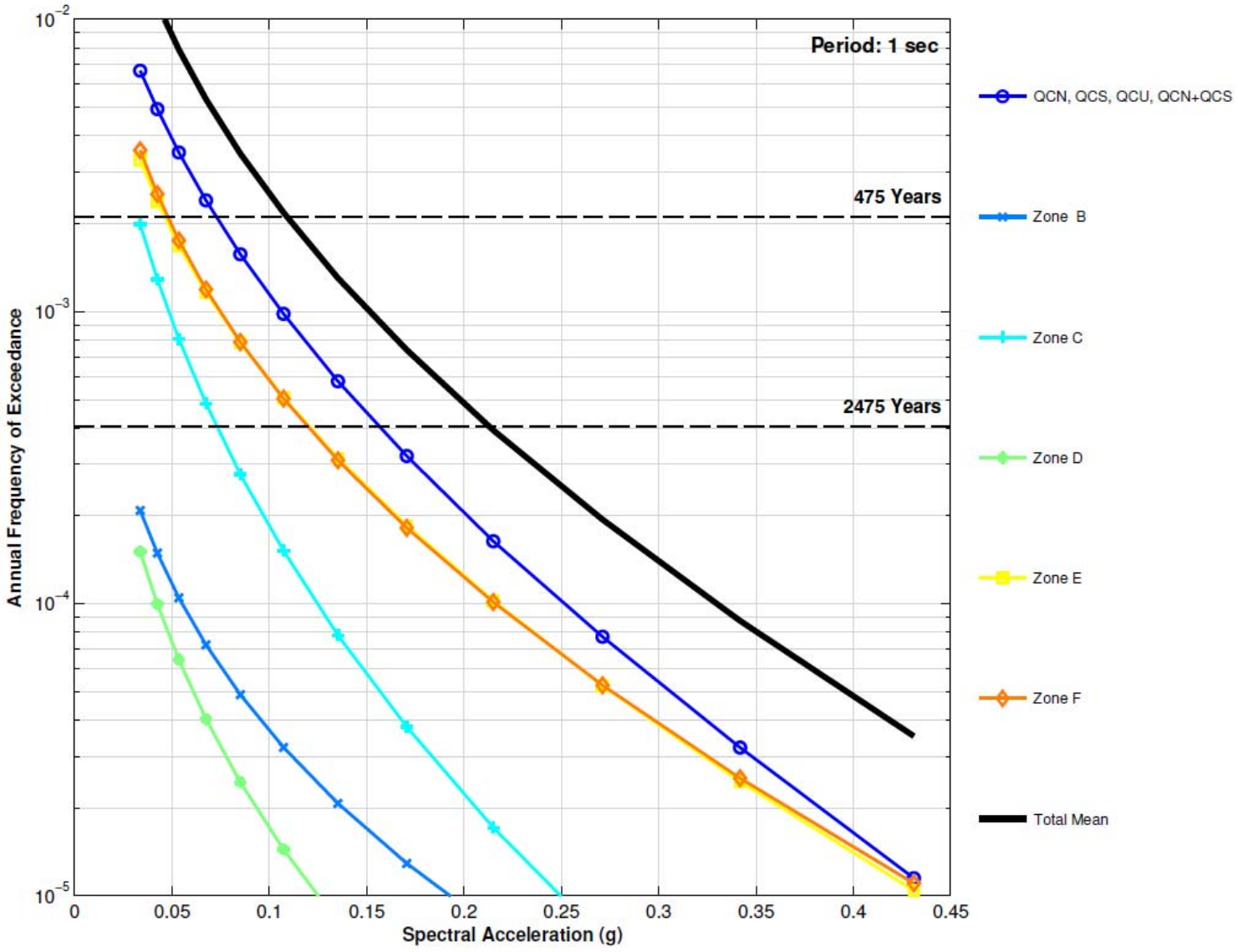
FIGURE 5-4c



ANNUAL HAZARDS CURVES PER SEISMIC SOURCE AT PGA - SITE CLASS A

PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

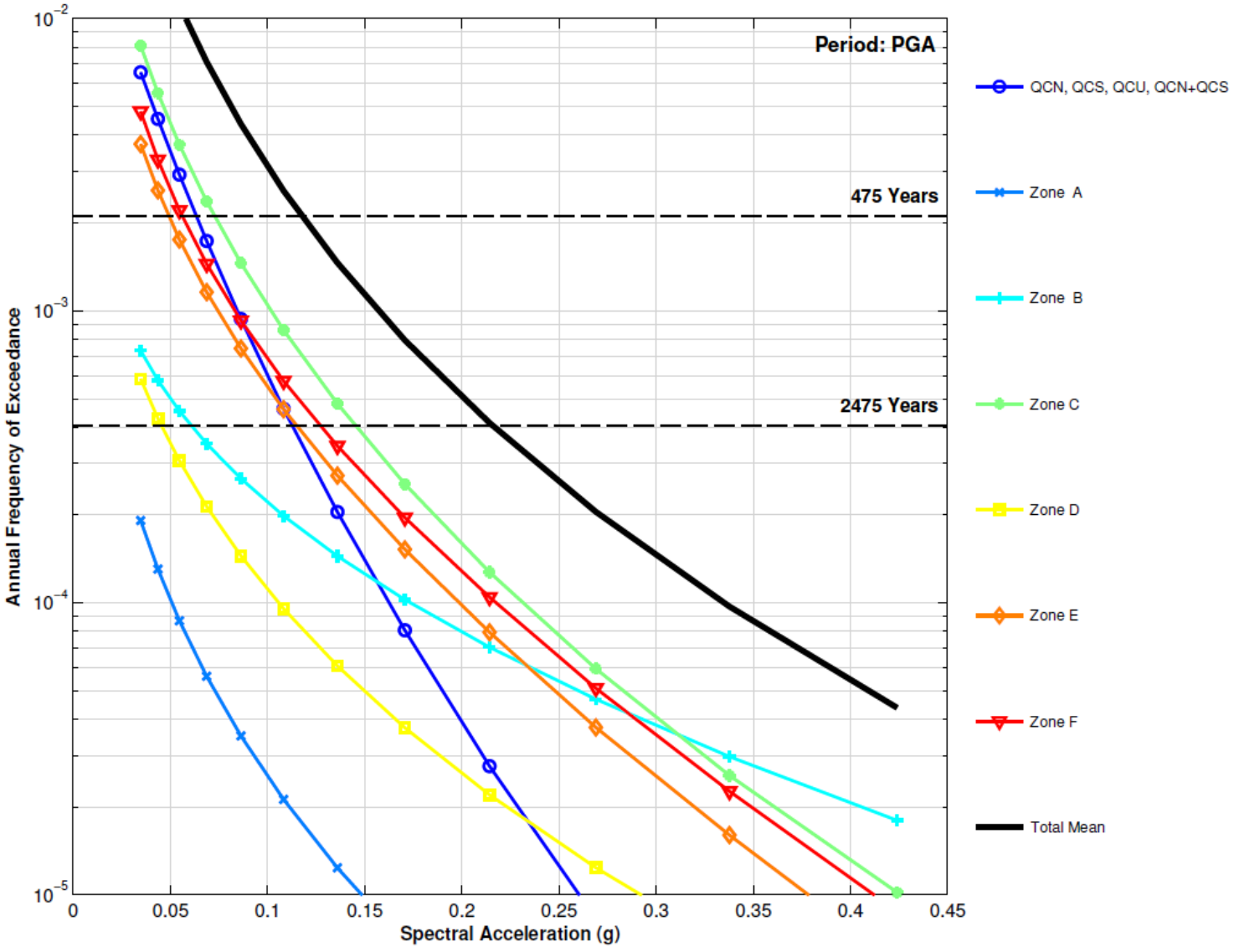
FIGURE 5-5ai



ANNUAL HAZARDS CURVES PER SEISMIC SOURCE AT 1 SEC - SITE CLASS A

PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

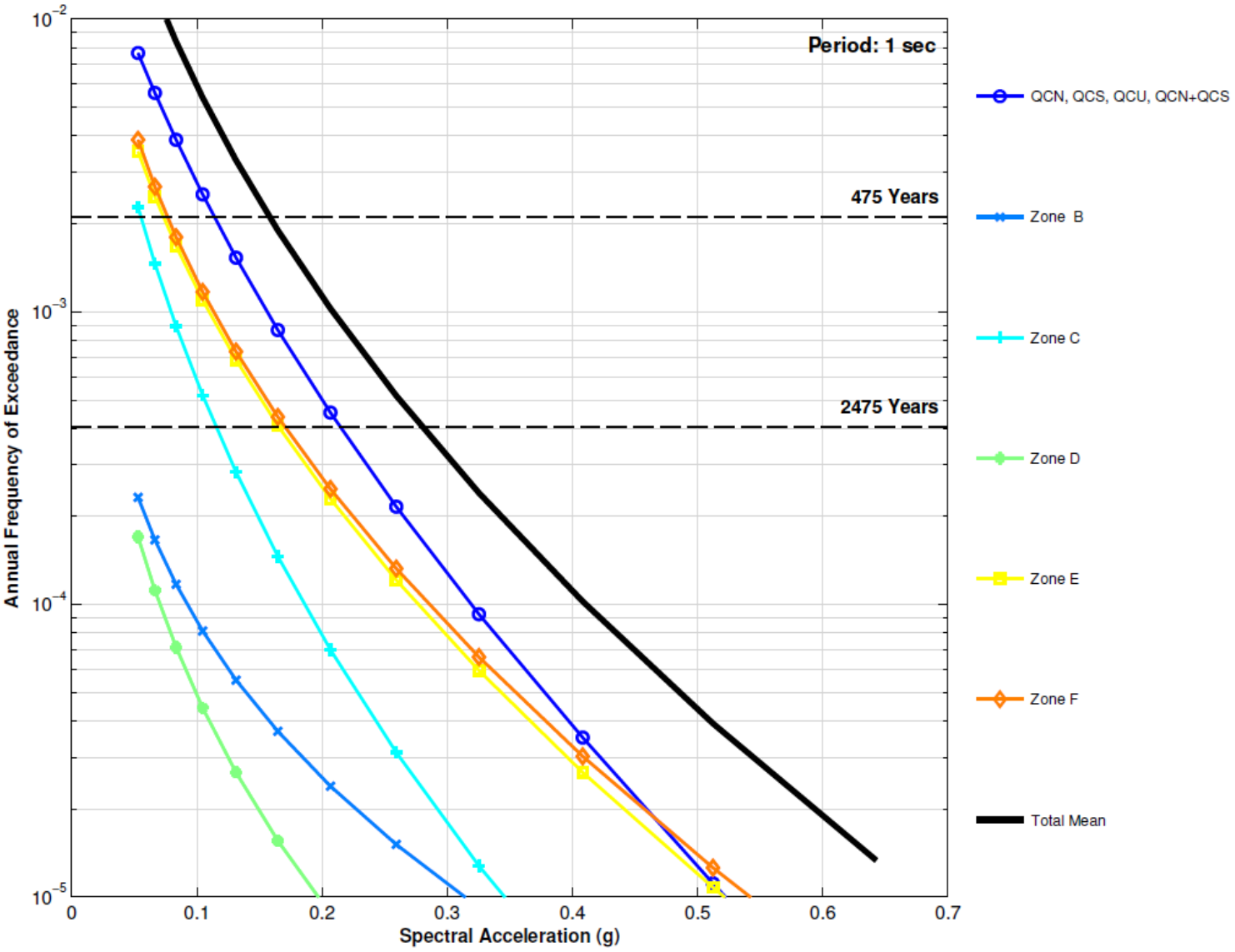
FIGURE 5-5aii



ANNUAL HAZARDS CURVES PER SEISMIC SOURCE AT PGA - SITE CLASS C

PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

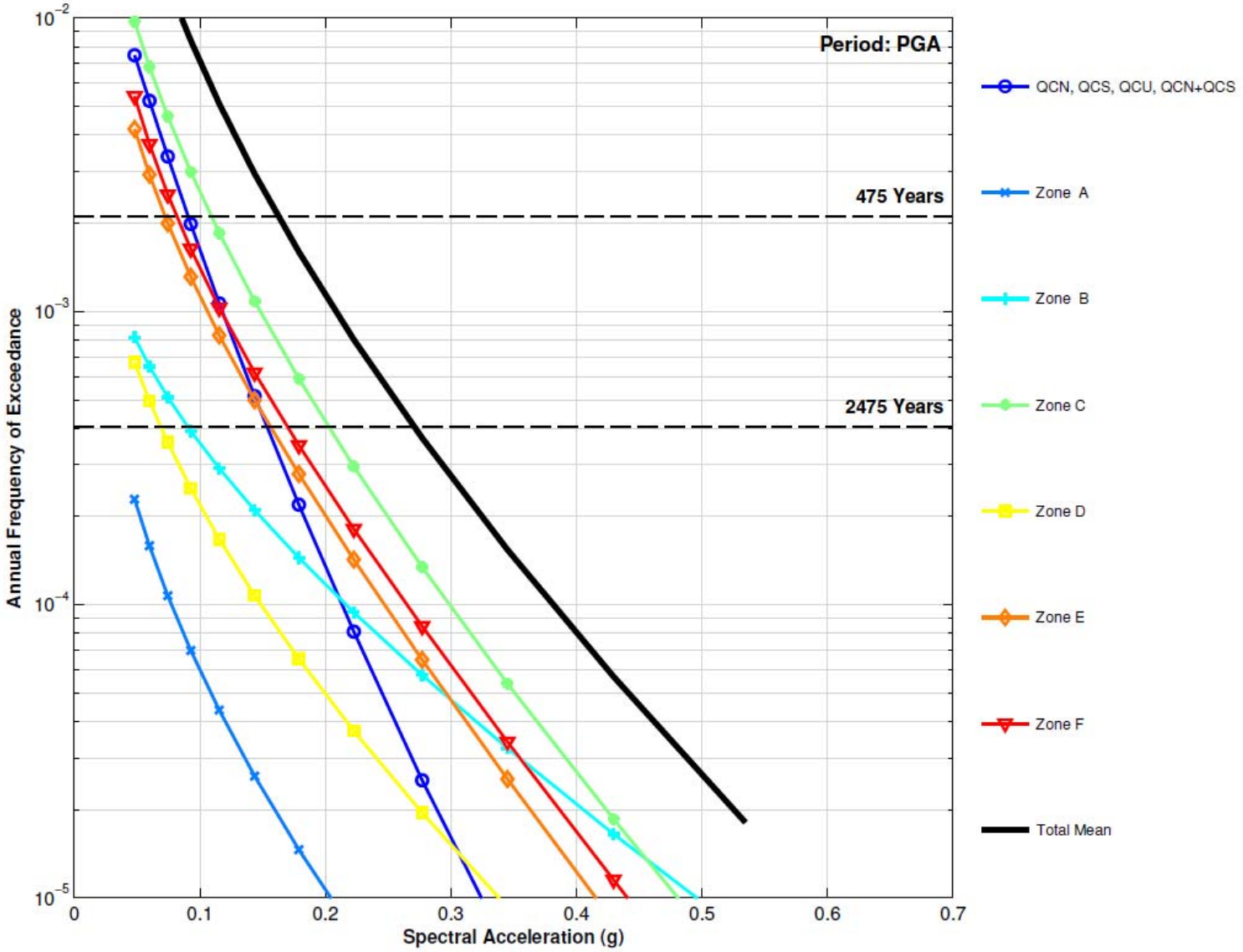
FIGURE 5-5bi



ANNUAL HAZARDS CURVES PER SEISMIC SOURCE AT 1 SEC - SITE CLASS C

PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

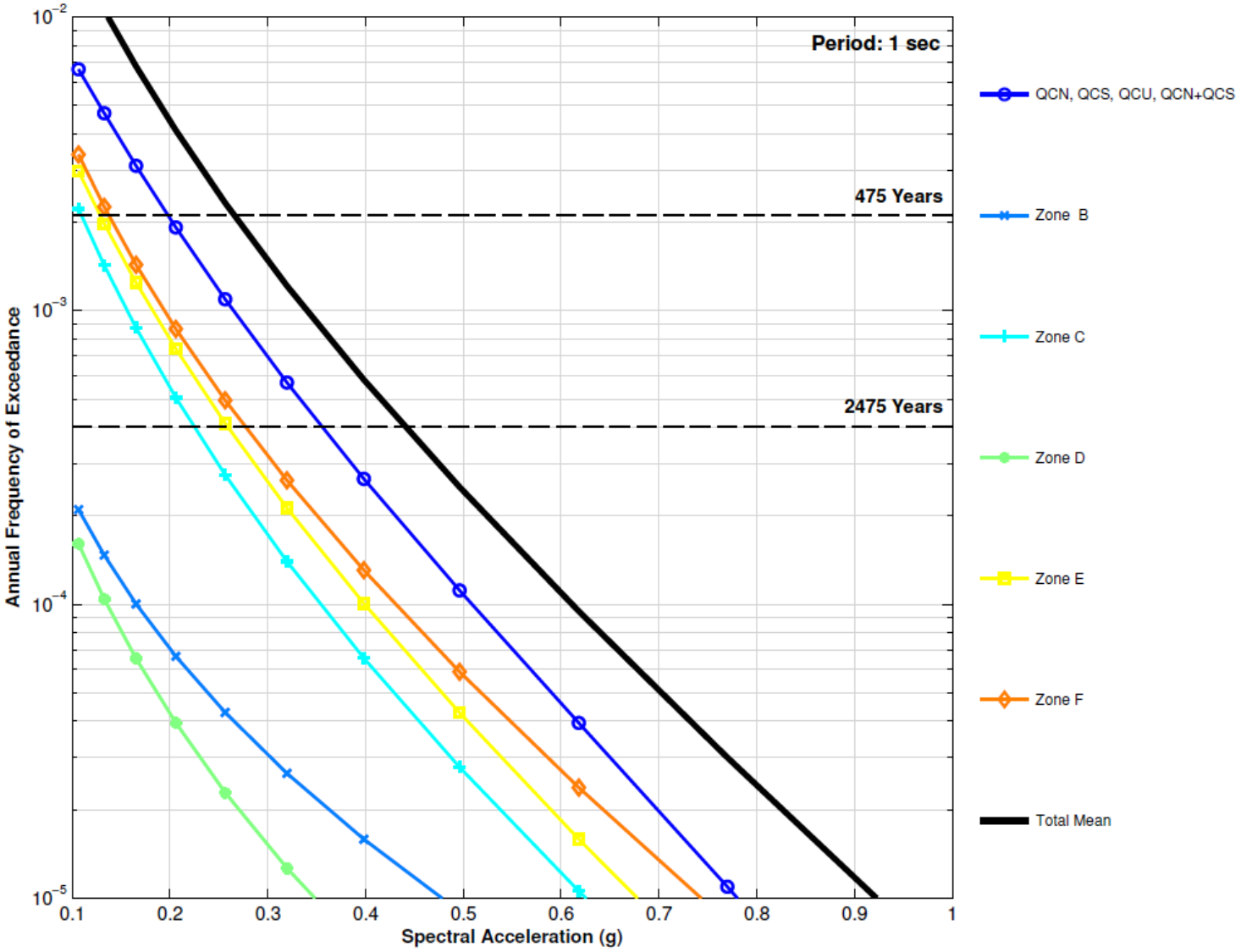
FIGURE 5-5bii



ANNUAL HAZARDS CURVES PER SEISMIC SOURCE AT PGA - SITE CLASS E

PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

FIGURE 5-5ci



ANNUAL HAZARDS CURVES PER SEISMIC SOURCE AT 1 SEC - SITE CLASS E

PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

FIGURE 5-5cii

Note: QC faults are F1, F2 and F3 (Qeen Charlotte North, South, and Underthrust, respectively). QC Zones are Zones E and F.

DEAGGREGATION OF THE HAZARD BY SEISMIC SOURCES FOR PGA AND 1SEC, 475 AND 2475 YEAR RETURN PERIOD - SITE CLASS A

PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

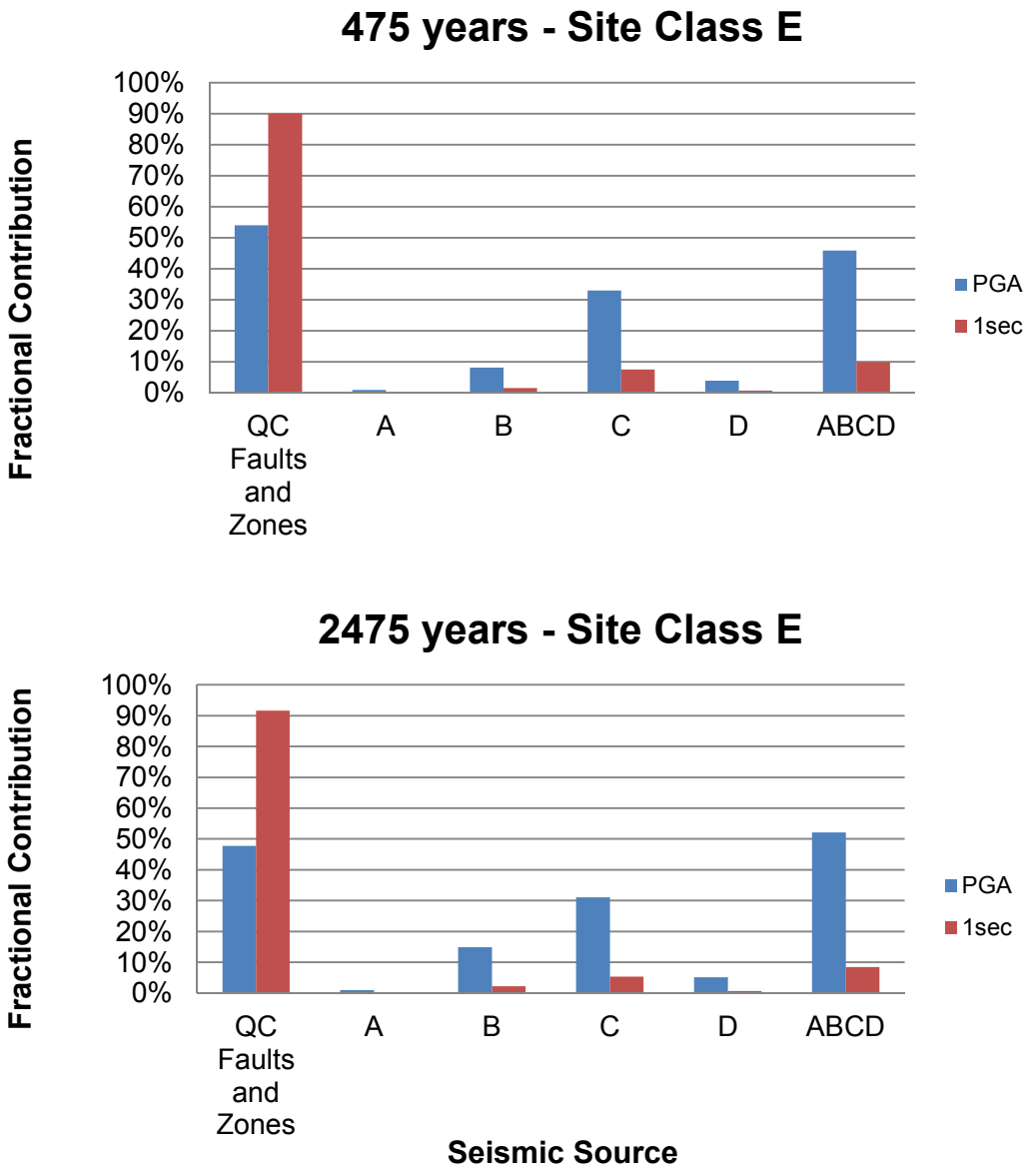
FIGURE 5-6a

Note: QC faults are F1, F2 and F3 (Qeen Charlotte North, South, and Underthrust, respectively). QC Zones are Zones E and F.

DEAGGREGATION OF THE HAZARD BY SEISMIC SOURCES FOR PGA AND 1SEC, 475 AND 2475 YEAR RETURN PERIOD - SITE CLASS C

PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

FIGURE 5-6b

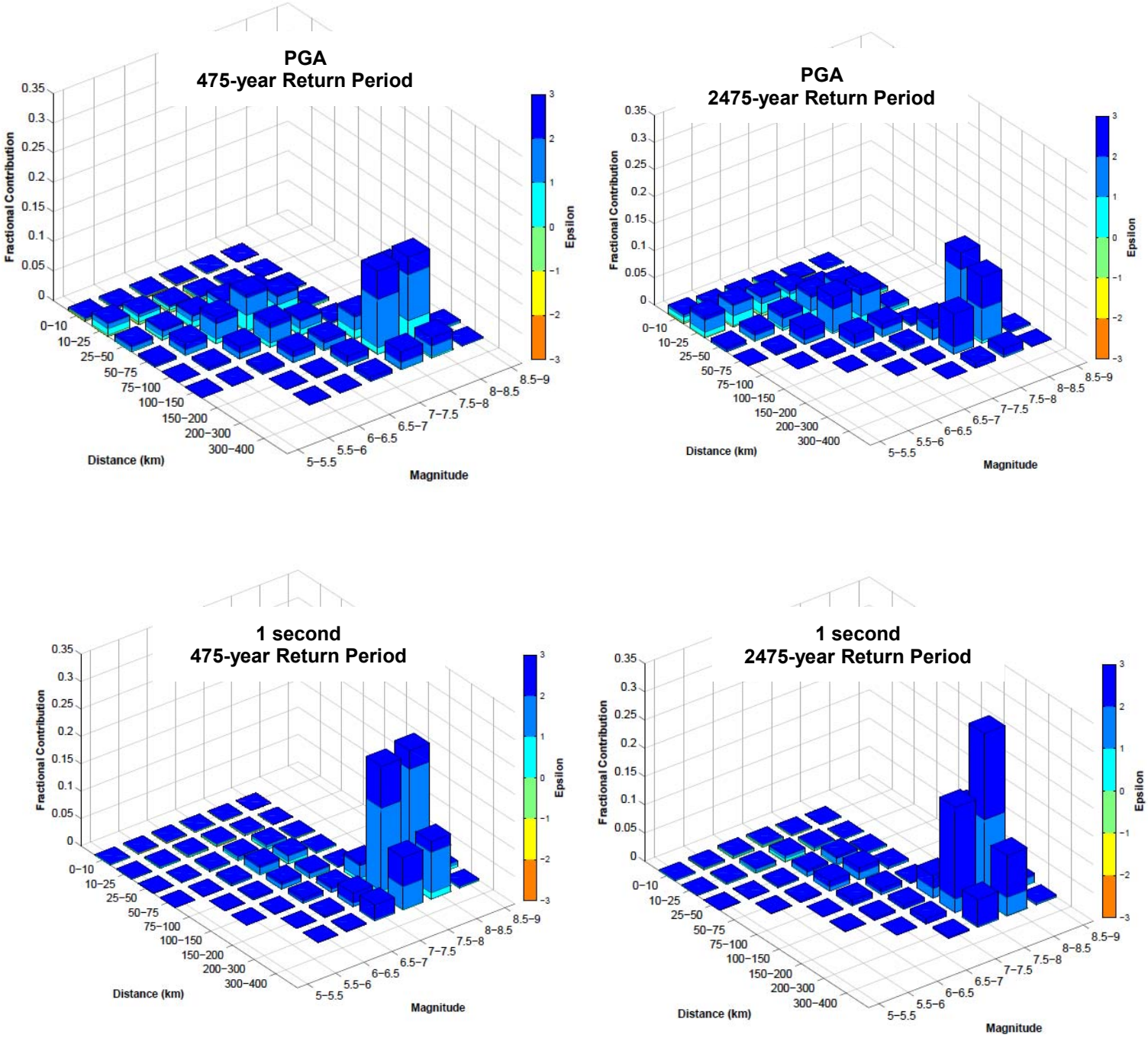


Note: QC faults are F1, F2 and F3 (Qeen Charlotte North, South, and Underthrust, respectively). QC Zones are Zones E and F.

DEAGGREGATION OF THE HAZARD BY SEISMIC SOURCES FOR PGA AND 1SEC, 475 AND 2475 YEAR RETURN PERIOD - SITE CLASS E

PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

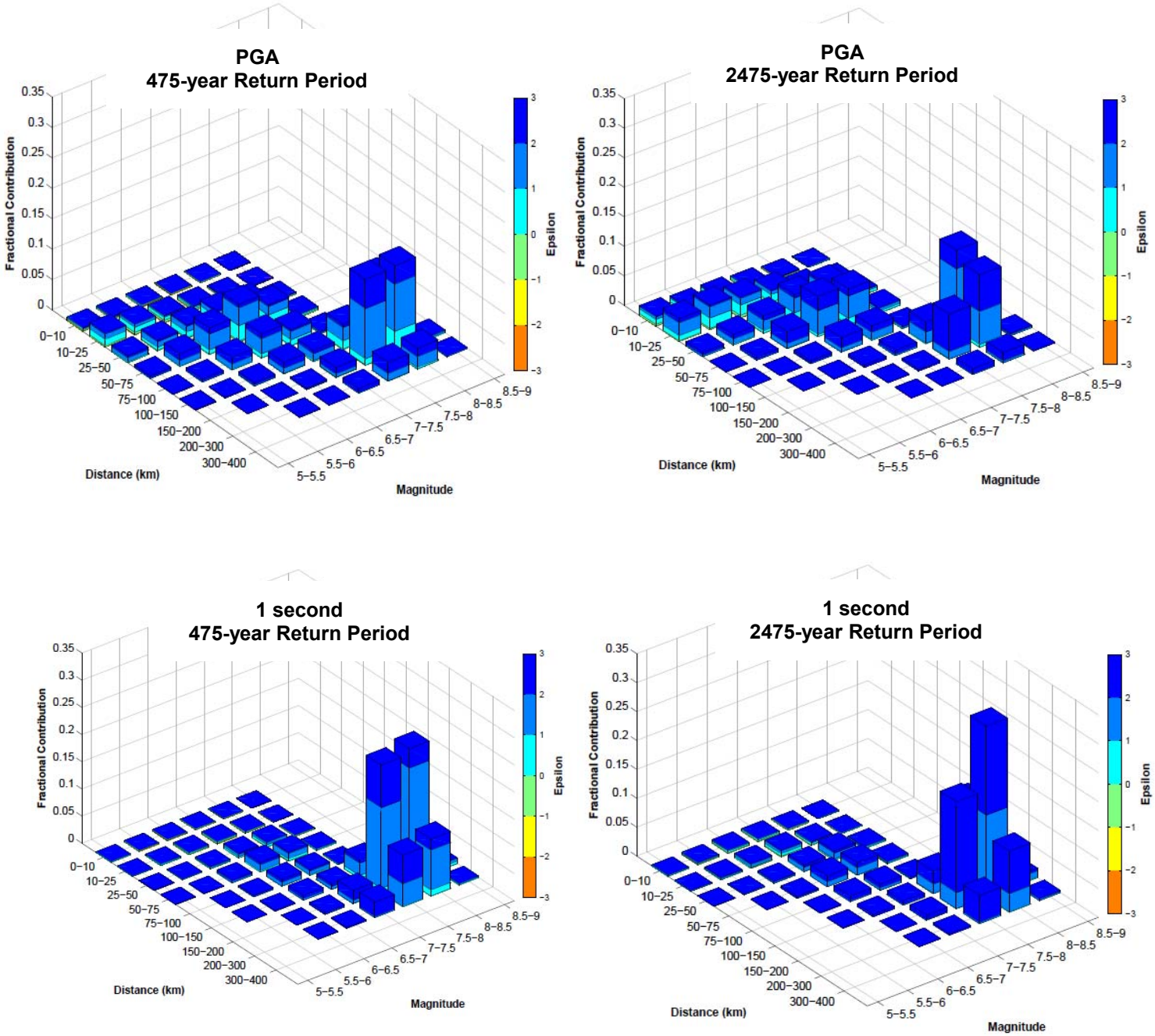
FIGURE 5-6c



DEAGGREGATION OF THE HAZARD BY MAGNITUDE AND DISTANCE FOR SITE CLASS A

PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

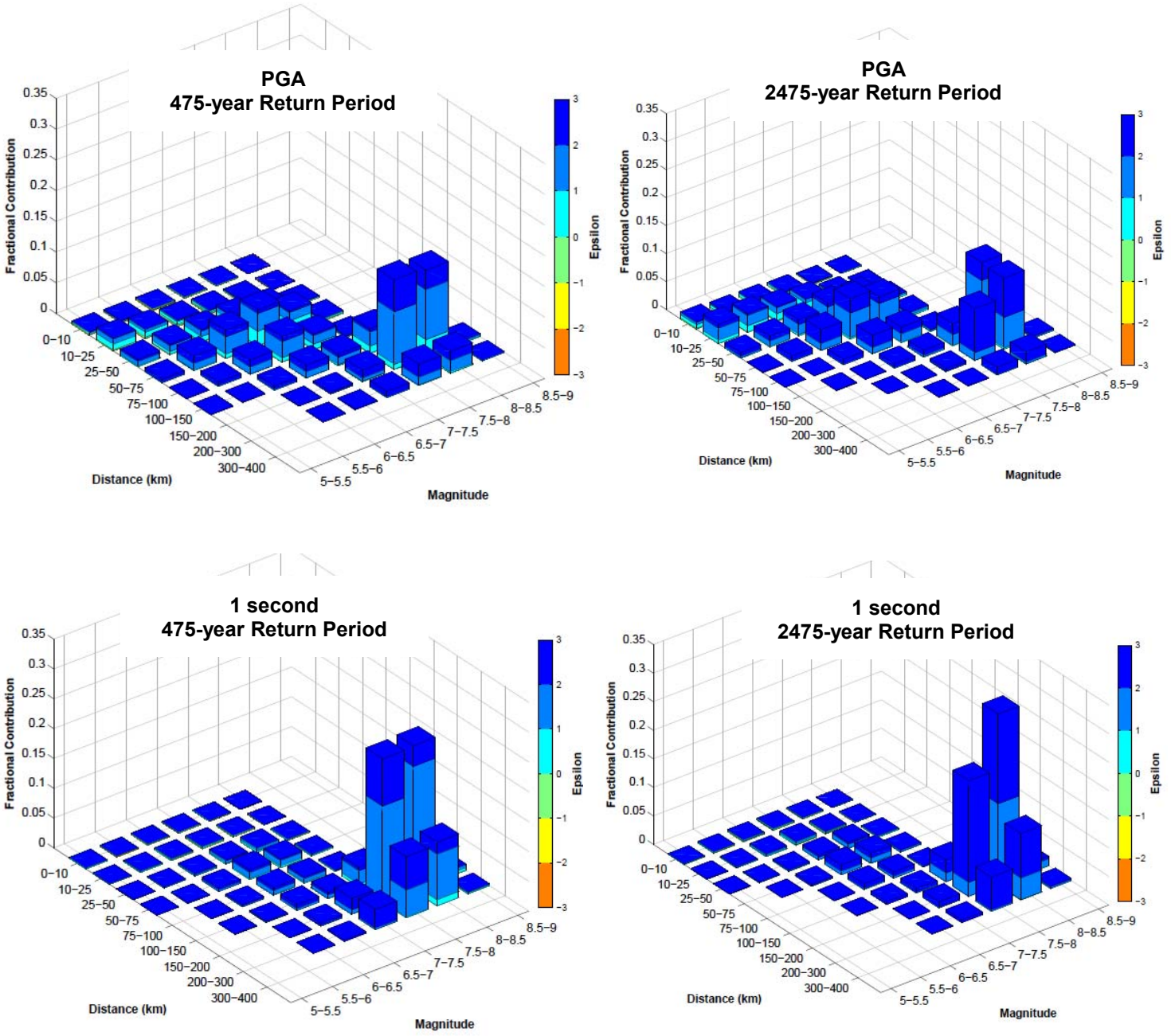
FIGURE 5-7a



DEAGGREGATION OF THE HAZARD BY MAGNITUDE AND DISTANCE FOR SITE CLASS C

PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

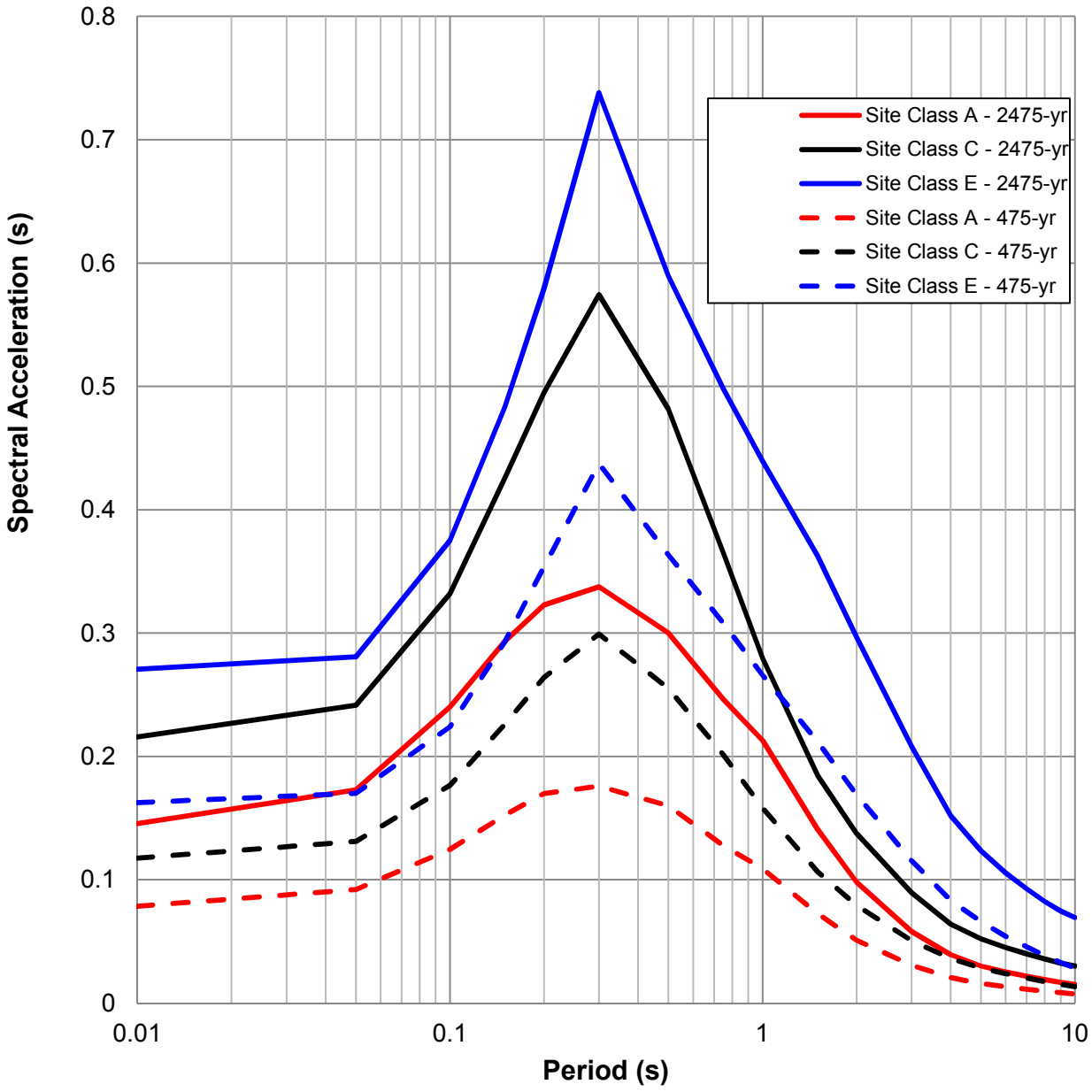
FIGURE 5-7b



DEAGGREGATION OF THE HAZARD BY MAGNITUDE AND DISTANCE FOR SITE CLASS E

PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

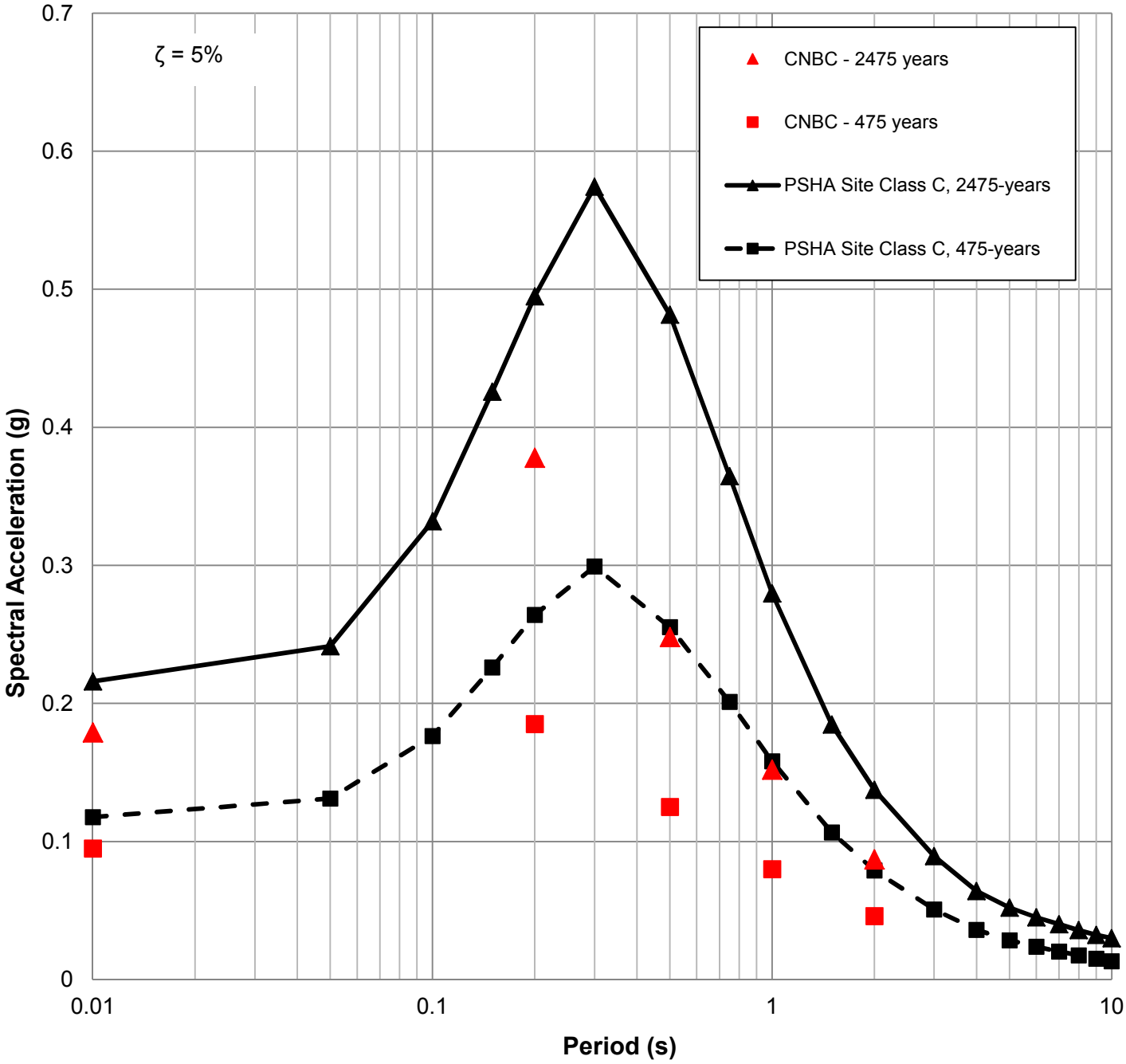
FIGURE 5-7c



SITE SPECIFIC UNIFORM HAZARD SPECTRA FOR SITE CLASS A, C AND E

PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

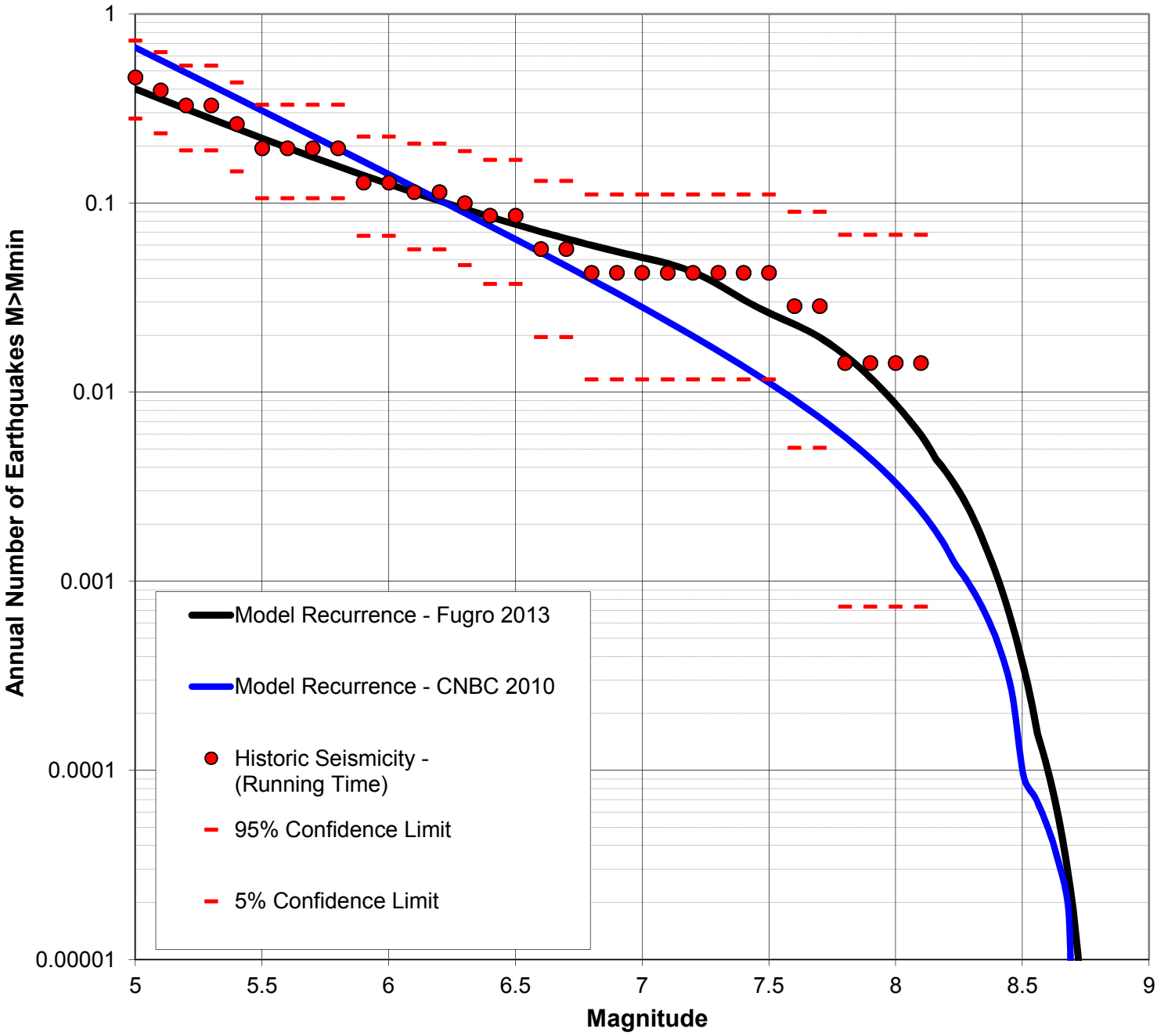
FIGURE 5-8



COMPARISON OF PSHA SITE CLASS C UHRS WITH CBC SPECTRUM FOR 475 AND 2475 YEARS

PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

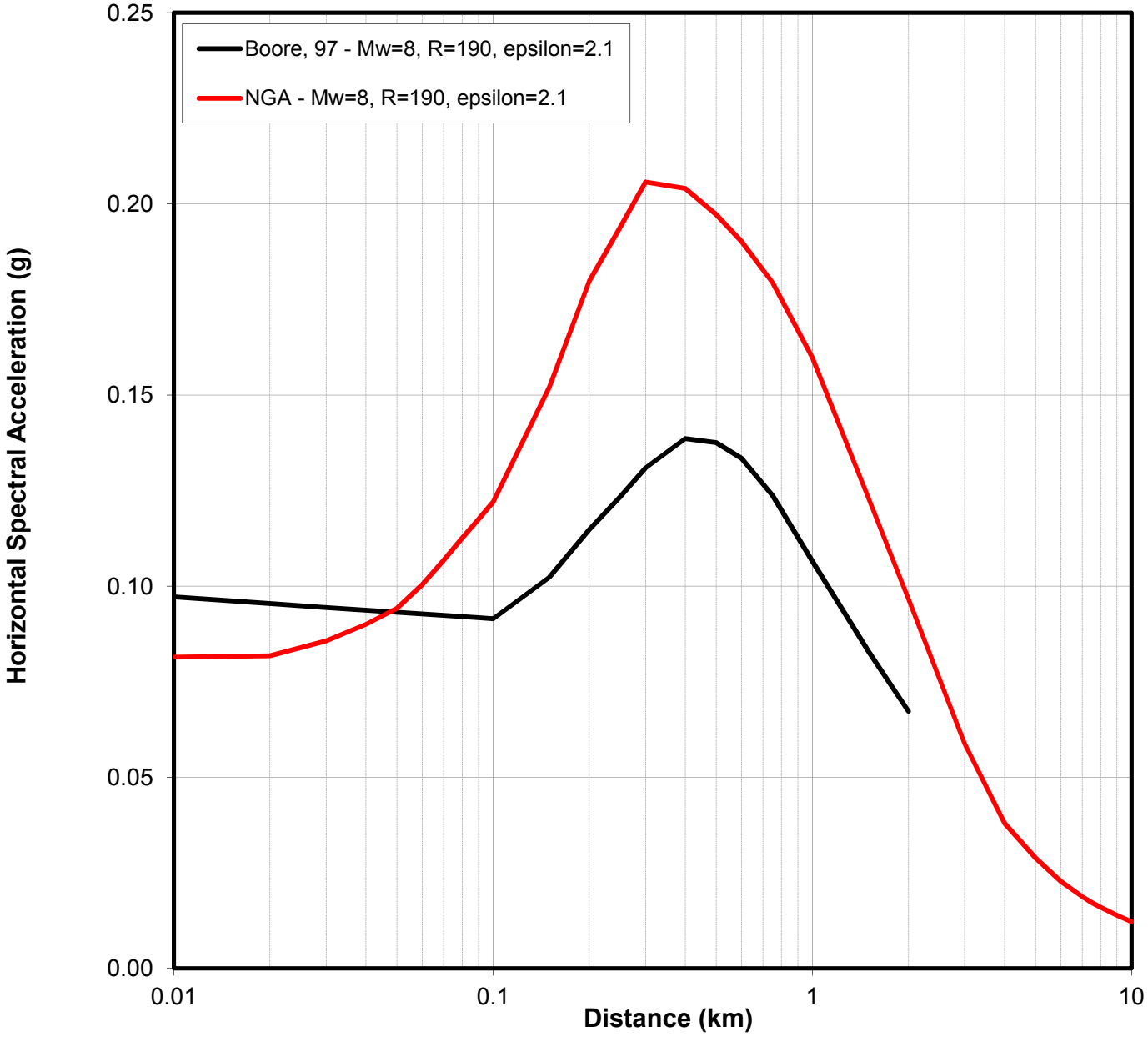
FIGURE 5-9a



MAGNITUDE RECURRENCE MODEL FOR THE QUEEN CHARLOTTE FAULT FOR THE NBCC, 2010 AND THE FUGRO, 2013 SEISMOTECTONIC MODELS

PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

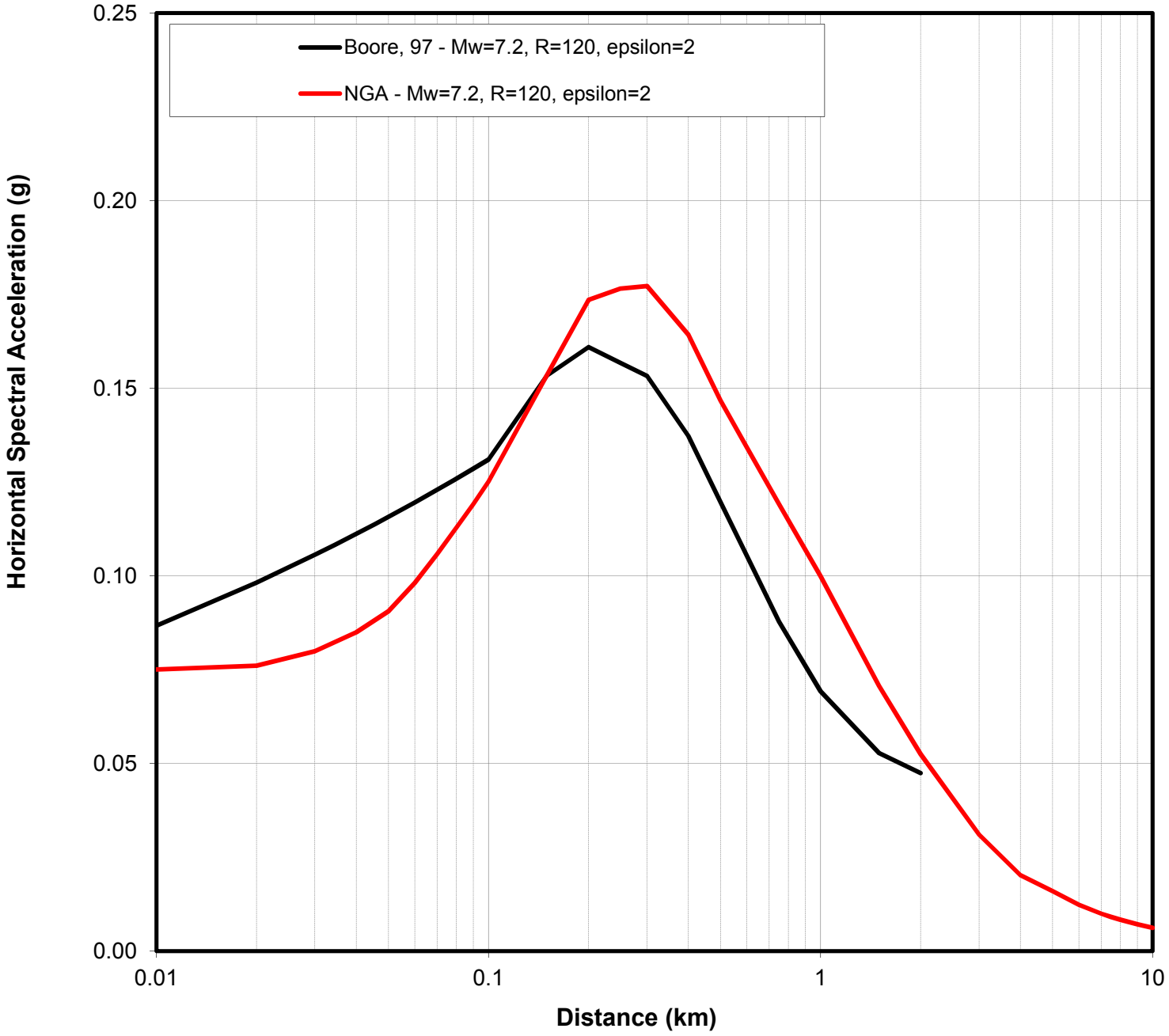
FIGURE 5-9b



EFFECT OF GMPE (NGA08 VS BJF97) ON DETERMINISTIC HORIZONTAL ACCELERATION RESPONSE SPECTRA - SITE CLASS A, M=8.0 R=190KM, ε=2.1

PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

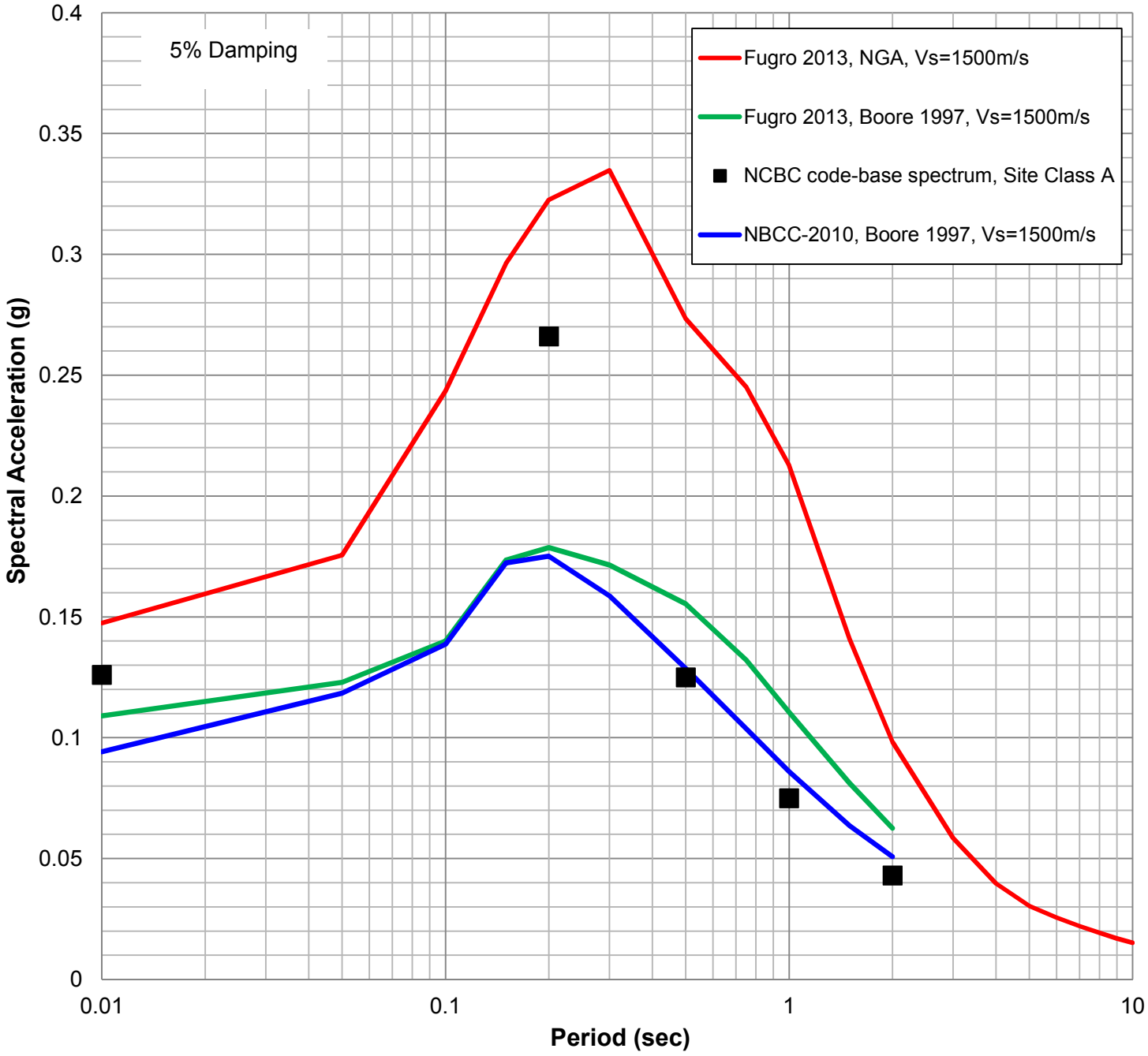
FIGURE 5-9c



EFFECT OF GMPE (NGA08 VS BJF97) ON DETERMINISTIC HORIZONTAL ACCELERATION RESPONSE SPECTRA - SITE CLASS A, M=7.2 R=120KM, ε=2

PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

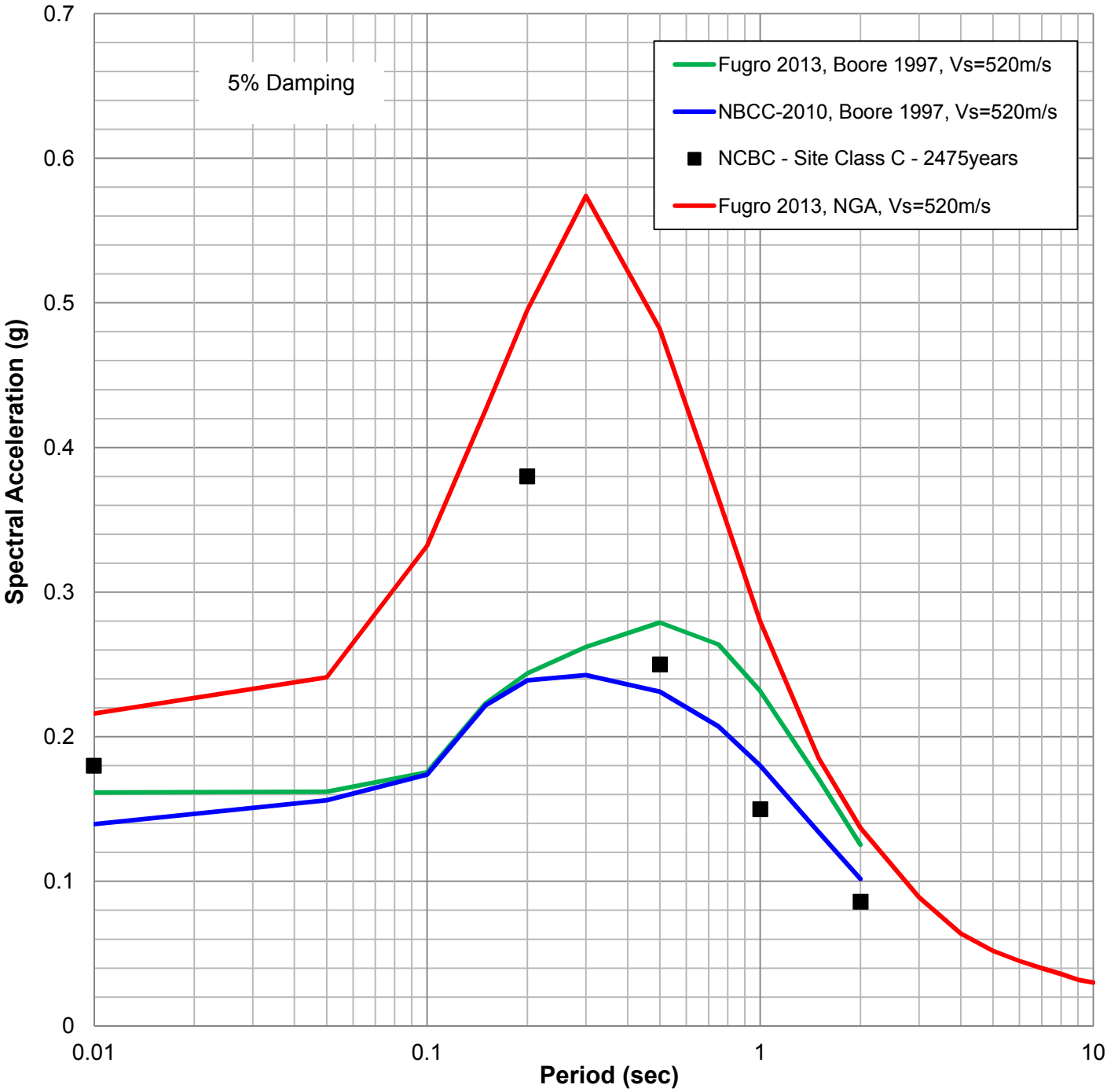
FIGURE 5-9d



EFFECT OF GMPE (NGA08 VS BJF97) ON PROBABILISTIC 2475-YEAR UHS - SITE CLASS A

PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

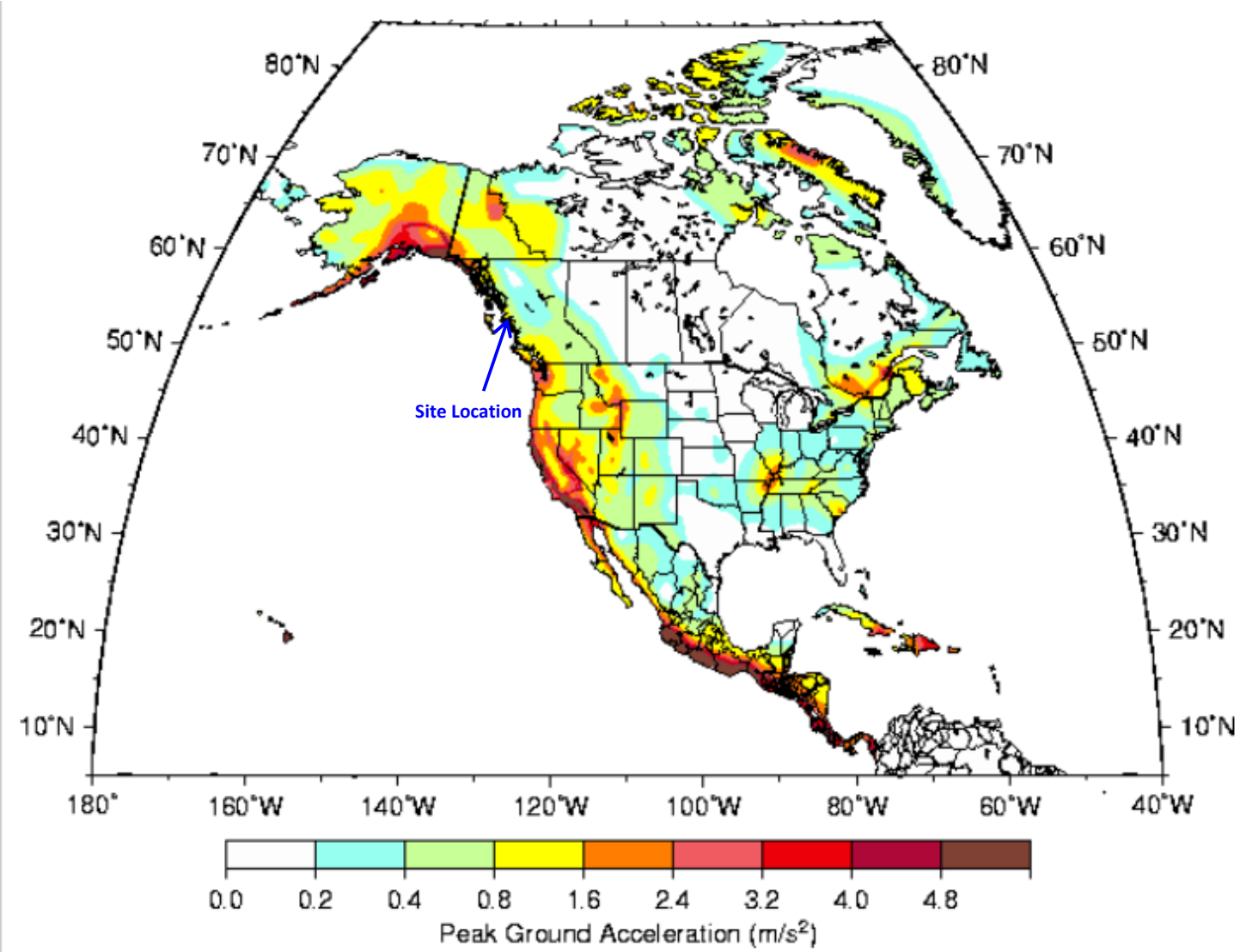
FIGURE 5-9e



EFFECT OF GMPE (NGA08 VS BJF97) ON PROBABILISTIC 2475-YEAR UHS - SITE CLASS C

PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

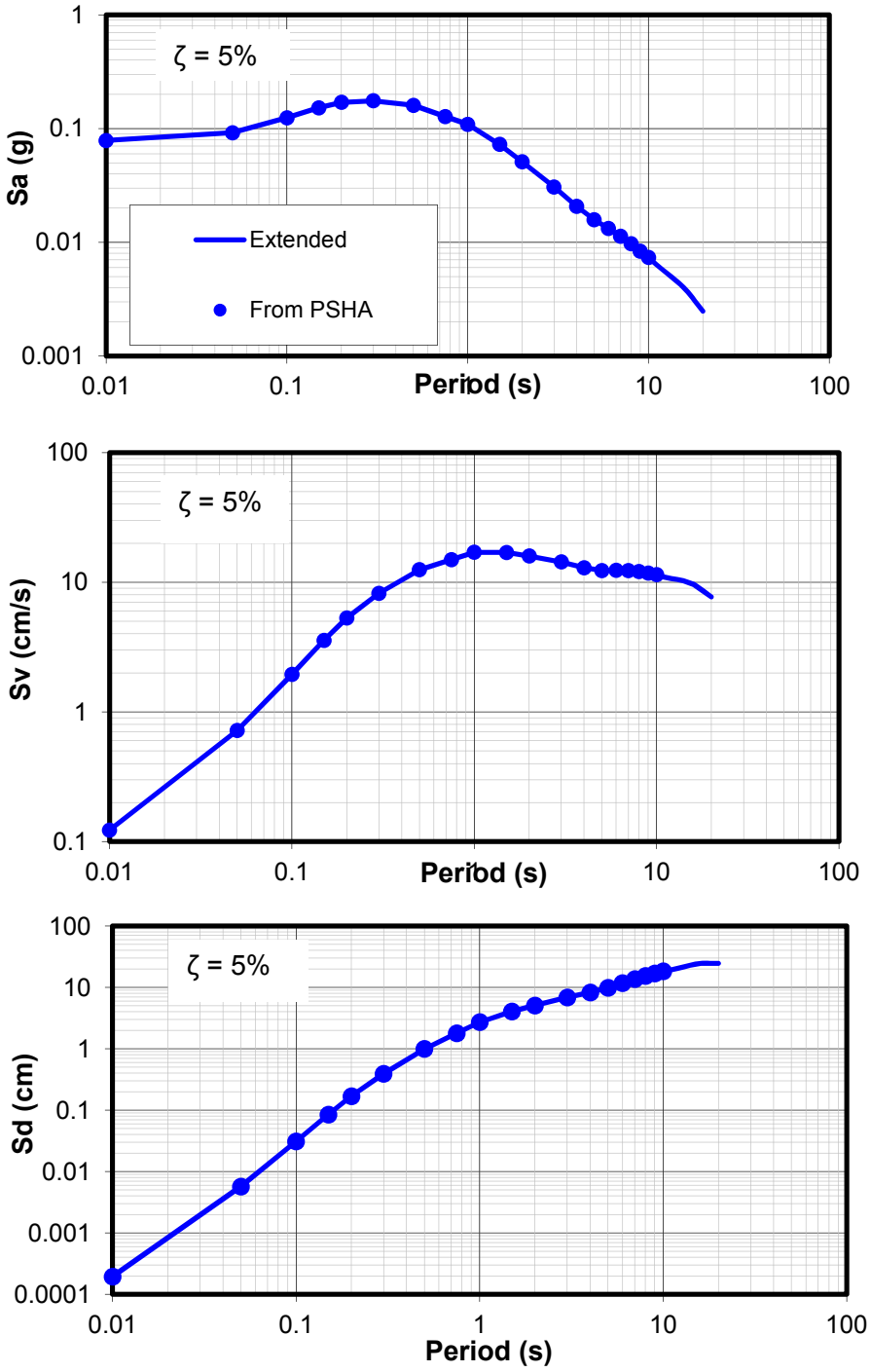
FIGURE 5-9f



GSHAP PGA MAP INCLUDING THE PROJECT SITE LOCATION

PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

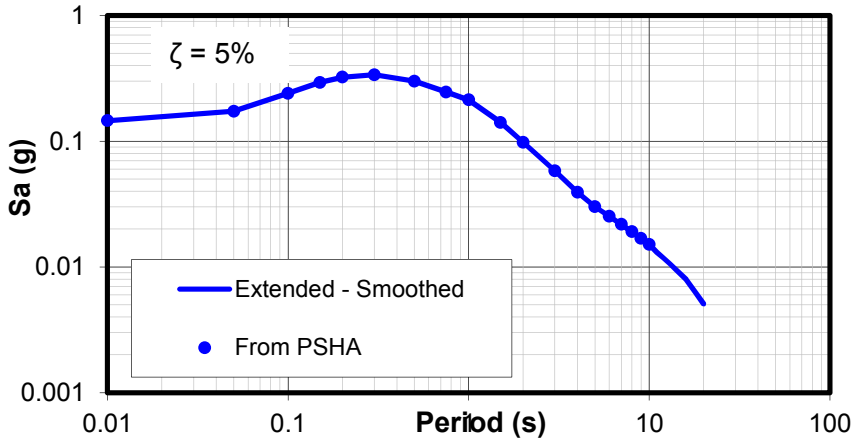
FIGURE 5-10

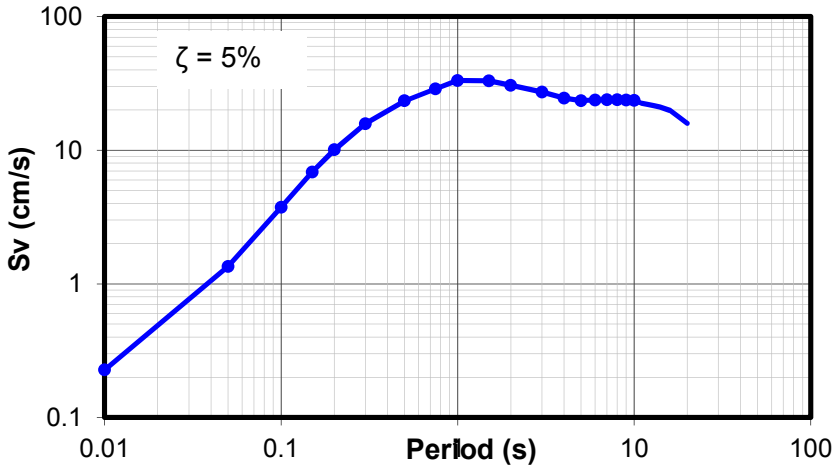


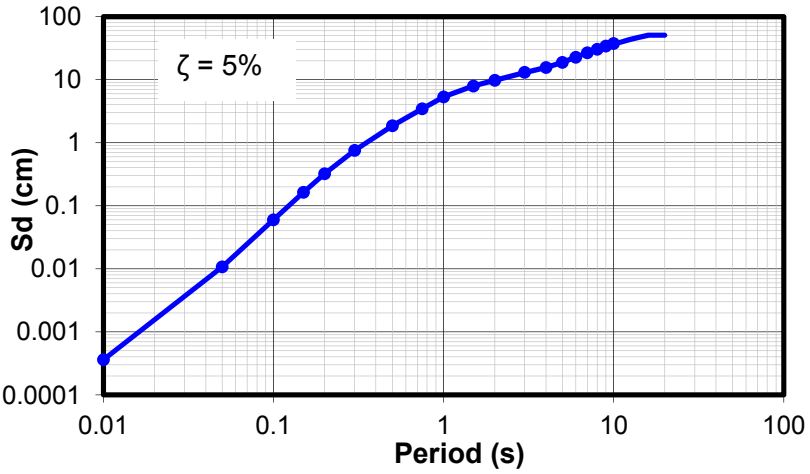
EXTENDED UNIFORM HAZARD SPECTRAL ACCELERATIONS, VELOCITIES AND DISPLACEMENTS FROM 10 TO 20 SECONDS - SITE CLASS A - 475 YEAR RETURN PERIOD

PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

FIGURE 5-11a



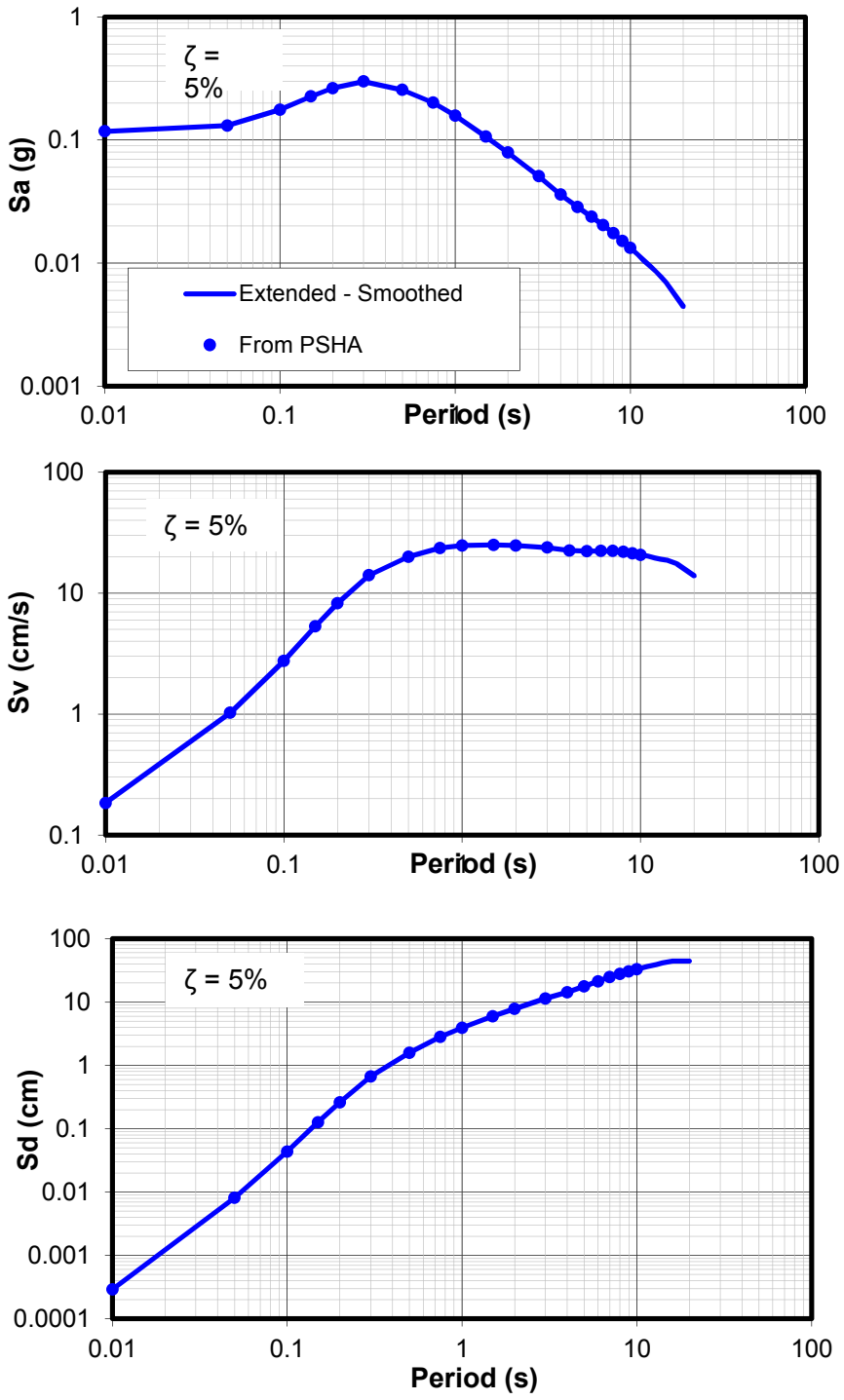




EXTENDED UNIFORM HAZARD SPECTRAL ACCELERATIONS, VELOCITIES AND DISPLACEMENTS FROM 10 TO 20 SECONDS - SITE CLASS A - 2475 YEAR RETURN PERIOD

PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

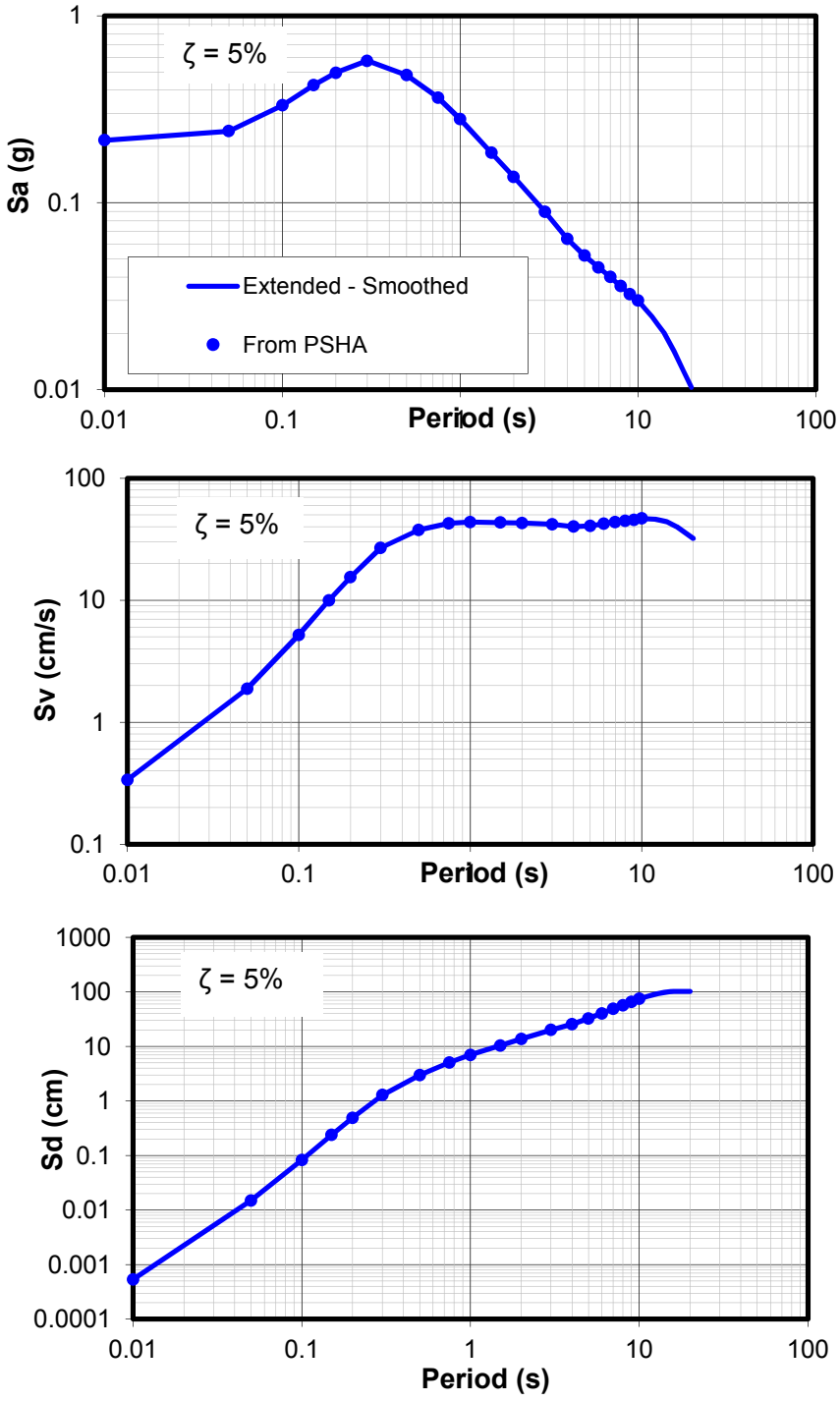
FIGURE 5-11b



EXTENDED UNIFORM HAZARD SPECTRAL ACCELERATIONS, VELOCITIES AND DISPLACEMENTS FROM 10 TO 20 SECONDS - SITE CLASS C - 475 YEAR RETURN PERIOD

PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

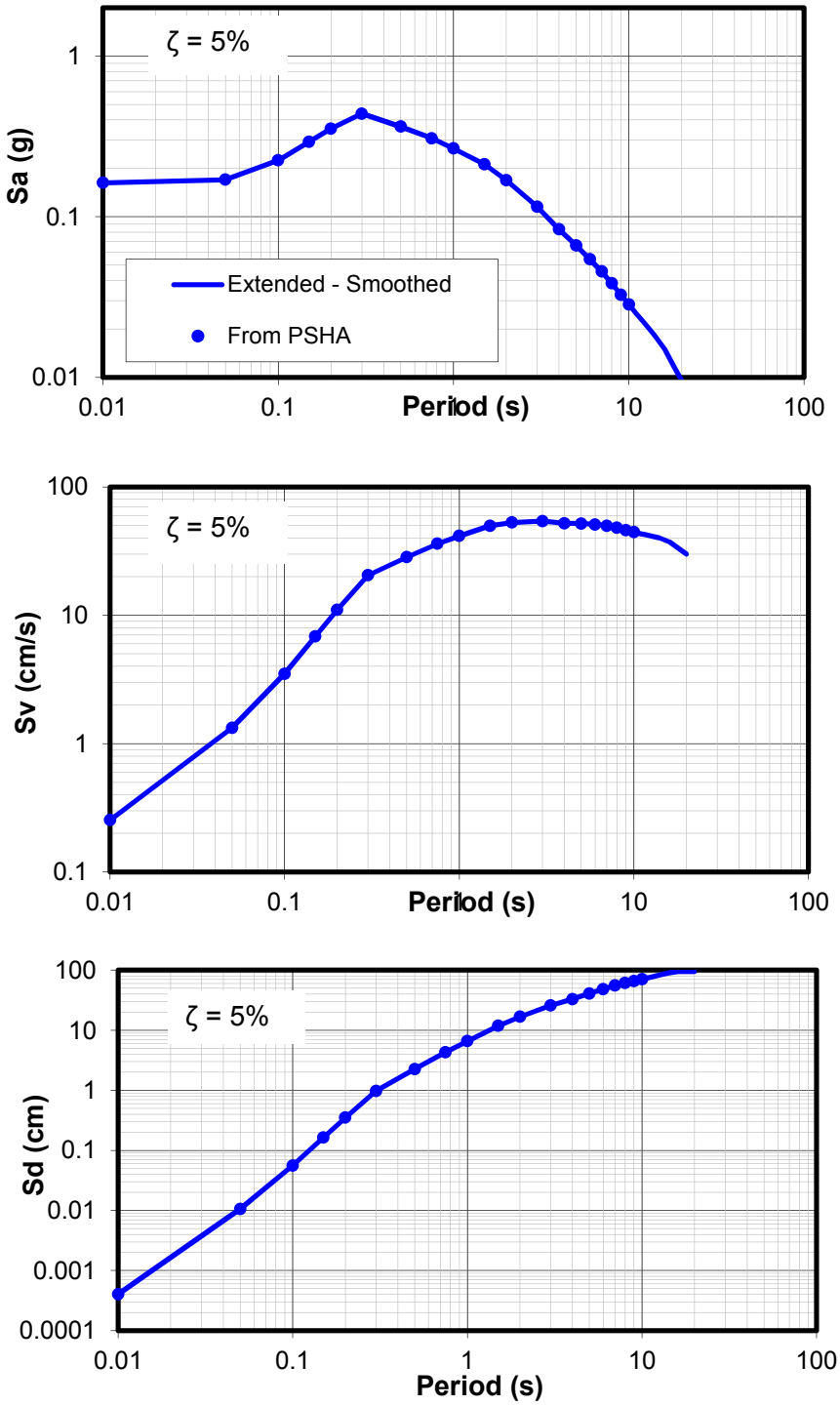
FIGURE 5-11c



EXTENDED UNIFORM HAZARD SPECTRAL ACCELERATIONS, VELOCITIES AND DISPLACEMENTS FROM 10 TO 20 SECONDS - SITE CLASS C - 2475 YEAR RETURN PERIOD

PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

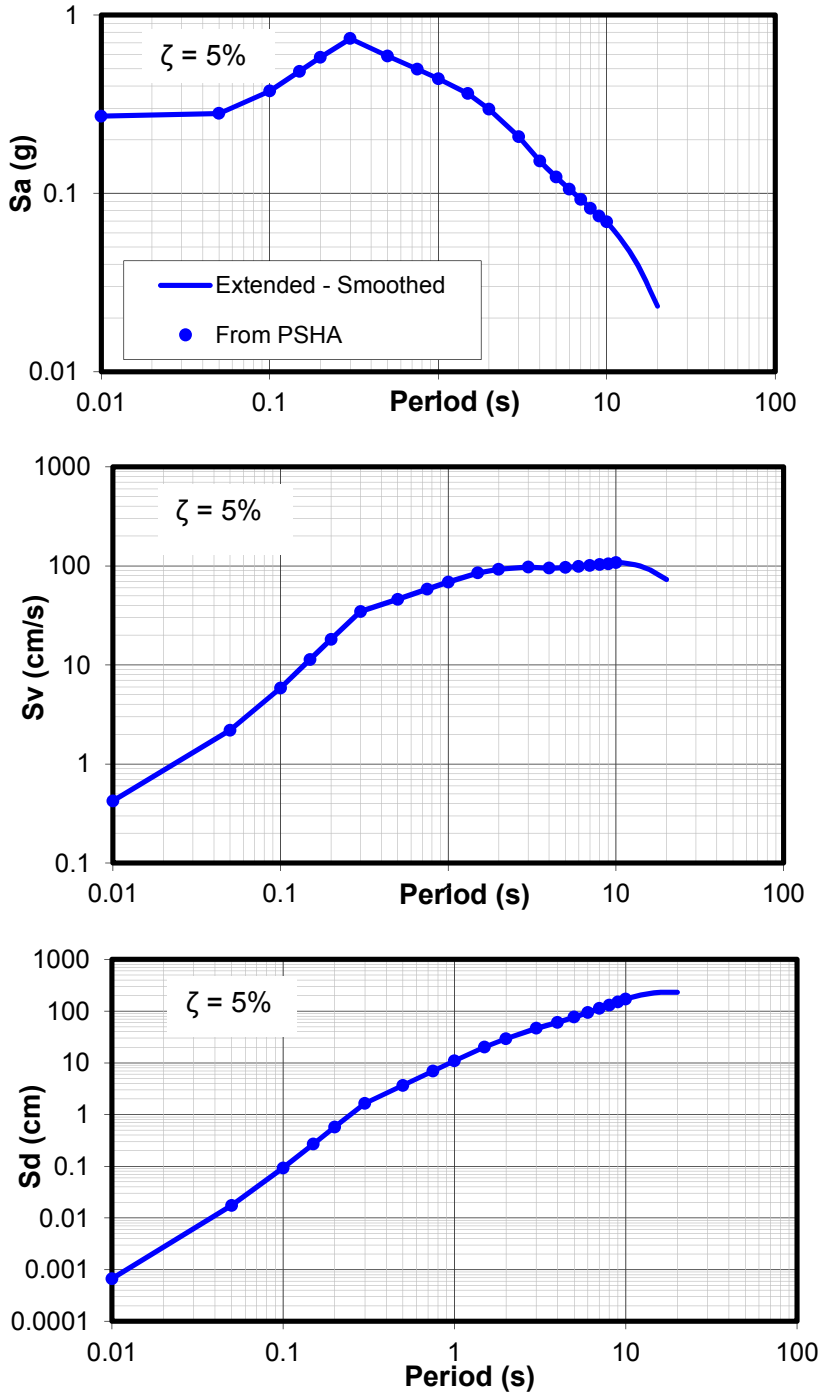
FIGURE 5-11d



EXTENDED UNIFORM HAZARD SPECTRAL ACCELERATIONS, VELOCITIES AND DISPLACEMENTS FROM 10 TO 20 SECONDS - SITE CLASS E - 475 YEAR RETURN PERIOD

PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

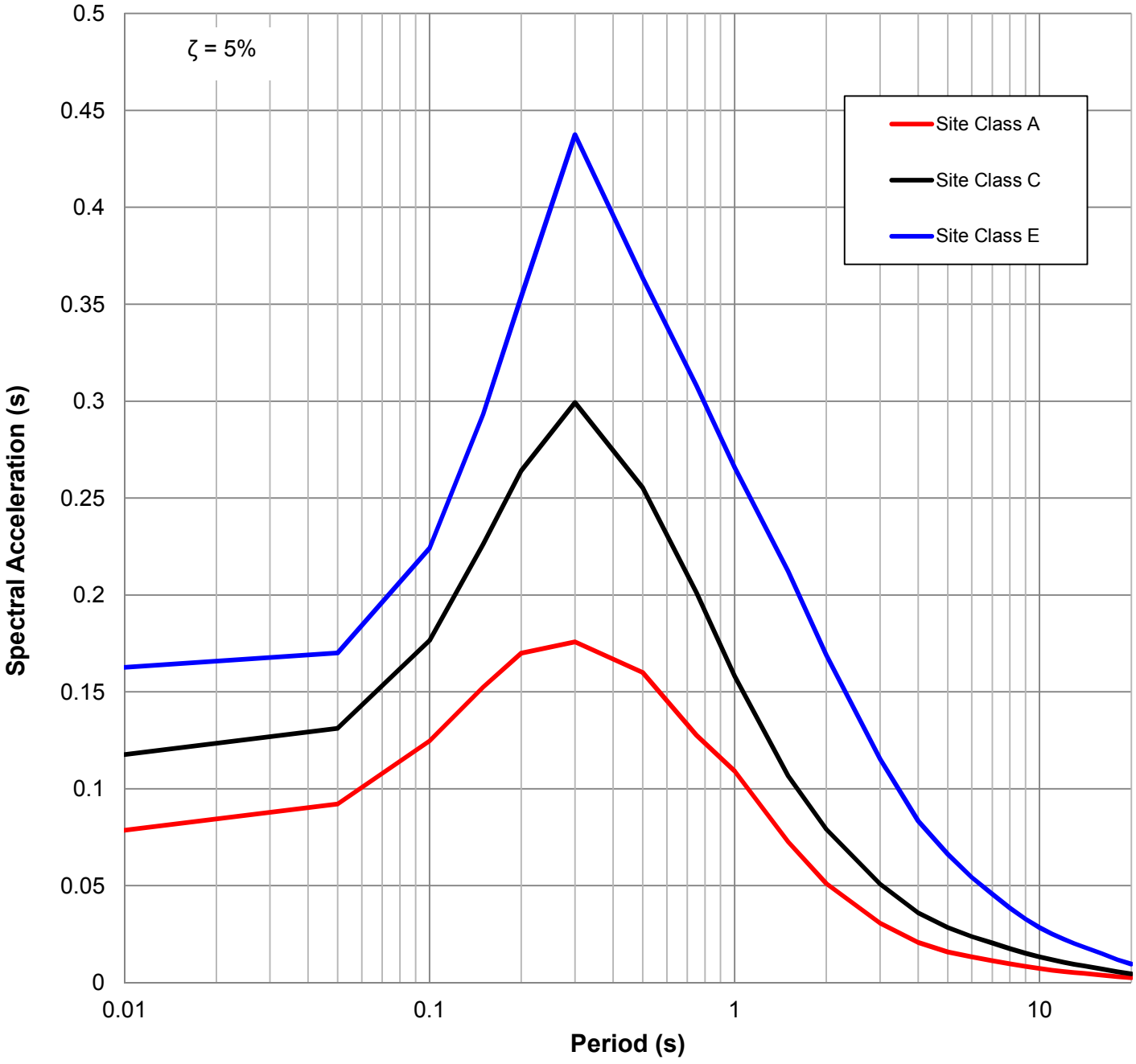
FIGURE 5-11e



EXTENDED UNIFORM HAZARD SPECTRAL ACCELERATIONS, VELOCITIES AND DISPLACEMENTS FROM 10 TO 20 SECONDS - SITE CLASS E - 2475 YEAR RETURN PERIOD

PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

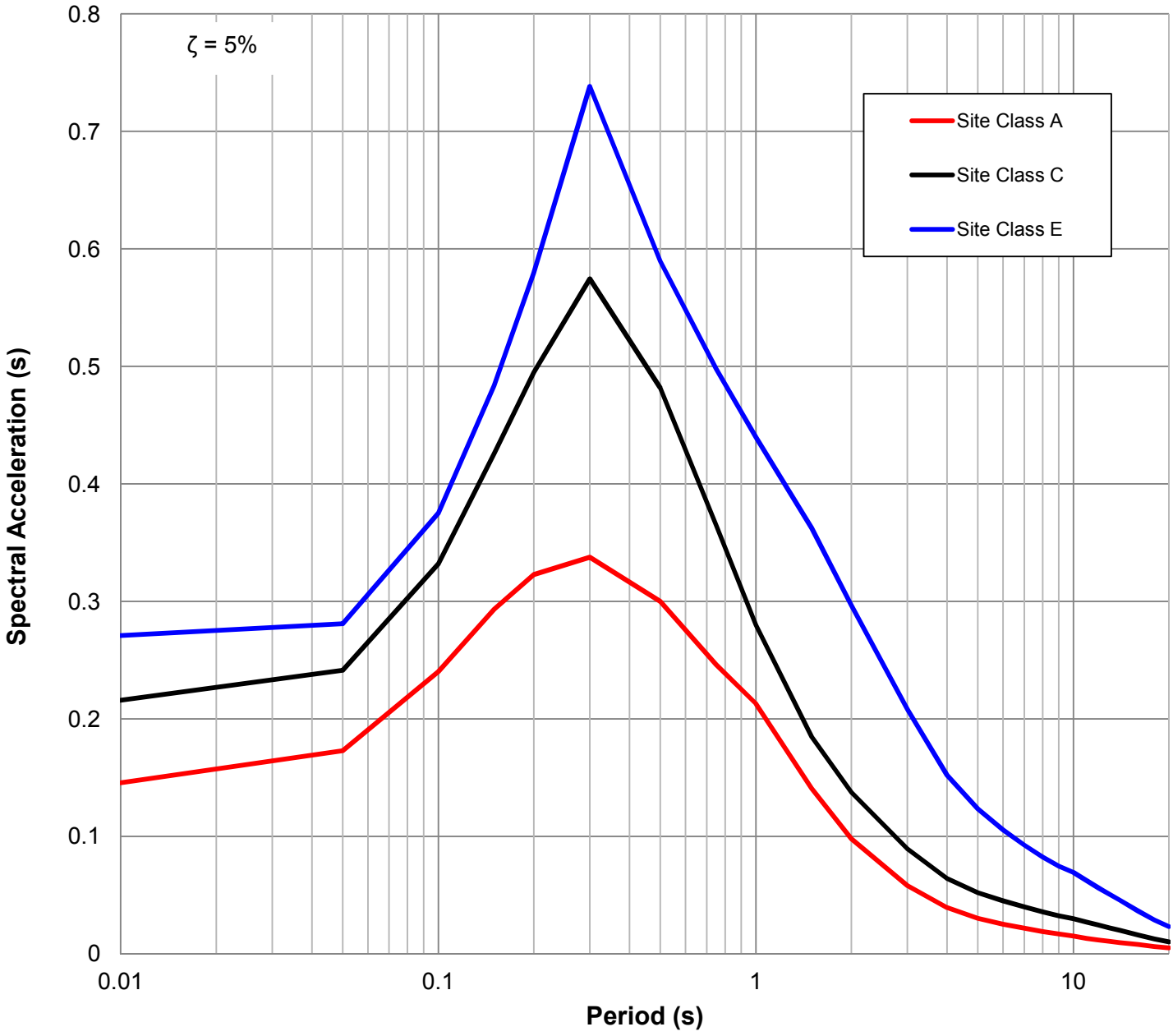
FIGURE 5-11f



EXTENDED UNIFORM HAZARD SPECTRA FOR 475 YEAR RETURN PERIOD

PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

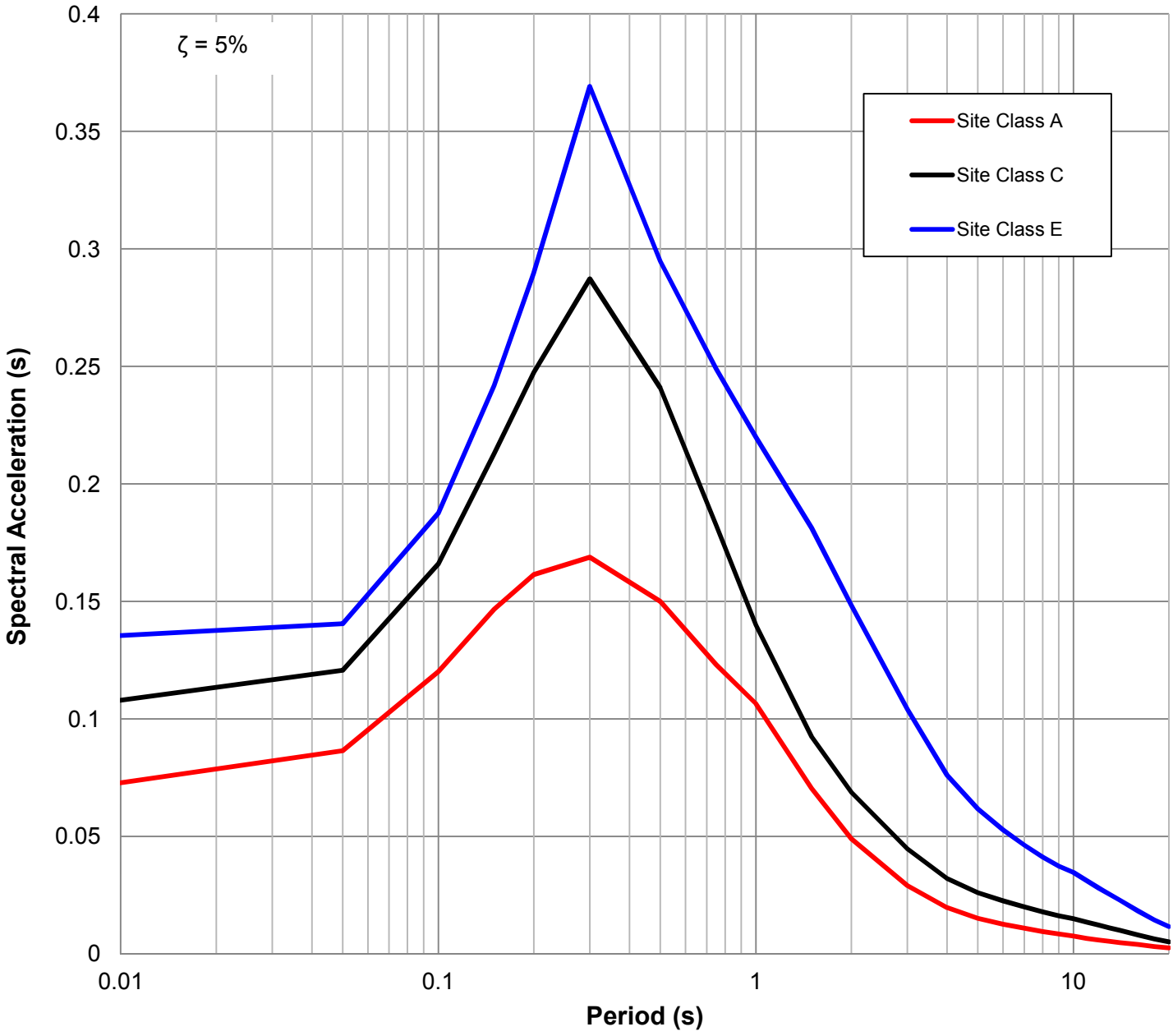
FIGURE 5-12a



EXTENDED UNIFORM HAZARD SPECTRA FOR 2475 YEAR RETURN PERIOD

PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

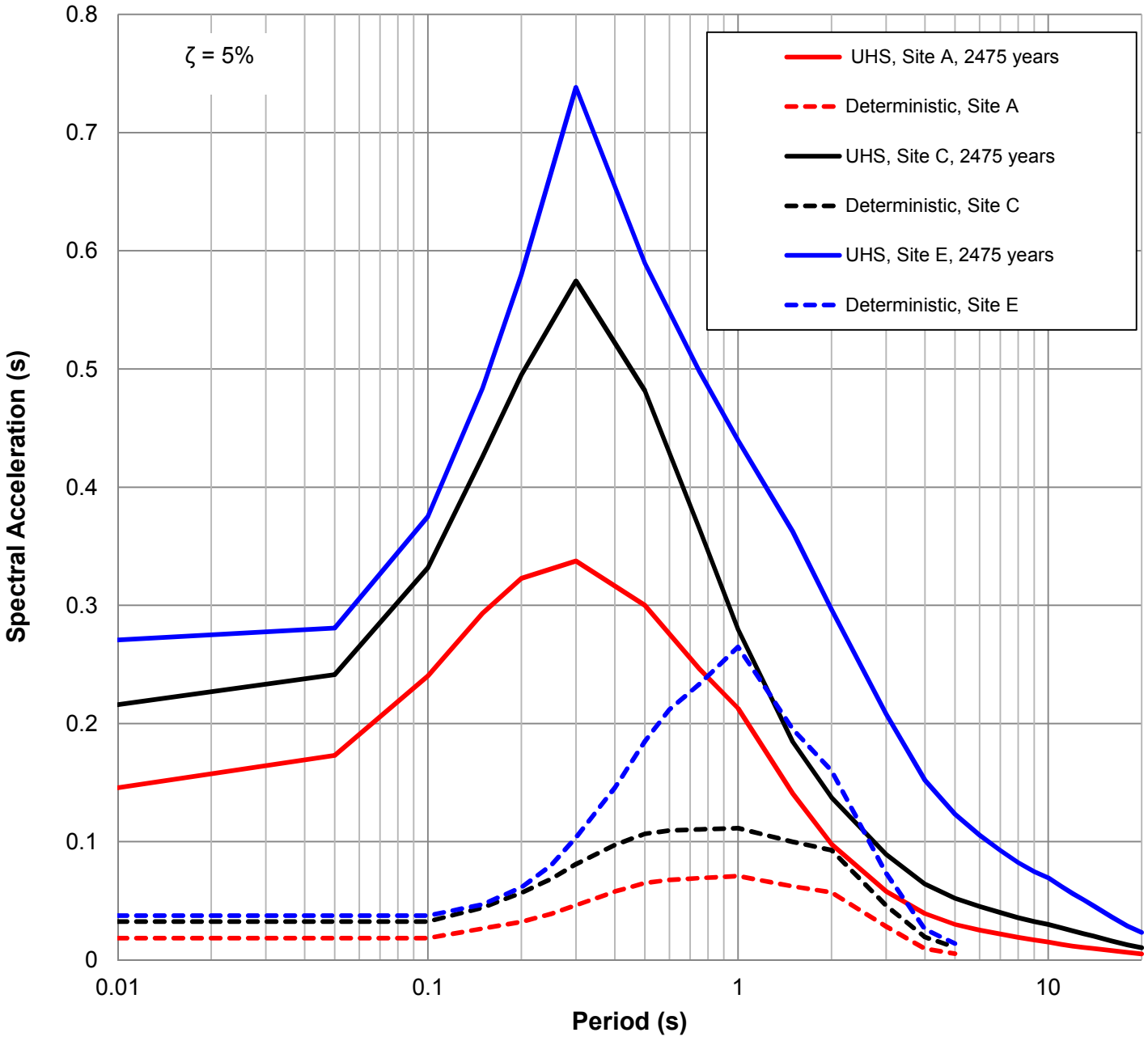
FIGURE 5-12b



EXTENDED UNIFORM HAZARD SPECTRA FOR AFTERSHOCK LEVEL EARTHQUAKE (ALE)

PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

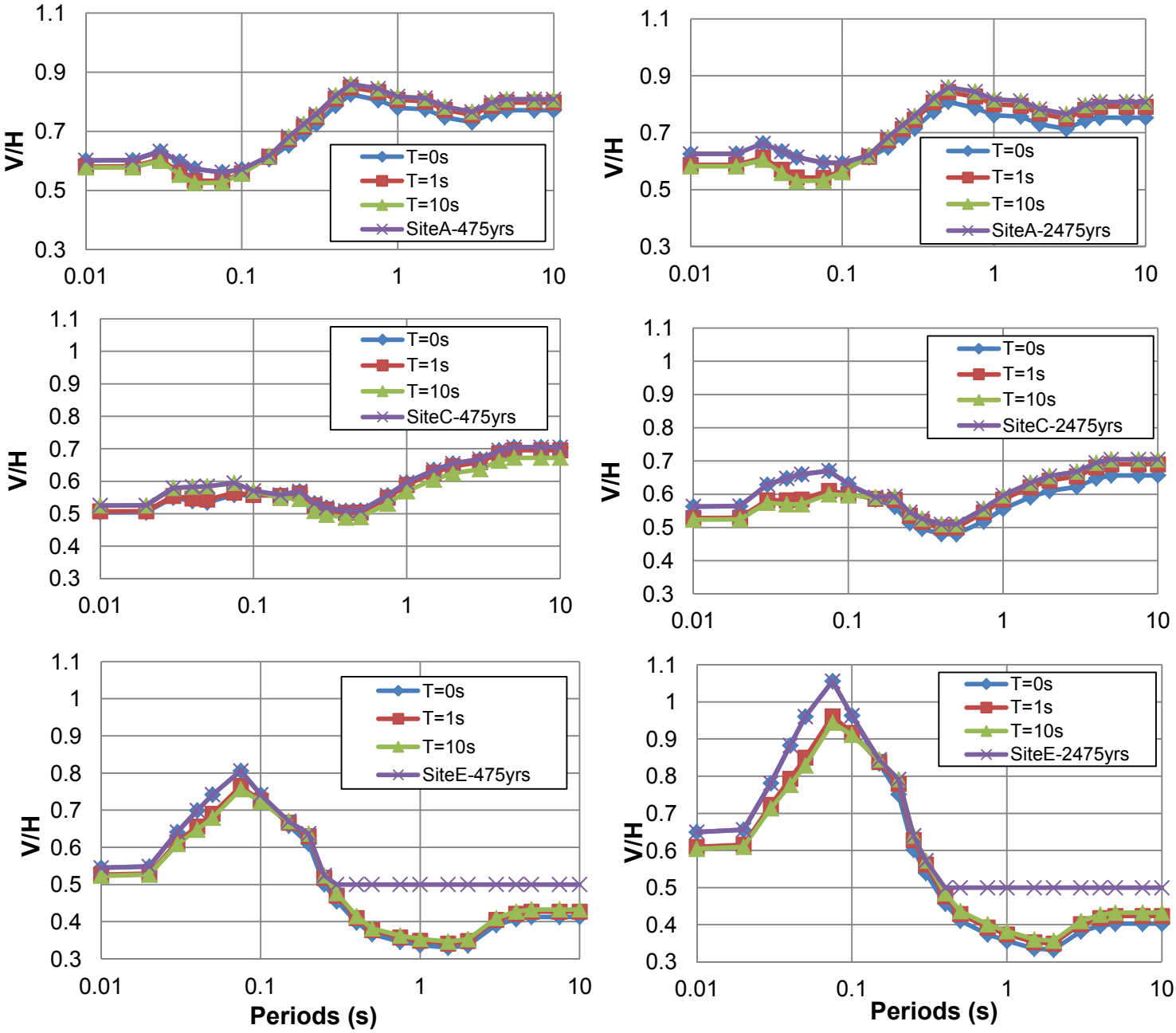
FIGURE 5-12c



COMPARISON OF UHS WITH RESPONSE SPECTRA (84TH PERCENTILE) FOR THE DETERMINISTIC SCENARIO OF CASCADIA SUBDUCTION FOR SITE CLASS A, C AND E AND 2475 YEAR RETURN PERIOD

PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

FIGURE 5-13

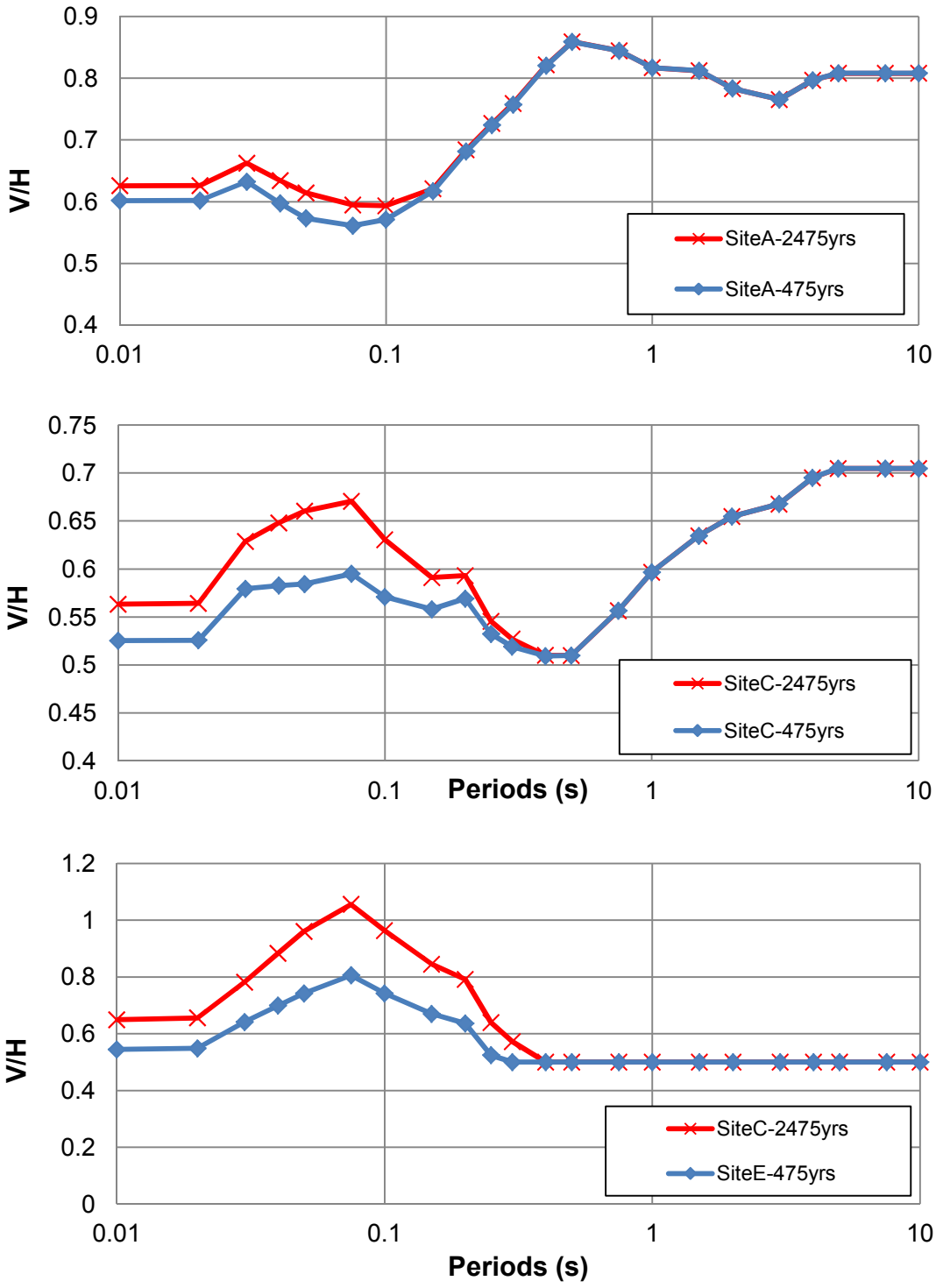


Note: For each structural period (PGA, T=1 sec and T=10 sec) Site Class (A, C and E) and Return Period Event (245 and 2475 years), the corresponding mean Magnitude and Distance scenarios from the hazard deaggregations were used for the calculation of the V/H ratio.

DEVELOPMENT OF V/H RATIOS

PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

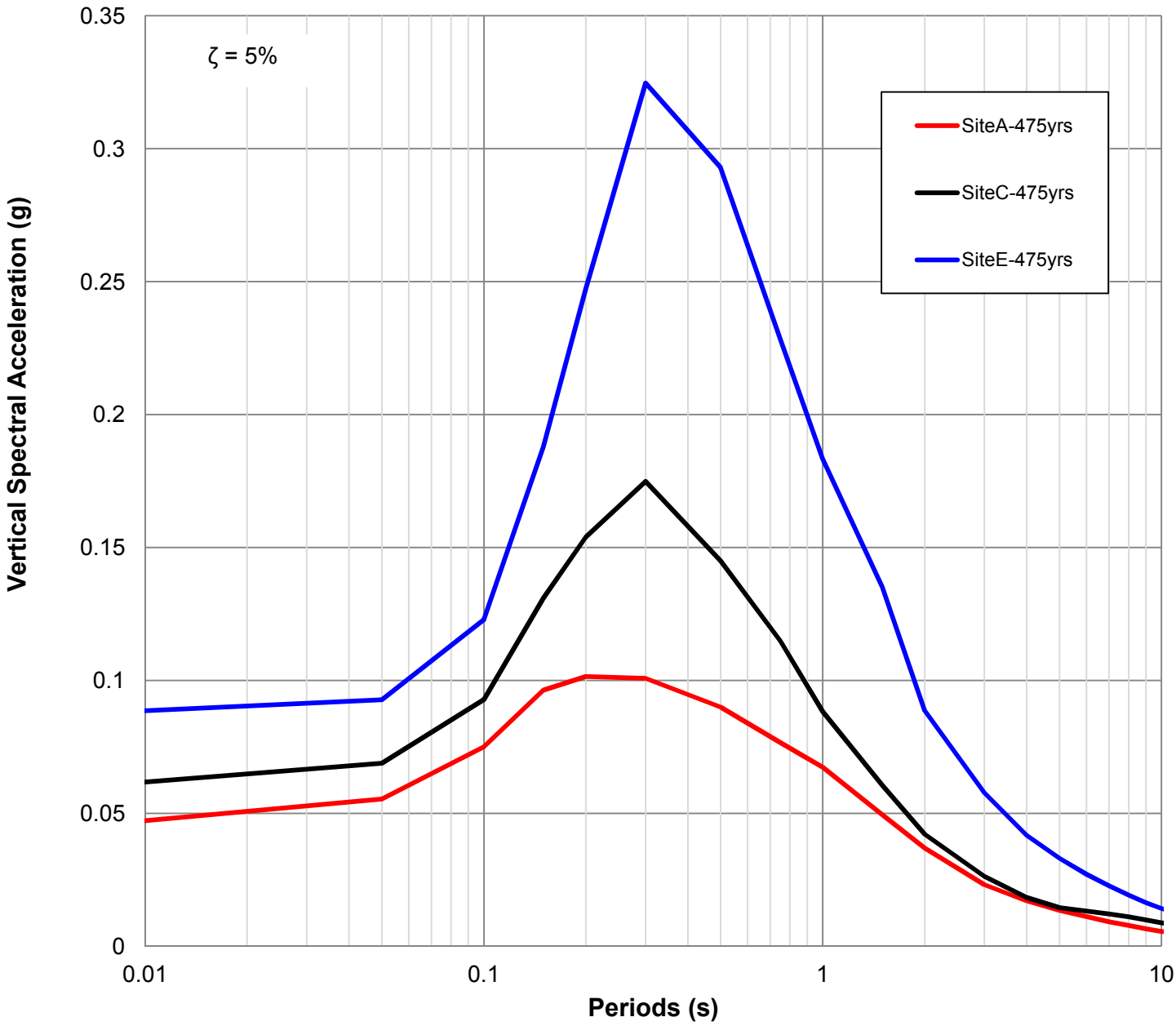
FIGURE 5-14



V/H RATIOS FOR SITE CLASS A, C AND E FOR 475 AND 2475 YEAR RETURN PERIODS

PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

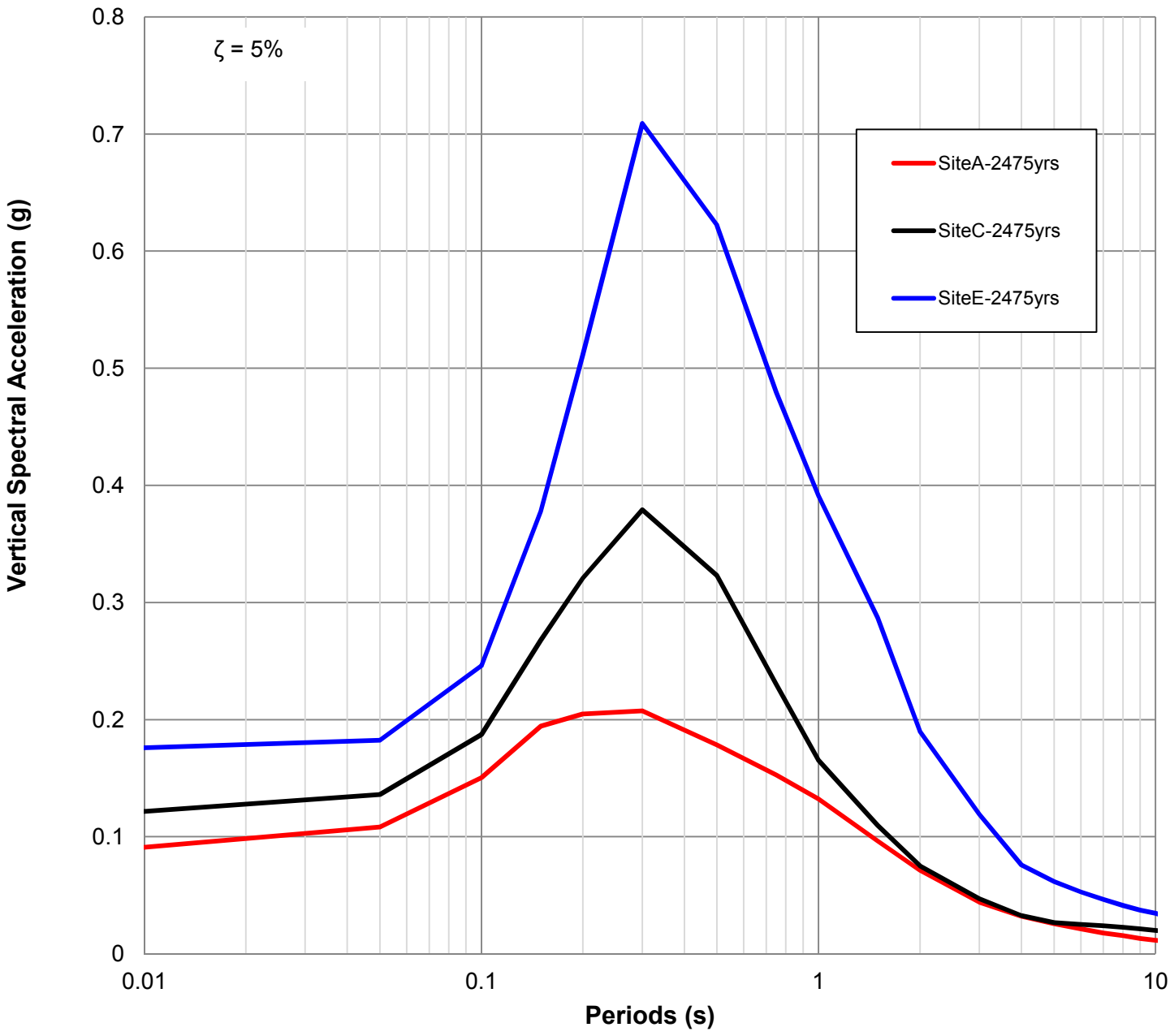
FIGURE 5-15



VERTICAL DESIGN SPECTRA FOR 475 YEAR RETURN PERIOD

PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

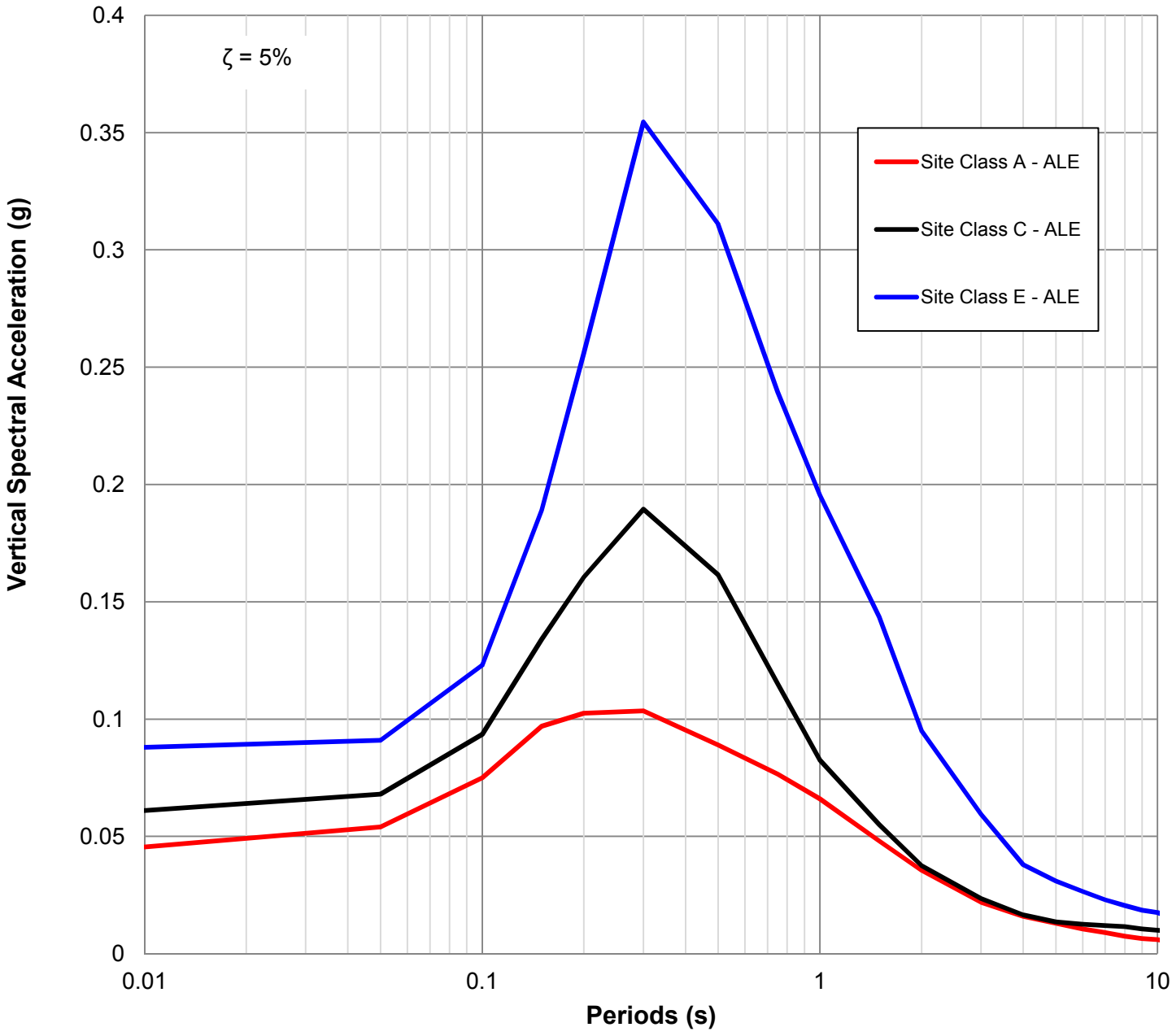
FIGURE 5-16a



VERTICAL DESIGN SPECTRA FOR 2475 YEAR RETURN PERIOD

PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

FIGURE 5-16b



VERTICAL DESIGN SPECTRA FOR AFTERSHOCK LEVEL EARTHQUAKE (ALE)

PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

FIGURE 5-16c

SECTION 6.0

6.0 ASSESSEMENT OF LIQUEFACTION HAZARD

6.1 General Introduction

Liquefaction is a dramatic loss of strength that can occur in saturated coarse-grained soils during seismic shaking and results from increased pore-water pressure and reduced effective stress. The primary susceptible soil type is clean sands, although recent studies (e.g., Bray and Sancio, 2006) have also shown liquefaction can occur in fine grained soils such as low-plasticity silts. The consequences of soil liquefaction can be severe and may result in significant damage to structures. Liquefaction-induced effects include ground settlement and differential settlement of structures, slope failure and lateral spreading, loss of foundation bearing capacity, loss of lateral support on deep foundations, drag loads and downdrag on deep foundations, kinematically-induced demands and uplift of light initially buried structures.

6.2 Liquefaction Hazard Assessment

A screening level liquefaction hazard evaluation was performed on the onshore areas based on the evaluation of available geotechnical data from 23 onshore borings (i.e., BH-5A through BH-30). The goal of the study was to explore the presence of liquefaction susceptible soils and delineate their extent.

Liquefaction is associated with the loss of shear strength in saturated soils (predominately sand) during an earthquake. The loss of strength is a consequence of increased pore water pressure and reduced effective stress in the soil during an earthquake. Recent studies have also shown liquefaction can occur in low-plasticity clays and silts.

6.3 Liquefaction Triggering Hazard Assessment

6.3.1 Coarse-Grained Soils

Of the 23 onshore borings evaluated, 6 borings (BH-5A, 15, 17, 22, 24, and 28) have been identified with soil strata classified as primarily sandy (and subject to conventional SPT-based triggering assessment). However, these strata are all above the final grade elevation of +25 meters.

Of these 6 borings, in 4 borings out of the 6 borings the sandy soil was characterized by blowcount values, N, of the Standard Penetration Test (SPT) N values greater than 50 and therefore was considered not susceptible to liquefaction. No borings contain sandy soil above the final grade elevation of +25 m.

Should the final grade change to elevation greater than 28.5 meters, liquefiable soil was identified in Borings BH-15 and BH-22 include thin shallow strata of medium dense clayey sand, although the thickness of liquefiable soil (clayey sand) is limited (0.3 and 1.3 meters) between the elevations

of +25 and +28.5 meters. The measured SPT blowcount values range between approximately 7 to 14. The thickness of these strata are as small as 0.3 meter (BH-22) to 1.3 meter (BH-15). A liquefaction triggering assessment was conducted based on the procedures of proposed by Youd et al. (2001), resulting in shows this clayey sand layer is liquefiable under SSE shaking levels with Factor of Safety with respect to liquefaction of approximately 0.9 for the SSE. with marginal increases as overburden is removed.

6.3.2 Fine-Grained Soils

An assessment of the liquefaction potential of fine grained soils (clays and silts) has been performed based on the procedures of Bray and Sancio (2006). Figure 6-1 shows a chart of Plasticity Index (PI) versus water content normalized by Liquid Limit (w_c/LL) with data from all onshore borings. Also shown are zones where soils are classified based on liquefaction susceptibility per Bray and Sancio (2006):

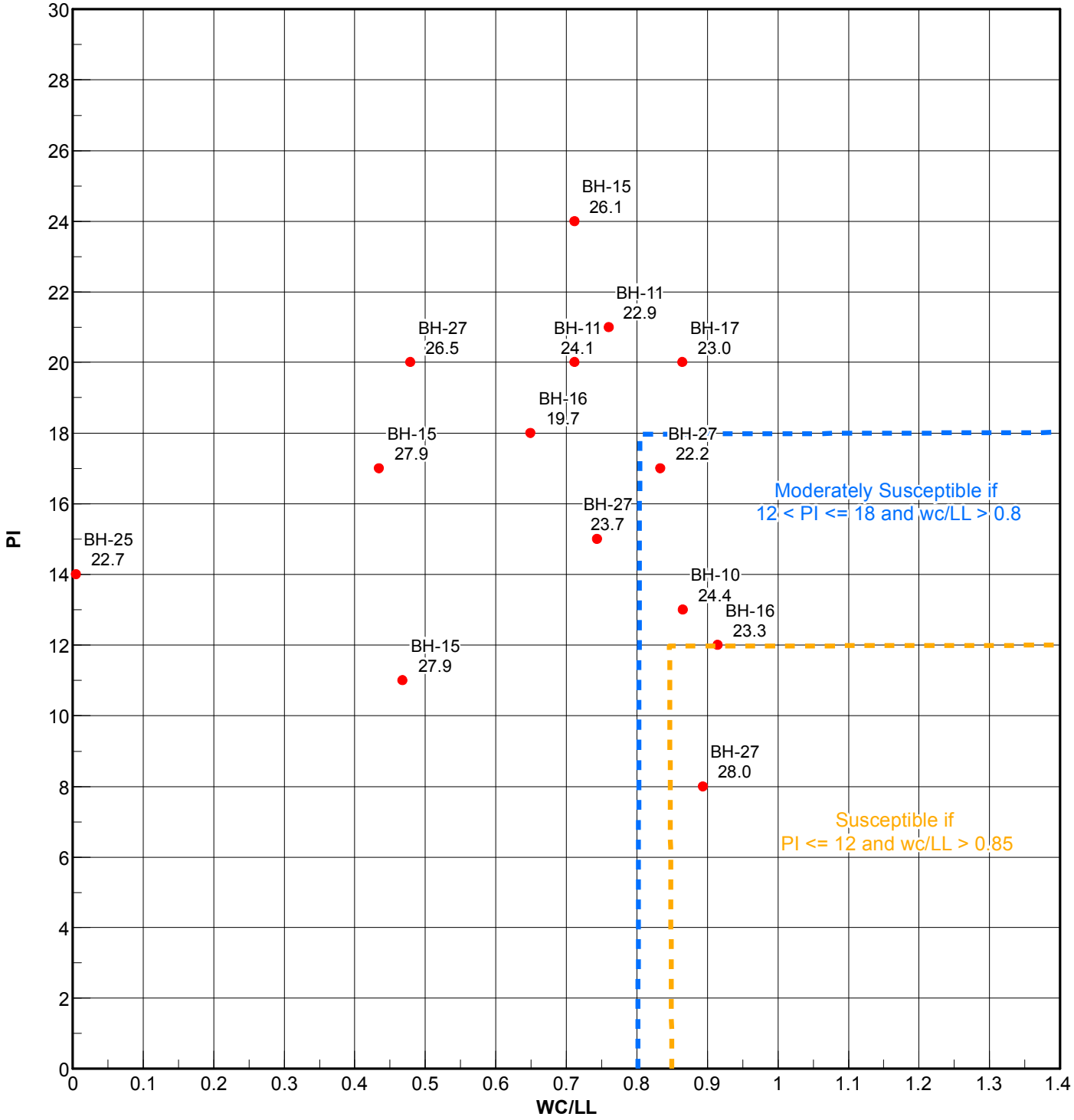
- Susceptible to liquefaction (PI<12, w_c>0.85LL) and
- Moderately susceptible to liquefaction (12<PI<18, w_c>0.8LL)

Three samples in BH10, 16, and 37 are estimated to be marginally susceptible to liquefaction. These were retrieved from at elevations of +22.2 to +24.4 meters, which are below the final grade (elevation +25 m). One sample in in BH-27 is estimated to be susceptible to liquefaction, however the sample location is at elevation +28 meters which is 3 meters above the final grade.

Although not characterized as “liquefiable”, the clays and silts have been shown to be sensitive (with significant reductions in post-peak residual shear strength) and are highly susceptible to cyclic softening during an earthquake.

6.4 Conclusions

Liquefaction triggering evaluation for coarse-grained soils and a liquefaction susceptibility evaluation of fine-grained soils has been performed for onshore borings on Lelu Island. Overall, liquefaction triggering hazard is negligible in the onshore areas. The potential for liquefaction has been identified over limited, isolated areas and thin strata (< ~1meter) encountered above the final grade of +25 meters. Some areas shown to be susceptible to liquefaction are expected to be excavated. However, in Borings BH10, 16, and 37 show presence of soft clays (CL) and silts (ML) potentially liquefiable clay (CL) or silt (ML) has been identified at in the at shallow depths of soils less than 3 meters below the proposed final grade (elevation +25 m). It is recommended (Fugro, 2013c) that these soils be removed and replaced as they are may be prone to cyclic softening if not liquefaction and degradation which can result in large ground deformations and pose a similar hazard to that of liquefaction of coarse-grained soils.



PLASTICITY INDEX VERSUS WC/LL
ONSHORE AREA
PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

FIGURE 6-1

N:\Projects\04_2013\04_1013_0058_LeluIsland\Outputs\2013_10_10_NearshoreGeotech\mxd\PI_WC_LL.mxd, 10/14/2013, CDean

SECTION 7.0

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APPENDIX G1
SEISMICITY CATALOG

APPENDIX G1.1
SEISMICITY CATALOG (UNDECLUSTERD)

APPENDIX G1.1

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID
1880	10	26	22	20	0	57.0000	-136.0000	0.0	6.3	MI	DNG	6.3	1
1910	11	06	20	29	0	53.0000	-135.0000	0.0	6.8	MS	ABE	6.7	2
1912	03	11	10	17	30	51.0000	-131.0000	0.0	6.5	ML	PAS	6.5	3
1920	03	29	05	07	53	51.0000	-129.0000	0.0	6.4	ML	PAS	6.4	4
1921	04	10	13	40	16	54.0000	-134.0000	25.0	6.5	ML	PAS	6.5	5
1924	03	30	00	08	56	50.0000	-130.2000	0.0	6.0	ML	PAS	6.0	6
1927	10	24	15	59	55	57.5000	-137.0000	25.0	7.1	ML	PAS	7.1	7
1929	03	01	07	31	13	51.5000	-130.7000	0.0	6.1	ML	PAS	6.1	8
1929	05	26	22	39	54	51.0000	-131.0000	0.0	7.0	ML	PAS	7.0	9
1929	09	17	19	17	34	51.0000	-131.0000	0.0	6.3	ML	PAS	6.3	10
1930	07	01	01	09	15	52.5000	-132.5000	0.0	5.7	ML	PAS	5.7	11
1936	12	21	19	03	13	52.5000	-131.5000	0.0	6.0	ML	PAS	6.0	12
1938	03	22	15	22	14	52.2000	-132.0000	0.0	6.3	ML	PAS	6.3	13
1938	03	22	22	27	46	52.2000	-132.0000	0.0	5.2	ML	PAS	5.2	14
1942	01	31	06	49	7	51.0000	-124.0000	0.0	5.5	ML	PAS	5.5	15
1942	03	19	11	59	19	50.5000	-131.0000	0.0	6.0	ML	PAS	6.0	16
1944	08	10	01	52	50	51.2000	-131.0000	0.0	6.2	ML	PAS	6.2	17
1945	08	02	20	44	45	54.0000	-133.0000	0.0	6.2	ML	PAS	6.2	18
1945	11	16	18	02	22	58.0000	-136.5000	0.0	5.6	ML	PAS	5.6	19
1949	08	22	00	00	0	53.0000	-132.0000	0.0	8.1	ML	SIG	8.1	20
1949	08	22	04	01	0	53.7000	-133.2000	25.0	8.1	ML	SIG	8.1	21
1949	08	23	20	24	32	53.0000	-132.0000	0.0	6.2	ML	PAS	6.2	22
1949	10	31	01	39	29	56.0500	-135.6900	0.0	6.2	ML	PAS	6.2	23
1956	02	19	02	18	0	52.0000	-131.5000	0.0	6.7	ML	PAS	6.7	24
1956	11	17	20	27	15	54.5000	-134.0000	0.0	6.5	ML	PAS	6.5	25
1956	12	21	08	08	57	51.3000	-130.6000	33.0	6.7	ML	ROT	6.7	26
1956	12	21	08	58	53	51.0000	-131.0000	0.0	6.7	ML	PAS	6.7	27
1957	03	24	08	22	22	50.8000	-130.3000	0.0	6.8	ML	PAS	6.8	28
1957	06	23	03	27	3	57.9000	-137.7000	16.0	6.0	ML	ROT	6.0	29
1958	07	10	06	15	47	56.0000	-136.0000	0.0	7.7	ML	MOS	7.7	30
1958	07	13	08	10	1	57.9000	-136.9000	0.0	5.6	ML	BRK	5.6	31
1959	08	26	10	27	40	50.6000	-130.5000	33.0	6.5	ML	ROT	6.5	32
1960	07	04	04	28	30	50.5000	-131.0000	0.0	6.7	ML	MOS	6.7	33
1960	07	04	13	10	5	51.8000	-131.1000	33.0	6.0	ML	ROT	6.0	34
1961	02	01	00	35	57	50.3000	-129.9000	23.0	5.5	ML	PAL	5.5	35
1961	09	08	04	52	0	51.7000	-131.3000	33.0	5.0	ML	BRK	5.0	36
1963	03	21	18	19	19	50.8000	-129.2000	6.0	4.0	MB	PDE	4.0	37
1963	03	27	09	11	44	51.2000	-129.8000	33.0	3.5	MB	PDE	3.6	38
1963	03	30	00	34	36	51.0000	-129.8000	19.0	4.2	MB	PDE	4.2	39
1963	04	23	12	58	5	50.9000	-129.1000	33.0	3.1	MB	PDE	3.2	40
1963	06	14	23	37	45	50.7500	-129.9790	0.0	4.4	MB	DNG	4.4	41
1963	06	16	09	19	49	50.7600	-129.6300	0.0	5.1	MB	DNG	5.1	42
1963	06	23	13	11	28	51.9000	-131.5000	33.0	4.5	MB	PDE	4.5	43
1963	06	24	10	17	2	52.8600	-131.8900	0.0	4.0	MB	DNG	4.0	44
1963	07	08	02	15	5	57.0000	-134.5000	28.0	3.7	MB	PDE	3.7	45
1963	07	12	06	54	43	50.1000	-129.8000	33.0	4.0	MB	PDE	4.0	46
1963	07	12	12	23	27	50.2000	-129.7000	33.0	4.5	MB	PDE	4.5	47
1963	07	12	12	52	41	50.2100	-129.5200	0.0	4.0	MB	DNG	4.0	48
1963	07	12	14	03	37	50.2500	-129.8600	0.0	4.8	MB	DNG	4.8	49
1963	09	01	15	23	54	50.0600	-129.6790	0.0	4.1	MB	DNG	4.1	50
1963	09	02	13	27	36	50.2800	-129.5000	0.0	4.6	MB	DNG	4.6	51
1963	09	02	13	30	2	50.4000	-129.1900	0.0	4.4	MB	DNG	4.4	52
1963	09	03	19	31	16	50.8000	-133.5000	33.0	3.9	MB	PDE	3.9	53
1963	09	05	11	36	31	50.3000	-129.1000	33.0	4.2	MB	PDE	4.2	54

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID
1963	09	06	20	31	42	50.2000	-129.5000	0.0	4.4	MB	DNG	4.4	55
1963	09	17	00	22	57	50.2000	-129.2000	0.0	4.0	MB	DNG	4.0	56
1963	10	05	18	40	46	50.9000	-131.1000	0.0	3.9	MB	DNG	3.9	57
1963	11	20	01	13	49	53.4000	-130.6000	39.0	4.0	MB	PDE	4.0	58
1963	12	02	06	52	19	54.1000	-134.2000	33.0	3.9	MB	PDE	3.9	59
1963	12	02	06	57	19	54.0000	-134.5000	33.0	3.6	MB	PDE	3.6	60
1963	12	15	15	44	18	50.7600	-129.3900	0.0	4.0	MB	DNG	4.0	61
1964	01	31	17	07	43	51.3000	-124.7000	14.0	4.2	MB	PDE	4.2	62
1964	03	24	09	37	56	50.9500	-129.9000	22.0	4.2	ML	ISC	4.2	63
1964	03	31	09	01	30	50.8000	-130.2000	15.0	6.1	ML	ROT	6.1	64
1964	05	10	13	44	2	51.4000	-129.2000	33.0	4.1	MB	USC	4.1	65
1964	08	03	18	54	54	53.8000	-132.1000	33.0	4.2	MB	PDE	4.2	66
1964	08	28	22	57	58	51.5000	-130.2000	33.0	4.2	MB	PDE	4.2	67
1964	09	03	05	31	15	50.5000	-129.5000	29.0	5.0	MB	PDE	5.0	68
1964	11	01	04	55	47	51.8000	-130.8000	33.0	4.9	MB	PDE	4.9	69
1965	02	26	15	43	19	50.2000	-130.0000	33.0	4.5	MB	PDE	4.5	70
1965	07	26	13	45	21	50.1000	-129.6000	0.0	4.0	MB	DNG	4.0	71
1965	08	12	09	04	38	50.2000	-129.7000	16.0	4.9	MB	PDE	4.9	72
1965	08	18	19	02	34	50.6000	-129.7000	0.0	3.5	MB	DNG	3.6	73
1965	08	31	01	09	15	50.5000	-129.0000	0.0	3.9	MB	DNG	3.9	74
1965	09	11	07	13	19	50.3000	-129.5000	0.0	5.0	MB	DNG	5.0	75
1965	10	11	15	47	55	50.5000	-129.5000	33.0	4.8	MB	PDE	4.8	76
1965	10	11	17	54	55	50.7700	-129.2000	43.0	4.3	ML	ISC	4.3	77
1966	01	20	19	51	14	51.3000	-131.2000	0.0	4.3	MB	DNG	4.3	78
1966	02	07	08	48	35	51.2000	-130.0000	34.0	4.9	MB	PDE	4.9	79
1966	02	07	14	03	3	51.5000	-129.4000	33.0	3.9	MB	ISC	3.9	80
1966	02	08	07	58	28	51.2000	-129.2000	33.0	4.9	MB	PDE	4.9	81
1966	03	25	21	59	26	56.6000	-135.4000	21.0	4.7	MB	PDE	4.7	82
1966	04	16	22	49	38	56.7000	-136.2000	5.0	4.1	MB	PDE	4.1	83
1966	04	17	16	46	53	54.2300	-133.2000	33.0	4.9	ML	ISC	4.9	84
1966	05	20	19	57	45	50.5000	-129.6000	40.0	3.7	ML	ISC	3.7	85
1966	05	20	23	58	51	50.2000	-129.7000	37.0	5.0	MB	PDE	5.0	86
1966	05	21	02	44	36	50.1000	-129.6000	33.0	4.2	MB	PDE	4.2	87
1966	07	23	19	34	57	54.5000	-134.8000	33.0	3.8	MB	PDE	3.8	88
1966	09	01	14	11	25	50.6800	-129.4000	37.0	4.4	MB	ISC	4.4	89
1966	10	10	21	17	34	57.4000	-136.1000	33.0	4.8	MB	PDE	4.8	90
1966	10	26	13	36	32	50.4000	-129.3000	41.0	4.3	MB	PDE	4.3	91
1967	02	16	02	58	43	51.3000	-129.1000	79.0	3.8	MB	ISC	3.8	92
1967	03	05	11	11	4	51.3000	-130.1000	62.0	4.0	MB	ISC	4.0	93
1967	04	12	00	54	40	56.1210	-136.1220	15.0	4.6	MB	PDE	4.6	94
1967	04	19	18	12	26	52.7100	-131.6000	60.0	4.7	MB	ISC	4.7	95
1967	04	24	10	05	10	50.5420	-129.2340	33.0	3.7	MB	PDE	3.7	96
1967	04	29	00	04	45	51.1350	-130.4090	33.0	5.3	MB	PDE	5.3	97
1967	04	30	02	44	27	50.6900	-129.6000	16.0	4.0	ML	ISC	4.0	98
1967	08	27	12	56	32	50.3700	-130.2000	3.0	4.0	ML	ISC	4.0	99
1967	08	27	13	34	52	50.2000	-130.0000	24.0	5.1	MB	PDE	5.1	100
1967	08	27	15	18	45	50.2000	-129.8000	33.0	3.8	MB	PDE	3.8	101
1967	08	27	17	51	58	50.4000	-130.2000	33.0	3.7	ML	ISC	3.7	102
1967	08	27	18	29	8	50.2600	-129.6400	37.0	4.4	MB	ISC	4.4	103
1967	08	28	11	32	6	50.3700	-129.9000	14.0	3.7	MB	ISC	3.7	104
1967	08	28	11	41	16	50.3200	-129.8000	33.0	3.9	MB	ISC	3.9	105
1967	08	28	11	45	34	50.3000	-129.7000	33.0	3.7	MB	PDE	3.7	106
1967	08	28	12	39	18	50.1000	-129.6000	36.0	4.1	MB	PDE	4.1	107
1967	08	28	12	43	54	50.3900	-129.1000	5.0	4.0	ML	ISC	4.0	108
1967	08	28	12	59	3	50.2000	-129.6000	33.0	4.0	MB	USC	4.0	109
1967	08	28	13	49	42	50.3000	-130.1000	18.0	4.6	MB	PDE	4.6	110

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID
1967	08	28	15	07	11	50.4000	-129.6000	33.0	4.5	MB	PDE	4.5	111
1967	08	28	15	25	51	50.4000	-129.9000	33.0	5.2	MB	PDE	5.2	112
1967	08	28	16	20	6	50.4000	-129.8000	33.0	5.1	MB	USC	5.1	113
1967	09	08	23	44	14	50.4000	-129.9000	33.0	3.9	MB	ISC	3.9	114
1967	09	09	14	45	39	50.2800	-129.5000	33.0	4.1	ML	ISC	4.1	115
1967	11	03	15	58	11	51.2000	-128.0000	50.0	3.9	MB	ISC	3.9	116
1967	11	10	13	47	18	51.0000	-130.0000	33.0	3.7	MB	ISC	3.7	117
1967	12	13	22	20	39	50.1000	-129.6000	33.0	4.1	MB	PDE	4.1	118
1968	01	15	12	24	29	52.1800	-130.5000	47.0	3.9	MB	ISC	3.9	119
1968	02	01	07	58	3	50.0000	-129.8000	14.0	5.4	MB	PDE	5.4	120
1968	02	15	18	27	30	51.6000	-130.3000	33.0	4.2	MB	PDE	4.2	121
1968	02	27	06	39	53	50.1000	-129.5000	33.0	4.3	MB	PDE	4.3	122
1968	04	25	09	58	28	50.9100	-129.6700	16.0	4.5	MB	ISC	4.5	123
1968	06	13	08	51	29	51.4900	-129.8350	33.0	4.1	MB	PDE	4.1	124
1968	06	18	05	37	54	50.8700	-130.1000	44.0	3.8	MB	ISC	3.8	125
1968	07	16	01	47	23	50.6900	-129.3000	28.0	4.1	MB	ISC	4.1	126
1968	07	28	21	16	52	50.5800	-129.4000	33.0	4.1	MB	ISC	4.1	127
1968	08	04	06	11	57	52.5000	-131.5500	18.0	3.7	MB	DNG	3.7	128
1968	09	22	03	51	55	51.5200	-130.7300	33.0	4.6	MB	ISC	4.6	129
1968	11	01	10	24	36	51.0200	-124.4800	18.0	4.5	MB	EDS	4.5	130
1968	11	20	08	24	49	50.7200	-129.3300	23.0	4.3	MB	ISC	4.3	131
1969	03	10	22	50	46	50.5000	-129.6000	33.0	4.1	MB	USC	4.1	132
1969	03	18	19	45	4	50.2700	-129.5000	41.0	4.6	MB	ISC	4.6	133
1969	03	18	20	31	27	50.1700	-129.8800	33.0	5.1	MB	ISC	5.1	134
1969	03	18	22	40	11	50.3700	-130.3000	33.0	3.5	MB	DNG	3.6	135
1969	03	19	02	48	54	50.5700	-129.1000	92.0	3.9	MB	DNG	3.9	136
1969	05	21	07	55	50	50.5000	-129.5000	37.0	3.9	MB	USC	3.9	137
1969	05	21	09	20	27	50.5770	-129.5010	27.0	3.9	MB	PDE	3.9	138
1969	10	19	10	45	16	50.5840	-129.3960	7.0	3.9	MB	PDE	3.9	139
1969	11	03	14	58	33	50.7700	-129.5200	40.0	4.6	MB	ISC	4.6	140
1969	12	11	09	54	49	51.8000	-133.3000	33.0	3.7	MB	ISC	3.7	141
1970	02	01	23	02	31	50.4000	-129.3000	33.0	4.0	MB	USC	4.0	142
1970	02	18	02	07	40	50.2000	-129.8000	28.0	4.7	MB	USC	4.7	143
1970	02	18	09	23	2	52.4000	-131.5000	4.0	4.8	MB	USC	4.8	144
1970	02	19	08	09	17	53.2650	-132.3370	33.0	4.0	MB	PDE	4.0	145
1970	06	24	07	30	30	51.8000	-130.8000	33.0	5.4	MS	USC	5.3	146
1970	06	24	13	09	0	51.8000	-131.0000	12.0	7.5	ML	SIG	7.5	147
1970	06	24	13	17	1	51.9000	-131.1000	33.0	5.5	MB	USC	5.5	148
1970	06	24	17	16	49	51.5800	-130.4500	0.0	3.9	MB	DNG	3.9	149
1970	06	24	19	10	13	51.5600	-130.4200	28.0	3.9	MB	DNG	3.9	150
1970	06	29	02	26	37	51.6800	-130.4400	0.0	3.7	MB	DNG	3.7	151
1970	07	25	15	19	50	57.2000	-137.7000	33.0	3.2	MB	DNG	3.3	152
1970	09	08	13	04	1	50.6000	-129.3000	33.0	3.7	MB	USC	3.7	153
1970	09	16	02	25	44	50.9000	-129.5000	33.0	3.4	MB	ISC	3.5	154
1970	11	10	02	10	47	50.5800	-129.2000	49.0	4.5	MB	ISC	4.5	155
1970	12	31	01	27	7	50.2000	-129.5000	33.0	4.3	MB	USC	4.3	156
1971	02	05	07	33	28	51.7500	-130.6490	18.0	5.7	MS	DNG	5.6	157
1971	02	11	06	24	42	54.3940	-135.7210	33.0	4.6	MB	ISC	4.6	158
1971	03	13	23	51	35	50.6030	-129.9470	33.0	6.1	MS	PDE	6.0	159
1971	03	14	00	51	8	50.7520	-129.5770	33.0	4.2	MB	PDE	4.2	160
1971	03	14	04	41	58	50.7000	-129.7000	33.0	4.2	MB	USN	4.2	161
1971	03	15	05	18	54	50.1000	-129.6000	35.0	4.8	MB	USN	4.8	162
1971	05	28	12	11	2	52.8180	-132.8870	33.0	4.7	MB	PDE	4.7	163
1971	06	29	06	28	25	51.2550	-129.9540	33.0	4.4	MB	ISC	4.4	164
1971	07	15	00	24	2	54.2150	-133.7340	33.0	5.2	MB	PDE	5.2	165
1971	07	22	14	05	31	50.8000	-129.4000	33.0	4.1	MB	USN	4.1	166

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID
1971	08	21	11	11	44	50.6300	-129.5720	16.0	4.3	MB	ISC	4.3	167
1971	12	09	00	23	0	57.0000	-136.0000	0.0	3.6	MI	DNG	3.6	168
1972	01	14	22	23	47	50.7830	-129.6930	5.0	4.5	MB	ISC	4.5	169
1972	01	28	23	11	23	50.7000	-129.6000	33.0	4.2	MB	USN	4.2	170
1972	05	14	20	35	46	50.8370	-129.6050	21.0	4.4	MB	ISC	4.4	171
1972	06	05	04	03	3	50.8000	-129.4000	33.0	4.1	MB	USN	4.1	172
1972	06	13	18	40	44	50.3890	-129.6540	33.0	4.3	MB	PDE	4.3	173
1972	07	23	10	52	33	50.1820	-129.1500	33.0	4.9	MB	PDE	4.9	174
1972	07	23	19	13	9	50.1490	-129.2730	33.0	6.4	MS	PDE	6.3	175
1972	07	23	20	17	32	50.1000	-129.3000	33.0	4.8	MB	USN	4.8	176
1972	07	23	21	43	4	50.0630	-129.2870	33.0	4.8	MB	ISC	4.8	177
1972	07	30	21	45	14	56.8000	-135.7000	25.0	7.9	ML	BDA	7.9	178
1972	08	04	09	48	11	56.2300	-135.6400	18.0	5.0	MS	DNG	5.0	179
1972	08	04	11	38	8	56.2050	-135.3420	20.0	6.0	ML	PAS	6.0	180
1972	08	07	08	31	45	55.9900	-136.3800	26.0	3.0	MI	DNG	3.0	181
1972	08	15	10	56	12	56.2520	-135.4950	21.0	5.6	MB	PDE	5.6	182
1972	11	17	16	41	34	56.0390	-135.5300	33.0	5.0	MB	PDE	5.0	183
1972	12	08	18	56	55	56.3480	-135.8940	20.0	4.2	MB	PDE	4.2	184
1973	01	12	05	59	31	56.1180	-135.7630	33.0	3.9	MB	PDE	3.9	185
1973	03	28	06	23	9	50.5000	-129.6000	33.0	4.2	MB	USN	4.2	186
1973	04	17	02	16	12	50.8000	-129.5000	19.0	4.2	MB	USN	4.2	187
1973	06	03	07	23	30	50.7430	-129.9400	28.0	4.5	MB	ISC	4.5	188
1973	07	01	13	33	34	57.8400	-137.3300	33.0	6.7	MS	PDE	6.6	189
1973	07	01	15	06	37	57.6200	-137.7400	33.0	3.8	MB	PDE	3.8	190
1973	07	01	15	12	4	57.8150	-137.4720	25.1	5.2	MB	ISC	5.2	191
1973	07	01	16	03	10	57.6660	-137.7050	42.0	4.2	MB	ISC	4.2	192
1973	07	02	13	36	49	57.7900	-137.8800	33.0	4.0	MB	DNG	4.0	193
1973	07	02	22	54	45	57.8470	-137.8590	33.0	4.6	MB	ISC	4.6	194
1973	07	03	17	44	16	57.9930	-137.8840	33.0	5.1	MB	PDE	5.1	195
1973	07	05	07	49	4	57.8950	-137.9890	31.9	5.4	MB	ISC	5.4	196
1973	07	09	17	47	44	50.8970	-129.7080	33.0	4.5	MB	PDE	4.5	197
1973	07	16	21	20	14	57.8300	-137.7800	0.0	3.8	MB	DNG	3.8	198
1973	08	03	02	01	37	57.7700	-137.9300	33.0	3.5	MB	DNG	3.6	199
1973	08	09	06	28	23	57.8100	-137.6900	33.0	4.1	MB	DNG	4.1	200
1973	09	06	17	15	47	51.1990	-129.6260	0.0	4.6	MB	ISC	4.6	201
1973	09	16	13	23	20	50.3000	-129.7000	33.0	4.4	MB	USN	4.4	202
1974	01	02	18	43	20	55.9000	-135.7700	0.0	3.4	ML	OTT	3.4	203
1974	01	25	19	05	4	50.8500	-130.7000	10.0	3.7	ML	OTT	3.7	204
1974	02	12	03	04	53	50.2100	-127.6100	0.0	3.4	ML	OTT	3.4	205
1974	03	07	07	50	29	50.7610	-129.7650	33.0	4.2	MB	PDE	4.2	206
1974	03	24	07	20	0	51.7300	-130.9800	10.0	2.9	ML	OTT	2.9	207
1974	03	27	11	44	32	50.1500	-130.1400	0.0	2.9	ML	OTT	2.9	208
1974	04	03	22	46	31	54.1390	-132.8700	0.0	4.5	ML	OTT	4.5	209
1974	04	08	23	24	40	54.0530	-134.0290	33.0	4.5	ML	OTT	4.5	210
1974	05	24	13	52	8	50.7100	-130.3800	10.0	3.6	ML	OTT	3.6	211
1974	05	25	14	00	47	51.5300	-129.4600	0.0	3.1	ML	OTT	3.1	212
1974	06	19	11	17	55	53.8600	-132.1500	0.0	3.3	ML	OTT	3.3	213
1974	07	13	16	39	37	50.3500	-130.4900	0.0	3.3	ML	OTT	3.3	214
1974	07	20	03	24	24	50.8100	-130.7100	0.0	3.2	ML	OTT	3.2	215
1974	07	20	03	28	28	50.7600	-130.6200	0.0	3.0	ML	OTT	3.0	216
1974	08	01	22	10	47	50.6620	-129.6660	33.0	4.1	MB	PDE	4.1	217
1974	08	02	02	20	18	50.1800	-130.3600	0.0	3.0	ML	OTT	3.0	218
1974	08	15	18	04	37	50.7100	-130.6800	0.0	3.1	ML	OTT	3.1	219
1974	08	20	04	25	4	51.0600	-130.7000	10.0	4.3	ML	OTT	4.3	220
1974	09	20	11	33	49	50.1100	-127.7700	0.0	3.5	ML	OTT	3.5	221
1974	11	23	23	52	34	50.6250	-130.1890	0.0	3.4	ML	OTT	3.4	222

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID
1974	11	26	14	29	43	50.6710	-129.6410	33.0	4.5	MB	PDE	4.5	223
1974	12	11	05	48	31	52.3100	-131.8700	0.0	3.0	ML	OTT	3.0	224
1974	12	11	12	28	7	52.1900	-131.8300	10.0	3.2	ML	OTT	3.2	225
1975	01	29	16	16	58	50.0770	-129.3460	33.0	4.5	MB	PDE	4.5	226
1975	01	29	17	24	59	50.1150	-129.4690	0.0	3.0	ML	OTT	3.0	227
1975	01	29	17	43	13	50.0620	-129.5480	33.0	4.3	MB	PDE	4.3	228
1975	01	30	21	23	28	50.5260	-129.2820	0.0	3.4	ML	OTT	3.4	229
1975	02	14	12	15	6	52.6700	-132.0600	10.0	3.8	ML	OTT	3.8	230
1975	02	18	20	21	13	50.7220	-129.9340	33.0	4.2	MB	PDE	4.2	231
1975	02	18	21	06	47	50.7130	-129.7650	33.0	4.0	MB	PDE	4.0	232
1975	02	21	16	43	26	51.0210	-130.2010	0.0	3.8	ML	OTT	3.8	233
1975	02	28	13	41	45	52.6000	-131.9200	0.0	2.9	ML	OTT	2.9	234
1975	03	20	20	36	56	50.7150	-129.2420	10.0	4.3	MB	PDE	4.3	235
1975	04	07	01	47	45	51.6200	-130.9200	10.0	4.7	ML	OTT	4.7	236
1975	04	14	00	53	16	51.8900	-130.9200	0.0	3.0	ML	OTT	3.0	237
1975	04	30	20	09	46	56.9890	-136.8970	0.0	3.8	ML	OTT	3.8	238
1975	05	07	02	00	52	50.7900	-130.7500	0.0	3.3	ML	OTT	3.3	239
1975	05	16	12	48	42	50.5700	-129.6100	0.0	2.9	ML	OTT	2.9	240
1975	05	16	18	33	10	50.7700	-129.6900	0.0	3.0	ML	OTT	3.0	241
1975	05	16	21	27	22	50.5900	-129.7900	0.0	3.0	ML	OTT	3.0	242
1975	05	16	22	07	45	50.7000	-129.7000	0.0	3.0	ML	OTT	3.0	243
1975	05	23	15	12	30	51.2200	-131.2300	18.0	5.6	MS	DNG	5.5	244
1975	05	25	01	47	42	51.3100	-131.3200	0.0	3.3	ML	OTT	3.3	245
1975	06	21	22	07	7	50.9440	-131.1900	0.0	3.4	ML	OTT	3.4	246
1975	06	22	19	22	56	50.2600	-130.3000	10.0	3.4	ML	OTT	3.4	247
1975	07	14	18	19	25	51.4600	-131.8500	10.0	3.8	ML	OTT	3.8	248
1975	07	14	18	41	36	51.3800	-131.9500	0.0	2.9	ML	OTT	2.9	249
1975	07	14	19	12	1	51.4600	-131.7600	10.0	3.3	ML	OTT	3.3	250
1975	07	22	17	37	31	50.3400	-130.5500	0.0	3.0	ML	OTT	3.0	251
1975	08	08	20	38	40	50.7000	-130.8700	10.0	3.6	ML	OTT	3.6	252
1975	08	20	02	05	57	51.5820	-130.6870	0.0	4.6	MB	ISC	4.6	253
1975	08	31	07	37	30	53.9200	-133.2900	0.0	3.5	ML	OTT	3.5	254
1975	09	08	08	37	8	50.3500	-130.0500	10.0	2.9	ML	OTT	2.9	255
1975	09	28	00	33	59	53.6500	-132.1700	0.0	3.5	ML	OTT	3.5	256
1975	10	06	04	47	1	50.7000	-130.0700	10.0	3.4	ML	OTT	3.4	257
1975	10	06	17	22	39	50.6100	-129.9600	0.0	3.0	ML	OTT	3.0	258
1975	11	19	10	20	47	51.6900	-130.7500	0.0	3.3	ML	OTT	3.3	259
1975	11	22	14	27	32	50.6300	-130.8000	0.0	3.5	ML	OTT	3.5	260
1975	11	24	10	35	43	51.5180	-130.5080	33.0	4.8	MB	PDE	4.8	261
1975	12	06	10	43	31	50.7110	-130.5860	0.0	3.1	ML	OTT	3.1	262
1975	12	11	06	28	34	50.1570	-129.9060	19.0	4.9	MB	ISC	4.9	263
1975	12	11	07	03	13	50.1840	-129.8470	22.0	4.8	MB	PDE	4.8	264
1975	12	11	10	37	47	50.2020	-130.1180	0.0	3.1	ML	OTT	3.1	265
1975	12	11	12	22	29	50.3070	-130.2770	0.0	2.9	ML	OTT	2.9	266
1975	12	12	00	09	2	50.4910	-129.5710	33.0	4.1	MB	PDE	4.1	267
1975	12	12	01	52	40	50.0100	-130.2300	10.0	4.3	ML	OTT	4.3	268
1975	12	12	02	14	31	50.3710	-130.1750	0.0	4.1	ML	OTT	4.1	269
1976	01	01	03	03	50	50.2730	-129.8240	0.0	4.8	MB	ISC	4.8	270
1976	01	01	03	07	23	50.0600	-130.2700	10.0	3.1	ML	OTT	3.1	271
1976	01	01	03	34	53	50.1300	-130.3300	10.0	2.9	ML	OTT	2.9	272
1976	01	01	04	11	39	50.2680	-129.9610	4.5	4.9	MB	ISC	4.9	273
1976	01	01	06	07	27	50.1760	-129.5560	33.0	4.3	MB	PDE	4.3	274
1976	01	01	16	45	3	50.3600	-130.1700	10.0	3.0	ML	OTT	3.0	275
1976	01	01	16	50	8	50.3300	-130.2100	10.0	3.0	ML	OTT	3.0	276
1976	01	02	03	36	20	50.3880	-129.8270	23.0	5.1	MB	PDE	5.1	277
1976	01	30	03	50	5	51.5600	-130.6600	10.0	2.9	ML	OTT	2.9	278

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID
1976	02	23	12	12	28	51.6320	-130.7490	0.0	4.1	ML	OTT	4.1	279
1976	02	23	12	32	57	51.4400	-130.9200	0.0	3.2	ML	OTT	3.2	280
1976	02	23	13	26	22	51.4400	-130.9600	10.0	3.7	ML	OTT	3.7	281
1976	02	23	14	58	58	51.5500	-130.5900	10.0	4.3	ML	OTT	4.3	282
1976	02	23	15	14	16	51.4200	-130.5600	10.0	6.1	ML	OTT	6.1	283
1976	02	23	16	12	21	51.6230	-130.3080	0.0	4.7	MB	ISC	4.7	284
1976	02	23	18	12	35	51.4300	-130.7300	10.0	4.5	ML	OTT	4.5	285
1976	02	27	10	39	31	51.0700	-130.5700	10.0	3.8	ML	OTT	3.8	286
1976	02	27	11	18	12	51.0000	-130.7600	10.0	3.6	ML	OTT	3.6	287
1976	02	27	13	08	18	50.8700	-130.7100	10.0	4.0	ML	OTT	4.0	288
1976	02	28	00	40	5	50.9600	-130.6400	10.0	3.8	ML	OTT	3.8	289
1976	02	28	00	42	43	51.0400	-130.9200	0.0	3.6	ML	OTT	3.6	290
1976	02	28	01	07	17	51.0000	-130.7600	10.0	4.1	ML	OTT	4.1	291
1976	02	28	01	46	51	50.9600	-130.4400	0.0	3.1	ML	OTT	3.1	292
1976	02	28	01	48	29	51.0600	-130.5400	0.0	3.5	ML	OTT	3.5	293
1976	02	28	02	11	8	50.8700	-130.8500	10.0	3.7	ML	OTT	3.7	294
1976	03	13	11	28	7	50.7800	-130.9300	10.0	3.0	ML	OTT	3.0	295
1976	03	23	13	19	5	54.1400	-133.3600	10.0	3.6	ML	OTT	3.6	296
1976	04	04	08	40	19	51.5270	-130.5710	0.0	3.1	ML	OTT	3.1	297
1976	04	07	01	53	34	57.6400	-125.2700	0.0	3.5	ML	OTT	3.5	298
1976	05	01	10	53	23	55.7400	-135.3000	0.0	3.0	ML	OTT	3.0	299
1976	05	13	07	11	44	52.8600	-132.2400	10.0	4.8	ML	OTT	4.8	300
1976	06	08	19	38	45	50.4700	-130.3100	0.0	3.3	ML	OTT	3.3	301
1976	06	18	09	19	24	53.9200	-133.0600	0.0	4.3	ML	OTT	4.3	302
1976	07	17	23	40	1	53.9100	-132.9400	10.0	3.9	ML	OTT	3.9	303
1976	08	17	03	44	19	50.4760	-130.9810	0.0	3.2	ML	OTT	3.2	304
1976	08	26	06	43	15	50.6260	-129.4340	33.0	4.4	MB	PDE	4.4	305
1976	09	03	10	01	29	50.3500	-130.4400	0.0	2.9	ML	OTT	2.9	306
1976	09	24	13	21	55	50.6040	-130.4040	0.0	3.1	ML	OTT	3.1	307
1976	10	15	20	29	31	54.6550	-133.5050	0.0	3.8	ML	OTT	3.8	308
1976	11	07	14	48	30	56.4400	-137.9770	10.0	3.2	DR	SCA	3.2	309
1976	11	09	20	17	15	50.7690	-129.6700	0.0	4.9	MB	ISC	4.9	310
1976	11	10	16	19	52	50.4800	-129.9600	0.0	3.2	ML	OTT	3.2	311
1976	11	10	19	16	31	51.6080	-130.5080	0.0	4.1	ML	OTT	4.1	312
1976	12	31	18	05	26	50.2570	-130.3530	0.0	3.1	ML	OTT	3.1	313
1977	01	14	14	55	54	51.4960	-130.2940	0.0	3.8	ML	OTT	3.8	314
1977	02	07	02	16	35	50.9100	-130.7400	10.0	3.4	ML	OTT	3.4	315
1977	02	13	04	28	40	54.3700	-133.7500	0.0	3.3	ML	OTT	3.3	316
1977	02	25	00	32	28	50.5520	-128.9470	0.0	3.1	ML	OTT	3.1	317
1977	03	06	01	11	54	50.4790	-130.5330	0.0	3.3	ML	OTT	3.3	318
1977	03	14	16	09	34	53.2660	-131.1100	0.0	3.7	ML	OTT	3.7	319
1977	03	15	06	15	6	50.5240	-130.3500	0.0	3.4	ML	OTT	3.4	320
1977	03	16	15	46	30	50.8040	-129.5560	33.0	4.5	MB	PDE	4.5	321
1977	04	03	18	45	45	50.6690	-129.8590	4.0	4.7	MB	PDE	4.7	322
1977	04	25	15	49	25	50.4410	-130.4910	0.0	3.3	ML	OTT	3.3	323
1977	05	20	15	05	42	50.1530	-130.0920	0.0	3.0	ML	OTT	3.0	324
1977	05	26	06	49	47	51.1690	-124.1730	0.0	3.5	ML	OTT	3.5	325
1977	07	09	08	04	18	50.8600	-130.7200	10.0	4.2	ML	OTT	4.2	326
1977	07	19	17	22	3	54.0880	-133.7610	0.0	4.6	ML	OTT	4.6	327
1977	07	25	11	07	57	56.5400	-125.0400	0.0	3.1	ML	OTT	3.1	328
1977	08	08	14	23	58	55.5600	-135.2600	0.0	4.6	ML	OTT	4.6	329
1977	09	17	19	05	50	53.3300	-132.6200	0.0	3.7	ML	OTT	3.7	330
1977	09	29	22	19	23	54.8300	-126.9700	0.0	3.3	ML	OTT	3.3	331
1977	12	25	07	20	59	50.6160	-129.6440	10.0	4.4	MB	PDE	4.4	332
1978	01	11	20	28	38	50.5910	-130.0250	0.0	3.3	ML	OTT	3.3	333
1978	01	11	21	14	15	50.8110	-129.6210	0.0	3.3	ML	OTT	3.3	334

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID
1978	01	13	08	25	31	52.6500	-132.1300	10.0	5.1	ML	OTT	5.1	335
1978	01	28	19	38	2	51.8400	-131.3200	10.0	3.2	ML	OTT	3.2	336
1978	02	26	10	33	35	50.8900	-130.5800	10.0	3.3	ML	OTT	3.3	337
1978	03	26	19	39	37	50.5000	-129.7930	10.0	3.9	MB	PDE	3.9	338
1978	03	29	09	58	45	50.0170	-127.6970	0.0	3.1	ML	OTT	3.1	339
1978	05	07	13	57	11	50.8950	-129.7320	0.0	3.5	ML	OTT	3.5	340
1978	05	25	21	53	36	50.0890	-128.3050	0.0	3.3	ML	OTT	3.3	341
1978	05	26	09	26	14	50.7800	-130.3000	0.0	3.1	ML	OTT	3.1	342
1978	05	26	16	35	29	50.9900	-130.4000	0.0	3.8	ML	OTT	3.8	343
1978	05	26	19	29	18	50.8600	-130.5600	10.0	3.6	ML	OTT	3.6	344
1978	05	26	20	01	57	51.1660	-130.4300	17.0	4.9	MB	PDE	4.9	345
1978	06	02	20	41	45	50.1300	-127.6400	10.0	5.7	ML	OTT	5.7	346
1978	06	03	11	54	40	50.1900	-127.6000	10.0	5.1	ML	OTT	5.1	347
1978	06	03	12	54	24	50.1840	-127.6100	0.0	3.0	ML	OTT	3.0	348
1978	06	12	10	52	23	50.2200	-127.6400	10.0	3.9	ML	OTT	3.9	349
1978	06	13	11	39	21	50.0720	-128.3220	0.0	3.6	ML	OTT	3.6	350
1978	07	11	02	55	1	52.7650	-132.1040	10.0	5.4	MB	PDE	5.4	351
1978	07	11	03	04	43	52.4590	-132.1390	0.0	4.2	MB	ISC	4.2	352
1978	07	12	18	53	35	56.6950	-137.5040	38.0	4.1	MB	PDE	4.1	353
1978	07	19	10	13	40	50.5740	-128.6860	0.0	4.0	ML	OTT	4.0	354
1978	07	25	23	30	50	50.3030	-127.5770	11.0	5.6	ML	OTT	5.6	355
1978	07	27	00	21	51	56.4360	-133.4560	18.0	3.3	DR	SCA	3.3	356
1978	08	18	09	44	59	56.3600	-135.1900	0.0	4.2	ML	OTT	4.2	357
1978	10	07	04	55	15	50.4960	-129.8790	10.0	3.9	MB	PDE	3.9	358
1978	11	01	11	04	43	50.7010	-129.6840	20.0	3.9	MB	PDE	3.9	359
1978	11	11	17	44	32	50.7740	-129.7670	0.0	4.1	MB	ISC	4.1	360
1979	01	15	19	48	22	57.8300	-137.0200	18.0	3.6	ML	OTT	3.6	361
1979	01	16	17	29	29	57.4900	-136.4900	18.0	3.3	ML	OTT	3.3	362
1979	01	20	12	57	51	51.5300	-130.5900	18.0	3.1	ML	OTT	3.1	363
1979	01	21	05	02	45	51.3000	-131.0600	18.0	3.2	ML	OTT	3.2	364
1979	02	16	03	01	53	50.3580	-129.6920	10.0	3.9	MB	PDE	3.9	365
1979	02	27	12	03	54	52.6200	-126.8900	18.0	3.2	ML	OTT	3.2	366
1979	03	13	08	29	32	50.0060	-129.5960	13.0	4.4	MB	ISC	4.4	367
1979	03	13	09	51	32	50.0280	-129.7130	10.0	5.3	MS	PDE	5.2	368
1979	03	13	10	27	8	50.0210	-129.6730	10.0	4.3	MB	PDE	4.3	369
1979	03	13	10	31	9	50.0220	-129.7430	10.0	4.3	MB	ISC	4.3	370
1979	03	13	13	09	48	50.0690	-129.7400	10.0	4.3	MB	PDE	4.3	371
1979	03	13	13	32	0	50.2050	-129.8790	18.0	4.0	MB	ISC	4.0	372
1979	03	13	13	36	57	50.0210	-129.6700	10.0	5.0	MB	ISC	5.0	373
1979	03	13	15	02	52	50.0540	-129.6980	10.0	5.1	MB	PDE	5.1	374
1979	03	13	15	42	39	50.1000	-129.9900	18.0	4.5	MB	DNG	4.5	375
1979	03	13	15	50	47	50.1600	-130.0200	18.0	3.1	ML	OTT	3.1	376
1979	03	13	16	06	38	50.1270	-129.4350	10.0	4.2	MB	PDE	4.2	377
1979	03	13	16	19	2	50.0730	-129.4000	10.0	4.2	MB	PDE	4.2	378
1979	03	13	17	09	15	50.1530	-129.9630	10.0	4.5	MB	PDE	4.5	379
1979	03	13	17	11	23	50.1380	-130.1140	10.0	4.8	MB	PDE	4.8	380
1979	03	13	17	40	20	50.3420	-129.7100	10.0	4.4	MB	PDE	4.4	381
1979	03	13	17	55	8	50.0410	-129.6980	10.0	3.6	MB	ISC	3.6	382
1979	03	13	18	27	35	50.2140	-129.8140	18.0	3.0	ML	OTT	3.0	383
1979	03	13	19	33	25	50.0460	-129.6470	10.0	4.4	MS	ISC	4.4	384
1979	03	13	20	23	45	50.0980	-129.4880	10.0	4.2	MB	PDE	4.2	385
1979	03	13	20	50	3	50.0280	-129.6820	1.8	5.0	MB	ISC	5.0	386
1979	03	13	21	26	50	50.0470	-129.7810	18.0	3.1	ML	OTT	3.1	387
1979	03	13	22	39	8	50.0860	-129.6520	10.0	5.0	MB	PDE	5.0	388
1979	03	14	01	27	26	50.1360	-130.5710	10.0	3.9	MB	PDE	3.9	389
1979	03	14	02	13	30	50.1760	-129.6440	10.0	4.4	MB	ISC	4.4	390

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID
1979	03	14	02	59	59	50.0850	-129.4620	10.0	4.5	MB	ISC	4.5	391
1979	03	14	05	30	3	50.0020	-129.7210	10.0	4.0	MB	PDE	4.0	392
1979	03	14	08	50	4	50.1330	-129.5770	10.0	4.3	MB	PDE	4.3	393
1979	03	14	14	29	49	50.1690	-129.6990	10.0	4.5	MB	ISC	4.5	394
1979	03	14	14	36	23	50.1040	-129.6220	10.0	5.1	MB	PDE	5.1	395
1979	03	14	15	13	33	50.2500	-129.9900	18.0	5.3	MS	DNG	5.2	396
1979	03	14	15	46	8	50.1600	-129.8000	18.0	3.2	ML	OTT	3.2	397
1979	04	08	09	42	38	50.6840	-129.9670	10.0	3.6	MB	PDE	3.6	398
1979	05	21	23	27	58	51.3450	-132.5100	18.0	3.8	MB	ISC	3.8	399
1979	06	15	11	34	44	50.8220	-125.6370	10.0	3.9	ML	OTT	3.9	400
1979	06	16	22	55	6	50.6500	-130.0500	18.0	3.4	ML	OTT	3.4	401
1979	06	17	04	09	0	51.2200	-131.2900	18.0	3.0	ML	OTT	3.0	402
1979	06	17	04	32	39	50.0790	-133.0480	18.0	3.3	ML	OTT	3.3	403
1979	06	21	10	48	21	50.4400	-130.3800	18.0	3.1	ML	OTT	3.1	404
1979	06	21	17	03	16	50.9900	-131.0390	18.0	5.3	MS	DNG	5.2	405
1979	06	23	18	39	22	57.9870	-133.2740	0.0	3.1	DR	SCA	3.1	406
1979	07	11	12	28	4	55.4100	-135.0400	0.0	5.1	MS	OTT	5.0	407
1979	10	10	23	36	45	56.1480	-135.7450	33.0	4.4	MB	PDE	4.4	408
1979	10	24	12	42	20	57.8000	-137.1400	18.0	3.3	ML	OTT	3.3	409
1979	10	28	16	12	8	57.8700	-137.0500	18.0	3.0	ML	OTT	3.0	410
1979	11	05	16	31	18	57.5410	-137.3570	18.0	3.8	ML	OTT	3.8	411
1979	11	08	10	59	32	50.5500	-130.0900	18.0	4.3	MS	DNG	4.3	412
1979	12	12	01	48	19	50.7530	-129.6060	18.0	3.6	ML	OTT	3.6	413
1980	01	01	16	43	31	51.1540	-129.8710	10.0	4.4	MB	PDE	4.4	414
1980	01	08	23	44	46	50.5050	-128.2260	18.0	3.0	ML	OTT	3.0	415
1980	01	09	21	36	50	51.2670	-131.3770	18.0	3.1	ML	OTT	3.1	416
1980	04	05	10	57	25	50.4700	-130.3400	18.0	3.1	ML	OTT	3.1	417
1980	04	06	16	21	6	50.8700	-130.3100	18.0	3.5	ML	OTT	3.5	418
1980	04	06	22	29	9	50.5700	-130.1900	18.0	3.4	ML	OTT	3.4	419
1980	05	24	04	49	17	51.1270	-124.3990	18.0	3.4	ML	OTT	3.4	420
1980	06	19	14	01	54	50.9080	-130.5140	18.0	3.7	ML	OTT	3.7	421
1980	07	12	03	44	25	51.1510	-130.0010	10.0	4.4	MB	PDE	4.4	422
1980	08	25	18	10	37	56.6700	-136.3990	25.0	3.7	ML	OTT	3.7	423
1980	10	02	03	42	48	50.3130	-130.0430	10.0	5.3	MB	PDE	5.3	424
1980	10	17	10	29	0	57.1610	-131.5370	18.0	3.3	ML	OTT	3.3	425
1980	10	20	17	57	37	51.5800	-131.0300	18.0	3.8	ML	OTT	3.8	426
1980	10	20	20	12	4	51.6600	-130.3800	18.0	3.0	ML	OTT	3.0	427
1980	11	06	07	54	4	50.9270	-130.1350	18.0	4.5	MB	ISC	4.5	428
1980	11	09	04	55	15	50.5900	-130.6500	18.0	3.4	ML	OTT	3.4	429
1980	11	09	14	35	56	54.3900	-133.5900	18.0	3.6	ML	OTT	3.6	430
1980	11	11	08	55	55	50.5200	-130.3300	18.0	3.2	ML	OTT	3.2	431
1980	12	13	09	17	47	50.7700	-130.2600	18.0	3.4	ML	OTT	3.4	432
1980	12	31	22	47	4	50.4900	-130.1600	18.0	3.3	ML	OTT	3.3	433
1981	01	08	02	17	1	50.4000	-130.1900	18.0	3.4	MS	OTT	3.4	434
1981	01	17	22	33	45	50.5000	-130.5100	18.0	3.2	MS	OTT	3.2	435
1981	01	20	15	36	53	55.1000	-134.5700	18.0	4.5	MS	OTT	4.5	436
1981	01	22	01	19	45	50.6000	-129.9400	18.0	3.3	MS	OTT	3.3	437
1981	01	29	18	03	26	50.5000	-130.4200	18.0	3.5	MS	OTT	3.5	438
1981	04	08	17	46	44	51.0000	-130.4500	18.0	3.7	ML	OTT	3.7	439
1981	05	03	15	28	29	51.6000	-130.8700	18.0	4.2	MS	OTT	4.2	440
1981	05	12	02	33	31	50.5000	-130.0500	18.0	4.1	MS	OTT	4.1	441
1981	05	13	19	18	41	51.0000	-130.9700	18.0	3.1	MS	OTT	3.1	442
1981	07	04	16	21	4	51.1000	-130.5000	18.0	3.1	MS	OTT	3.1	443
1981	07	05	21	09	51	51.6000	-131.5900	18.0	3.0	MS	OTT	3.1	444
1981	07	24	02	47	17	51.0000	-124.5900	18.0	3.0	MS	OTT	3.1	445
1981	07	27	01	10	15	52.8000	-132.3500	18.0	3.3	MS	OTT	3.3	446

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID
1981	07	30	06	59	45	51.5000	-130.8900	18.0	3.1	MS	OTT	3.1	447
1981	09	05	07	37	31	51.2000	-130.7900	10.0	3.0	MS	OTT	3.1	448
1981	09	08	19	43	31	54.2000	-133.7500	10.0	3.7	MS	OTT	3.7	449
1981	09	11	21	05	45	50.6000	-130.4800	10.0	3.0	MS	OTT	3.1	450
1981	09	13	04	14	43	51.0000	-130.5300	10.0	3.1	MS	OTT	3.1	451
1981	09	28	16	55	41	51.2000	-130.9700	10.0	3.4	MS	OTT	3.4	452
1981	10	17	13	43	1	55.5360	-135.7710	10.0	3.1	DR	SCA	3.1	453
1981	10	29	17	51	16	50.5000	-130.6600	10.0	3.6	MS	OTT	3.6	454
1981	11	20	02	18	49	50.5000	-129.9000	10.0	3.2	MS	OTT	3.2	455
1981	11	30	05	23	39	54.0000	-133.9500	10.0	3.0	MS	OTT	3.1	456
1981	12	01	17	47	46	53.9000	-133.4600	18.0	3.7	MS	OTT	3.7	457
1981	12	15	03	37	59	51.0000	-130.3900	18.0	3.6	MS	OTT	3.6	458
1981	12	17	15	26	29	52.6000	-132.1000	18.0	3.8	MS	OTT	3.8	459
1981	12	24	13	46	19	50.6000	-128.8900	33.0	4.1	MB	DNG	4.1	460
1981	12	25	10	20	52	57.2000	-136.2500	18.0	4.1	MS	OTT	4.1	461
1981	12	25	10	43	48	57.1000	-136.4500	18.0	3.0	MS	OTT	3.1	462
1982	01	11	12	44	7	50.4000	-130.3100	10.0	3.2	ML	OTT	3.2	463
1982	01	11	20	18	40	50.3000	-131.2500	10.0	3.5	ML	OTT	3.5	464
1982	01	18	12	49	23	52.7250	-132.0450	18.0	3.3	ML	OTT	3.3	465
1982	01	23	12	39	48	53.8000	-130.8000	18.0	3.8	ML	OTT	3.8	466
1982	01	30	01	09	27	51.8000	-131.5800	18.0	3.7	ML	OTT	3.7	467
1982	02	02	06	22	20	50.6000	-131.2200	18.0	3.2	ML	OTT	3.2	468
1982	02	12	00	48	36	50.6000	-131.0700	18.0	3.1	ML	OTT	3.1	469
1982	02	13	07	45	46	50.7210	-129.6240	10.0	4.6	MB	ISC	4.6	470
1982	02	15	13	52	58	53.7000	-133.2500	18.0	3.0	ML	OTT	3.0	471
1982	02	27	22	46	38	50.6000	-130.1500	18.0	3.0	ML	OTT	3.0	472
1982	03	15	05	43	2	50.9000	-130.8900	10.0	3.1	ML	OTT	3.1	473
1982	03	27	14	05	32	57.9160	-126.0180	18.0	3.2	ML	OTT	3.2	474
1982	03	30	08	53	53	54.7000	-134.2000	18.0	3.0	ML	OTT	3.0	475
1982	04	12	00	06	48	50.1650	-130.7780	10.0	3.3	ML	OTT	3.3	476
1982	04	14	13	21	47	50.5070	-130.0420	10.0	3.7	MB	PDE	3.7	477
1982	05	14	10	00	54	54.4000	-134.1000	18.0	4.2	ML	OTT	4.2	478
1982	05	15	11	49	13	50.2020	-130.5790	10.0	3.0	ML	OTT	3.0	479
1982	05	15	18	45	1	50.7130	-129.7360	10.0	4.1	MB	ISC	4.1	480
1982	05	15	18	48	50	50.4000	-129.9600	10.0	5.8	MS	DNG	5.7	481
1982	05	15	19	03	43	50.5860	-131.7760	10.0	3.1	ML	OTT	3.1	482
1982	05	15	19	16	21	50.6000	-130.0300	10.0	3.0	ML	OTT	3.0	483
1982	05	15	21	30	24	50.8140	-129.5440	10.0	4.3	MB	ISC	4.3	484
1982	05	15	21	53	4	50.5000	-129.9700	10.0	3.3	ML	OTT	3.3	485
1982	05	15	21	55	18	50.6340	-129.8340	10.0	4.4	MB	PDE	4.4	486
1982	05	15	22	16	4	50.8130	-129.5020	10.0	4.4	MB	ISC	4.4	487
1982	05	16	05	04	52	50.3800	-129.9700	10.0	4.1	MB	DNG	4.1	488
1982	05	16	22	35	10	50.7000	-130.0100	10.0	3.1	ML	OTT	3.1	489
1982	05	17	10	27	3	50.6750	-130.3090	10.0	3.6	MB	ISC	3.6	490
1982	05	28	11	26	10	53.9000	-132.1900	18.0	4.2	ML	OTT	4.2	491
1982	05	30	20	26	46	50.5170	-130.5070	10.0	3.2	ML	OTT	3.2	492
1982	06	03	22	40	51	50.6680	-131.2410	10.0	3.8	ML	OTT	3.8	493
1982	06	05	20	26	11	50.4000	-130.2800	10.0	3.1	ML	OTT	3.1	494
1982	06	06	00	52	13	50.9740	-130.3950	10.0	4.9	MB	PDE	4.9	495
1982	06	08	11	07	12	50.5270	-129.8070	10.0	3.6	MB	ISC	3.6	496
1982	06	08	14	53	30	50.2000	-129.9200	10.0	3.0	ML	OTT	3.0	497
1982	06	08	15	18	7	50.4000	-129.7900	10.0	3.7	ML	OTT	3.7	498
1982	06	08	15	25	43	50.3000	-129.7100	10.0	3.5	ML	OTT	3.5	499
1982	06	08	15	40	58	50.3000	-129.7400	10.0	3.2	ML	OTT	3.2	500
1982	06	13	14	24	25	56.7000	-135.9000	18.0	4.2	ML	OTT	4.2	501
1982	06	14	07	09	46	52.0000	-131.9400	18.0	3.1	ML	OTT	3.1	502

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID
1982	06	14	18	51	2	50.2000	-127.7000	18.0	3.0	ML	OTT	3.0	503
1982	06	16	11	31	4	51.6000	-131.5800	18.0	3.0	ML	OTT	3.0	504
1982	07	09	01	38	15	51.7810	-131.2920	18.0	3.4	ML	OTT	3.4	505
1982	07	19	03	00	37	51.1580	-130.1090	10.0	4.7	MS	PDE	4.7	506
1982	07	19	03	51	43	50.9000	-130.4000	10.0	3.8	ML	OTT	3.8	507
1982	07	19	04	56	25	51.0500	-130.3830	10.0	4.6	MB	ISC	4.6	508
1982	07	19	06	41	16	50.8870	-130.6520	10.0	3.3	ML	OTT	3.3	509
1982	07	19	07	14	41	51.0470	-130.3480	10.0	3.7	ML	OTT	3.7	510
1982	07	19	07	18	36	50.9000	-130.4400	10.0	4.1	ML	OTT	4.1	511
1982	07	19	08	08	41	50.8000	-130.2100	10.0	3.1	ML	OTT	3.1	512
1982	07	19	13	23	22	50.9380	-130.5090	10.0	3.0	ML	OTT	3.0	513
1982	07	19	17	40	9	50.9930	-130.0470	10.0	4.3	MB	PDE	4.3	514
1982	07	22	19	11	39	53.7440	-132.1920	18.0	3.5	ML	OTT	3.5	515
1982	07	30	14	08	10	51.0000	-130.5300	10.0	3.9	ML	OTT	3.9	516
1982	09	03	20	05	45	50.7090	-129.6590	10.0	4.2	MB	PDE	4.2	517
1982	09	05	07	39	38	50.4100	-130.5370	10.0	3.0	ML	OTT	3.0	518
1982	10	11	02	27	50	50.5210	-130.3550	10.0	3.1	ML	OTT	3.1	519
1982	10	11	05	53	27	50.5100	-130.2800	10.0	3.2	ML	OTT	3.2	520
1982	10	23	20	00	28	50.3070	-130.4960	10.0	3.2	ML	OTT	3.2	521
1982	10	26	18	29	47	52.8290	-132.5400	18.0	3.3	ML	OTT	3.3	522
1982	11	15	07	07	9	51.3340	-131.3140	18.0	3.0	ML	OTT	3.0	523
1982	11	16	21	17	44	51.4640	-131.0220	18.0	3.4	ML	OTT	3.4	524
1982	11	17	01	52	20	51.3000	-131.4000	18.0	3.5	ML	OTT	3.5	525
1982	11	25	19	19	4	57.2000	-136.2600	18.0	3.0	ML	OTT	3.0	526
1982	12	30	15	34	34	51.4000	-131.1000	18.0	3.7	ML	OTT	3.7	527
1983	01	06	03	31	28	50.0000	-129.8700	10.0	3.0	ML	OTT	3.0	528
1983	01	15	17	36	38	51.4000	-130.9500	10.0	4.4	ML	OTT	4.4	529
1983	02	06	23	58	11	50.7000	-131.2500	10.0	3.7	ML	OTT	3.7	530
1983	02	10	06	20	47	50.6670	-130.5810	10.0	3.1	ML	OTT	3.1	531
1983	02	15	09	02	39	50.4760	-130.3830	10.0	3.4	ML	OTT	3.4	532
1983	02	27	20	40	30	50.7250	-129.9280	10.0	5.0	MB	ISC	5.0	533
1983	03	13	20	22	54	50.8000	-130.4200	10.0	3.8	ML	OTT	3.8	534
1983	03	14	19	44	3	51.0000	-130.2400	10.0	3.8	ML	OTT	3.8	535
1983	03	14	22	07	27	51.0000	-130.3600	10.0	3.0	ML	OTT	3.0	536
1983	03	15	11	24	29	50.5000	-130.4200	10.0	3.0	ML	OTT	3.0	537
1983	03	18	06	57	51	51.0190	-130.2490	10.0	3.1	ML	OTT	3.1	538
1983	03	23	19	53	47	50.6490	-130.6140	10.0	3.3	ML	OTT	3.3	539
1983	04	06	09	22	15	54.0000	-133.8200	18.0	5.3	ML	OTT	5.3	540
1983	04	16	01	59	42	51.0790	-130.4390	2.0	3.0	ML	OTT	3.0	541
1983	04	16	09	34	35	50.9500	-130.5990	18.0	3.4	ML	OTT	3.4	542
1983	04	22	16	28	31	52.7000	-132.0800	18.0	3.2	ML	OTT	3.2	543
1983	04	22	16	42	56	52.5590	-132.3940	18.0	3.6	ML	OTT	3.6	544
1983	05	07	09	01	47	56.7180	-136.6150	33.0	4.0	MB	PDE	4.0	545
1983	05	14	09	44	10	50.2950	-127.7460	27.0	3.0	ML	OTT	3.0	546
1983	05	23	14	23	6	56.6000	-136.7400	18.0	3.0	ML	OTT	3.0	547
1983	05	31	07	50	40	57.9740	-134.2700	18.0	3.4	ML	OTT	3.4	548
1983	06	02	17	18	40	51.5230	-131.7220	18.0	3.5	ML	OTT	3.5	549
1983	06	21	14	31	33	52.6570	-131.3990	0.0	3.2	ML	OTT	3.2	550
1983	07	06	06	19	8	53.8000	-132.0000	18.0	4.0	ML	OTT	4.0	551
1983	07	13	20	45	50	50.7550	-130.6350	10.0	3.3	ML	OTT	3.3	552
1983	07	27	13	20	36	50.6690	-130.7100	10.0	3.0	ML	OTT	3.0	553
1983	07	31	16	11	4	53.9800	-133.9140	10.0	4.8	MB	ISC	4.8	554
1983	08	09	17	47	35	54.0880	-133.7400	18.0	4.0	ML	OTT	4.0	555
1983	08	13	23	38	5	54.0000	-133.5100	18.0	3.7	ML	OTT	3.7	556
1983	08	24	17	37	24	55.2000	-134.8400	18.0	3.0	ML	OTT	3.0	557
1983	08	27	19	53	35	57.8380	-134.8510	18.0	3.5	ML	OTT	3.5	558

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID
1983	08	28	03	25	30	57.7510	-135.1590	18.0	3.3	ML	OTT	3.3	559
1983	08	28	16	37	58	50.5000	-130.1000	10.0	3.0	ML	OTT	3.0	560
1983	08	29	08	37	16	57.9730	-134.3410	18.0	3.3	ML	OTT	3.3	561
1983	09	15	16	52	54	51.0770	-130.7140	9.0	4.0	ML	OTT	4.0	562
1983	09	15	17	57	8	51.1000	-130.5900	18.0	4.2	ML	OTT	4.2	563
1983	09	15	19	20	16	51.0320	-130.8010	6.0	4.0	ML	OTT	4.0	564
1983	09	22	13	22	9	53.8000	-132.0200	18.0	3.1	ML	OTT	3.1	565
1983	09	22	22	07	9	50.7000	-130.5600	10.0	3.6	ML	OTT	3.6	566
1983	09	25	05	10	59	57.9830	-134.2970	18.0	3.4	ML	OTT	3.4	567
1983	10	10	18	16	24	54.0000	-132.8400	18.0	3.0	ML	OTT	3.0	568
1983	10	18	10	37	13	50.7060	-129.8740	10.0	3.0	ML	OTT	3.0	569
1983	11	12	13	12	25	50.7470	-129.8520	10.0	4.1	MB	ISC	4.1	570
1983	11	14	14	46	44	51.2000	-131.5800	18.0	3.2	ML	OTT	3.2	571
1983	11	30	16	46	56	54.0000	-132.0900	18.0	3.0	ML	OTT	3.0	572
1983	12	05	06	27	8	54.1000	-132.5600	18.0	3.0	ML	OTT	3.0	573
1983	12	07	11	19	20	50.4000	-130.4300	10.0	3.0	ML	OTT	3.0	574
1983	12	07	15	37	15	50.6710	-129.6960	10.0	4.4	MB	PDE	4.4	575
1983	12	10	00	20	17	50.4800	-130.1030	10.0	4.4	MB	ISC	4.4	576
1983	12	10	10	52	18	54.0000	-133.5300	18.0	3.5	ML	OTT	3.5	577
1983	12	24	16	47	52	51.7000	-130.8400	18.0	3.0	ML	OTT	3.0	578
1983	12	28	05	18	23	50.3470	-130.2350	10.0	3.7	MB	ISC	3.7	579
1984	01	22	04	38	58	54.2510	-136.4080	18.0	4.1	MB	ISC	4.1	580
1984	01	29	08	10	21	55.1000	-133.1600	18.0	3.0	ML	OTT	3.0	581
1984	01	29	08	12	25	55.1000	-133.2000	18.0	3.3	ML	OTT	3.3	582
1984	02	17	00	18	50	50.5000	-130.1600	10.0	3.5	ML	OTT	3.5	583
1984	02	19	15	07	15	52.3000	-132.0000	18.0	3.4	ML	OTT	3.4	584
1984	03	15	09	50	24	50.5420	-130.3320	10.0	4.1	MB	ISC	4.1	585
1984	04	01	19	01	59	54.0000	-134.1600	18.0	3.2	ML	OTT	3.2	586
1984	04	03	08	32	20	53.9000	-133.4700	18.0	3.7	ML	OTT	3.7	587
1984	04	08	22	35	39	50.5000	-128.8900	18.0	3.3	ML	OTT	3.3	588
1984	04	14	00	05	27	54.0000	-133.4400	18.0	4.6	ML	OTT	4.6	589
1984	04	18	20	44	35	56.9880	-137.6750	10.0	3.5	DR	SCA	3.5	590
1984	04	23	18	21	1	57.7000	-137.6100	18.0	3.4	ML	OTT	3.4	591
1984	04	29	00	06	23	55.0000	-133.0000	18.0	3.7	ML	OTT	3.7	592
1984	05	02	18	59	6	55.4000	-135.3000	18.0	5.1	ML	OTT	5.1	593
1984	05	19	04	13	37	50.5260	-130.3250	10.0	3.6	MB	ISC	3.6	594
1984	05	25	22	24	41	57.7000	-125.2500	18.0	3.1	ML	OTT	3.1	595
1984	06	24	21	33	10	51.1000	-130.7000	35.0	5.9	MS	PEK	5.8	596
1984	06	24	22	25	25	51.0000	-130.6200	10.0	4.3	ML	OTT	4.3	597
1984	06	24	22	37	57	51.0000	-130.7100	10.0	3.6	ML	OTT	3.6	598
1984	06	24	22	54	50	51.0000	-130.7700	10.0	3.2	ML	OTT	3.2	599
1984	06	24	22	59	0	51.1000	-130.5700	10.0	3.2	ML	OTT	3.2	600
1984	06	24	23	02	20	51.4000	-130.0800	10.0	3.0	ML	OTT	3.0	601
1984	06	24	23	11	24	51.0000	-130.6200	10.0	3.3	ML	OTT	3.3	602
1984	06	25	01	39	20	51.2560	-130.1590	10.0	4.4	MS	ISC	4.4	603
1984	06	25	01	48	39	51.0000	-130.7000	10.0	3.4	ML	OTT	3.4	604
1984	06	25	05	37	52	51.1000	-130.6100	10.0	4.0	ML	OTT	4.0	605
1984	06	25	12	06	37	51.1000	-130.6100	10.0	3.6	ML	OTT	3.6	606
1984	06	27	10	43	38	55.6000	-135.7400	18.0	3.5	ML	OTT	3.5	607
1984	07	02	16	23	16	52.6000	-132.3100	18.0	3.1	LG	OTT	3.1	608
1984	08	12	00	24	54	50.9300	-130.1600	33.0	5.5	MB	MOS	5.5	609
1984	08	12	01	40	31	50.2100	-130.0800	10.0	4.7	MB	DNG	4.7	610
1984	08	14	21	13	52	52.3000	-132.6500	18.0	3.4	ML	OTT	3.4	611
1984	08	26	11	05	3	50.7800	-130.3800	10.0	4.5	MB	DNG	4.5	612
1984	08	29	07	28	13	51.4630	-130.5360	10.0	4.4	MB	PDE	4.4	613
1984	08	30	12	28	45	54.7000	-134.2000	25.0	5.9	MS	PEK	5.8	614

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID
1984	08	30	18	29	10	53.8000	-133.3100	18.0	3.2	ML	OTT	3.2	615
1984	08	31	07	07	4	53.8000	-133.3800	18.0	3.8	ML	OTT	3.8	616
1984	08	31	16	10	32	50.7000	-130.3800	10.0	3.1	ML	OTT	3.1	617
1984	09	01	04	43	30	53.8000	-133.5100	18.0	3.0	ML	OTT	3.0	618
1984	09	06	18	09	57	53.9000	-133.4500	18.0	4.2	ML	OTT	4.2	619
1984	09	10	19	35	17	50.6000	-129.1700	18.0	3.0	ML	OTT	3.0	620
1984	09	12	19	48	58	50.2990	-130.5910	10.0	4.2	MB	PDE	4.2	621
1984	09	22	20	16	29	51.2000	-124.7900	18.0	3.2	ML	OTT	3.2	622
1984	09	23	15	35	27	50.7000	-130.5200	10.0	3.2	ML	OTT	3.2	623
1984	09	24	22	23	17	50.7000	-130.2800	10.0	3.2	ML	OTT	3.2	624
1984	10	04	08	25	46	50.7000	-130.5500	10.0	3.6	ML	OTT	3.6	625
1984	10	08	17	48	35	53.9000	-133.4800	18.0	3.1	ML	OTT	3.1	626
1984	10	23	16	39	53	54.8000	-134.5400	18.0	4.3	ML	OTT	4.3	627
1984	10	29	03	13	17	51.7000	-131.0400	18.0	3.8	ML	OTT	3.8	628
1984	11	25	02	06	7	50.7360	-130.5140	10.0	4.0	MB	ISC	4.0	629
1984	12	07	14	37	42	54.1000	-133.5400	18.0	3.3	ML	OTT	3.3	630
1984	12	14	12	40	42	50.7810	-129.8400	10.0	4.6	MB	ISC	4.6	631
1984	12	22	13	40	28	55.3000	-137.9300	18.0	3.2	ML	OTT	3.2	632
1985	01	14	15	02	15	53.9000	-133.5800	18.0	3.0	ML	OTT	3.0	633
1985	01	19	03	51	15	53.5740	-133.2930	18.0	2.9	ML	OTT	2.9	634
1985	02	06	09	55	48	53.4200	-131.6010	18.0	3.0	ML	OTT	3.0	635
1985	02	26	20	49	17	51.5400	-130.7460	18.0	3.5	ML	OTT	3.5	636
1985	03	11	02	32	28	51.2860	-130.9950	18.0	3.0	ML	OTT	3.0	637
1985	03	19	15	04	21	52.3150	-131.5530	18.0	3.6	ML	OTT	3.6	638
1985	03	19	21	04	21	52.3600	-131.5420	18.0	2.9	ML	OTT	2.9	639
1985	04	04	06	37	14	53.0450	-133.7870	10.0	4.4	ML	PMR	4.4	640
1985	04	26	04	40	38	51.4800	-130.2900	10.0	4.3	ML	OTT	4.3	641
1985	04	26	06	22	27	51.3950	-130.7820	0.0	3.8	MB	ISC	3.8	642
1985	05	12	07	32	33	50.6200	-129.7900	10.0	4.0	ML	OTT	4.0	643
1985	05	15	15	09	13	50.0850	-127.8150	43.0	3.1	ML	OTT	3.1	644
1985	05	21	02	53	17	52.4000	-132.3000	18.0	3.3	ML	OTT	3.3	645
1985	05	27	02	32	35	50.2430	-129.6140	10.0	4.0	MB	ISC	4.0	646
1985	07	10	13	07	16	52.8380	-135.7450	18.0	3.6	ML	OTT	3.6	647
1985	07	22	08	16	49	50.6180	-129.6290	10.0	4.2	MB	PDE	4.2	648
1985	07	30	23	43	6	50.8000	-130.4500	18.0	3.1	ML	OTT	3.1	649
1985	08	01	18	31	4	50.7000	-130.6200	18.0	3.0	ML	OTT	3.0	650
1985	08	06	03	02	49	50.8200	-129.8900	10.0	4.2	ML	OTT	4.2	651
1985	08	07	14	28	25	50.7400	-130.5000	10.0	4.2	MB	DNG	4.2	652
1985	08	07	14	32	42	50.7000	-130.4800	10.0	3.2	ML	OTT	3.2	653
1985	08	18	19	47	39	52.5430	-132.2750	18.0	2.9	ML	OTT	2.9	654
1985	08	20	16	27	41	53.8000	-132.7200	18.0	3.2	ML	OTT	3.2	655
1985	08	24	17	17	16	50.7540	-130.4280	10.0	3.0	ML	OTT	3.0	656
1985	09	02	11	14	10	54.0150	-133.5310	18.0	3.4	ML	OTT	3.4	657
1985	09	04	11	03	15	57.6740	-125.5340	18.0	3.1	ML	OTT	3.1	658
1985	09	22	18	35	3	50.8430	-130.4310	18.0	2.9	ML	OTT	2.9	659
1985	09	23	23	03	37	50.8450	-130.5130	18.0	2.9	ML	OTT	2.9	660
1985	09	30	23	08	19	50.7800	-130.1500	10.0	4.2	ML	OTT	4.2	661
1985	09	30	23	15	50	50.7000	-130.4300	18.0	3.0	ML	OTT	3.0	662
1985	10	01	02	38	16	50.8740	-130.1020	10.0	4.3	MB	PDE	4.3	663
1985	10	02	15	26	29	50.8000	-130.5000	18.0	3.4	ML	OTT	3.4	664
1985	10	02	15	30	59	50.9000	-130.2700	18.0	3.3	ML	OTT	3.3	665
1985	10	02	19	25	17	50.8210	-130.4740	18.0	2.9	ML	OTT	2.9	666
1985	10	02	20	30	0	50.8000	-130.4300	18.0	3.0	ML	OTT	3.0	667
1985	10	16	12	54	47	50.8600	-130.0600	10.0	4.2	ML	OTT	4.2	668
1985	10	24	23	13	40	53.8000	-131.5000	18.0	4.1	ML	OTT	4.1	669
1985	11	26	13	06	27	50.0000	-130.0600	10.0	3.0	ML	OTT	3.0	670

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID
1985	11	26	16	47	29	50.6000	-130.4800	18.0	3.5	ML	OTT	3.5	671
1985	11	26	22	21	41	50.8000	-130.2800	18.0	3.0	ML	OTT	3.0	672
1985	11	30	17	55	13	56.7000	-131.1500	18.0	3.3	ML	OTT	3.3	673
1985	12	15	12	43	31	50.8880	-134.4660	10.0	4.7	MB	PDE	4.7	674
1986	01	11	02	13	45	53.9000	-133.4500	18.0	3.0	ML	OTT	3.0	675
1986	01	12	07	46	57	51.5000	-130.8200	18.0	3.2	ML	OTT	3.2	676
1986	01	25	06	46	25	53.8000	-131.6900	18.0	3.1	ML	OTT	3.1	677
1986	02	01	05	00	29	57.7000	-132.5000	18.0	3.4	ML	OTT	3.4	678
1986	02	07	02	33	36	54.0000	-133.7500	18.0	3.1	ML	OTT	3.1	679
1986	02	07	23	17	5	53.8000	-131.6100	18.0	3.2	ML	OTT	3.2	680
1986	02	08	09	02	57	53.8000	-131.6500	18.0	3.0	ML	OTT	3.0	681
1986	02	19	17	01	35	50.1000	-128.2800	24.0	2.9	ML	OTT	2.9	682
1986	02	20	06	13	48	50.5900	-129.9800	10.0	2.9	ML	OTT	2.9	683
1986	03	19	11	22	4	50.9000	-130.5300	18.0	3.0	ML	OTT	3.0	684
1986	03	21	22	41	41	54.2000	-132.8900	10.0	3.2	ML	OTT	3.2	685
1986	03	27	03	28	27	52.8000	-132.5900	18.0	3.0	ML	OTT	3.0	686
1986	04	26	15	02	17	50.9000	-130.4500	10.0	3.0	ML	OTT	3.0	687
1986	04	26	17	12	22	50.5100	-129.8100	10.0	4.4	ML	OTT	4.4	688
1986	04	28	08	45	7	53.8000	-131.6800	18.0	3.3	ML	OTT	3.3	689
1986	04	29	08	38	16	50.6000	-130.1300	10.0	3.4	ML	OTT	3.4	690
1986	05	12	23	08	44	58.0000	-137.4400	18.0	3.8	ML	OTT	3.8	691
1986	05	16	05	03	3	50.0240	-127.7300	0.0	2.9	ML	OTT	2.9	692
1986	05	21	05	43	20	50.3420	-130.0090	10.0	3.7	MB	PDE	3.7	693
1986	05	28	01	00	6	50.5000	-130.5700	10.0	3.1	ML	OTT	3.1	694
1986	05	28	15	41	28	50.6020	-130.2830	10.0	2.9	ML	OTT	2.9	695
1986	06	06	14	47	29	50.2800	-129.6500	10.0	4.5	ML	OTT	4.5	696
1986	07	29	02	09	39	53.2160	-133.0510	18.0	3.3	ML	OTT	3.3	697
1986	09	07	11	51	9	53.1120	-132.7990	18.0	3.4	ML	PGC	3.4	698
1986	10	04	04	11	40	57.8450	-132.6850	18.0	3.2	ML	OTT	3.2	699
1986	10	08	07	10	4	51.0470	-130.2850	10.0	3.0	ML	PGC	3.0	700
1986	10	08	13	13	42	51.0650	-130.2440	10.0	3.3	ML	OTT	3.3	701
1986	10	15	02	39	35	50.5320	-130.0250	10.0	3.0	ML	OTT	3.0	702
1986	10	27	10	49	41	50.8890	-130.3600	10.0	3.2	ML	OTT	3.2	703
1986	11	04	05	00	4	53.3510	-127.0440	18.0	3.5	ML	PGC	3.5	704
1986	11	04	06	38	25	54.4830	-134.0530	18.0	3.6	ML	OTT	3.6	705
1986	11	14	18	33	53	51.0710	-133.8970	10.0	3.1	ML	OTT	3.1	706
1986	12	06	05	33	54	50.1950	-129.7930	10.0	4.6	MB	ISC	4.6	707
1986	12	06	21	04	12	51.1110	-130.5820	18.0	4.5	ML	OTT	4.5	708
1986	12	09	12	56	9	57.8900	-137.5260	18.0	3.5	ML	PGC	3.5	709
1986	12	14	10	59	32	52.1940	-131.8220	18.0	3.0	ML	OTT	3.0	710
1987	01	13	11	31	56	50.6180	-130.3260	10.0	3.7	ML	OTT	3.7	711
1987	01	19	00	12	29	50.6700	-130.4370	10.0	3.6	ML	OTT	3.6	712
1987	01	19	11	26	57	50.7800	-129.6330	10.0	4.2	ML	OTT	4.2	713
1987	01	19	11	31	19	50.6880	-130.4570	10.0	3.1	ML	OTT	3.1	714
1987	01	19	11	50	8	50.6630	-130.4460	10.0	3.1	ML	PGC	3.1	715
1987	01	19	23	49	43	50.6960	-130.3900	10.0	3.2	ML	OTT	3.2	716
1987	01	19	23	57	3	50.6470	-130.4610	10.0	3.7	ML	PGC	3.7	717
1987	01	20	22	12	43	50.5350	-130.2650	10.0	3.1	ML	OTT	3.1	718
1987	01	22	08	09	40	50.6190	-130.2710	10.0	2.9	ML	OTT	2.9	719
1987	01	25	00	21	24	50.6910	-130.1110	10.0	3.3	ML	OTT	3.3	720
1987	01	31	14	21	12	50.3160	-129.6550	10.0	4.5	MB	ISC	4.5	721
1987	01	31	14	25	48	50.2920	-129.8190	10.0	4.8	MB	ISC	4.8	722
1987	01	31	20	27	57	50.2590	-129.9320	10.0	4.4	MB	PDE	4.4	723
1987	02	04	11	42	54	50.6910	-129.6030	10.0	4.4	MB	ISC	4.4	724
1987	02	13	15	50	56	55.8100	-135.5150	18.0	3.5	ML	OTT	3.5	725
1987	03	09	11	49	16	52.5310	-131.8110	18.0	3.4	ML	OTT	3.4	726

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID
1987	03	26	02	35	47	50.7490	-129.9180	10.0	4.7	MB	ISC	4.7	727
1987	05	15	23	03	23	54.1050	-133.6750	18.0	3.4	ML	OTT	3.4	728
1987	05	17	07	30	28	53.9030	-131.7050	18.0	3.0	ML	OTT	3.0	729
1987	05	17	07	34	13	51.7290	-131.5170	18.0	2.9	ML	OTT	2.9	730
1987	06	07	08	00	3	51.0010	-129.6650	18.0	3.0	ML	PGC	3.0	731
1987	07	02	02	28	21	50.9870	-124.6190	5.0	3.4	ML	OTT	3.4	732
1987	07	03	01	32	53	54.0860	-133.7930	18.0	4.5	ML	OTT	4.5	733
1987	08	15	06	09	9	53.8310	-133.3160	18.0	3.5	ML	PGC	3.5	734
1987	08	17	04	48	27	50.8020	-130.5470	10.0	3.0	ML	OTT	3.0	735
1987	08	17	05	27	31	50.8240	-130.4370	10.0	3.3	ML	OTT	3.3	736
1987	08	17	06	16	52	50.8320	-130.4440	10.0	3.5	ML	OTT	3.5	737
1987	09	16	21	43	0	50.9630	-130.1380	10.0	4.5	MB	ISC	4.5	738
1987	09	16	23	03	34	50.8400	-130.5000	10.0	2.9	ML	OTT	2.9	739
1987	09	16	23	09	40	50.8260	-130.4700	10.0	3.1	ML	OTT	3.1	740
1987	09	17	01	25	50	50.3770	-128.3580	10.0	3.8	MB	PDE	3.8	741
1987	09	17	17	39	39	50.7250	-130.5080	10.0	3.4	ML	OTT	3.4	742
1987	09	17	17	43	19	50.8450	-130.4300	10.0	4.5	MB	ISC	4.5	743
1987	09	17	17	51	33	50.7940	-130.5120	10.0	3.2	ML	OTT	3.2	744
1987	09	17	18	04	50	51.0070	-130.2150	10.0	4.8	MS	ISC	4.8	745
1987	09	17	18	26	25	50.7130	-130.4960	10.0	3.2	ML	OTT	3.2	746
1987	09	17	18	29	8	50.8640	-130.4160	10.0	3.4	ML	PGC	3.4	747
1987	09	17	19	46	25	51.0330	-130.1340	10.0	4.7	MS	ISC	4.7	748
1987	09	17	21	17	49	50.8660	-130.1930	10.0	4.4	MB	PDE	4.4	749
1987	09	17	21	28	51	50.8560	-130.3180	10.0	3.8	MB	PDE	3.8	750
1987	09	18	21	06	11	50.9670	-129.7450	10.0	4.4	MB	PDE	4.4	751
1987	09	18	21	18	26	50.9740	-130.1630	10.0	4.1	MB	PDE	4.1	752
1987	09	18	21	33	54	50.9130	-130.4630	10.0	3.0	ML	OTT	3.0	753
1987	09	18	23	29	4	50.8400	-130.4760	10.0	2.9	ML	OTT	2.9	754
1987	09	25	03	02	36	52.6360	-133.1180	18.0	3.0	ML	OTT	3.0	755
1987	10	11	09	11	20	50.6440	-129.5130	10.0	4.0	MB	PDE	4.0	756
1987	10	11	09	45	45	50.4990	-130.2980	10.0	3.0	ML	OTT	3.0	757
1987	10	13	09	23	43	52.8570	-132.5710	18.0	3.1	ML	OTT	3.1	758
1987	10	18	13	06	49	50.6640	-129.6040	10.0	4.4	MB	PDE	4.4	759
1987	10	20	09	32	54	56.2100	-136.8630	18.0	3.4	ML	OTT	3.4	760
1987	11	14	22	10	28	50.5390	-125.9610	16.0	3.2	ML	OTT	3.2	761
1987	11	27	11	49	1	50.8050	-130.8850	10.0	2.9	ML	OTT	2.9	762
1987	12	03	15	57	43	52.4390	-131.6250	18.0	3.2	ML	OTT	3.2	763
1987	12	05	09	31	6	52.0580	-133.7730	10.0	3.1	ML	PGC	3.1	764
1987	12	12	12	20	23	54.3840	-133.7000	18.0	3.2	ML	OTT	3.2	765
1987	12	18	18	26	47	54.0510	-133.7680	18.0	3.2	ML	OTT	3.2	766
1988	01	14	01	56	33	50.7700	-130.3870	10.0	3.7	ML	OTT	3.7	767
1988	02	10	23	54	33	50.5520	-130.1920	10.0	3.3	ML	OTT	3.3	768
1988	02	11	09	14	13	51.6270	-130.7700	18.0	3.3	ML	OTT	3.3	769
1988	02	11	14	16	34	51.6410	-130.7620	18.0	3.7	ML	OTT	3.7	770
1988	02	11	16	33	57	51.6780	-130.7330	18.0	3.1	ML	OTT	3.1	771
1988	02	11	17	08	26	51.6390	-130.7680	18.0	2.9	ML	OTT	2.9	772
1988	02	11	22	31	16	51.6640	-130.7490	18.0	3.4	ML	OTT	3.4	773
1988	02	11	22	42	23	51.6370	-130.7690	18.0	3.0	ML	OTT	3.0	774
1988	02	12	00	29	42	51.6260	-130.7600	18.0	2.9	ML	OTT	2.9	775
1988	02	12	01	45	57	51.6260	-130.7630	18.0	3.1	ML	OTT	3.1	776
1988	02	12	05	26	16	51.6180	-130.7810	18.0	3.1	ML	OTT	3.1	777
1988	02	14	01	15	30	51.6860	-130.7440	18.0	3.1	ML	OTT	3.1	778
1988	02	15	11	11	1	50.6250	-130.5080	10.0	3.0	ML	PGC	3.0	779
1988	02	15	23	10	59	51.6680	-130.7640	18.0	2.9	ML	OTT	2.9	780
1988	02	27	22	13	24	52.7890	-132.6400	18.0	3.0	ML	OTT	3.0	781
1988	03	16	09	26	46	52.5170	-132.1430	18.0	2.9	ML	OTT	2.9	782

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID
1988	04	05	16	49	41	54.0230	-133.7480	18.0	3.8	ML	OTT	3.8	783
1988	04	29	01	45	30	50.0440	-127.9880	35.0	3.5	ML	OTT	3.5	784
1988	04	29	05	43	32	51.2070	-130.7970	18.0	3.0	ML	OTT	3.0	785
1988	04	30	07	58	21	50.5360	-130.2410	10.0	2.9	ML	OTT	2.9	786
1988	05	05	22	22	50	57.8300	-136.4890	18.0	3.7	ML	PGC	3.7	787
1988	05	21	07	24	6	57.9270	-136.3860	18.0	3.3	ML	PGC	3.3	788
1988	05	26	14	09	53	50.9040	-130.5060	10.0	2.9	ML	OTT	2.9	789
1988	06	07	01	24	4	53.2320	-133.7720	18.0	3.0	ML	PGC	3.0	790
1988	06	20	05	24	40	52.5740	-132.4900	18.0	3.4	ML	OTT	3.4	791
1988	07	13	15	30	10	50.5110	-130.2390	10.0	4.3	ML	OTT	4.3	792
1988	07	19	10	54	47	50.9000	-130.5500	33.0	5.8	MB	MOS	5.8	793
1988	07	20	01	43	12	50.5020	-129.9530	10.0	3.6	MB	PDE	3.6	794
1988	07	30	08	06	57	50.4700	-130.1760	10.0	4.5	ML	OTT	4.5	795
1988	08	04	03	58	6	50.5430	-130.1060	10.0	3.2	ML	PGC	3.2	796
1988	08	04	08	08	40	50.5290	-130.1780	10.0	3.1	ML	OTT	3.1	797
1988	08	20	10	37	48	50.0090	-130.1120	10.0	4.3	ML	OTT	4.3	798
1988	08	25	07	05	27	53.2190	-135.4540	10.0	3.7	ML	OTT	3.7	799
1988	08	28	13	31	14	51.8070	-130.8210	18.0	3.2	ML	OTT	3.2	800
1988	09	02	14	13	35	52.7370	-135.4670	10.0	3.1	ML	OTT	3.1	801
1988	09	04	02	11	9	53.8800	-131.7800	10.0	3.2	ML	PGC	3.2	802
1988	09	07	19	06	19	51.0170	-133.8190	10.0	2.9	ML	OTT	2.9	803
1988	09	18	16	03	53	51.9120	-128.3840	18.0	3.5	ML	OTT	3.5	804
1988	10	01	11	19	47	50.1730	-127.9820	33.0	3.9	ML	OTT	3.9	805
1988	10	04	15	15	51	51.0040	-130.4560	10.0	3.7	ML	OTT	3.7	806
1988	10	07	19	33	40	52.7850	-132.5560	18.0	3.1	ML	OTT	3.1	807
1988	10	26	11	50	47	53.9050	-132.2100	16.0	2.9	ML	OTT	2.9	808
1988	10	27	12	37	3	50.4530	-130.1210	10.0	3.1	ML	PGC	3.1	809
1988	10	27	18	51	25	53.8980	-132.2160	14.0	3.0	ML	OTT	3.0	810
1988	11	27	00	36	20	50.7700	-130.3800	25.0	5.5	MS	BJI	5.4	811
1988	11	27	00	41	55	50.7520	-130.4960	10.0	3.6	ML	OTT	3.6	812
1988	11	27	03	05	23	50.7870	-130.5450	10.0	3.0	ML	OTT	3.0	813
1988	11	27	06	29	10	50.8690	-130.5300	10.0	3.1	ML	OTT	3.1	814
1988	11	27	06	40	42	50.7960	-130.4650	10.0	4.0	ML	OTT	4.0	815
1988	11	27	06	48	2	50.8040	-130.5250	10.0	2.9	ML	OTT	2.9	816
1988	11	27	06	52	30	50.8040	-130.4430	10.0	3.9	ML	OTT	3.9	817
1988	11	27	07	51	11	50.7520	-130.7580	10.0	2.9	ML	OTT	2.9	818
1988	11	27	07	57	6	50.8160	-130.5940	10.0	3.3	ML	PGC	3.3	819
1988	11	27	09	16	49	50.6720	-130.7820	10.0	3.2	ML	OTT	3.2	820
1988	11	27	09	29	37	50.8630	-130.5300	10.0	3.4	ML	OTT	3.4	821
1988	11	27	09	39	1	50.8090	-130.5700	10.0	3.1	ML	PGC	3.1	822
1988	11	27	09	43	8	50.7940	-130.6010	10.0	3.2	ML	PGC	3.2	823
1988	11	27	20	25	44	50.8080	-130.5110	10.0	3.0	ML	OTT	3.0	824
1988	11	27	21	25	14	50.8670	-130.5550	10.0	2.9	ML	OTT	2.9	825
1988	12	01	16	30	6	50.7830	-130.3710	10.0	3.0	ML	PGC	3.0	826
1988	12	04	13	41	27	50.8150	-130.5040	10.0	4.1	MB	PGC	4.1	827
1988	12	04	20	49	19	50.7630	-130.5420	10.0	3.0	ML	OTT	3.0	828
1988	12	06	11	54	0	50.8190	-130.4810	10.0	3.3	ML	PGC	3.3	829
1988	12	06	12	57	0	50.8200	-130.4940	10.0	3.7	ML	PGC	3.7	830
1989	01	13	09	03	57	53.3890	-131.4880	28.0	3.5	ML	OTT	3.5	831
1989	01	13	09	09	1	53.3940	-131.5020	24.0	3.2	ML	PGC	3.2	832
1989	01	13	10	02	25	53.3830	-131.4730	31.0	3.7	ML	OTT	3.7	833
1989	01	15	06	56	34	53.5690	-133.3130	18.0	3.4	ML	OTT	3.4	834
1989	02	01	09	59	17	50.5770	-130.0910	10.0	3.8	ML	OTT	3.8	835
1989	02	07	03	48	48	52.4210	-131.7520	18.0	3.1	ML	OTT	3.1	836
1989	02	17	07	38	9	57.7840	-137.8860	10.0	4.7	MB	PGC	4.7	837
1989	02	21	12	17	40	51.7650	-131.4240	18.0	3.8	ML	OTT	3.8	838

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID
1989	02	24	09	41	55	50.5350	-130.1270	10.0	4.3	ML	OTT	4.3	839
1989	02	26	04	42	14	52.5430	-132.1290	18.0	3.5	ML	OTT	3.5	840
1989	03	04	20	02	2	51.2400	-130.4210	18.0	3.0	ML	PGC	3.0	841
1989	03	06	23	33	23	51.5630	-130.6720	18.0	3.1	ML	OTT	3.1	842
1989	03	12	07	28	16	51.4240	-131.2220	18.0	2.9	ML	OTT	2.9	843
1989	03	12	08	55	50	51.3560	-131.3700	18.0	3.1	ML	OTT	3.1	844
1989	03	21	10	01	3	50.5250	-130.1510	10.0	3.3	ML	PGC	3.3	845
1989	03	30	01	55	42	52.4260	-131.6180	18.0	3.0	ML	OTT	3.0	846
1989	03	31	23	18	32	53.0960	-133.4120	18.0	3.3	ML	OTT	3.3	847
1989	04	01	10	16	35	50.0030	-127.7910	10.0	4.2	MB	PDE	4.2	848
1989	04	06	07	35	55	51.6380	-130.7680	18.0	2.9	ML	OTT	2.9	849
1989	04	06	07	48	7	51.5390	-130.7520	18.0	3.4	ML	PGC	3.4	850
1989	04	06	23	59	7	51.6240	-130.7590	18.0	2.9	ML	OTT	2.9	851
1989	04	07	00	02	11	51.6250	-130.7460	18.0	3.5	ML	OTT	3.5	852
1989	04	08	10	28	56	51.6140	-130.7970	18.0	3.6	ML	OTT	3.6	853
1989	04	09	00	51	9	54.7220	-128.1270	5.0	2.9	ML	OTT	2.9	854
1989	04	10	17	32	9	52.4180	-131.9810	18.0	3.9	ML	PGC	3.9	855
1989	04	12	10	42	4	50.6960	-130.2880	10.0	3.0	ML	PGC	3.0	856
1989	04	21	22	36	23	51.5620	-131.0330	18.0	3.4	ML	OTT	3.4	857
1989	04	21	22	47	0	51.6160	-130.8420	18.0	3.1	ML	PGC	3.1	858
1989	04	23	05	36	36	52.4150	-132.6560	18.0	2.9	ML	OTT	2.9	859
1989	04	23	10	43	0	51.3880	-130.5730	18.0	3.0	ML	PGC	3.0	860
1989	05	02	00	51	5	52.7580	-132.4370	18.0	3.2	ML	PGC	3.2	861
1989	05	03	05	25	16	50.6470	-129.5550	17.5	4.7	MB	ISC	4.7	862
1989	05	05	19	52	27	50.7400	-130.3060	10.0	3.0	ML	OTT	3.0	863
1989	05	08	21	21	8	50.5750	-130.1910	10.0	4.2	ML	OTT	4.2	864
1989	05	20	07	29	48	55.3080	-135.1340	18.0	3.4	ML	OTT	3.4	865
1989	05	21	10	55	35	53.9350	-132.1410	5.0	3.5	ML	OTT	3.5	866
1989	05	26	09	02	21	50.6510	-130.2750	10.0	3.0	ML	OTT	3.0	867
1989	06	02	12	17	37	52.6280	-132.1950	18.0	3.5	ML	OTT	3.5	868
1989	06	06	07	20	22	51.1110	-124.5430	20.0	3.6	ML	PGC	3.6	869
1989	07	08	14	46	41	52.5430	-132.2060	18.0	3.9	MB	ISC	3.9	870
1989	08	01	05	23	24	51.2090	-130.8020	18.0	3.2	ML	OTT	3.2	871
1989	08	01	06	28	59	51.1930	-130.8010	18.0	3.2	ML	OTT	3.2	872
1989	08	01	22	00	48	50.0890	-128.6440	10.0	3.4	ML	OTT	3.4	873
1989	08	05	04	30	36	50.6080	-130.2050	10.0	3.3	ML	OTT	3.3	874
1989	08	11	06	41	24	50.5650	-130.1170	10.0	3.0	ML	OTT	3.0	875
1989	08	18	08	55	11	53.0170	-133.3040	18.0	3.1	ML	OTT	3.1	876
1989	08	18	10	22	39	50.6130	-130.2390	10.0	3.5	ML	OTT	3.5	877
1989	08	20	01	27	27	50.0160	-130.0630	10.0	3.2	ML	OTT	3.2	878
1989	08	30	01	48	38	50.1280	-130.1300	10.0	3.3	ML	OTT	3.3	879
1989	08	30	03	33	1	51.6160	-130.7820	18.0	3.0	ML	PGC	3.0	880
1989	09	02	22	37	41	51.7560	-130.8760	18.0	3.0	ML	OTT	3.0	881
1989	09	07	01	58	3	51.1270	-130.5860	18.0	3.0	ML	PGC	3.0	882
1989	09	24	01	12	47	50.9060	-125.5090	5.0	3.8	ML	OTT	3.8	883
1989	10	02	09	08	36	50.8250	-130.4300	10.0	4.1	ML	PGC	4.1	884
1989	10	05	18	31	0	51.7900	-128.3990	18.0	3.1	ML	PGC	3.1	885
1989	10	09	01	38	40	51.6390	-130.7990	18.0	2.9	ML	OTT	2.9	886
1989	10	11	08	50	17	57.4260	-136.3050	10.0	4.4	ML	OTT	4.4	887
1989	10	11	11	25	39	51.6560	-131.2290	18.0	2.9	ML	OTT	2.9	888
1989	10	11	12	58	37	51.6410	-131.2440	18.0	3.1	ML	OTT	3.1	889
1989	10	17	11	25	6	57.3830	-136.2060	18.0	3.2	ML	PGC	3.2	890
1989	10	17	18	23	39	53.2160	-133.3300	18.0	3.0	ML	OTT	3.0	891
1989	10	17	23	56	28	51.2470	-130.8220	18.0	4.1	ML	PGC	4.1	892
1989	10	18	00	18	16	51.2740	-130.7860	18.0	3.8	ML	OTT	3.8	893
1989	10	19	22	58	24	51.5590	-130.9860	18.0	3.1	ML	OTT	3.1	894

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID
1989	10	28	07	19	7	51.4690	-131.1500	18.0	3.0	ML	PGC	3.0	895
1989	11	12	19	56	48	50.4920	-129.9880	10.0	3.1	ML	OTT	3.1	896
1989	11	19	04	15	20	54.1490	-133.7380	18.0	2.9	ML	OTT	2.9	897
1989	11	26	16	31	21	50.7890	-130.4850	10.0	3.2	ML	OTT	3.2	898
1989	11	26	19	51	46	51.2080	-131.0800	18.0	3.6	ML	OTT	3.6	899
1989	12	18	09	25	36	52.4210	-132.0870	18.0	3.1	ML	OTT	3.1	900
1989	12	23	05	58	8	50.6320	-130.1760	10.0	2.9	ML	OTT	2.9	901
1989	12	23	06	56	35	50.6350	-130.2130	10.0	3.2	ML	OTT	3.2	902
1989	12	25	16	35	57	50.6070	-130.1140	10.0	3.1	ML	OTT	3.1	903
1989	12	26	06	54	14	50.5680	-130.2670	10.0	3.5	ML	OTT	3.5	904
1989	12	27	03	18	44	54.0570	-133.7330	18.0	3.0	ML	OTT	3.0	905
1990	01	12	22	17	10	53.9800	-131.4500	39.0	5.4	MB	MOS	5.4	906
1990	01	12	22	22	19	53.9520	-131.1910	17.0	3.0	ML	OTT	3.0	907
1990	01	12	22	48	15	53.8310	-131.4000	10.0	4.2	MB	GS	4.2	908
1990	01	12	23	27	27	53.8930	-131.2870	17.0	3.4	ML	OTT	3.4	909
1990	01	13	00	27	1	53.8020	-131.3980	0.0	3.0	ML	PGC	3.0	910
1990	01	13	19	34	36	53.8550	-131.3070	5.0	3.5	ML	OTT	3.5	911
1990	01	13	23	06	29	53.8300	-131.2880	7.0	3.5	ML	OTT	3.5	912
1990	01	15	00	45	7	53.8430	-131.3200	14.0	2.9	ML	OTT	2.9	913
1990	01	15	10	16	52	53.8390	-131.3330	14.0	4.4	ML	OTT	4.4	914
1990	01	16	08	46	34	53.8540	-131.3370	17.0	2.9	ML	OTT	2.9	915
1990	01	19	10	33	26	52.0520	-131.1900	18.0	3.5	ML	OTT	3.5	916
1990	01	22	00	48	33	54.9420	-134.5030	18.0	3.0	ML	OTT	3.0	917
1990	01	26	20	13	37	53.9040	-132.2140	14.0	4.5	ML	OTT	4.5	918
1990	01	27	04	06	33	57.8080	-137.8520	10.0	2.9	ML	OTT	2.9	919
1990	01	27	23	54	31	53.9120	-132.2040	14.0	3.4	ML	OTT	3.4	920
1990	01	27	23	56	20	50.7380	-130.3980	10.0	3.3	ML	OTT	3.3	921
1990	02	03	09	54	56	51.0850	-130.1670	10.0	5.4	MS	ISC	5.3	922
1990	02	03	10	35	44	51.0530	-130.4710	18.0	3.0	ML	OTT	3.0	923
1990	02	03	12	17	26	50.9560	-130.6200	18.0	3.7	ML	OTT	3.7	924
1990	02	03	17	21	7	51.0100	-130.6380	18.0	3.3	ML	PGC	3.3	925
1990	02	04	02	15	21	50.9970	-130.6320	18.0	4.2	ML	OTT	4.2	926
1990	02	04	02	36	20	51.0170	-130.7850	18.0	3.4	ML	OTT	3.4	927
1990	02	04	02	54	20	51.1050	-130.6250	18.0	3.8	ML	OTT	3.8	928
1990	02	04	23	52	24	50.2750	-132.0200	10.0	3.7	ML	OTT	3.7	929
1990	02	07	07	56	26	53.8290	-131.3550	6.0	3.3	ML	OTT	3.3	930
1990	02	15	01	56	36	51.0480	-130.5670	18.0	3.2	ML	OTT	3.2	931
1990	02	16	03	10	39	50.5200	-130.1570	10.0	3.1	ML	OTT	3.1	932
1990	02	16	16	26	19	51.2050	-130.6760	18.0	3.2	ML	OTT	3.2	933
1990	02	18	08	48	45	50.0860	-130.1860	10.0	4.6	MW	NRC	4.6	934
1990	02	18	12	28	50	50.5320	-130.2790	10.0	3.4	ML	OTT	3.4	935
1990	02	19	08	41	19	50.3540	-129.9970	10.0	4.0	MB	GS	4.0	936
1990	02	19	09	11	43	50.0750	-130.1450	10.0	4.3	ML	OTT	4.3	937
1990	02	21	13	49	33	53.2520	-133.3570	18.0	2.9	ML	OTT	2.9	938
1990	02	26	00	26	16	51.8160	-131.1910	18.0	3.6	ML	OTT	3.6	939
1990	03	02	14	18	29	51.7260	-131.1230	18.0	2.9	ML	OTT	2.9	940
1990	03	06	10	04	12	50.5670	-129.9830	10.0	3.0	ML	OTT	3.0	941
1990	03	14	21	28	35	50.5640	-130.1750	10.0	2.9	ML	OTT	2.9	942
1990	03	15	00	13	29	50.5200	-130.1630	10.0	3.0	ML	OTT	3.0	943
1990	03	19	23	17	50	53.3980	-131.4860	5.0	3.8	ML	OTT	3.8	944
1990	03	22	08	57	27	50.8440	-130.4520	10.0	3.3	ML	OTT	3.3	945
1990	03	28	06	54	36	55.0960	-135.3250	18.0	4.3	ML	OTT	4.3	946
1990	04	06	05	08	44	54.9370	-134.6070	18.0	2.9	ML	OTT	2.9	947
1990	04	16	10	32	7	50.5090	-130.4800	10.0	3.2	ML	PGC	3.2	948
1990	04	24	21	25	35	50.9810	-130.4410	10.0	3.3	ML	OTT	3.3	949
1990	04	26	07	02	8	50.9040	-130.6270	10.0	3.4	ML	PGC	3.4	950

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID
1990	04	26	09	06	55	51.5940	-130.6780	18.0	2.9	ML	OTT	2.9	951
1990	05	11	01	24	18	51.5520	-130.7150	18.0	3.1	ML	OTT	3.1	952
1990	05	19	01	26	47	50.6740	-130.3300	10.0	3.5	ML	OTT	3.5	953
1990	05	22	09	55	36	50.8620	-130.4530	10.0	3.1	ML	OTT	3.1	954
1990	06	04	16	35	4	50.1070	-128.9420	10.0	4.4	MB	GS	4.4	955
1990	06	10	19	36	9	52.6230	-132.1930	18.0	4.6	MW	NRC	4.6	956
1990	06	15	11	41	22	57.8280	-137.0690	10.0	3.4	ML	OTT	3.4	957
1990	06	21	03	56	7	50.6140	-130.3080	10.0	4.1	MW	NRC	4.1	958
1990	06	23	04	11	49	50.5020	-129.8910	10.0	3.1	ML	OTT	3.1	959
1990	06	23	15	30	8	51.1140	-124.4100	5.0	3.0	ML	PGC	3.0	960
1990	07	02	02	13	50	50.5860	-130.1950	10.0	3.1	ML	OTT	3.1	961
1990	07	21	22	02	11	50.6730	-130.1630	10.0	2.9	ML	OTT	2.9	962
1990	08	04	20	09	12	50.1420	-130.1800	10.0	3.4	ML	OTT	3.4	963
1990	08	14	03	31	53	53.3860	-131.5000	9.0	2.9	ML	OTT	2.9	964
1990	08	28	16	40	7	54.0460	-133.6670	18.0	3.2	ML	PGC	3.2	965
1990	09	05	16	01	46	50.5840	-130.2650	10.0	3.8	ML	OTT	3.8	966
1990	09	20	11	40	55	55.7710	-135.8550	10.0	4.2	ML	OTT	4.2	967
1990	09	28	01	14	56	52.8490	-132.9850	18.0	3.6	ML	OTT	3.6	968
1990	10	06	17	12	28	54.0250	-133.5800	18.0	2.9	ML	OTT	2.9	969
1990	10	27	06	59	46	57.0050	-137.7830	10.0	3.0	ML	OTT	3.0	970
1990	11	09	23	27	1	54.9940	-133.5990	18.0	2.9	ML	OTT	2.9	971
1990	11	10	04	19	7	51.2930	-131.1920	10.0	3.2	ML	PGC	3.2	972
1990	11	16	03	37	53	50.7680	-130.2820	10.0	3.1	ML	OTT	3.1	973
1990	12	13	14	10	44	50.8760	-130.3600	10.0	3.0	ML	OTT	3.0	974
1990	12	22	03	50	56	51.3790	-130.9710	18.0	3.3	ML	OTT	3.3	975
1990	12	26	12	36	2	50.5810	-130.2570	10.0	3.1	ML	PGC	3.1	976
1991	01	01	22	55	11	50.7350	-130.5420	10.0	3.0	ML	OTT	3.0	977
1991	01	03	16	24	6	50.1550	-130.1800	10.0	3.4	ML	PGC	3.4	978
1991	01	08	18	35	35	51.1490	-130.5900	10.0	4.0	ML	OTT	4.0	979
1991	01	08	18	44	13	51.1330	-130.6120	10.0	3.2	ML	OTT	3.2	980
1991	01	08	18	50	52	51.1840	-130.5760	10.0	3.9	ML	OTT	3.9	981
1991	01	08	19	17	43	51.0390	-130.8190	10.0	3.3	ML	OTT	3.3	982
1991	01	08	19	46	48	51.1380	-130.6460	10.0	3.2	ML	OTT	3.2	983
1991	01	09	09	18	31	51.2100	-130.5210	10.0	3.4	ML	OTT	3.4	984
1991	01	09	09	47	40	51.1040	-130.5940	10.0	2.9	ML	OTT	2.9	985
1991	01	28	10	24	5	57.8950	-137.8430	10.0	3.1	ML	OTT	3.1	986
1991	02	12	18	38	53	54.0830	-133.8310	18.0	3.1	ML	OTT	3.1	987
1991	03	05	16	12	3	50.5240	-130.1610	10.0	4.0	MB	OTT	4.0	988
1991	03	05	17	21	19	50.5760	-130.1500	10.0	3.2	ML	OTT	3.2	989
1991	03	06	05	07	18	50.5650	-130.1030	10.0	3.0	ML	OTT	3.0	990
1991	03	20	22	03	43	50.6650	-129.9820	10.0	4.4	MB	ISC	4.4	991
1991	03	21	00	15	56	50.5780	-130.2450	10.0	3.3	ML	OTT	3.3	992
1991	03	29	18	13	24	50.7860	-130.4710	10.0	3.4	ML	OTT	3.4	993
1991	04	01	01	40	46	50.1480	-129.9580	10.0	3.7	MB	ISC	3.7	994
1991	04	01	05	02	44	50.1280	-129.9750	10.0	3.1	ML	OTT	3.1	995
1991	04	03	16	29	41	53.9090	-133.5060	18.0	3.4	ML	OTT	3.4	996
1991	04	10	11	22	52	50.6480	-130.3250	10.0	3.1	ML	OTT	3.1	997
1991	04	21	00	44	14	50.4880	-130.1650	10.0	3.9	MB	OTT	3.9	998
1991	04	23	13	42	46	50.5470	-130.0620	10.0	3.7	ML	OTT	3.7	999
1991	04	30	01	03	8	50.4920	-130.0470	10.0	3.2	ML	PGC	3.2	1000
1991	04	30	22	49	24	50.5820	-129.9960	10.0	3.1	ML	OTT	3.1	1001
1991	05	01	19	22	50	52.4610	-131.9270	18.0	3.0	ML	OTT	3.0	1002
1991	05	14	00	28	34	50.7010	-130.3930	10.0	3.1	ML	OTT	3.1	1003
1991	05	17	04	39	59	53.0010	-135.7280	10.0	3.0	ML	OTT	3.0	1004
1991	05	24	12	49	24	50.6110	-130.2780	10.0	4.0	MB	OTT	4.0	1005
1991	06	11	23	27	51	50.1510	-129.6240	10.0	3.9	MB	ISC	3.9	1006

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID
1991	06	28	23	38	23	54.0390	-133.7220	18.0	3.4	ML	OTT	3.4	1007
1991	07	11	09	11	54	51.3180	-131.4760	10.0	2.9	ML	OTT	2.9	1008
1991	07	17	07	12	8	50.5900	-130.7000	20.0	5.5	MS	BJI	5.4	1009
1991	07	17	07	35	0	50.7820	-130.5380	10.0	3.0	ML	OTT	3.0	1010
1991	07	17	07	43	0	50.7820	-130.5380	10.0	3.0	ML	OTT	3.0	1011
1991	07	17	07	51	0	50.7820	-130.5380	10.0	3.0	ML	OTT	3.0	1012
1991	07	17	08	22	23	50.7820	-130.5380	10.0	3.7	ML	OTT	3.7	1013
1991	07	17	20	14	32	53.4860	-134.9730	10.0	4.1	MB	GS	4.1	1014
1991	07	18	17	59	38	50.9590	-130.2220	10.0	2.9	ML	OTT	2.9	1015
1991	07	30	08	49	28	50.6330	-129.0950	10.0	3.2	ML	OTT	3.2	1016
1991	08	15	01	29	16	50.7630	-130.4770	10.0	3.2	ML	OTT	3.2	1017
1991	08	16	00	58	19	50.5150	-130.0840	10.0	4.0	MB	OTT	4.0	1018
1991	08	19	02	42	8	52.6440	-132.1540	18.0	3.1	ML	PGC	3.1	1019
1991	08	19	15	15	4	50.4900	-130.1160	10.0	4.2	ML	PGC	4.2	1020
1991	09	16	11	16	7	51.0710	-130.8830	10.0	3.0	ML	PGC	3.0	1021
1991	10	05	10	39	19	50.7130	-130.3670	10.0	4.6	MW	NRC	4.6	1022
1991	10	10	22	55	50	55.3740	-134.9600	18.0	3.5	ML	OTT	3.5	1023
1991	10	12	18	45	13	51.2490	-130.9630	18.0	3.0	ML	OTT	3.0	1024
1991	10	29	13	39	15	52.4580	-131.9640	18.0	3.1	ML	OTT	3.1	1025
1991	10	30	03	12	58	52.7950	-132.6380	18.0	2.9	ML	OTT	2.9	1026
1991	11	03	09	51	17	54.7890	-134.3950	18.0	3.4	ML	OTT	3.4	1027
1991	11	14	02	26	18	50.6170	-130.2210	10.0	4.0	ML	OTT	4.0	1028
1991	11	14	04	45	17	50.6070	-130.1880	10.0	3.7	ML	OTT	3.7	1029
1991	11	15	18	35	8	57.7620	-133.6250	10.0	3.4	ML	PGC	3.4	1030
1991	11	19	23	45	54	50.7610	-130.7030	10.0	3.0	ML	OTT	3.0	1031
1991	12	10	21	28	7	52.6020	-132.2270	18.0	3.2	ML	OTT	3.2	1032
1991	12	18	21	32	36	57.2830	-136.2530	10.0	3.0	ML	OTT	3.0	1033
1992	01	01	07	13	26	50.3690	-129.9630	10.0	3.2	ML	OTT	3.2	1034
1992	01	13	20	56	13	57.7910	-126.0580	10.0	3.2	ML	OTT	3.2	1035
1992	01	17	05	04	19	53.0570	-133.0880	10.0	3.9	ML	PGC	3.9	1036
1992	01	17	07	51	5	51.2210	-131.1340	10.0	2.9	ML	OTT	2.9	1037
1992	01	18	11	33	1	50.1730	-127.9460	30.0	3.5	ML	PGC	3.5	1038
1992	02	15	07	02	58	50.1240	-129.7210	1.3	4.6	MB	ISC	4.6	1039
1992	02	16	03	32	3	50.9200	-130.7190	10.0	3.3	ML	PGC	3.3	1040
1992	02	21	15	35	6	56.1340	-134.4470	10.0	3.1	ML	PGC	3.1	1041
1992	02	26	18	34	53	51.5450	-130.9620	18.0	2.9	ML	OTT	2.9	1042
1992	03	19	09	03	15	50.5500	-129.9320	10.0	4.5	ML	PGC	4.5	1043
1992	03	21	16	03	1	50.8620	-130.7480	10.0	3.8	MW	NRC	3.8	1044
1992	03	29	20	10	1	51.6240	-130.8370	10.0	2.9	ML	OTT	2.9	1045
1992	04	06	13	54	38	50.5500	-130.4600	10.0	6.8	ML	OTT	6.8	1046
1992	04	06	13	57	49	50.5300	-130.3900	10.0	5.2	MB	PGC	5.2	1047
1992	04	06	14	24	28	50.4990	-129.9820	10.0	4.0	ML	PGC	4.0	1048
1992	04	06	15	07	15	50.8210	-130.6100	10.0	3.8	MB	PGC	3.8	1049
1992	04	06	15	16	9	50.2500	-130.3400	25.0	6.2	MS	BJI	6.1	1050
1992	04	06	15	49	1	50.6480	-129.8130	10.0	4.6	MB	ISC	4.6	1051
1992	04	06	16	13	26	50.6590	-130.0540	10.0	4.1	MB	GS	4.1	1052
1992	04	06	19	50	33	50.7790	-130.3880	10.0	3.4	ML	PGC	3.4	1053
1992	04	07	00	35	29	50.9200	-130.7300	10.0	4.3	ML	PGC	4.3	1054
1992	04	07	00	42	17	51.1000	-130.4000	10.0	5.3	MS	BJI	5.2	1055
1992	04	07	01	18	53	51.0070	-130.6450	10.0	2.9	ML	OTT	2.9	1056
1992	04	07	09	12	36	50.9100	-130.6500	10.0	3.7	MB	PGC	3.7	1057
1992	04	07	10	04	56	50.9530	-130.4150	10.0	3.6	MB	GS	3.6	1058
1992	04	07	10	48	28	50.7900	-130.6800	10.0	3.9	ML	PGC	3.9	1059
1992	04	07	14	53	55	51.0900	-130.9700	10.0	4.0	MB	PGC	4.0	1060
1992	04	07	17	56	44	50.2600	-130.2100	10.0	3.9	MB	PGC	3.9	1061
1992	04	07	18	12	24	50.2100	-130.2700	10.0	4.3	MB	PGC	4.3	1062

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID
1992	04	08	08	30	14	50.7300	-130.5300	10.0	4.1	ML	PGC	4.1	1063
1992	04	08	09	05	45	50.8780	-130.5580	10.0	2.9	ML	OTT	2.9	1064
1992	04	09	15	56	29	51.0560	-130.5240	10.0	3.2	ML	OTT	3.2	1065
1992	04	09	16	52	48	50.6690	-130.1820	10.0	3.5	MB	GS	3.6	1066
1992	04	10	19	09	28	50.7930	-130.1400	10.0	4.1	ML	PGC	4.1	1067
1992	04	17	14	32	13	51.0290	-130.5690	10.0	3.2	ML	OTT	3.2	1068
1992	04	21	23	40	10	51.2510	-131.3980	10.0	2.9	ML	OTT	2.9	1069
1992	04	22	03	28	5	51.3370	-131.1590	10.0	3.5	ML	PGC	3.5	1070
1992	04	22	16	52	55	51.3620	-131.2760	10.0	3.5	ML	OTT	3.5	1071
1992	04	23	00	07	15	51.3000	-131.1900	18.0	5.2	MS	BJI	5.1	1072
1992	04	23	00	28	34	51.2910	-131.1050	10.0	4.2	MB	GS	4.2	1073
1992	04	23	04	48	39	51.3920	-131.0480	10.0	4.0	MB	PGC	4.0	1074
1992	04	23	05	40	10	51.2630	-131.1690	10.0	5.8	MS	PGC	5.7	1075
1992	04	23	06	04	11	51.2460	-131.3240	10.0	4.3	MB	PGC	4.3	1076
1992	04	23	08	17	2	51.3530	-131.0070	10.0	3.6	ML	PGC	3.6	1077
1992	04	23	16	28	21	51.1960	-131.3880	10.0	3.6	ML	OTT	3.6	1078
1992	04	23	16	32	14	51.4490	-131.0710	10.0	4.4	ML	PGC	4.4	1079
1992	04	24	03	17	52	51.3190	-131.3290	10.0	3.4	ML	OTT	3.4	1080
1992	04	24	17	36	50	51.2810	-131.3050	10.0	3.3	ML	OTT	3.3	1081
1992	04	28	16	43	19	51.5880	-130.6760	10.0	2.9	ML	OTT	2.9	1082
1992	04	30	14	30	27	51.3120	-131.1890	10.0	3.3	ML	OTT	3.3	1083
1992	05	21	00	31	49	51.4700	-130.9890	10.0	2.9	ML	OTT	2.9	1084
1992	06	05	16	18	55	50.6420	-130.3870	10.0	3.1	ML	OTT	3.1	1085
1992	06	06	14	43	37	50.5840	-130.1940	10.0	2.9	ML	OTT	2.9	1086
1992	06	19	16	02	54	50.4940	-130.2390	10.0	3.0	ML	OTT	3.0	1087
1992	06	19	17	34	54	50.4730	-130.2580	10.0	3.5	ML	OTT	3.5	1088
1992	07	05	08	10	46	50.5570	-130.4160	10.0	3.1	ML	OTT	3.1	1089
1992	07	05	14	01	23	50.5280	-130.4500	10.0	4.2	ML	OTT	4.2	1090
1992	07	06	21	29	25	50.4060	-130.0040	10.0	3.1	ML	PGC	3.1	1091
1992	07	23	09	04	15	50.4840	-130.3750	10.0	3.1	ML	OTT	3.1	1092
1992	07	27	01	40	37	50.0580	-130.2030	10.0	4.1	MB	PGC	4.1	1093
1992	07	27	04	19	10	50.2430	-129.9160	10.0	4.9	MS	ISC	4.9	1094
1992	07	27	04	21	34	50.2900	-130.4300	33.0	5.3	MB	MOS	5.3	1095
1992	07	27	05	01	39	50.2440	-129.9030	10.0	4.3	MB	ISC	4.3	1096
1992	07	27	07	01	49	50.1470	-130.0550	10.0	3.9	MB	ISC	3.9	1097
1992	08	03	06	48	38	50.5200	-130.3290	10.0	3.6	ML	OTT	3.6	1098
1992	08	05	19	53	5	51.8660	-131.2590	18.0	3.1	ML	PGC	3.1	1099
1992	08	13	19	09	3	57.1080	-130.9540	10.0	3.4	ML	PGC	3.4	1100
1992	08	13	19	29	17	57.1070	-130.9250	10.0	2.9	ML	OTT	2.9	1101
1992	08	21	03	31	27	51.2300	-135.7610	10.0	3.7	ML	OTT	3.7	1102
1992	08	23	10	49	52	50.5580	-130.4380	10.0	3.5	ML	OTT	3.5	1103
1992	09	03	02	50	10	52.7020	-133.0440	18.0	3.4	ML	OTT	3.4	1104
1992	09	03	13	42	11	50.6780	-129.8120	10.0	4.6	MB	ISC	4.6	1105
1992	09	05	05	19	0	51.3540	-130.9140	10.0	3.0	ML	PGC	3.0	1106
1992	09	05	06	44	48	51.3170	-130.9460	10.0	3.0	ML	PGC	3.0	1107
1992	09	10	02	43	28	50.4770	-130.1150	10.0	3.6	ML	OTT	3.6	1108
1992	09	14	18	46	43	50.5640	-130.2950	10.0	3.0	ML	OTT	3.0	1109
1992	09	28	21	48	48	50.5300	-130.3800	10.0	3.1	ML	OTT	3.1	1110
1992	09	29	13	05	37	53.5680	-133.2380	18.0	3.0	ML	OTT	3.0	1111
1992	10	02	07	45	49	50.5210	-130.3410	10.0	3.5	ML	OTT	3.5	1112
1992	10	18	12	42	21	54.2070	-133.8210	18.0	3.0	ML	OTT	3.0	1113
1992	10	22	22	16	28	53.2340	-132.8730	18.0	3.2	ML	OTT	3.2	1114
1992	12	14	00	45	41	50.5320	-130.4030	10.0	3.0	ML	PGC	3.0	1115
1992	12	19	16	35	50	50.9850	-131.1730	10.0	3.7	ML	OTT	3.7	1116
1993	01	11	18	53	33	53.8400	-131.5300	15.0	2.9	ML	PGC	2.9	1117
1993	01	21	09	15	17	50.6810	-129.9710	10.0	4.4	MB	ISC	4.4	1118

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID
1993	02	03	08	36	57	50.5900	-130.4550	10.0	3.7	ML	PGC	3.7	1119
1993	02	12	02	13	41	53.4490	-133.2220	18.0	2.9	ML	PGC	2.9	1120
1993	02	18	22	24	14	50.5280	-130.3520	10.0	3.5	ML	PGC	3.5	1121
1993	03	01	10	42	8	50.6460	-130.0490	10.0	3.7	MB	GS	3.7	1122
1993	03	24	09	17	35	50.5310	-130.3670	10.0	2.9	ML	PGC	2.9	1123
1993	04	18	15	27	47	56.7010	-137.8850	10.0	3.4	MW	NRC	3.4	1124
1993	05	04	04	51	8	56.0500	-135.2310	10.0	3.9	ML	PGC	3.9	1125
1993	05	25	20	59	21	50.5330	-130.4020	10.0	3.1	ML	PGC	3.1	1126
1993	05	27	05	03	49	50.5190	-130.3010	10.0	3.5	ML	PGC	3.5	1127
1993	05	29	05	29	18	50.4170	-130.2400	10.0	4.3	ML	OTT	4.3	1128
1993	05	30	07	18	12	50.4830	-130.3140	10.0	3.1	ML	PGC	3.1	1129
1993	06	21	09	14	13	53.2200	-133.0840	18.0	3.0	ML	PGC	3.0	1130
1993	06	25	10	17	34	53.6310	-131.7420	15.0	3.5	ML	PGC	3.5	1131
1993	07	06	13	25	45	50.4580	-130.2760	10.0	3.7	ML	PGC	3.7	1132
1993	07	25	21	26	27	50.6250	-130.5040	10.0	3.4	ML	PGC	3.4	1133
1993	08	03	07	20	2	51.4600	-131.5400	5.0	6.2	MS	BJI	6.1	1134
1993	08	03	07	30	42	51.2210	-130.1440	10.0	3.2	ML	PGC	3.2	1135
1993	08	03	07	56	34	51.1440	-131.1730	10.0	3.7	ML	OTT	3.7	1136
1993	08	03	09	20	33	51.2380	-130.7630	10.0	4.5	ML	PGC	4.5	1137
1993	08	03	11	14	59	51.2390	-131.4410	10.0	3.9	ML	OTT	3.9	1138
1993	08	03	13	03	57	51.2970	-130.7400	10.0	5.2	MS	GS	5.1	1139
1993	08	03	15	29	55	51.1070	-130.9690	10.0	3.5	ML	PGC	3.5	1140
1993	08	04	00	17	44	51.0780	-130.9720	10.0	3.7	ML	OTT	3.7	1141
1993	08	04	05	28	42	51.2150	-130.8770	10.0	3.8	ML	PGC	3.8	1142
1993	08	04	09	14	8	51.2080	-130.8630	10.0	3.5	ML	PGC	3.5	1143
1993	08	04	09	44	12	51.2040	-130.8430	10.0	4.1	ML	PGC	4.1	1144
1993	08	04	23	20	26	51.2120	-131.3980	10.0	3.8	ML	OTT	3.8	1145
1993	08	05	20	33	56	51.2420	-131.2080	10.0	3.3	ML	OTT	3.3	1146
1993	08	09	00	06	22	51.1800	-131.1640	10.0	3.7	MB	GS	3.7	1147
1993	08	24	05	05	13	50.5360	-130.4000	10.0	4.0	MB	GS	4.0	1148
1993	09	05	17	30	52	57.7950	-137.8470	0.0	4.1	MW	NRC	4.1	1149
1993	09	05	17	58	12	57.7990	-137.6960	10.0	3.6	ML	OTT	3.6	1150
1993	09	29	03	06	6	53.8620	-131.5870	13.5	3.2	ML	PGC	3.2	1151
1993	11	09	00	11	16	57.5660	-132.7480	5.0	3.5	ML	PGC	3.5	1152
1993	11	21	20	40	54	52.6350	-132.3760	18.0	3.1	ML	PGC	3.1	1153
1993	12	03	04	07	42	50.8200	-130.5910	10.0	3.4	ML	OTT	3.4	1154
1993	12	17	21	18	24	50.4930	-130.3400	10.0	3.0	MW	NRC	3.0	1155
1993	12	22	08	06	57	50.1340	-129.7560	10.0	3.2	ML	OTT	3.2	1156
1993	12	22	23	39	58	50.1080	-129.6610	10.0	3.3	ML	PGC	3.3	1157
1993	12	22	23	43	10	50.1140	-129.6250	10.0	3.3	ML	PGC	3.3	1158
1994	02	08	18	53	16	51.6620	-131.3050	10.0	3.5	ML	PGC	3.5	1159
1994	02	19	11	17	37	50.5300	-130.2700	10.0	4.0	ML	OTT	4.0	1160
1994	02	21	15	58	34	50.4940	-130.2810	10.0	4.2	ML	OTT	4.2	1161
1994	03	02	14	07	21	50.6500	-130.6570	10.0	3.1	MW	NRC	3.1	1162
1994	03	11	19	31	25	51.9190	-131.6500	18.0	4.0	ML	PGC	4.0	1163
1994	04	02	00	14	14	50.7530	-130.5210	10.0	3.2	ML	PGC	3.2	1164
1994	04	02	16	25	51	54.3860	-137.8730	10.0	3.4	MW	NRC	3.4	1165
1994	04	02	16	51	58	52.4720	-131.8720	18.0	3.3	ML	PGC	3.3	1166
1994	04	12	21	14	24	50.3530	-130.2110	10.0	4.4	ML	OTT	4.4	1167
1994	04	18	17	47	15	51.1000	-130.6000	10.0	4.0	ML	GIA	4.0	1168
1994	04	20	00	18	51	50.8980	-130.1450	10.0	3.7	ML	PGC	3.7	1169
1994	05	02	23	57	29	51.6520	-131.4860	10.0	4.6	MW	NRC	4.6	1170
1994	05	14	15	37	48	52.6680	-132.1140	18.0	2.9	MW	NRC	2.9	1171
1994	06	13	22	35	6	53.7920	-133.5120	18.0	2.9	MW	NRC	2.9	1172
1994	07	07	21	07	58	53.9140	-133.9080	10.0	4.4	ML	PGC	4.4	1173
1994	07	10	21	51	27	50.4000	-130.3000	10.0	3.2	ML	GIA	3.2	1174

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID
1994	07	11	07	57	50	50.3000	-130.1000	10.0	3.5	ML	GIA	3.5	1175
1994	07	15	05	02	13	50.3000	-130.2000	10.0	4.2	ML	GIA	4.2	1176
1994	07	15	22	20	50	57.9680	-126.3780	18.0	2.9	ML	PGC	2.9	1177
1994	08	21	13	05	5	50.4060	-130.3970	10.0	4.4	MB	PGC	4.4	1178
1994	08	30	20	49	13	52.7250	-132.2720	18.0	3.0	ML	PGC	3.0	1179
1994	09	04	07	34	39	50.6900	-130.2590	10.0	4.1	MB	ISC	4.1	1180
1994	09	05	04	10	55	51.7920	-131.4620	10.0	4.4	ML	PGC	4.4	1181
1994	10	15	00	39	50	50.4840	-130.2440	10.0	3.1	ML	PGC	3.1	1182
1994	10	21	16	23	52	50.0390	-130.2970	10.0	4.3	MB	PGC	4.3	1183
1994	10	23	21	02	43	50.4280	-130.1120	10.0	3.6	ML	PGC	3.6	1184
1994	11	02	13	52	19	50.5150	-130.2860	10.0	4.1	ML	PGC	4.1	1185
1994	12	30	17	18	49	50.2240	-130.3000	10.0	3.1	ML	PGC	3.1	1186
1995	01	04	06	15	2	57.9730	-137.5780	0.0	3.4	ML	PGC	3.4	1187
1995	01	04	16	33	42	57.9400	-137.6900	5.0	3.9	ML	PGC	3.9	1188
1995	01	09	06	50	12	51.0120	-130.7900	10.0	4.8	MW	NRC	4.8	1189
1995	01	13	07	52	18	53.1690	-132.7560	18.0	3.0	ML	PGC	3.0	1190
1995	01	16	07	01	27	50.2730	-129.5980	10.0	4.3	MB	ISC	4.3	1191
1995	01	16	07	26	53	50.0070	-130.0590	10.0	3.9	MB	PGC	3.9	1192
1995	01	17	03	30	53	50.0260	-130.2370	10.0	4.0	MB	PGC	4.0	1193
1995	01	17	08	13	29	50.0180	-130.2120	10.0	4.3	MB	PGC	4.3	1194
1995	01	17	11	39	1	50.0830	-130.0990	10.0	4.2	MB	PGC	4.2	1195
1995	01	17	12	46	13	50.0090	-130.2510	10.0	4.2	MB	PGC	4.2	1196
1995	01	17	14	42	30	50.0000	-130.1900	10.0	5.0	MS	GS	5.0	1197
1995	01	18	10	03	8	50.0070	-129.9080	10.0	3.8	MB	PGC	3.8	1198
1995	01	26	00	31	16	50.4800	-130.2400	10.0	3.4	ML	PGC	3.4	1199
1995	02	03	01	14	52	50.1700	-127.9310	22.0	2.9	ML	PGC	2.9	1200
1995	02	04	23	49	39	50.6360	-129.7370	10.0	4.3	MB	ISC	4.3	1201
1995	03	08	16	29	58	50.4850	-130.2460	10.0	4.9	MW	NRC	4.9	1202
1995	03	14	08	03	25	54.1880	-133.7790	18.0	3.0	ML	PGC	3.0	1203
1995	04	06	05	32	40	50.9280	-130.7110	10.0	3.5	ML	PGC	3.5	1204
1995	04	06	07	54	59	51.0030	-130.6280	10.0	3.5	ML	PGC	3.5	1205
1995	04	11	14	52	20	50.6780	-129.6360	10.0	4.3	MB	ISC	4.3	1206
1995	04	23	09	29	49	50.4530	-130.1960	10.0	4.4	MW	NRC	4.4	1207
1995	04	26	06	40	56	55.1390	-133.2550	10.0	3.0	ML	PGC	3.0	1208
1995	05	31	03	38	1	50.9540	-130.6760	10.0	5.3	MW	NRC	5.3	1209
1995	06	03	21	36	36	55.0660	-134.9710	0.0	3.4	ML	PGC	3.4	1210
1995	06	06	11	06	11	53.8510	-131.5110	8.8	4.4	ML	PGC	4.4	1211
1995	06	12	22	43	0	53.8160	-132.2350	10.0	3.2	ML	PGC	3.2	1212
1995	06	13	18	46	26	53.8310	-132.1010	0.3	4.1	MB	ISC	4.1	1213
1995	06	18	04	10	56	50.7010	-130.4740	10.0	3.0	ML	PGC	3.0	1214
1995	06	21	20	24	13	50.9720	-130.6730	10.0	5.4	MW	NRC	5.4	1215
1995	06	22	02	33	17	50.9540	-130.6240	10.0	3.0	ML	PGC	3.0	1216
1995	06	23	04	47	56	51.0120	-130.5960	10.0	3.1	ML	PGC	3.1	1217
1995	07	08	17	53	15	50.4810	-130.2030	10.0	3.1	MW	NRC	3.1	1218
1995	07	09	12	23	0	53.7070	-131.9540	15.0	3.3	ML	PGC	3.3	1219
1995	07	13	20	12	24	52.7230	-132.8500	18.0	3.7	MW	NRC	3.7	1220
1995	07	14	01	22	1	52.8100	-132.7110	18.0	2.9	MW	NRC	2.9	1221
1995	08	08	14	59	5	50.4730	-130.3050	10.0	3.7	MW	NRC	3.7	1222
1995	09	05	07	39	40	50.9810	-130.7160	10.0	3.6	MW	NRC	3.6	1223
1995	09	12	22	00	37	51.1710	-131.2140	10.0	3.2	ML	PGC	3.2	1224
1995	09	12	22	14	17	51.1830	-131.1820	10.0	3.4	MW	NRC	3.4	1225
1995	09	12	22	44	23	51.2090	-131.2250	10.0	5.3	MW	NRC	5.3	1226
1995	09	12	22	59	50	51.2170	-131.2050	10.0	3.9	ML	PGC	3.9	1227
1995	09	12	23	20	4	51.1960	-131.2310	10.0	3.3	ML	PGC	3.3	1228
1995	09	12	23	38	13	51.1550	-131.2120	10.0	3.4	ML	PGC	3.4	1229
1995	09	13	06	20	27	51.2030	-131.2270	10.0	3.6	MW	NRC	3.6	1230

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID
1995	09	13	07	54	20	51.1200	-131.1290	10.0	3.5	ML	PGC	3.5	1231
1995	09	13	07	59	7	51.4710	-130.5320	10.0	5.0	MS	ISC	5.0	1232
1995	09	13	08	21	28	51.0890	-131.1220	10.0	3.9	MW	NRC	3.9	1233
1995	09	13	11	19	31	51.1040	-131.0820	10.0	4.4	MW	NRC	4.4	1234
1995	09	23	00	06	17	50.9620	-130.6500	10.0	3.5	MW	NRC	3.5	1235
1995	09	23	11	11	39	50.7120	-130.4920	10.0	3.2	MW	NRC	3.2	1236
1995	09	29	09	42	14	51.7560	-130.8600	18.0	2.9	MW	NRC	2.9	1237
1995	10	14	01	27	1	50.5470	-130.3630	10.0	2.9	MW	NRC	2.9	1238
1995	10	17	04	35	2	51.0560	-130.6070	10.0	3.8	ML	PGC	3.8	1239
1995	10	18	13	00	18	51.3400	-131.3790	10.0	3.4	ML	PGC	3.4	1240
1995	10	23	05	48	20	55.5140	-135.4100	5.0	4.0	ML	PGC	4.0	1241
1995	10	23	07	54	10	55.5240	-135.1810	5.0	4.3	MW	NRC	4.3	1242
1995	10	23	09	27	19	55.6110	-135.2270	5.0	3.5	ML	PGC	3.5	1243
1995	10	23	11	05	3	55.5340	-135.3110	0.0	3.9	ML	PGC	3.9	1244
1995	10	23	12	10	3	55.5170	-135.3020	0.0	4.2	ML	PGC	4.2	1245
1995	10	23	18	17	58	55.4840	-135.0660	0.0	4.1	ML	PGC	4.1	1246
1995	10	24	14	59	30	55.4000	-135.0140	0.0	4.1	ML	PGC	4.1	1247
1995	10	26	02	21	55	55.3930	-136.0280	10.0	3.1	MW	NRC	3.1	1248
1995	10	31	19	40	51	50.5570	-130.4800	10.0	4.1	ML	PGC	4.1	1249
1995	11	01	05	23	24	55.6290	-135.4080	10.0	3.1	ML	PGC	3.1	1250
1995	11	12	04	32	4	55.8000	-135.7000	10.0	4.8	ML	GIA	4.8	1251
1995	11	18	10	25	17	55.5340	-135.5640	10.0	3.8	ML	PGC	3.8	1252
1995	11	30	19	32	41	55.7580	-135.3980	10.0	3.3	MW	NRC	3.3	1253
1995	12	01	03	29	23	50.3520	-129.9730	10.0	4.5	MW	NRC	4.5	1254
1995	12	02	04	00	41	51.6120	-130.7960	10.0	3.5	MW	NRC	3.5	1255
1996	01	14	05	56	49	50.5730	-130.3470	10.0	2.9	MW	NRC	2.9	1256
1996	01	28	16	15	20	52.2060	-132.0390	18.0	3.2	MW	NRC	3.2	1257
1996	03	10	21	12	16	50.5710	-130.4220	10.0	4.7	MW	NRC	4.7	1258
1996	03	16	23	18	37	50.4640	-130.3150	10.0	5.1	MW	NRC	5.1	1259
1996	03	23	10	17	25	52.5050	-131.7520	18.0	2.9	MW	NRC	2.9	1260
1996	03	27	05	41	15	50.2270	-127.9660	22.0	3.0	ML	PGC	3.0	1261
1996	03	28	18	45	32	50.6180	-129.9440	10.0	3.5	MB	ISC	3.6	1262
1996	04	04	02	41	13	53.9280	-133.6190	18.0	3.0	MW	NRC	3.0	1263
1996	04	18	01	14	14	50.5580	-129.9830	15.1	3.6	MB	ISC	3.6	1264
1996	04	18	14	47	25	56.8110	-135.9130	10.0	3.1	ML	PGC	3.1	1265
1996	05	13	14	08	20	50.6940	-130.4720	10.0	3.0	ML	PGC	3.0	1266
1996	05	24	23	01	20	54.5390	-134.8060	10.0	3.6	ML	PGC	3.6	1267
1996	06	22	02	45	44	51.5350	-130.8520	10.0	3.2	MW	NRC	3.2	1268
1996	06	25	18	34	26	51.4280	-130.9710	10.0	3.1	MW	NRC	3.1	1269
1996	07	21	19	23	8	57.4950	-137.1820	5.0	3.8	MW	NRC	3.8	1270
1996	07	27	14	03	26	51.1910	-124.9310	0.0	2.9	MW	NRC	2.9	1271
1996	08	16	03	03	10	51.1030	-130.6920	10.0	3.3	ML	PGC	3.3	1272
1996	08	16	03	41	9	51.0620	-130.7480	10.0	5.2	MW	NRC	5.2	1273
1996	08	16	03	49	55	51.0810	-130.7270	10.0	3.2	ML	PGC	3.2	1274
1996	08	16	04	03	4	51.0930	-130.7500	10.0	3.2	ML	PGC	3.2	1275
1996	08	16	06	26	16	51.1180	-130.6470	10.0	3.1	MW	NRC	3.1	1276
1996	08	16	09	54	39	51.1380	-130.6710	10.0	4.8	MW	NRC	4.8	1277
1996	08	16	10	15	25	51.1520	-130.6080	10.0	3.2	ML	PGC	3.2	1278
1996	08	16	13	48	36	51.1360	-130.6710	10.0	3.3	ML	PGC	3.3	1279
1996	08	20	22	15	40	50.5200	-130.2210	10.0	3.2	MW	NRC	3.2	1280
1996	08	20	22	25	53	50.4890	-130.2660	10.0	3.2	MW	NRC	3.2	1281
1996	08	20	22	41	7	50.5080	-130.2650	10.0	4.1	MW	NRC	4.1	1282
1996	08	29	06	32	46	57.9040	-137.7670	0.0	3.2	MW	NRC	3.2	1283
1996	09	05	21	47	10	50.7190	-130.4200	10.0	3.3	MW	NRC	3.3	1284
1996	09	30	20	44	1	50.2320	-129.7060	10.0	3.1	ML	PGC	3.1	1285
1996	10	09	16	53	45	50.1640	-129.2170	33.0	3.9	MB	ISC	3.9	1286

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID
1996	10	13	19	27	38	50.0070	-129.3470	10.0	3.7	MB	ISC	3.7	1287
1996	11	06	06	55	46	50.4520	-130.1890	10.0	4.5	MW	NRC	4.5	1288
1996	11	25	13	19	15	55.3110	-134.9450	10.0	3.1	ML	PGC	3.1	1289
1996	12	02	21	54	31	50.1180	-129.0510	10.0	4.4	MB	ISC	4.4	1290
1996	12	03	16	30	19	50.5880	-130.2670	10.0	2.9	MW	NRC	2.9	1291
1996	12	10	01	08	3	54.0970	-131.7760	13.0	3.5	ML	PGC	3.5	1292
1996	12	10	22	52	33	54.0690	-131.7600	12.1	3.1	ML	PGC	3.1	1293
1996	12	24	12	40	36	51.8950	-131.6200	15.5	4.4	ML	PGC	4.4	1294
1996	12	29	03	42	16	51.1700	-130.2860	10.0	3.4	MB	GS	3.5	1295
1997	01	07	11	27	42	51.0390	-130.7120	10.0	3.5	ML	PGC	3.5	1296
1997	02	01	06	27	12	53.2920	-131.5640	11.6	3.1	MW	NRC	3.1	1297
1997	02	05	19	27	27	51.7000	-131.1000	33.0	4.7	ML	GIA	4.7	1298
1997	02	05	19	29	5	51.5550	-131.4640	29.1	5.3	MB	PGC	5.3	1299
1997	02	06	12	43	16	51.7620	-130.9670	10.0	3.9	MB	GS	3.9	1300
1997	02	06	12	45	36	51.6560	-131.1260	10.0	4.0	MB	GS	4.0	1301
1997	02	12	06	33	0	53.1670	-133.2500	18.0	3.2	MW	NRC	3.2	1302
1997	02	20	18	16	54	55.0400	-134.5260	10.0	3.5	MW	NRC	3.5	1303
1997	02	26	21	21	51	50.6940	-129.4740	10.0	3.7	MB	ISC	3.7	1304
1997	03	09	11	03	7	56.6180	-136.0170	10.0	3.8	ML	PGC	3.8	1305
1997	03	29	05	45	42	50.4750	-130.2120	10.0	4.5	MW	NRC	4.5	1306
1997	03	30	06	50	40	50.4830	-130.1960	10.0	4.5	MW	NRC	4.5	1307
1997	04	05	12	56	57	53.9380	-132.4480	10.0	3.7	MW	NRC	3.7	1308
1997	04	13	20	25	56	51.2990	-131.2370	10.0	4.9	MW	NRC	4.9	1309
1997	04	18	19	42	6	55.5200	-135.2610	0.0	3.3	ML	PGC	3.3	1310
1997	04	21	13	37	20	50.5110	-130.2570	10.0	3.3	MW	NRC	3.3	1311
1997	06	03	08	26	43	52.5680	-132.1620	18.0	2.9	MW	NRC	2.9	1312
1997	06	09	15	38	39	51.1930	-130.9830	10.0	3.0	MW	NRC	3.0	1313
1997	07	23	17	10	49	50.6730	-130.5360	10.0	3.3	MW	NRC	3.3	1314
1997	08	16	05	10	24	50.3840	-130.1780	10.0	3.0	ML	PGC	3.0	1315
1997	08	16	20	14	59	55.8160	-135.4650	0.0	3.0	MW	NRC	3.0	1316
1997	08	26	07	57	40	51.6500	-131.5340	10.0	3.1	ML	PGC	3.1	1317
1997	08	27	10	46	15	51.1970	-129.5830	10.0	3.5	MB	ISC	3.6	1318
1997	09	03	03	17	14	50.7970	-129.6910	10.0	3.2	ML	PGC	3.2	1319
1997	09	20	04	39	53	50.7580	-130.5740	10.0	5.3	MW	NRC	5.3	1320
1997	09	20	07	09	57	50.7750	-130.5620	10.0	5.3	MW	NRC	5.3	1321
1997	09	20	07	25	17	50.7600	-130.5320	10.0	3.5	ML	PGC	3.5	1322
1997	09	20	15	42	5	50.7460	-130.5790	10.0	2.9	MW	NRC	2.9	1323
1997	10	07	04	32	49	54.4130	-133.9110	18.0	3.1	MW	NRC	3.1	1324
1997	10	15	17	49	23	54.3720	-133.8810	18.0	3.2	MW	NRC	3.2	1325
1997	10	15	23	48	20	54.3830	-133.8610	18.0	3.3	ML	PGC	3.3	1326
1997	10	21	08	10	29	50.4120	-130.1680	10.0	4.6	MW	NRC	4.6	1327
1997	11	02	05	19	45	55.4180	-132.3820	0.0	3.3	MW	NRC	3.3	1328
1997	12	12	09	05	15	51.0480	-130.5830	10.0	3.7	MW	NRC	3.7	1329
1997	12	18	11	04	42	50.5140	-130.2600	10.0	3.1	ML	PGC	3.1	1330
1997	12	20	04	22	34	50.4430	-130.3360	10.0	4.7	MW	NRC	4.7	1331
1997	12	25	17	03	4	50.3880	-130.1720	10.0	2.9	MW	NRC	2.9	1332
1997	12	28	05	06	10	52.8340	-132.5530	18.0	3.7	MW	NRC	3.7	1333
1998	01	31	05	44	34	50.5320	-129.3180	10.0	3.0	MW	NRC	3.0	1334
1998	02	08	19	11	57	50.4930	-130.2710	10.0	4.5	MW	NRC	4.5	1335
1998	02	14	05	33	22	50.8420	-130.5250	10.0	3.1	ML	PGC	3.1	1336
1998	02	14	05	45	26	50.8450	-130.4840	10.0	4.5	MW	NRC	4.5	1337
1998	02	14	06	19	6	50.8550	-130.5110	10.0	4.6	MW	NRC	4.6	1338
1998	02	19	13	14	44	51.0250	-130.5350	10.0	3.1	ML	PGC	3.1	1339
1998	02	19	13	31	32	50.9740	-130.5010	10.0	3.1	MW	NRC	3.1	1340
1998	03	22	12	41	33	50.5120	-130.2950	10.0	3.1	ML	PGC	3.1	1341
1998	04	18	09	46	11	50.6880	-130.1140	10.0	3.6	MB	ISC	3.6	1342

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID
1998	04	28	09	53	39	57.7970	-137.6540	0.0	3.0	ML	PGC	3.0	1343
1998	06	14	18	04	19	53.1150	-132.6830	20.0	2.9	MW	NRC	2.9	1344
1998	06	25	22	51	55	50.2610	-130.0280	10.0	5.4	MW	HRV	5.4	1345
1998	06	26	03	39	52	50.0630	-130.2380	10.0	3.3	MW	NRC	3.3	1346
1998	07	10	03	05	28	50.5460	-130.3190	10.0	4.1	MW	NRC	4.1	1347
1998	07	31	06	45	37	51.3440	-130.7830	10.0	3.0	MW	NRC	3.0	1348
1998	07	31	07	20	39	51.3250	-130.7890	10.0	2.9	MW	NRC	2.9	1349
1998	07	31	07	40	28	51.3600	-130.7760	10.0	4.7	MW	NRC	4.7	1350
1998	07	31	08	18	1	51.3330	-130.7890	10.0	4.3	MW	NRC	4.3	1351
1998	08	06	02	43	38	52.1250	-131.6340	20.0	4.4	MW	NRC	4.4	1352
1998	08	06	03	18	50	52.1500	-131.6260	20.0	3.2	MW	NRC	3.2	1353
1998	08	16	19	25	20	50.0120	-130.2320	10.0	4.3	MW	NRC	4.3	1354
1998	08	16	20	19	39	50.0230	-130.2150	10.0	3.2	ML	PGC	3.2	1355
1998	08	18	08	07	54	53.8410	-131.6230	3.2	3.4	MW	NRC	3.4	1356
1998	08	19	04	39	7	50.3840	-130.3290	10.0	4.9	MW	NRC	4.9	1357
1998	08	19	05	04	57	50.4410	-130.1830	10.0	2.9	ML	PGC	2.9	1358
1998	08	27	02	54	35	57.7700	-136.5000	5.0	3.9	ML	AEI	3.9	1359
1998	08	30	11	33	33	50.9090	-130.6390	10.0	6.2	MW	NRC	6.2	1360
1998	08	30	11	43	51	50.9360	-130.5350	10.0	3.3	ML	PGC	3.3	1361
1998	08	30	11	49	40	50.9090	-130.5970	10.0	3.1	MW	NRC	3.1	1362
1998	08	30	12	56	24	50.9100	-130.7120	10.0	3.0	ML	PGC	3.0	1363
1998	08	30	12	58	33	50.9020	-130.6750	10.0	3.0	MW	NRC	3.0	1364
1998	08	30	15	29	58	50.8710	-130.7330	10.0	3.3	ML	PGC	3.3	1365
1998	08	30	15	38	36	50.9140	-130.6350	10.0	3.1	ML	PGC	3.1	1366
1998	08	31	21	48	54	50.7500	-130.5290	10.0	3.0	MW	NRC	3.0	1367
1998	09	01	07	43	1	50.8930	-130.6880	10.0	4.3	MW	NRC	4.3	1368
1998	09	01	12	02	32	50.9130	-130.6350	10.0	3.0	MW	NRC	3.0	1369
1998	09	01	14	52	2	50.6940	-130.5350	10.0	3.1	ML	PGC	3.1	1370
1998	09	01	16	18	39	50.7290	-130.5580	10.0	3.6	MW	NRC	3.6	1371
1998	09	01	18	12	49	50.7310	-130.5770	10.0	4.8	MW	NRC	4.8	1372
1998	09	03	10	54	34	53.9000	-131.6440	17.6	3.6	ML	PGC	3.6	1373
1998	09	06	09	26	14	53.8350	-131.5700	1.0	3.0	MW	NRC	3.0	1374
1998	09	09	14	48	41	54.1580	-133.9370	20.0	4.6	ML	PGC	4.6	1375
1998	09	13	17	04	12	56.3210	-136.0970	10.0	3.7	MW	NRC	3.7	1376
1998	09	24	00	00	58	50.2200	-129.7580	10.0	4.1	MB	GS	4.1	1377
1998	09	29	07	42	52	50.0190	-130.0890	10.0	3.1	ML	PGC	3.1	1378
1998	10	15	11	29	30	50.6090	-130.5130	10.0	3.3	MW	NRC	3.3	1379
1998	10	18	15	08	17	50.4950	-130.2560	10.0	2.9	ML	PGC	2.9	1380
1998	11	07	20	51	24	50.5220	-130.3950	10.0	3.0	ML	PGC	3.0	1381
1998	11	24	13	50	47	50.4610	-130.3290	10.0	3.1	MW	NRC	3.1	1382
1998	12	16	05	54	2	55.4720	-135.1390	10.0	4.6	MB	ISC	4.6	1383
1999	01	12	14	41	18	50.2220	-129.7440	10.0	3.4	ML	PGC	3.4	1384
1999	01	17	21	23	19	50.1890	-129.7100	10.0	3.0	ML	PGC	3.0	1385
1999	01	24	12	20	8	50.1030	-130.0090	10.0	4.0	MB	ISC	4.0	1386
1999	02	01	19	24	56	50.2470	-129.3930	10.0	3.5	MB	ISC	3.6	1387
1999	02	08	00	40	9	50.1660	-129.6200	10.0	3.1	ML	PGC	3.1	1388
1999	02	19	17	02	20	50.5570	-130.3680	10.0	2.9	MW	NRC	2.9	1389
1999	02	20	20	16	38	57.1950	-136.3080	0.0	3.8	ML	PGC	3.8	1390
1999	02	25	20	42	10	50.5520	-130.0560	10.0	3.3	MB	ISC	3.4	1391
1999	03	07	03	42	14	53.3910	-131.4760	5.2	3.8	MW	NRC	3.8	1392
1999	03	07	23	07	6	52.7430	-132.1160	20.0	3.6	ML	PGC	3.6	1393
1999	03	18	06	00	3	50.5730	-130.3060	10.0	2.9	ML	PGC	2.9	1394
1999	04	04	19	47	22	50.6610	-130.4930	10.0	3.2	MW	NRC	3.2	1395
1999	04	17	11	33	5	50.4890	-130.2520	10.0	4.7	MW	NRC	4.7	1396
1999	04	17	12	21	40	50.5050	-130.2820	10.0	4.5	MW	NRC	4.5	1397
1999	05	22	12	47	24	52.5780	-132.9630	10.0	3.4	MW	NRC	3.4	1398

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID
1999	05	27	11	09	8	53.5020	-133.4570	20.0	3.0	MW	NRC	3.0	1399
1999	05	27	11	54	8	52.2050	-133.8160	20.0	2.9	MW	NRC	2.9	1400
1999	06	20	19	55	3	52.6030	-132.1420	0.0	3.2	ML	PGC	3.2	1401
1999	07	06	03	24	46	55.6200	-135.4390	10.0	2.9	MW	NRC	2.9	1402
1999	07	07	11	53	16	57.7030	-133.7740	5.0	3.2	ML	PGC	3.2	1403
1999	07	19	08	39	48	52.2260	-132.0080	20.0	3.2	ML	PGC	3.2	1404
1999	07	22	12	07	42	50.7100	-130.5560	10.0	4.2	MW	NRC	4.2	1405
1999	08	16	13	17	50	52.6850	-132.0260	20.0	3.1	MW	NRC	3.1	1406
1999	09	10	03	18	47	53.5040	-131.5870	6.0	3.0	MW	NRC	3.0	1407
1999	09	12	12	15	42	50.6730	-130.5880	10.0	3.4	MW	NRC	3.4	1408
1999	09	14	13	36	5	55.3390	-134.5400	10.0	2.9	ML	PGC	2.9	1409
1999	10	05	16	22	41	53.3980	-131.4240	1.1	3.6	MW	NRC	3.6	1410
1999	10	07	12	03	3	50.5350	-130.3670	10.0	4.2	MW	NRC	4.2	1411
1999	10	14	08	29	25	50.4670	-130.2140	10.0	4.4	MW	NRC	4.4	1412
1999	10	19	05	49	0	58.0000	-136.9600	0.0	4.7	ML	PMR	4.7	1413
1999	10	27	01	12	33	57.3320	-136.2040	10.0	3.3	ML	PGC	3.3	1414
1999	11	06	02	50	49	50.6420	-130.4340	10.0	3.2	ML	PGC	3.2	1415
1999	11	11	13	09	33	50.7630	-130.4710	10.0	2.9	MW	NRC	2.9	1416
1999	12	06	05	01	37	52.3340	-131.7390	20.0	3.2	MW	NRC	3.2	1417
1999	12	08	21	25	6	50.2780	-130.1840	10.0	3.0	ML	PGC	3.0	1418
1999	12	12	16	37	59	51.3240	-131.0740	10.0	4.8	MW	NRC	4.8	1419
1999	12	13	02	05	11	57.9720	-137.9470	0.0	2.9	ML	PGC	2.9	1420
1999	12	16	21	40	43	54.6820	-130.4730	10.0	2.9	MW	NRC	2.9	1421
1999	12	17	10	08	37	51.2290	-124.1920	20.0	3.4	ML	PGC	3.4	1422
2000	01	03	12	26	40	50.4760	-130.3270	10.0	4.3	MW	NRC	4.3	1423
2000	01	03	15	24	16	50.6310	-130.2190	10.0	3.6	MB	ISC	3.6	1424
2000	01	12	18	13	59	54.2130	-133.9710	20.0	2.9	ML	PGC	2.9	1425
2000	01	12	19	41	36	54.2320	-133.9960	20.0	2.9	ML	PGC	2.9	1426
2000	01	13	00	55	25	54.1510	-133.8750	20.0	3.5	ML	PGC	3.5	1427
2000	01	18	06	56	7	50.5330	-130.3620	10.0	4.5	MW	NRC	4.5	1428
2000	01	23	05	53	58	52.2460	-131.8390	20.0	4.3	MW	NRC	4.3	1429
2000	01	26	06	44	20	50.4430	-130.2020	10.0	3.5	MW	NRC	3.5	1430
2000	02	10	18	09	30	50.0720	-130.0670	10.0	2.9	ML	PGC	2.9	1431
2000	02	14	06	43	23	50.5740	-130.4080	10.0	3.4	MW	NRC	3.4	1432
2000	03	09	17	25	42	50.9600	-130.5960	10.0	2.9	ML	PGC	2.9	1433
2000	03	15	14	32	27	52.4660	-131.8410	20.0	2.9	MW	NRC	2.9	1434
2000	03	28	02	14	53	50.7120	-130.4770	10.0	3.1	ML	PGC	3.1	1435
2000	03	28	03	29	17	50.7020	-130.4830	10.0	3.0	ML	PGC	3.0	1436
2000	04	01	02	28	35	50.5440	-130.3470	10.0	4.2	MW	NRC	4.2	1437
2000	04	09	12	32	0	55.1480	-134.9230	10.0	3.0	ML	PGC	3.0	1438
2000	04	12	22	21	30	50.5300	-130.2800	10.0	3.2	ML	PGC	3.2	1439
2000	04	29	14	37	39	50.3120	-130.2250	10.0	3.0	ML	PGC	3.0	1440
2000	04	29	17	21	46	50.8450	-130.5550	10.0	3.0	MW	NRC	3.0	1441
2000	04	30	01	11	39	50.3920	-130.0340	10.0	3.2	MB	ISC	3.3	1442
2000	04	30	01	55	14	50.8400	-130.5900	10.0	3.9	ML	PGC	3.9	1443
2000	04	30	01	58	28	50.9950	-130.4840	10.0	3.3	MS	ISC	3.3	1444
2000	04	30	05	47	22	50.8270	-130.6060	10.0	3.9	MW	NRC	3.9	1445
2000	04	30	05	49	25	50.7560	-130.6580	10.0	4.6	MW	NRC	4.6	1446
2000	04	30	07	12	4	50.8300	-130.6660	10.0	3.1	ML	PGC	3.1	1447
2000	04	30	08	29	25	50.8270	-130.6440	10.0	5.4	MW	NRC	5.4	1448
2000	04	30	09	47	30	50.8900	-130.5710	10.0	3.7	MW	NRC	3.7	1449
2000	04	30	10	13	0	50.5230	-130.9310	10.0	5.7	MW	NRC	5.7	1450
2000	04	30	10	23	38	50.8540	-130.4010	10.0	2.9	MW	NRC	2.9	1451
2000	04	30	10	54	6	51.3750	-129.9170	10.0	5.1	MW	NRC	5.1	1452
2000	04	30	12	40	3	50.9180	-130.4410	10.0	3.0	ML	PGC	3.0	1453
2000	04	30	18	01	47	50.8800	-130.4990	10.0	3.0	ML	PGC	3.0	1454

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID
2000	05	01	11	10	14	50.6210	-130.5190	10.0	4.7	MW	NRC	4.7	1455
2000	05	02	06	41	50	50.8520	-130.5240	10.0	2.9	MW	NRC	2.9	1456
2000	05	02	14	30	24	50.8090	-130.6490	10.0	3.1	ML	PGC	3.1	1457
2000	05	08	23	09	34	52.5070	-131.9420	20.0	3.9	MW	NRC	3.9	1458
2000	05	13	12	28	42	50.6810	-130.3080	10.0	3.7	MB	ISC	3.7	1459
2000	05	14	20	01	19	50.2400	-129.6000	10.0	4.4	MB	ISC	4.4	1460
2000	05	14	22	39	10	50.0120	-130.0820	10.0	3.5	MB	ISC	3.6	1461
2000	05	15	00	33	8	50.0300	-130.0550	10.0	4.2	MB	ISC	4.2	1462
2000	05	15	03	49	59	50.4170	-129.5360	24.3	4.0	MB	ISC	4.0	1463
2000	05	15	05	12	57	50.3290	-129.6350	10.0	4.7	MB	ISC	4.7	1464
2000	05	15	05	24	38	50.2460	-130.0250	10.0	4.1	MB	ISC	4.1	1465
2000	05	15	07	06	1	50.0510	-130.1430	10.0	4.4	MW	NRC	4.4	1466
2000	05	15	07	11	48	50.1100	-130.2800	15.0	5.5	MW	HRV	5.5	1467
2000	05	15	07	23	46	50.0710	-130.2900	10.0	4.1	MB	ISC	4.1	1468
2000	05	15	07	26	32	50.0580	-130.2030	10.0	3.0	ML	PGC	3.0	1469
2000	05	15	07	49	39	50.0320	-130.2130	10.0	4.4	MW	NRC	4.4	1470
2000	05	15	07	53	18	50.0470	-130.1990	10.0	3.2	MW	NRC	3.2	1471
2000	05	15	08	51	9	50.0720	-130.2130	10.0	2.9	ML	PGC	2.9	1472
2000	05	15	09	04	47	50.1740	-130.2670	10.0	3.4	MB	ISC	3.5	1473
2000	05	15	09	40	47	50.1210	-130.0480	10.0	3.5	MB	ISC	3.6	1474
2000	05	15	09	56	36	50.2120	-129.5780	10.0	3.5	MB	ISC	3.6	1475
2000	05	15	10	10	52	50.1340	-130.1640	10.0	4.1	MB	ISC	4.1	1476
2000	05	15	13	52	22	50.0270	-130.1170	10.0	3.0	ML	PGC	3.0	1477
2000	05	25	13	14	40	50.4860	-130.2500	10.0	2.9	MW	NRC	2.9	1478
2000	05	26	15	51	29	51.4830	-130.7850	10.0	3.0	ML	PGC	3.0	1479
2000	05	26	15	55	35	51.5380	-130.7500	10.0	2.9	MW	NRC	2.9	1480
2000	05	26	16	12	29	51.4460	-130.7740	10.0	3.3	MW	NRC	3.3	1481
2000	05	26	16	37	23	51.5040	-130.7700	10.0	3.5	MW	NRC	3.5	1482
2000	05	27	18	49	59	51.4800	-130.7770	10.0	3.5	MW	NRC	3.5	1483
2000	05	27	22	53	38	51.5240	-130.7650	10.0	3.0	ML	PGC	3.0	1484
2000	05	27	23	14	59	51.3190	-131.0860	10.0	3.1	ML	PGC	3.1	1485
2000	05	27	23	26	31	51.3460	-131.0500	10.0	2.9	ML	PGC	2.9	1486
2000	06	01	13	08	47	51.8020	-131.6090	20.0	3.6	MW	NRC	3.6	1487
2000	06	08	23	27	22	50.1910	-130.3040	10.0	3.0	MW	NRC	3.0	1488
2000	06	09	21	25	14	50.0700	-130.4320	10.0	4.6	MW	NRC	4.6	1489
2000	06	10	03	56	34	50.1800	-130.2900	10.0	3.9	MB	GS	3.9	1490
2000	06	10	15	04	43	50.5140	-130.4170	10.0	5.0	MW	NRC	5.0	1491
2000	06	14	23	52	42	50.5890	-130.4090	10.0	3.1	MW	NRC	3.1	1492
2000	06	25	00	49	26	51.1570	-131.1790	10.0	3.4	ML	PGC	3.4	1493
2000	07	06	00	02	48	57.9140	-133.9070	1.0	3.0	ML	PGC	3.0	1494
2000	07	07	01	13	18	57.9680	-133.9050	1.0	3.1	ML	PGC	3.1	1495
2000	07	07	17	49	29	57.4930	-134.2100	1.0	2.9	ML	PGC	2.9	1496
2000	07	19	16	11	44	51.0480	-130.7090	10.0	3.1	MW	NRC	3.1	1497
2000	08	01	11	01	11	57.9210	-133.7920	1.0	2.9	MW	NRC	2.9	1498
2000	08	01	14	19	59	50.0490	-129.9040	10.0	4.0	MB	ISC	4.0	1499
2000	08	01	14	23	13	50.0700	-129.8460	10.0	4.0	MB	ISC	4.0	1500
2000	08	01	15	33	58	50.0750	-129.8600	10.0	3.2	MS	ISC	3.2	1501
2000	08	15	04	29	52	55.3410	-134.8340	20.0	3.1	MW	NRC	3.1	1502
2000	09	09	09	12	49	52.1810	-131.7090	20.0	2.9	MW	NRC	2.9	1503
2000	09	16	03	42	48	50.2250	-129.8150	10.0	3.0	ML	PGC	3.0	1504
2000	09	16	03	50	49	50.2180	-129.8210	10.0	3.2	MW	NRC	3.2	1505
2000	09	27	03	45	45	50.4940	-130.4840	10.0	4.9	MW	NRC	4.9	1506
2000	09	27	04	20	43	50.5500	-130.3630	10.0	3.0	ML	PGC	3.0	1507
2000	10	11	14	33	33	50.4960	-128.9620	10.0	3.2	ML	PGC	3.2	1508
2000	10	17	02	20	54	50.6040	-130.4270	10.0	3.5	ML	PGC	3.5	1509
2000	10	19	09	29	27	50.4280	-130.1820	10.0	4.8	MW	NRC	4.8	1510

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID
2000	10	19	12	10	40	53.8710	-133.4980	20.0	3.3	ML	PGC	3.3	1511
2000	10	22	09	53	0	51.3370	-130.9660	10.0	4.0	MW	NRC	4.0	1512
2000	10	22	10	24	7	51.4650	-130.6590	10.0	3.3	MW	NRC	3.3	1513
2000	11	04	13	57	30	50.0630	-130.2070	10.0	3.2	ML	PGC	3.2	1514
2000	11	11	16	21	10	56.3830	-131.0720	1.0	3.4	MW	NRC	3.4	1515
2000	11	19	00	11	49	50.7780	-130.4910	10.0	2.9	ML	PGC	2.9	1516
2000	11	19	01	46	46	50.7220	-130.5250	10.0	3.4	MW	NRC	3.4	1517
2000	11	19	05	12	24	50.7230	-130.5410	10.0	3.4	MW	NRC	3.4	1518
2000	11	19	20	38	44	50.7640	-130.4460	10.0	4.8	MW	NRC	4.8	1519
2000	11	19	22	14	30	50.7460	-130.4600	10.0	4.9	MW	NRC	4.9	1520
2000	11	20	00	41	39	50.7810	-130.4230	10.0	3.0	ML	PGC	3.0	1521
2000	11	20	02	49	1	50.7980	-130.4580	10.0	3.2	ML	PGC	3.2	1522
2000	11	20	05	06	0	50.7880	-130.4850	10.0	3.1	ML	PGC	3.1	1523
2000	11	20	05	15	14	50.8250	-130.4070	10.0	4.0	MW	NRC	4.0	1524
2000	11	20	14	04	46	50.5650	-130.3560	10.0	4.0	MW	NRC	4.0	1525
2000	11	20	19	17	52	50.7870	-130.3830	10.0	2.9	ML	PGC	2.9	1526
2000	11	21	05	24	24	50.3940	-130.2670	10.0	3.0	ML	PGC	3.0	1527
2000	11	21	10	11	31	50.3770	-130.2810	10.0	3.4	ML	PGC	3.4	1528
2000	11	21	11	13	38	50.4020	-130.2220	10.0	3.2	MW	NRC	3.2	1529
2000	11	22	20	59	51	50.8170	-130.4160	10.0	3.2	ML	PGC	3.2	1530
2000	11	23	03	05	15	50.7910	-130.4100	10.0	3.0	ML	PGC	3.0	1531
2000	11	25	15	00	33	50.9830	-130.8150	10.0	3.4	ML	PGC	3.4	1532
2000	11	25	16	40	9	51.0610	-130.6920	10.0	4.3	MW	NRC	4.3	1533
2000	11	25	16	49	46	51.1000	-130.6630	10.0	3.2	ML	PGC	3.2	1534
2000	11	27	11	46	12	51.0760	-130.6470	10.0	4.8	MW	NRC	4.8	1535
2000	11	27	12	20	44	50.8550	-131.0780	10.0	3.3	ML	PGC	3.3	1536
2000	11	27	12	52	53	50.9530	-130.8430	10.0	3.0	MW	NRC	3.0	1537
2000	11	27	14	21	34	51.0200	-130.7360	10.0	4.2	MW	NRC	4.2	1538
2000	11	27	17	36	5	51.0460	-130.7330	10.0	3.3	ML	PGC	3.3	1539
2000	11	28	12	53	8	50.9990	-130.8130	10.0	3.0	ML	PGC	3.0	1540
2000	12	04	19	49	18	50.6500	-130.5450	10.0	3.9	MW	NRC	3.9	1541
2000	12	18	02	57	4	50.6060	-130.4340	10.0	3.1	ML	PGC	3.1	1542
2001	01	16	22	26	49	53.4600	-133.2670	20.0	3.5	MW	NRC	3.5	1543
2001	01	17	18	23	26	50.5040	-130.3410	10.0	3.8	MW	NRC	3.8	1544
2001	01	19	18	28	41	50.4810	-130.2340	10.0	3.3	ML	PGC	3.3	1545
2001	01	19	18	39	49	50.4800	-130.2750	10.0	3.1	ML	PGC	3.1	1546
2001	01	19	23	07	33	50.4470	-130.3560	10.0	3.1	MW	NRC	3.1	1547
2001	01	20	00	14	23	50.4930	-130.3620	10.0	5.5	MW	NRC	5.5	1548
2001	01	20	00	17	54	50.5080	-130.2440	10.0	3.8	ML	PGC	3.8	1549
2001	01	20	00	20	52	50.5170	-130.2600	10.0	3.2	MW	NRC	3.2	1550
2001	01	20	00	25	49	50.5130	-130.2470	10.0	3.4	ML	PGC	3.4	1551
2001	01	20	00	27	2	50.4830	-130.2330	10.0	3.0	ML	PGC	3.0	1552
2001	01	20	01	40	47	50.5120	-130.2530	10.0	3.1	ML	PGC	3.1	1553
2001	01	22	01	06	52	50.4370	-130.3120	10.0	3.0	MW	NRC	3.0	1554
2001	02	03	01	51	22	50.5010	-129.5440	10.0	3.6	MB	ISC	3.6	1555
2001	02	06	01	21	45	50.5500	-130.3870	10.0	3.9	MW	NRC	3.9	1556
2001	02	11	23	59	53	53.9110	-133.8110	1.0	4.1	MW	NRC	4.1	1557
2001	02	12	22	40	58	50.5240	-130.2800	10.0	4.5	MW	NRC	4.5	1558
2001	02	17	20	11	28	54.0200	-133.6960	20.0	6.3	MW	NRC	6.3	1559
2001	02	17	20	39	14	53.9430	-133.5160	20.0	5.0	MW	NRC	5.0	1560
2001	02	17	21	17	16	54.1760	-133.4180	10.0	4.1	MB	GS	4.1	1561
2001	02	17	21	19	5	53.9980	-133.6080	10.0	5.1	MS	ISC	5.0	1562
2001	02	17	23	59	53	53.9100	-133.8100	1.0	4.3	ML	PMR	4.3	1563
2001	02	19	16	27	8	53.9010	-133.5940	20.0	3.2	ML	PGC	3.2	1564
2001	02	19	17	53	34	54.0530	-133.7430	20.0	3.0	MW	NRC	3.0	1565
2001	03	02	10	03	14	52.3500	-132.0210	20.0	3.1	MW	NRC	3.1	1566

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID
2001	03	07	23	47	29	51.1880	-131.1570	10.0	3.0	ML	PGC	3.0	1567
2001	03	21	07	51	5	50.4020	-130.2130	10.0	4.4	MW	PGC	4.4	1568
2001	03	24	20	16	26	55.1890	-134.7270	1.0	3.9	MW	NRC	3.9	1569
2001	04	01	06	39	55	53.9320	-133.8440	10.0	4.0	MW	PGC	4.0	1570
2001	04	06	21	16	57	50.3400	-130.1900	10.0	4.0	MB	GS	4.0	1571
2001	04	07	00	45	19	50.5520	-129.8000	10.0	3.8	MB	ISC	3.8	1572
2001	04	10	09	36	6	50.4760	-130.4040	10.0	5.3	MW	PGC	5.3	1573
2001	04	10	09	43	5	50.5920	-130.3290	10.0	3.2	MW	NRC	3.2	1574
2001	04	11	05	13	12	55.3950	-137.7440	10.0	3.4	MW	NRC	3.4	1575
2001	04	14	05	08	9	53.6550	-131.6930	8.5	2.9	ML	PGC	2.9	1576
2001	04	19	01	42	56	50.5410	-130.3480	10.0	4.4	MW	NRC	4.4	1577
2001	04	21	21	20	47	50.5690	-130.3840	10.0	3.5	MW	NRC	3.5	1578
2001	05	05	04	56	25	50.1080	-129.6990	10.0	4.0	MB	ISC	4.0	1579
2001	05	07	00	03	25	50.5280	-130.2780	10.0	3.1	MW	NRC	3.1	1580
2001	05	16	04	21	7	50.4180	-130.2260	10.0	4.8	MW	PGC	4.8	1581
2001	05	16	09	26	40	51.6660	-130.8350	10.0	2.9	MW	NRC	2.9	1582
2001	05	17	07	48	44	53.8400	-133.4870	20.0	3.2	ML	PGC	3.2	1583
2001	05	20	10	04	27	50.4720	-130.2100	10.0	4.6	MW	NRC	4.6	1584
2001	05	20	10	10	4	50.4810	-130.2400	10.0	4.1	MW	PGC	4.1	1585
2001	05	20	11	30	55	50.4640	-130.2360	10.0	4.1	MW	PGC	4.1	1586
2001	05	20	13	01	9	50.4650	-130.2210	10.0	4.3	MW	PGC	4.3	1587
2001	05	25	06	14	23	54.7990	-134.5290	20.0	3.1	MW	NRC	3.1	1588
2001	05	26	17	46	55	55.4030	-135.1570	20.0	3.1	MW	NRC	3.1	1589
2001	06	01	04	44	50	54.7950	-134.5730	20.0	2.9	MW	NRC	2.9	1590
2001	06	17	04	17	52	56.6380	-136.1960	10.0	3.2	MW	NRC	3.2	1591
2001	06	17	14	08	2	50.5800	-130.3190	10.0	3.0	ML	PGC	3.0	1592
2001	06	27	06	45	12	50.4980	-130.2370	10.0	3.9	MW	NRC	3.9	1593
2001	06	30	10	01	20	51.4680	-131.1260	10.0	3.1	ML	PGC	3.1	1594
2001	07	01	00	55	58	56.1990	-134.8650	1.0	3.0	MW	NRC	3.0	1595
2001	07	09	03	26	47	50.5830	-130.3580	10.0	4.9	MW	NRC	4.9	1596
2001	07	09	09	26	19	56.2050	-135.0800	15.0	4.9	MW	NRC	4.9	1597
2001	07	10	03	43	8	50.4490	-130.0640	10.0	3.2	MB	ISC	3.3	1598
2001	08	05	11	11	42	50.0090	-130.2460	10.0	4.7	MW	NRC	4.7	1599
2001	08	07	20	53	14	50.4720	-130.1730	10.0	3.0	ML	PGC	3.0	1600
2001	08	12	06	37	13	50.5760	-130.4360	10.0	3.1	MW	NRC	3.1	1601
2001	08	13	02	03	53	50.4190	-130.1000	10.0	2.9	MW	NRC	2.9	1602
2001	09	02	08	52	31	53.9290	-133.5460	20.0	2.9	MW	NRC	2.9	1603
2001	09	02	22	09	31	52.7720	-132.3350	20.0	2.9	MW	NRC	2.9	1604
2001	09	09	09	32	13	50.4270	-130.1930	10.0	3.4	MW	NRC	3.4	1605
2001	09	09	10	24	35	50.4130	-130.1570	10.0	3.2	MW	NRC	3.2	1606
2001	09	13	02	21	20	52.6210	-132.9690	20.0	3.0	ML	PGC	3.0	1607
2001	09	16	16	11	25	56.6300	-136.0990	10.0	4.1	MW	NRC	4.1	1608
2001	10	11	08	48	49	50.0000	-130.1300	10.0	4.4	MB	GS	4.4	1609
2001	10	12	05	02	35	52.6600	-132.1260	20.0	6.3	MW	NRC	6.3	1610
2001	10	12	05	12	39	52.6880	-132.1840	20.0	3.2	MW	NRC	3.2	1611
2001	10	12	05	15	41	52.6800	-132.1500	20.0	3.2	MW	NRC	3.2	1612
2001	10	12	05	27	17	52.6330	-132.3220	20.0	4.7	MW	NRC	4.7	1613
2001	10	12	05	40	33	52.5890	-132.2820	20.0	2.9	MW	NRC	2.9	1614
2001	10	12	06	05	44	52.6140	-132.1930	20.0	3.7	MW	NRC	3.7	1615
2001	10	12	06	07	36	52.5730	-132.3120	20.0	3.4	MW	NRC	3.4	1616
2001	10	12	06	22	25	52.6050	-132.2850	20.0	2.9	MW	NRC	2.9	1617
2001	10	12	09	48	40	52.7060	-132.1370	20.0	3.8	MW	NRC	3.8	1618
2001	10	12	11	30	44	52.5560	-132.2210	20.0	2.9	MW	NRC	2.9	1619
2001	10	12	20	27	13	52.5750	-132.1320	20.0	2.9	MW	NRC	2.9	1620
2001	10	12	20	33	55	52.5970	-132.1780	20.0	3.5	MW	NRC	3.5	1621
2001	10	12	21	23	5	52.6150	-132.1260	20.0	2.9	ML	PGC	2.9	1622

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID
2001	10	13	00	01	43	52.5540	-132.1680	20.0	2.9	MW	NRC	2.9	1623
2001	10	13	17	41	35	52.5900	-132.2080	20.0	2.9	MW	NRC	2.9	1624
2001	10	14	01	40	6	52.7020	-131.9780	20.0	2.9	ML	PGC	2.9	1625
2001	10	15	19	18	38	52.6210	-132.2660	20.0	3.0	MW	NRC	3.0	1626
2001	10	15	21	43	20	52.6850	-132.1210	20.0	3.0	MW	NRC	3.0	1627
2001	10	18	00	17	11	52.5510	-132.2060	20.0	3.3	MW	NRC	3.3	1628
2001	10	18	08	32	10	53.0610	-132.8090	20.0	3.2	MW	NRC	3.2	1629
2001	10	18	20	17	7	52.7730	-131.9210	20.0	3.1	ML	PGC	3.1	1630
2001	10	20	00	18	54	50.0550	-127.7790	38.3	4.1	MW	NRC	4.1	1631
2001	11	10	23	46	20	50.2690	-130.2540	10.0	3.1	ML	PGC	3.1	1632
2001	11	10	23	49	19	50.2580	-130.2430	10.0	3.1	ML	PGC	3.1	1633
2001	11	11	01	20	45	50.2820	-130.1310	10.0	3.0	ML	PGC	3.0	1634
2001	11	11	01	31	50	50.4000	-129.7690	10.0	3.8	MB	ISC	3.8	1635
2001	11	11	02	56	58	50.2650	-130.2100	10.0	3.0	MW	NRC	3.0	1636
2001	11	12	09	13	38	50.2500	-130.3380	10.0	2.9	ML	PGC	2.9	1637
2001	11	12	20	52	43	50.6700	-130.5650	10.0	3.8	MW	NRC	3.8	1638
2001	11	21	18	28	15	52.7840	-132.4240	20.0	2.9	MW	NRC	2.9	1639
2001	12	19	02	59	47	52.4450	-131.7730	20.0	3.1	MW	NRC	3.1	1640
2001	12	20	13	06	23	50.9410	-130.6470	10.0	3.2	MW	NRC	3.2	1641
2001	12	20	13	10	13	50.9430	-130.8440	10.0	3.0	MW	NRC	3.0	1642
2001	12	21	19	37	25	53.8240	-133.3740	20.0	3.1	ML	PGC	3.1	1643
2001	12	23	20	47	17	50.5710	-130.3280	10.0	2.9	ML	PGC	2.9	1644
2001	12	25	20	28	18	55.3620	-133.0660	10.0	3.1	MW	NRC	3.1	1645
2002	01	05	18	13	56	50.5100	-130.3400	10.0	4.3	MW	PGC	4.3	1646
2002	01	12	04	54	22	51.1250	-130.7560	10.0	3.0	MW	NRC	3.0	1647
2002	01	16	05	46	27	51.7760	-130.8240	20.0	3.0	MW	NRC	3.0	1648
2002	01	18	04	37	58	55.8740	-135.1330	20.0	3.0	MW	NRC	3.0	1649
2002	01	23	21	14	33	50.7400	-130.5100	10.0	4.3	MW	NRC	4.3	1650
2002	01	28	11	41	26	50.2700	-130.2400	10.0	4.7	MW	PGC	4.7	1651
2002	02	04	09	47	20	52.5840	-132.1940	20.0	3.5	MW	NRC	3.5	1652
2002	02	19	08	01	47	52.6630	-132.1280	20.0	3.3	MW	NRC	3.3	1653
2002	02	20	03	17	14	51.1300	-131.1000	10.0	5.1	MW	PGC	5.1	1654
2002	02	23	08	33	18	50.0350	-129.9460	10.0	3.5	MB	ISC	3.6	1655
2002	02	25	11	51	5	50.9990	-130.5670	10.0	3.3	ML	PGC	3.3	1656
2002	03	21	23	18	37	51.0570	-130.9570	10.0	4.2	MW	NRC	4.2	1657
2002	04	04	04	29	8	50.5290	-130.4140	10.0	5.0	MW	PGC	5.0	1658
2002	04	08	05	08	14	54.0040	-133.6550	20.0	3.2	ML	PGC	3.2	1659
2002	05	11	17	04	48	51.1210	-130.7310	10.0	3.4	ML	PGC	3.4	1660
2002	05	13	03	32	51	50.4600	-130.2560	10.0	4.9	MW	NRC	4.9	1661
2002	06	01	05	59	19	57.2650	-134.7900	10.0	2.9	ML	PGC	2.9	1662
2002	06	06	15	37	54	50.0810	-130.2860	10.0	4.7	MW	NRC	4.7	1663
2002	06	09	07	11	39	50.8440	-129.7480	10.0	3.6	MW	NRC	3.6	1664
2002	06	10	13	00	47	51.0200	-130.6200	10.0	4.3	MB	GS	4.3	1665
2002	06	12	10	42	16	54.3460	-131.7490	1.0	3.0	MW	NRC	3.0	1666
2002	06	22	15	08	33	56.5900	-136.1500	1.0	3.8	ML	PMR	3.8	1667
2002	06	23	15	39	19	57.1800	-137.2600	10.0	4.0	ML	PMR	4.0	1668
2002	06	29	06	40	39	52.8400	-132.2600	20.0	4.1	MB	GS	4.1	1669
2002	07	03	14	34	51	50.5130	-130.3440	10.0	3.7	MW	NRC	3.7	1670
2002	07	06	16	04	58	51.0630	-130.6420	10.0	2.9	MW	NRC	2.9	1671
2002	07	10	03	53	40	57.6570	-137.5430	5.0	3.2	ML	PGC	3.2	1672
2002	07	10	10	48	34	50.5490	-130.3850	10.0	3.3	ML	PGC	3.3	1673
2002	08	06	10	51	55	54.0650	-133.6410	20.0	3.2	MW	NRC	3.2	1674
2002	08	16	09	38	49	52.7040	-132.2920	20.0	3.3	MW	NRC	3.3	1675
2002	09	05	11	29	5	54.0770	-133.7750	20.0	5.2	MW	PGC	5.2	1676
2002	09	14	14	56	2	52.5590	-132.0270	20.0	3.3	ML	PGC	3.3	1677
2002	10	13	15	57	54	50.0880	-129.4730	10.0	4.0	MB	ISC	4.0	1678

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID
2002	10	16	22	12	6	50.0410	-129.4640	15.0	3.9	MB	ISC	3.9	1679
2002	10	16	22	32	46	50.0420	-129.5130	15.0	4.3	MB	ISC	4.3	1680
2002	10	18	15	11	32	50.0480	-129.7240	10.0	4.0	MB	ISC	4.0	1681
2002	10	19	00	26	54	50.4720	-130.1320	10.0	2.9	ML	PGC	2.9	1682
2002	10	24	08	11	31	50.7350	-130.4290	10.0	2.9	ML	PGC	2.9	1683
2002	10	30	02	32	5	52.7500	-132.1000	20.0	4.4	MB	GS	4.4	1684
2002	11	03	01	49	26	51.3290	-130.9510	10.0	5.8	MW	PGC	5.8	1685
2002	11	03	01	58	52	51.3830	-130.9730	10.0	2.9	MW	NRC	2.9	1686
2002	11	03	02	57	23	51.3300	-131.0650	10.0	3.1	MW	NRC	3.1	1687
2002	11	03	04	00	1	51.5460	-130.7380	10.0	3.7	ML	PGC	3.7	1688
2002	11	03	05	26	55	51.3810	-130.8740	10.0	3.4	MW	NRC	3.4	1689
2002	11	03	06	30	2	51.4990	-130.8050	10.0	4.6	MW	PGC	4.6	1690
2002	11	03	07	08	9	51.3410	-131.0230	10.0	3.0	ML	PGC	3.0	1691
2002	11	03	10	05	25	51.3360	-130.9270	10.0	3.1	MW	NRC	3.1	1692
2002	11	03	11	24	1	51.4190	-131.0440	10.0	3.2	ML	PGC	3.2	1693
2002	11	03	15	32	19	51.2910	-131.3720	10.0	3.1	MW	NRC	3.1	1694
2002	11	03	15	50	35	51.4930	-131.0770	10.0	3.0	MW	NRC	3.0	1695
2002	11	03	17	37	47	51.5680	-131.0380	10.0	3.0	ML	PGC	3.0	1696
2002	11	06	15	16	57	55.6650	-134.2220	10.0	2.9	ML	PGC	2.9	1697
2002	11	13	21	55	23	51.0100	-130.3960	10.0	3.1	MW	NRC	3.1	1698
2002	11	21	04	12	39	50.4030	-130.4060	10.0	3.1	ML	PGC	3.1	1699
2002	11	23	22	10	56	50.7000	-130.5600	10.0	4.5	MB	GS	4.5	1700
2002	12	11	17	13	1	55.3500	-130.7810	10.0	2.9	ML	PGC	2.9	1701
2002	12	13	15	51	31	50.1740	-130.2860	10.0	5.5	MW	PGC	5.5	1702
2002	12	13	16	37	34	50.3150	-130.0800	10.0	3.2	ML	PGC	3.2	1703
2002	12	13	18	18	51	50.3240	-130.1560	10.0	2.9	ML	PGC	2.9	1704
2002	12	13	19	25	4	50.2900	-130.1780	10.0	3.2	ML	PGC	3.2	1705
2002	12	13	22	28	28	50.3100	-130.2300	10.0	3.6	ML	PGC	3.6	1706
2002	12	13	23	39	54	50.3050	-129.9930	10.0	3.7	MS	ISC	3.7	1707
2002	12	17	08	49	55	50.3640	-130.2220	10.0	3.3	ML	PGC	3.3	1708
2002	12	17	08	51	20	50.3730	-130.2180	10.0	4.3	MW	NRC	4.3	1709
2002	12	17	08	57	10	50.4210	-130.1640	10.0	4.2	MW	NRC	4.2	1710
2002	12	17	23	16	28	50.3530	-130.2070	10.0	2.9	ML	PGC	2.9	1711
2002	12	18	16	27	22	51.0160	-130.6730	10.0	3.4	ML	PGC	3.4	1712
2002	12	18	19	14	52	51.0570	-130.5990	10.0	3.6	ML	PGC	3.6	1713
2002	12	20	04	58	37	50.4400	-130.1700	10.0	3.4	ML	PGC	3.4	1714
2002	12	20	05	05	8	50.4040	-130.0950	10.0	2.9	ML	PGC	2.9	1715
2002	12	22	04	15	10	50.4400	-130.1500	10.0	4.1	MB	GS	4.1	1716
2003	01	07	13	00	18	50.5400	-130.2780	10.0	4.5	MW	NRC	4.5	1717
2003	01	18	00	56	26	50.5500	-130.3000	10.0	3.0	ML	PGC	3.0	1718
2003	01	25	17	47	26	57.7520	-137.5620	10.0	3.7	MW	NRC	3.7	1719
2003	02	01	16	11	36	52.6880	-132.2700	20.0	2.9	MW	NRC	2.9	1720
2003	02	08	08	45	38	52.8390	-127.5870	1.0	2.9	ML	PGC	2.9	1721
2003	02	15	07	24	21	55.9150	-136.0540	10.0	3.4	ML	PGC	3.4	1722
2003	02	22	04	20	31	54.2720	-136.3380	10.0	3.3	ML	PGC	3.3	1723
2003	02	22	12	08	32	50.6060	-130.4010	10.0	3.2	MW	NRC	3.2	1724
2003	02	22	14	16	48	50.5600	-130.4000	10.0	3.2	ML	PGC	3.2	1725
2003	03	07	03	35	49	57.8880	-137.9750	1.0	3.9	MW	NRC	3.9	1726
2003	03	11	09	09	45	51.2700	-131.3600	10.0	3.6	ML	PGC	3.6	1727
2003	03	11	13	59	18	50.4210	-130.1900	10.0	4.5	MW	NRC	4.5	1728
2003	03	17	22	48	47	50.5540	-130.2820	10.0	3.3	MW	NRC	3.3	1729
2003	04	14	00	35	10	52.1900	-131.8300	20.0	3.0	MW	NRC	3.0	1730
2003	04	23	12	28	18	57.7450	-137.8320	1.0	3.4	ML	PGC	3.4	1731
2003	05	05	21	31	34	51.3200	-131.2730	10.0	3.9	MW	NRC	3.9	1732
2003	05	08	02	45	11	54.2200	-131.6500	17.0	3.5	ML	PGC	3.5	1733
2003	05	11	22	50	47	52.6150	-132.1790	20.0	2.9	MW	NRC	2.9	1734

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID
2003	05	13	04	17	30	51.3060	-131.1540	10.0	3.2	MW	NRC	3.2	1735
2003	05	22	20	30	59	53.4310	-135.5510	10.0	3.2	ML	PGC	3.2	1736
2003	07	01	15	49	6	50.5030	-130.2820	10.0	5.0	MW	NRC	5.0	1737
2003	07	06	14	40	12	51.1600	-130.8900	10.0	3.4	ML	PGC	3.4	1738
2003	07	12	18	12	20	52.4410	-131.9530	20.0	3.1	MW	NRC	3.1	1739
2003	07	12	18	17	40	52.4430	-131.9390	20.0	2.9	MW	NRC	2.9	1740
2003	07	12	23	01	38	54.6500	-134.4700	20.0	6.0	MW	GS	6.0	1741
2003	07	22	03	52	5	57.4900	-136.3930	1.0	4.3	MW	PGC	4.3	1742
2003	07	22	12	51	18	50.1850	-129.8220	7.6	3.4	MB	ISC	3.5	1743
2003	07	22	18	53	22	50.0990	-130.2310	10.0	4.3	MW	NRC	4.3	1744
2003	07	22	19	07	49	50.0780	-130.2690	10.0	3.0	MW	NRC	3.0	1745
2003	07	25	10	38	23	50.9850	-130.5450	10.0	2.9	ML	PGC	2.9	1746
2003	08	01	16	19	55	57.8210	-132.8650	1.0	3.2	ML	PGC	3.2	1747
2003	09	22	10	52	46	53.2600	-133.3040	20.0	4.4	MW	NRC	4.4	1748
2003	09	26	01	26	41	50.2440	-129.9970	14.3	3.5	MB	ISC	3.6	1749
2003	09	30	10	29	54	50.9540	-130.6140	10.0	3.1	MW	NRC	3.1	1750
2003	10	06	19	26	2	53.6060	-126.5550	1.0	3.2	ML	PGC	3.2	1751
2003	10	07	05	45	32	53.6160	-126.5640	1.0	3.0	ML	PGC	3.0	1752
2003	10	20	18	38	4	50.0100	-130.2040	10.0	2.9	ML	PGC	2.9	1753
2003	10	23	08	16	18	50.4830	-130.3040	10.0	4.9	MW	NRC	4.9	1754
2003	11	11	15	55	2	50.1150	-130.0110	10.0	2.9	ML	PGC	2.9	1755
2003	11	28	23	19	38	51.8330	-125.2990	1.0	3.4	ML	PGC	3.4	1756
2003	12	05	13	38	37	51.0970	-130.7690	10.0	2.9	ML	PGC	2.9	1757
2003	12	18	14	32	19	50.8890	-129.8300	10.0	3.1	ML	PGC	3.1	1758
2003	12	25	14	51	22	50.8580	-130.0080	10.0	3.0	MW	NRC	3.0	1759
2004	01	07	01	31	50	50.4120	-130.2260	10.0	3.4	ML	PGC	3.4	1760
2004	01	07	02	42	8	50.5310	-130.2110	10.0	4.2	MW	NRC	4.2	1761
2004	01	07	03	53	7	50.4870	-130.2710	10.0	4.6	MW	NRC	4.6	1762
2004	01	12	14	23	6	50.7890	-130.5680	10.0	3.1	ML	PGC	3.1	1763
2004	02	05	19	23	9	54.2270	-133.9820	20.0	4.2	MW	PGC	4.2	1764
2004	02	08	11	02	11	55.4870	-135.0690	15.0	5.3	MS	ISC	5.2	1765
2004	02	26	21	45	30	50.1470	-129.7760	10.0	4.1	MB	GS	4.1	1766
2004	02	28	01	57	41	50.9430	-130.6440	10.0	4.8	MW	PGC	4.8	1767
2004	02	28	02	00	43	50.9270	-130.6310	10.0	4.9	MW	NRC	4.9	1768
2004	02	28	02	05	17	50.9520	-130.6420	10.0	5.1	MW	NRC	5.1	1769
2004	02	28	02	45	56	50.9680	-130.5430	10.0	3.0	MW	NRC	3.0	1770
2004	02	28	02	54	51	51.0020	-130.5340	10.0	4.1	MW	PGC	4.1	1771
2004	02	28	03	01	36	50.9770	-130.5680	10.0	4.8	MW	NRC	4.8	1772
2004	02	28	04	24	53	50.9610	-130.5930	10.0	3.0	MW	NRC	3.0	1773
2004	02	28	04	40	6	51.1500	-130.3030	8.6	3.8	MS	ISC	3.8	1774
2004	02	28	11	43	17	50.9580	-130.5790	10.0	3.2	MW	NRC	3.2	1775
2004	02	29	05	21	10	55.4370	-135.3600	1.0	3.1	MW	NRC	3.1	1776
2004	03	10	08	30	37	51.4160	-132.8670	10.0	2.9	MW	NRC	2.9	1777
2004	04	19	01	42	37	50.5760	-130.4770	10.0	3.7	ML	PGC	3.7	1778
2004	06	11	19	05	27	50.6290	-129.8610	10.0	3.9	MB	ISC	3.9	1779
2004	06	13	05	29	17	50.9870	-130.6080	10.0	3.8	ML	PGC	3.8	1780
2004	06	18	15	10	49	51.2740	-130.7330	10.0	3.0	MW	NRC	3.0	1781
2004	06	23	18	19	24	50.4300	-130.2500	10.0	4.0	MB	GS	4.0	1782
2004	06	24	14	52	21	50.2490	-129.9030	10.0	3.9	MB	ISC	3.9	1783
2004	06	28	09	49	46	54.7950	-134.2460	20.0	6.8	MW	NRC	6.8	1784
2004	06	28	16	44	25	54.8210	-134.3880	20.0	3.8	MW	NRC	3.8	1785
2004	06	29	13	53	54	54.9700	-134.2500	20.0	3.3	ML	AEI	3.3	1786
2004	06	30	00	04	2	54.7200	-134.1500	20.0	3.5	ML	AEI	3.5	1787
2004	07	01	03	47	0	55.0880	-134.4630	20.0	3.0	ML	PGC	3.0	1788
2004	07	02	10	19	25	54.9800	-134.4510	20.0	3.0	MW	NRC	3.0	1789
2004	07	03	23	07	20	50.0300	-130.2400	10.0	4.0	MB	GS	4.0	1790

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID
2004	07	04	03	10	45	54.9960	-134.3650	20.0	2.9	MW	NRC	2.9	1791
2004	07	04	23	17	18	54.9590	-134.6620	20.0	5.0	MW	PGC	5.0	1792
2004	07	07	23	51	48	50.6180	-130.4410	10.0	3.8	ML	PGC	3.8	1793
2004	07	18	10	18	36	51.9910	-131.3550	20.0	4.2	ML	PGC	4.2	1794
2004	07	22	15	17	30	55.0150	-134.4340	20.0	3.0	MW	NRC	3.0	1795
2004	07	24	11	35	3	50.5640	-130.4790	10.0	3.2	ML	PGC	3.2	1796
2004	07	28	04	38	50	51.9760	-131.6400	20.0	3.0	ML	PGC	3.0	1797
2004	07	31	00	35	22	52.6850	-132.0670	20.0	4.9	MW	PGC	4.9	1798
2004	08	14	05	42	41	50.5600	-130.4000	10.0	3.2	ML	PGC	3.2	1799
2004	08	21	18	06	39	53.4280	-131.6690	12.2	3.8	MW	NRC	3.8	1800
2004	08	21	18	13	25	53.4350	-131.6860	13.4	3.2	MW	NRC	3.2	1801
2004	08	22	02	24	56	53.3380	-133.2380	20.0	2.9	ML	PGC	2.9	1802
2004	08	27	12	22	37	51.3590	-131.4040	10.0	3.2	MW	NRC	3.2	1803
2004	08	27	13	33	1	51.3610	-131.3340	10.0	3.5	ML	PGC	3.5	1804
2004	08	27	14	34	24	51.3230	-131.4720	10.0	2.9	MW	NRC	2.9	1805
2004	09	07	02	21	4	56.8000	-131.3700	5.0	4.2	ML	PMR	4.2	1806
2004	09	09	00	22	58	52.4950	-131.9310	20.0	3.1	MW	NRC	3.1	1807
2004	09	17	12	48	46	50.5000	-130.3150	10.0	3.4	ML	PGC	3.4	1808
2004	10	06	04	39	47	52.7450	-127.3080	1.0	4.2	MS	ISC	4.2	1809
2004	10	29	22	50	53	51.2410	-131.0890	10.0	3.4	MW	NRC	3.4	1810
2004	11	02	15	29	52	51.0130	-130.9110	10.0	3.0	MW	NRC	3.0	1811
2004	11	02	15	31	17	51.0060	-130.9270	10.0	3.2	MW	NRC	3.2	1812
2004	11	02	17	20	53	50.9620	-130.9350	10.0	4.3	MW	NRC	4.3	1813
2004	11	10	01	16	6	56.9850	-137.0150	10.0	3.0	ML	PGC	3.0	1814
2004	11	15	17	45	35	50.5050	-130.2660	10.0	4.7	MW	NRC	4.7	1815
2004	11	15	17	51	55	50.4200	-130.2110	10.0	5.0	MW	NRC	5.0	1816
2004	11	15	17	57	25	50.5150	-130.2480	10.0	4.4	MW	NRC	4.4	1817
2004	11	27	12	36	55	50.6120	-130.3130	10.0	3.0	MW	NRC	3.0	1818
2004	11	30	10	16	55	57.4630	-133.1780	1.0	3.6	MW	NRC	3.6	1819
2004	12	24	10	37	36	50.9970	-130.9960	10.0	3.3	MW	NRC	3.3	1820
2004	12	25	22	12	22	50.4260	-130.1550	10.0	3.0	ML	PGC	3.0	1821
2005	02	07	06	23	31	51.2350	-131.1480	10.0	5.7	MW	PGC	5.7	1822
2005	02	07	12	11	59	51.2150	-131.3090	10.0	3.7	MW	NRC	3.7	1823
2005	02	08	02	03	39	51.1970	-131.1590	10.0	3.3	MW	NRC	3.3	1824
2005	02	23	18	56	49	50.5170	-130.1770	10.0	3.1	MW	NRC	3.1	1825
2005	02	23	18	58	34	50.4630	-130.1910	10.0	3.7	MW	NRC	3.7	1826
2005	02	23	19	07	36	50.4410	-130.2100	10.0	3.8	MW	NRC	3.8	1827
2005	03	03	08	24	15	53.7790	-132.4220	16.2	3.2	MW	NRC	3.2	1828
2005	03	03	19	58	3	53.8120	-132.4050	17.5	2.9	ML	PGC	2.9	1829
2005	03	11	15	28	21	50.3110	-128.7220	26.2	4.8	MW	NRC	4.8	1830
2005	03	11	16	25	18	50.3300	-128.6900	30.0	3.9	MB	GS	3.9	1831
2005	03	13	14	00	18	50.4650	-130.0800	10.0	3.1	MW	NRC	3.1	1832
2005	03	15	10	35	19	50.7310	-130.5400	10.0	4.6	MW	PGC	4.6	1833
2005	03	23	22	10	9	50.8530	-129.8390	10.0	3.0	MW	PGC	3.0	1834
2005	03	27	23	53	32	53.7870	-132.1280	18.6	3.1	MW	NRC	3.1	1835
2005	04	15	06	10	5	50.6410	-130.5010	10.0	3.2	MW	PGC	3.2	1836
2005	05	06	11	03	59	50.4220	-130.1140	10.0	3.1	MW	NRC	3.1	1837
2005	05	07	07	16	59	50.4170	-130.1360	10.0	3.4	MW	NRC	3.4	1838
2005	05	11	16	25	18	50.5230	-130.3070	10.0	3.7	MW	NRC	3.7	1839
2005	05	11	16	39	30	50.5550	-130.4090	10.0	4.6	MW	PGC	4.6	1840
2005	05	21	22	23	13	50.4710	-130.3260	10.0	3.3	MW	NRC	3.3	1841
2005	06	01	15	08	51	51.7120	-130.7600	20.0	3.0	MW	NRC	3.0	1842
2005	06	01	15	11	57	51.7220	-130.7380	20.0	3.3	MW	NRC	3.3	1843
2005	06	01	18	29	39	51.6830	-130.7790	20.0	4.2	MW	NRC	4.2	1844
2005	06	07	20	50	59	51.0530	-130.7160	10.0	3.0	MW	NRC	3.0	1845
2005	06	08	21	34	6	51.6390	-130.9580	20.0	4.5	MW	PGC	4.5	1846

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID
2005	06	09	14	00	46	51.4480	-131.2660	20.0	5.9	MW	NRC	5.9	1847
2005	06	09	14	53	48	51.1500	-131.5860	20.0	2.9	MW	NRC	2.9	1848
2005	06	13	17	49	6	50.8150	-130.6180	10.0	3.5	MW	PGC	3.5	1849
2005	06	15	17	06	47	50.9650	-130.6100	10.0	3.2	MW	NRC	3.2	1850
2005	06	22	09	08	3	50.4630	-130.2080	10.0	4.1	MW	PGC	4.1	1851
2005	06	28	03	57	18	55.3010	-134.9560	10.0	3.1	MW	NRC	3.1	1852
2005	07	10	21	40	20	51.3990	-131.1820	10.0	3.2	MW	NRC	3.2	1853
2005	07	11	03	11	38	51.3770	-131.1730	10.0	3.8	MW	NRC	3.8	1854
2005	07	11	04	34	26	51.2870	-131.4890	10.0	3.1	MW	NRC	3.1	1855
2005	07	11	05	12	16	51.4500	-131.1020	10.0	3.1	MW	NRC	3.1	1856
2005	07	11	07	17	5	51.4180	-131.1040	10.0	3.0	MW	PGC	3.0	1857
2005	07	25	10	54	58	50.4840	-130.2510	10.0	4.6	MW	NRC	4.6	1858
2005	07	31	04	01	9	50.0790	-130.1890	10.0	3.1	MW	PGC	3.1	1859
2005	08	06	07	02	23	50.4510	-130.1590	10.0	2.9	MW	NRC	2.9	1860
2005	08	11	07	24	38	50.0680	-130.1010	10.0	3.4	MW	NRC	3.4	1861
2005	08	11	15	44	5	56.9910	-131.9070	1.0	3.4	ML	PGC	3.4	1862
2005	09	03	16	53	58	50.3910	-130.0260	10.0	3.4	MW	NRC	3.4	1863
2005	09	06	06	25	23	51.5670	-130.8110	10.0	3.3	ML	PGC	3.3	1864
2005	09	11	09	22	49	51.0170	-130.5860	10.0	3.4	MW	NRC	3.4	1865
2005	09	19	04	35	57	50.5370	-130.2910	10.0	2.9	MW	NRC	2.9	1866
2005	09	27	16	52	23	52.7240	-132.2980	20.0	3.7	MW	NRC	3.7	1867
2005	09	27	22	43	10	50.6010	-130.4250	10.0	3.2	MW	NRC	3.2	1868
2005	10	13	19	20	7	50.9940	-130.7700	10.0	3.8	MW	PGC	3.8	1869
2005	10	15	16	08	31	50.5460	-130.4180	10.0	4.2	MW	NRC	4.2	1870
2005	10	19	00	04	39	51.1000	-130.8640	10.0	4.2	MW	NRC	4.2	1871
2005	10	24	03	54	27	52.8090	-135.8710	10.0	2.9	ML	PGC	2.9	1872
2005	11	15	14	15	1	51.3310	-131.0900	10.0	3.4	MW	PGC	3.4	1873
2005	11	22	16	26	48	50.0190	-130.0300	10.0	3.6	MW	NRC	3.6	1874
2005	11	30	10	13	24	51.2210	-130.9230	10.0	3.3	MW	PGC	3.3	1875
2005	12	02	17	51	22	50.3480	-130.2070	10.0	3.5	MW	NRC	3.5	1876
2005	12	04	11	58	52	52.6410	-132.4030	20.0	3.1	MW	NRC	3.1	1877
2005	12	12	08	08	37	56.9520	-131.8980	10.0	2.9	ML	PGC	2.9	1878
2005	12	13	23	16	31	50.1880	-130.2500	10.0	3.0	MW	NRC	3.0	1879
2005	12	23	02	45	33	50.5730	-130.2820	10.0	2.9	MW	NRC	2.9	1880
2005	12	28	10	40	16	53.8500	-131.4420	22.1	4.3	MW	PGC	4.3	1881
2006	01	12	16	02	27	50.7430	-130.4560	10.0	3.0	MW	NRC	3.0	1882
2006	02	01	06	10	29	50.0400	-129.5720	10.0	3.7	MS	ISC	3.7	1883
2006	02	03	08	24	36	50.5580	-130.3100	10.0	3.4	MW	NRC	3.4	1884
2006	02	13	12	43	49	51.2140	-130.9090	10.0	4.3	MW	NRC	4.3	1885
2006	02	23	15	53	50	50.5750	-130.3750	10.0	3.0	MW	NRC	3.0	1886
2006	02	26	21	24	53	51.1700	-131.1580	10.0	3.0	ML	PGC	3.0	1887
2006	03	12	13	13	4	51.2640	-131.2220	10.0	3.1	MW	PGC	3.1	1888
2006	03	15	02	41	30	50.1010	-130.1470	10.0	3.2	MW	NRC	3.2	1889
2006	03	20	19	43	30	50.0440	-130.2230	10.0	3.5	MW	NRC	3.5	1890
2006	03	21	23	26	56	50.0280	-130.1400	10.0	2.9	MW	NRC	2.9	1891
2006	03	26	01	09	0	57.0620	-136.5830	5.0	3.9	ML	PGC	3.9	1892
2006	03	29	04	10	19	50.0280	-128.4040	10.0	3.6	MW	NRC	3.6	1893
2006	03	29	12	58	56	50.5720	-130.4060	10.0	3.4	MW	NRC	3.4	1894
2006	03	29	15	11	56	50.5740	-130.3760	10.0	3.9	MW	NRC	3.9	1895
2006	04	02	09	46	39	50.5200	-130.3000	10.0	4.3	MW	PGC	4.3	1896
2006	04	03	15	29	33	50.5980	-130.3990	10.0	3.1	MW	NRC	3.1	1897
2006	04	13	15	39	52	50.5550	-130.3630	10.0	4.1	MW	NRC	4.1	1898
2006	04	15	23	49	4	50.2420	-130.2330	10.0	3.0	MW	PGC	3.0	1899
2006	04	22	16	31	30	50.6780	-130.5330	10.0	3.6	MW	NRC	3.6	1900
2006	05	09	13	55	21	50.5040	-130.1740	10.0	3.4	MW	NRC	3.4	1901
2006	05	09	14	00	7	50.5160	-130.2150	10.0	3.0	MW	PGC	3.0	1902

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID
2006	05	10	12	57	57	50.0620	-130.1140	10.0	3.1	MW	NRC	3.1	1903
2006	05	15	15	03	18	50.5930	-130.3380	10.0	3.1	MW	NRC	3.1	1904
2006	05	19	05	02	40	51.1650	-130.9360	10.0	3.0	MW	NRC	3.0	1905
2006	05	20	02	31	52	51.3120	-131.2420	10.0	3.3	MW	NRC	3.3	1906
2006	05	20	03	05	17	51.3310	-131.2020	10.0	2.9	MW	NRC	2.9	1907
2006	05	27	00	17	15	55.1670	-134.8510	20.0	3.0	MW	NRC	3.0	1908
2006	05	31	01	33	19	50.6430	-130.4840	10.0	4.1	MW	NRC	4.1	1909
2006	06	02	02	03	35	50.5590	-130.3090	10.0	4.3	MW	NRC	4.3	1910
2006	06	04	08	56	30	50.6580	-130.4600	10.0	5.2	MW	NRC	5.2	1911
2006	06	08	09	57	26	56.9340	-137.9520	15.0	3.2	ML	AEI	3.2	1912
2006	06	20	10	02	4	51.3390	-130.8990	10.0	5.8	MW	PGC	5.8	1913
2006	06	20	10	20	25	51.5170	-130.6180	10.0	3.4	MW	NRC	3.4	1914
2006	06	20	10	27	21	51.5320	-130.7340	10.0	3.4	MW	NRC	3.4	1915
2006	06	20	11	52	25	51.5710	-130.4090	10.0	4.1	MB	ISC	4.1	1916
2006	06	20	12	04	44	51.4000	-130.7410	10.0	3.6	MW	NRC	3.6	1917
2006	06	20	20	54	43	51.3490	-130.9280	10.0	3.7	ML	PGC	3.7	1918
2006	06	20	22	55	34	51.4540	-130.6630	10.0	2.9	MW	NRC	2.9	1919
2006	06	22	01	08	49	51.0020	-130.6670	10.0	3.3	MW	NRC	3.3	1920
2006	06	22	01	35	19	50.9480	-130.8110	10.0	2.9	MW	NRC	2.9	1921
2006	06	22	03	51	39	50.9760	-130.7640	10.0	4.0	MW	PGC	4.0	1922
2006	06	27	22	08	36	50.7000	-130.4440	10.0	2.9	MW	NRC	2.9	1923
2006	07	05	10	32	56	51.2150	-130.4130	10.0	3.1	MW	NRC	3.1	1924
2006	07	05	10	46	15	51.2480	-130.4410	10.0	3.5	MW	NRC	3.5	1925
2006	07	05	11	04	17	51.2160	-130.4050	10.0	3.0	MW	NRC	3.0	1926
2006	07	05	12	26	26	51.1440	-130.5220	10.0	3.3	ML	PGC	3.3	1927
2006	07	05	14	23	20	51.3370	-130.1780	10.0	3.4	MW	PGC	3.4	1928
2006	07	11	14	18	47	53.9090	-133.4520	20.0	3.1	ML	PGC	3.1	1929
2006	07	14	19	01	11	51.2710	-130.3080	10.0	3.1	MW	PGC	3.1	1930
2006	07	15	02	27	35	51.2220	-130.3950	10.0	3.4	MW	PGC	3.4	1931
2006	07	15	14	32	33	51.4750	-130.6380	10.0	3.2	MW	PGC	3.2	1932
2006	07	18	08	03	16	51.2360	-130.4050	10.0	4.4	MW	OTT	4.4	1933
2006	07	18	13	09	3	51.2770	-130.3030	10.0	3.1	ML	PGC	3.1	1934
2006	07	21	08	48	37	51.4590	-130.6830	10.0	3.4	MW	NRC	3.4	1935
2006	07	27	14	34	28	50.2120	-130.2090	10.0	3.2	MW	NRC	3.2	1936
2006	08	02	14	16	51	50.4980	-130.1360	10.0	3.2	MW	NRC	3.2	1937
2006	08	02	21	15	35	50.4530	-130.3090	10.0	4.6	MW	NRC	4.6	1938
2006	08	03	05	49	44	50.6670	-130.6230	10.0	3.5	MW	NRC	3.5	1939
2006	08	03	05	54	6	50.7050	-130.6320	10.0	3.3	MW	PGC	3.3	1940
2006	08	04	05	31	37	50.4700	-130.1810	10.0	2.9	MW	PGC	2.9	1941
2006	08	05	20	20	30	50.5570	-130.3420	10.0	3.1	MW	NRC	3.1	1942
2006	08	22	20	44	39	50.5390	-130.3600	10.0	3.4	MW	NRC	3.4	1943
2006	09	01	03	26	20	50.9290	-130.5170	10.0	3.1	MW	NRC	3.1	1944
2006	09	04	14	23	42	50.5500	-130.3440	10.0	3.1	MW	NRC	3.1	1945
2006	09	05	06	58	39	50.2590	-130.2980	10.0	3.7	MW	PGC	3.7	1946
2006	09	07	12	41	19	57.3920	-132.6150	1.0	3.6	MW	NRC	3.6	1947
2006	09	08	15	26	57	50.5230	-129.2570	10.0	3.1	ML	PGC	3.1	1948
2006	09	09	01	18	28	50.5150	-129.3160	10.0	3.3	MW	NRC	3.3	1949
2006	09	17	11	26	57	51.0120	-130.9350	10.0	3.6	MW	NRC	3.6	1950
2006	09	17	12	37	21	50.9220	-130.9680	10.0	3.2	MW	NRC	3.2	1951
2006	09	17	13	16	5	51.1270	-130.9320	10.0	4.3	MW	PGC	4.3	1952
2006	09	17	13	36	27	51.0450	-130.8580	10.0	4.1	MW	NRC	4.1	1953
2006	09	17	13	40	34	51.0980	-130.8670	10.0	3.1	MW	PGC	3.1	1954
2006	09	17	13	48	18	51.0530	-130.9040	10.0	3.3	MW	PGC	3.3	1955
2006	09	27	12	20	18	50.4020	-130.2930	10.0	3.5	MW	NRC	3.5	1956
2006	09	27	21	54	23	50.3840	-130.2630	10.0	3.0	MW	PGC	3.0	1957
2006	09	28	01	44	31	50.4780	-130.1540	10.0	2.9	MW	NRC	2.9	1958

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID
2006	09	28	01	53	33	50.4420	-130.2200	10.0	4.7	MW	NRC	4.7	1959
2006	09	28	02	15	44	50.4330	-130.2700	10.0	4.6	MW	NRC	4.6	1960
2006	09	28	03	01	47	50.4500	-130.2230	10.0	3.2	MW	NRC	3.2	1961
2006	09	28	03	03	47	50.4570	-130.2220	10.0	3.4	MW	NRC	3.4	1962
2006	09	28	03	36	9	50.4260	-130.2670	10.0	4.4	MW	PGC	4.4	1963
2006	09	28	11	25	13	50.9180	-130.7210	10.0	3.6	MW	NRC	3.6	1964
2006	09	28	11	29	7	50.9980	-130.6140	10.0	4.0	MW	PGC	4.0	1965
2006	09	28	12	59	14	50.9820	-130.6200	10.0	3.5	MW	NRC	3.5	1966
2006	09	28	15	25	24	50.4100	-130.2630	10.0	3.0	MW	NRC	3.0	1967
2006	09	29	10	47	52	51.0490	-130.5360	10.0	2.9	MW	NRC	2.9	1968
2006	10	08	13	40	10	53.1960	-133.0130	20.0	3.1	MW	NRC	3.1	1969
2006	10	14	07	28	25	51.0190	-130.5760	10.0	3.3	ML	PGC	3.3	1970
2006	10	14	08	07	32	51.0400	-130.5480	10.0	2.9	MW	NRC	2.9	1971
2006	10	14	12	13	38	51.0090	-130.5780	10.0	3.2	ML	PGC	3.2	1972
2006	10	14	12	16	20	51.0560	-130.5130	10.0	3.0	MW	NRC	3.0	1973
2006	10	26	02	16	23	51.0280	-130.5780	10.0	2.9	ML	PGC	2.9	1974
2006	10	26	02	21	47	51.0420	-130.7700	10.0	2.9	ML	PGC	2.9	1975
2006	10	26	11	06	50	51.0750	-130.4600	10.0	3.2	ML	PGC	3.2	1976
2006	10	28	18	17	19	56.7080	-137.0040	10.0	3.5	ML	PGC	3.5	1977
2006	11	04	15	34	58	51.4320	-131.1370	10.0	3.0	ML	PGC	3.0	1978
2006	11	17	01	07	25	57.5330	-132.6990	1.0	2.9	ML	PGC	2.9	1979
2006	11	17	07	55	37	51.4860	-131.0800	10.0	3.0	MW	NRC	3.0	1980
2006	11	18	23	35	23	54.3370	-137.5690	20.0	3.7	ML	PGC	3.7	1981
2006	11	28	00	21	25	52.2950	-131.7440	20.0	3.2	MW	NRC	3.2	1982
2006	11	28	09	33	3	52.2850	-131.6950	20.0	3.5	ML	PGC	3.5	1983
2006	11	28	10	37	16	52.3010	-131.7260	20.0	3.9	ML	PGC	3.9	1984
2006	12	10	10	07	45	53.7370	-134.1920	10.0	3.5	MB	ISC	3.6	1985
2006	12	19	00	37	3	53.5310	-135.4980	35.0	3.8	MB	GS	3.8	1986
2006	12	21	14	22	32	50.8270	-130.4350	10.0	3.3	ML	PGC	3.3	1987
2006	12	21	19	47	6	50.8210	-130.4530	10.0	3.2	ML	PGC	3.2	1988
2006	12	21	22	56	45	50.5690	-130.4000	10.0	4.6	MW	NRC	4.6	1989
2006	12	21	23	31	45	50.6350	-130.2710	10.0	3.0	ML	PGC	3.0	1990
2006	12	21	23	52	0	50.5700	-130.2940	10.0	3.1	ML	PGC	3.1	1991
2006	12	22	00	07	6	50.6180	-130.3100	10.0	3.1	ML	PGC	3.1	1992
2006	12	22	05	57	23	52.7640	-132.3970	20.0	3.0	ML	PGC	3.0	1993
2006	12	22	15	31	39	54.0540	-133.8360	20.0	2.9	MW	NRC	2.9	1994
2007	01	13	09	58	4	50.7020	-130.5270	10.0	3.0	ML	PGC	3.0	1995
2007	01	22	08	21	57	51.2670	-130.4310	10.0	3.6	MS	ISC	3.6	1996
2007	01	22	22	45	54	51.0280	-130.5240	10.0	3.1	ML	PGC	3.1	1997
2007	01	22	22	58	12	51.1020	-130.1840	10.0	3.2	ML	PGC	3.2	1998
2007	01	24	08	09	54	51.0680	-130.5540	10.0	3.5	ML	PGC	3.5	1999
2007	01	24	08	49	42	51.0530	-130.4960	10.0	3.3	ML	PGC	3.3	2000
2007	01	24	09	08	24	50.9720	-130.8140	10.0	2.9	ML	PGC	2.9	2001
2007	01	24	09	29	54	51.2390	-130.4780	10.0	3.8	MS	ISC	3.8	2002
2007	01	24	09	57	41	50.9180	-130.6670	10.0	3.0	ML	PGC	3.0	2003
2007	01	24	10	06	44	51.0530	-130.5280	10.0	3.9	MW	NRC	3.9	2004
2007	01	24	10	23	56	51.0530	-130.5830	10.0	3.3	ML	PGC	3.3	2005
2007	01	24	10	43	44	51.0640	-130.5240	10.0	3.4	ML	PGC	3.4	2006
2007	01	24	19	30	17	51.1000	-130.3840	10.0	3.0	ML	PGC	3.0	2007
2007	01	26	05	25	56	51.0200	-130.6010	10.0	3.1	ML	PGC	3.1	2008
2007	01	27	18	44	27	57.2940	-136.7940	20.0	3.8	MW	NRC	3.8	2009
2007	02	08	17	23	58	51.0340	-130.4590	10.0	3.3	MW	NRC	3.3	2010
2007	02	14	03	14	10	50.0660	-129.7210	16.3	4.0	MB	ISC	4.0	2011
2007	03	03	05	32	14	50.2100	-129.7700	14.1	3.9	MB	ISC	3.9	2012
2007	03	03	11	37	40	51.0170	-130.4610	10.0	2.9	ML	PGC	2.9	2013
2007	03	04	09	17	5	51.2550	-131.0270	10.0	2.9	ML	PGC	2.9	2014

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID
2007	03	06	19	53	24	50.3520	-130.1380	10.0	3.3	MW	NRC	3.3	2015
2007	03	07	03	38	9	55.5580	-135.3490	1.0	3.6	ML	PGC	3.6	2016
2007	03	07	06	06	11	51.0310	-130.3040	10.0	3.0	ML	PGC	3.0	2017
2007	03	08	08	00	14	57.8980	-137.7890	1.0	2.9	ML	PGC	2.9	2018
2007	03	08	17	22	15	51.4100	-130.8690	10.0	2.9	ML	PGC	2.9	2019
2007	03	10	13	11	27	51.0140	-130.4640	10.0	3.2	MW	NRC	3.2	2020
2007	03	11	03	48	53	50.5840	-129.9790	10.0	3.2	MW	NRC	3.2	2021
2007	03	11	04	12	3	52.5520	-132.4570	20.0	3.0	ML	PGC	3.0	2022
2007	03	13	21	19	20	50.5230	-130.3100	10.0	2.9	ML	PGC	2.9	2023
2007	03	19	17	52	8	52.8410	-132.8590	20.0	3.2	ML	PGC	3.2	2024
2007	03	26	21	51	45	51.9110	-131.8010	20.0	2.9	ML	PGC	2.9	2025
2007	03	28	06	33	35	50.1130	-130.0230	10.0	3.1	MW	NRC	3.1	2026
2007	03	29	07	05	6	50.1350	-130.3500	10.0	3.5	MW	PGC	3.5	2027
2007	03	29	13	56	16	51.1040	-130.7390	10.0	3.5	MW	NRC	3.5	2028
2007	04	10	03	28	16	52.6440	-132.3630	20.0	3.0	ML	PGC	3.0	2029
2007	04	11	02	26	36	50.1430	-130.4030	10.0	3.1	MW	NRC	3.1	2030
2007	04	15	19	41	30	55.3480	-134.9290	20.0	3.2	ML	PGC	3.2	2031
2007	04	16	21	51	9	51.6380	-131.3840	20.0	3.1	ML	PGC	3.1	2032
2007	04	18	12	05	47	50.5870	-129.9340	10.0	3.0	MW	NRC	3.0	2033
2007	04	24	23	49	30	50.4300	-130.3560	10.0	3.4	MW	NRC	3.4	2034
2007	04	24	23	55	40	50.5150	-130.2950	10.0	3.4	MW	NRC	3.4	2035
2007	04	25	01	18	25	50.4530	-130.2480	10.0	3.0	MW	NRC	3.0	2036
2007	04	28	19	29	41	53.8940	-133.6430	20.0	4.7	ML	PGC	4.7	2037
2007	05	05	06	15	43	50.7670	-130.0490	10.0	5.0	MW	GCM	5.0	2038
2007	05	12	00	49	27	50.6520	-129.6650	11.5	4.4	MB	ISC	4.4	2039
2007	05	19	16	58	48	50.9310	-130.4920	10.0	2.9	ML	PGC	2.9	2040
2007	05	27	08	36	44	56.1780	-134.6540	1.0	3.0	ML	PGC	3.0	2041
2007	05	29	08	02	32	57.3580	-137.0030	10.0	3.3	ML	PGC	3.3	2042
2007	05	29	17	48	34	50.9290	-130.4780	10.0	3.0	MW	NRC	3.0	2043
2007	05	30	06	02	37	51.0030	-130.4480	10.0	2.9	MW	NRC	2.9	2044
2007	05	30	09	43	26	52.6870	-132.2890	20.0	3.7	ML	PGC	3.7	2045
2007	06	06	07	33	8	50.9560	-130.6250	10.0	3.3	MW	PGC	3.3	2046
2007	06	08	18	17	28	50.9620	-130.4530	10.0	3.4	MW	NRC	3.4	2047
2007	06	09	13	09	2	51.0200	-130.3610	10.0	4.2	MW	NRC	4.2	2048
2007	06	09	13	15	42	51.0460	-130.3270	10.0	3.0	MW	NRC	3.0	2049
2007	06	09	13	57	53	51.0230	-130.2990	10.0	2.9	MW	NRC	2.9	2050
2007	06	09	14	22	38	51.0210	-130.3010	10.0	2.9	MW	NRC	2.9	2051
2007	06	10	20	02	18	52.6660	-132.3150	20.0	3.7	ML	PGC	3.7	2052
2007	06	11	01	14	18	50.2460	-129.8070	10.0	3.1	MW	NRC	3.1	2053
2007	06	15	06	54	2	51.0110	-130.3630	10.0	3.3	MW	PGC	3.3	2054
2007	06	15	11	53	0	51.0150	-130.3790	10.0	2.9	MW	PGC	2.9	2055
2007	06	15	19	07	31	52.7520	-132.2660	20.0	3.4	ML	PGC	3.4	2056
2007	06	24	05	38	29	57.3450	-133.0360	10.0	3.3	ML	PGC	3.3	2057
2007	06	28	15	19	53	50.5300	-130.3090	10.0	3.8	MW	NRC	3.8	2058
2007	06	28	15	34	50	50.5000	-130.2600	10.0	3.8	MW	PGC	3.8	2059
2007	07	09	15	52	20	50.9640	-130.6360	10.0	3.0	MW	NRC	3.0	2060
2007	07	11	06	45	7	50.4990	-130.2800	10.0	4.2	MW	PGC	4.2	2061
2007	07	13	07	50	18	51.1070	-130.7680	10.0	3.9	MW	NRC	3.9	2062
2007	07	13	21	58	25	54.9480	-129.1680	5.0	3.2	MW	NRC	3.2	2063
2007	07	15	19	01	48	53.8590	-131.6860	27.3	4.3	MW	NRC	4.3	2064
2007	07	18	04	20	11	57.8250	-133.6720	20.0	3.4	MW	NRC	3.4	2065
2007	07	23	10	08	11	51.0870	-130.7660	10.0	3.0	MW	NRC	3.0	2066
2007	07	27	03	40	17	50.9140	-130.5850	10.0	3.0	MW	NRC	3.0	2067
2007	08	05	23	34	42	52.4610	-127.3290	1.0	3.2	ML	PGC	3.2	2068
2007	08	08	20	45	51	53.1660	-133.0350	20.0	2.9	ML	PGC	2.9	2069
2007	08	14	12	21	7	57.8590	-137.7510	1.0	2.9	ML	PGC	2.9	2070

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID
2007	08	14	17	00	7	56.6030	-135.5300	5.0	3.4	ML	PGC	3.4	2071
2007	08	21	08	53	22	57.3300	-136.5200	1.0	3.0	ML	PGC	3.0	2072
2007	08	25	13	02	20	51.0530	-131.0010	10.0	3.0	MW	NRC	3.0	2073
2007	08	25	18	11	59	50.7150	-130.3380	10.0	3.0	MW	NRC	3.0	2074
2007	08	25	22	45	20	50.5580	-130.4420	10.0	4.3	MW	PGC	4.3	2075
2007	08	26	13	57	48	50.5810	-130.3920	10.0	2.9	MW	NRC	2.9	2076
2007	09	03	01	06	43	50.4920	-130.2030	10.0	3.3	MW	NRC	3.3	2077
2007	09	08	20	18	53	50.2120	-129.4910	10.0	4.1	MB	GS	4.1	2078
2007	09	11	02	32	9	51.2960	-130.8480	10.0	3.4	MW	PGC	3.4	2079
2007	09	16	13	46	55	50.6580	-130.3910	10.0	3.4	MW	NRC	3.4	2080
2007	09	20	10	47	58	50.4750	-130.2800	10.0	3.8	MW	NRC	3.8	2081
2007	09	29	12	23	17	51.9110	-126.4910	1.0	3.5	ML	PGC	3.5	2082
2007	09	29	12	55	55	51.8750	-126.5300	1.0	3.1	ML	PGC	3.1	2083
2007	09	29	13	11	54	51.8860	-126.5360	1.0	2.9	ML	PGC	2.9	2084
2007	10	01	00	51	34	50.3850	-129.8520	10.0	4.4	MB	ISC	4.4	2085
2007	10	01	01	12	33	50.0470	-130.2360	10.0	3.0	ML	PGC	3.0	2086
2007	10	01	01	20	48	50.1720	-130.0570	10.0	3.2	MW	PGC	3.2	2087
2007	10	01	03	04	29	50.1070	-130.1000	10.0	3.2	MW	PGC	3.2	2088
2007	10	01	05	11	59	50.0410	-130.2880	10.0	3.5	MW	PGC	3.5	2089
2007	10	02	11	17	5	50.0450	-130.2330	10.0	4.2	MW	PGC	4.2	2090
2007	10	02	20	30	14	50.8290	-130.2250	8.2	4.4	MS	ISC	4.4	2091
2007	10	05	00	20	53	50.0840	-130.0670	10.0	3.1	MW	NRC	3.1	2092
2007	10	06	08	49	16	50.4300	-130.1570	10.0	3.4	MW	NRC	3.4	2093
2007	10	06	14	37	4	50.2530	-130.2680	10.0	3.5	MW	PGC	3.5	2094
2007	10	07	05	40	52	50.2460	-129.5760	10.0	4.5	MB	ISC	4.5	2095
2007	10	08	18	39	51	53.9750	-133.7120	20.0	3.4	MW	NRC	3.4	2096
2007	10	10	17	50	41	52.8830	-124.0730	26.7	3.9	MW	PGC	3.9	2097
2007	10	11	05	51	31	50.0070	-130.1100	10.0	3.8	MS	ISC	3.8	2098
2007	10	11	23	54	30	52.8600	-133.2940	10.0	3.4	MW	NRC	3.4	2099
2007	10	24	10	30	53	51.2960	-130.8770	10.0	2.9	ML	PGC	2.9	2100
2007	10	25	17	51	21	50.6520	-130.6590	10.0	3.1	MW	NRC	3.1	2101
2007	10	29	11	26	12	50.4220	-130.3470	10.0	4.0	MW	NRC	4.0	2102
2007	11	01	15	11	37	51.0420	-130.5950	10.0	3.1	ML	PGC	3.1	2103
2007	11	16	14	35	7	50.4800	-129.9610	10.0	3.5	MW	PGC	3.5	2104
2007	11	22	17	40	50	53.1670	-135.4890	10.0	3.2	MW	NRC	3.2	2105
2007	12	04	20	35	47	50.4900	-130.2350	10.0	3.6	MW	NRC	3.6	2106
2007	12	05	15	01	50	51.1110	-130.7860	10.0	3.4	MW	NRC	3.4	2107
2007	12	08	03	59	53	51.3750	-131.0540	10.0	3.2	MW	NRC	3.2	2108
2007	12	12	23	39	59	52.1020	-131.5540	10.0	5.8	MW	GCM	5.8	2109
2007	12	12	23	48	18	52.0270	-131.8670	20.0	3.0	ML	PGC	3.0	2110
2007	12	13	00	59	58	51.9970	-131.8470	20.0	3.6	ML	PGC	3.6	2111
2007	12	22	01	44	50	50.5020	-130.1150	10.0	3.3	MW	NRC	3.3	2112
2007	12	22	01	52	23	50.4970	-130.1720	10.0	3.3	MW	NRC	3.3	2113
2007	12	22	04	51	46	54.6550	-134.1220	20.0	3.0	ML	PGC	3.0	2114
2007	12	26	16	59	50	53.3320	-133.1240	20.0	3.0	ML	PGC	3.0	2115
2008	01	05	10	39	9	50.9760	-130.9280	10.0	5.7	MW	PGC	5.7	2116
2008	01	05	10	44	52	51.0800	-131.0560	10.0	4.4	MW	PGC	4.4	2117
2008	01	05	10	47	47	51.0280	-130.9710	10.0	4.0	MW	NRC	4.0	2118
2008	01	05	11	01	6	51.2540	-130.7460	15.0	6.6	MW	GCM	6.6	2119
2008	01	05	11	16	50	51.3440	-131.2720	10.0	4.0	MW	NRC	4.0	2120
2008	01	05	11	23	51	51.2040	-131.6770	10.0	4.1	MW	PGC	4.1	2121
2008	01	05	11	30	46	51.5170	-130.8680	10.0	3.9	MB	GS	3.9	2122
2008	01	05	11	41	19	51.2490	-131.4460	10.0	4.4	MW	NRC	4.4	2123
2008	01	05	11	44	44	50.8280	-130.9820	10.0	6.4	MW	NRC	6.4	2124
2008	01	05	11	50	55	51.2550	-131.4620	10.0	5.2	MW	NRC	5.2	2125
2008	01	05	11	55	35	51.2990	-131.4280	10.0	4.7	MW	NRC	4.7	2126

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID
2008	01	05	11	57	26	51.2550	-131.3670	10.0	4.6	MW	NRC	4.6	2127
2008	01	05	12	00	18	51.5420	-130.8650	10.0	4.8	MS	ISC	4.8	2128
2008	01	05	12	27	20	51.1810	-131.1110	10.0	3.6	MW	NRC	3.6	2129
2008	01	05	12	32	47	51.3520	-131.4690	10.0	3.5	MW	NRC	3.5	2130
2008	01	05	12	38	21	51.3550	-131.3920	10.0	3.7	MW	NRC	3.7	2131
2008	01	05	12	45	51	51.4610	-131.1200	10.0	3.9	MW	NRC	3.9	2132
2008	01	05	12	49	3	51.3560	-131.4310	10.0	3.6	MW	PGC	3.6	2133
2008	01	05	12	52	1	51.2220	-131.4540	10.0	3.6	MW	PGC	3.6	2134
2008	01	05	12	58	3	51.3690	-131.3450	10.0	3.6	MW	PGC	3.6	2135
2008	01	05	13	07	17	50.9580	-130.6590	10.0	3.5	MW	NRC	3.5	2136
2008	01	05	13	38	45	51.3420	-131.3020	10.0	3.7	MW	NRC	3.7	2137
2008	01	05	13	44	1	51.3980	-131.3450	10.0	3.9	MW	PGC	3.9	2138
2008	01	05	14	08	46	51.3920	-131.2590	10.0	3.6	MW	NRC	3.6	2139
2008	01	05	14	11	33	50.9090	-130.6460	10.0	3.4	MW	NRC	3.4	2140
2008	01	05	14	26	49	51.4580	-131.0650	10.0	3.5	MW	NRC	3.5	2141
2008	01	05	15	21	59	50.9280	-130.7130	10.0	3.5	MW	NRC	3.5	2142
2008	01	05	15	49	13	51.3780	-131.3520	10.0	3.7	MW	NRC	3.7	2143
2008	01	05	15	53	14	50.8910	-130.8880	10.0	3.8	MW	NRC	3.8	2144
2008	01	05	16	07	25	51.3000	-131.3980	10.0	3.8	MW	NRC	3.8	2145
2008	01	05	16	31	2	51.4680	-131.2400	10.0	3.4	MW	PGC	3.4	2146
2008	01	05	17	16	0	51.1140	-131.0820	10.0	4.4	MW	PGC	4.4	2147
2008	01	05	18	59	29	51.3700	-131.4620	10.0	3.5	MW	NRC	3.5	2148
2008	01	05	19	03	12	51.3090	-131.3810	10.0	4.1	MW	NRC	4.1	2149
2008	01	05	19	12	12	51.4020	-131.1640	10.0	3.6	MW	NRC	3.6	2150
2008	01	05	19	16	44	51.4400	-131.0850	10.0	3.7	MW	NRC	3.7	2151
2008	01	05	20	39	38	51.4620	-130.9920	10.0	3.7	MW	NRC	3.7	2152
2008	01	05	20	52	29	51.2240	-131.3100	10.0	3.9	MW	NRC	3.9	2153
2008	01	05	21	13	40	51.2840	-131.3600	10.0	3.8	MW	NRC	3.8	2154
2008	01	05	22	21	34	50.8950	-130.7010	10.0	3.5	MW	NRC	3.5	2155
2008	01	05	23	01	29	51.3280	-131.3290	10.0	4.0	MW	NRC	4.0	2156
2008	01	05	23	23	25	51.4610	-131.0680	10.0	3.6	MW	NRC	3.6	2157
2008	01	05	23	36	43	51.2780	-131.3790	10.0	3.7	MW	NRC	3.7	2158
2008	01	06	00	17	40	51.3900	-131.3260	10.0	3.7	MW	NRC	3.7	2159
2008	01	06	00	20	32	51.4600	-131.1440	10.0	5.0	MS	ISC	5.0	2160
2008	01	06	00	43	53	51.3120	-131.3290	10.0	3.7	MW	NRC	3.7	2161
2008	01	06	01	48	12	51.3670	-131.1570	10.0	3.7	MW	NRC	3.7	2162
2008	01	06	02	15	27	51.2660	-131.5200	10.0	3.9	MW	NRC	3.9	2163
2008	01	06	03	32	54	51.2880	-131.3890	10.0	4.2	MW	NRC	4.2	2164
2008	01	06	04	49	43	51.3180	-131.3820	10.0	3.8	MW	NRC	3.8	2165
2008	01	06	04	52	46	51.2770	-131.4580	10.0	4.0	MW	NRC	4.0	2166
2008	01	06	04	55	43	51.3670	-131.2040	10.0	3.7	MW	NRC	3.7	2167
2008	01	06	05	13	10	51.3270	-131.2970	10.0	3.7	MW	NRC	3.7	2168
2008	01	06	05	30	29	51.3860	-131.0350	10.0	4.0	MW	NRC	4.0	2169
2008	01	06	07	02	47	51.3720	-131.2660	10.0	3.5	MW	NRC	3.5	2170
2008	01	06	07	29	51	51.4920	-131.0790	10.0	3.5	MW	NRC	3.5	2171
2008	01	06	07	41	2	51.3660	-131.1860	10.0	3.9	MW	PGC	3.9	2172
2008	01	06	08	19	28	51.3790	-131.1030	10.0	3.6	MW	NRC	3.6	2173
2008	01	06	08	52	13	51.3630	-131.1290	10.0	3.7	MW	NRC	3.7	2174
2008	01	06	09	00	51	51.2920	-131.3810	10.0	3.8	MW	NRC	3.8	2175
2008	01	06	09	08	58	51.3350	-131.2980	10.0	3.6	MW	NRC	3.6	2176
2008	01	06	09	10	7	51.4110	-131.1030	10.0	3.7	MW	PGC	3.7	2177
2008	01	06	10	11	46	51.3580	-131.2570	10.0	3.6	MW	NRC	3.6	2178
2008	01	06	10	21	10	51.3360	-131.2410	10.0	3.9	MW	NRC	3.9	2179
2008	01	06	10	39	25	51.2790	-131.4630	10.0	3.6	MW	NRC	3.6	2180
2008	01	06	10	51	46	51.2980	-131.4020	10.0	3.7	MW	NRC	3.7	2181
2008	01	06	12	26	47	51.2410	-131.4590	10.0	3.6	MW	NRC	3.6	2182

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID
2008	01	06	13	15	6	51.1870	-131.5850	10.0	3.8	MW	PGC	3.8	2183
2008	01	06	14	01	11	51.3600	-131.2870	10.0	3.5	MW	NRC	3.5	2184
2008	01	06	14	33	7	51.3980	-131.1300	10.0	3.4	MW	PGC	3.4	2185
2008	01	06	15	29	2	51.0520	-131.0170	10.0	3.5	MW	PGC	3.5	2186
2008	01	06	16	24	3	51.3090	-131.3460	10.0	3.8	MW	PGC	3.8	2187
2008	01	06	16	39	21	51.3640	-131.2610	10.0	3.7	MW	NRC	3.7	2188
2008	01	06	16	43	33	51.3690	-131.1530	10.0	3.5	MW	NRC	3.5	2189
2008	01	06	17	02	53	51.2310	-131.4770	10.0	3.7	MW	NRC	3.7	2190
2008	01	06	17	06	37	51.3250	-131.2660	10.0	3.5	MW	NRC	3.5	2191
2008	01	06	17	19	34	51.4530	-131.0080	10.0	3.5	MS	ISC	3.5	2192
2008	01	06	17	50	35	51.3300	-131.3270	10.0	3.6	MW	NRC	3.6	2193
2008	01	06	17	56	33	51.2920	-131.3650	10.0	3.9	MW	NRC	3.9	2194
2008	01	06	17	58	15	51.2770	-131.3980	10.0	4.0	MW	NRC	4.0	2195
2008	01	06	18	02	58	51.2660	-131.4350	10.0	3.6	MW	NRC	3.6	2196
2008	01	06	18	15	9	51.3930	-131.2370	10.0	3.4	MW	PGC	3.4	2197
2008	01	06	18	39	22	51.4260	-131.0650	10.0	3.5	MW	NRC	3.5	2198
2008	01	06	18	47	8	51.3240	-131.2610	10.0	4.0	MW	PGC	4.0	2199
2008	01	06	18	49	17	51.4500	-131.0870	10.0	3.6	MW	NRC	3.6	2200
2008	01	06	19	07	2	51.3820	-131.1770	10.0	3.4	MW	PGC	3.4	2201
2008	01	06	19	53	56	51.3440	-131.2470	10.0	3.5	MW	NRC	3.5	2202
2008	01	06	20	12	17	51.3860	-131.1300	10.0	3.5	MW	NRC	3.5	2203
2008	01	06	20	18	12	51.3090	-131.2230	10.0	3.9	MW	NRC	3.9	2204
2008	01	06	20	25	26	51.3010	-131.3300	10.0	3.8	MW	NRC	3.8	2205
2008	01	06	20	43	46	51.3130	-131.3350	10.0	3.5	MW	NRC	3.5	2206
2008	01	06	21	01	33	51.5160	-130.8730	10.0	3.4	MW	NRC	3.4	2207
2008	01	06	21	05	48	51.1270	-131.5830	10.0	3.7	MW	NRC	3.7	2208
2008	01	06	22	28	0	51.3920	-131.1740	10.0	3.5	MW	PGC	3.5	2209
2008	01	06	22	35	57	51.3390	-131.1970	10.0	4.0	MW	NRC	4.0	2210
2008	01	06	23	45	53	51.3580	-131.2480	10.0	3.9	MW	NRC	3.9	2211
2008	01	06	23	49	56	51.3560	-131.2450	10.0	3.7	MW	NRC	3.7	2212
2008	01	07	00	15	29	51.3690	-131.1270	10.0	3.4	MW	NRC	3.4	2213
2008	01	07	00	54	8	51.4400	-131.0730	10.0	3.2	MW	PGC	3.2	2214
2008	01	07	01	01	32	51.3580	-131.2690	10.0	3.4	MW	NRC	3.4	2215
2008	01	07	01	51	3	51.3970	-131.2430	10.0	3.4	MW	PGC	3.4	2216
2008	01	07	02	05	0	51.3360	-131.2330	10.0	3.4	MW	PGC	3.4	2217
2008	01	07	06	20	40	51.6660	-131.5170	10.0	3.6	MW	NRC	3.6	2218
2008	01	07	06	55	51	51.3500	-131.1850	10.0	3.4	MW	NRC	3.4	2219
2008	01	07	07	02	42	51.4140	-131.1360	10.0	3.4	MW	NRC	3.4	2220
2008	01	07	08	24	0	50.9980	-130.7850	10.0	3.4	MW	PGC	3.4	2221
2008	01	07	09	29	15	51.4130	-131.2400	10.0	3.3	MW	NRC	3.3	2222
2008	01	07	09	42	34	51.4100	-131.1290	10.0	3.4	MW	NRC	3.4	2223
2008	01	07	10	45	43	51.3670	-131.2350	10.0	3.6	MW	NRC	3.6	2224
2008	01	07	18	47	20	51.2990	-131.3810	10.0	3.4	MW	NRC	3.4	2225
2008	01	08	00	37	47	51.2680	-131.3640	10.0	3.4	MW	NRC	3.4	2226
2008	01	08	01	25	23	51.3060	-131.3460	10.0	3.5	MW	NRC	3.5	2227
2008	01	08	06	25	6	51.0400	-130.7720	10.0	3.6	MW	PGC	3.6	2228
2008	01	08	10	40	50	51.3670	-131.1360	10.0	3.5	MW	NRC	3.5	2229
2008	01	08	12	28	44	51.5490	-131.3480	10.0	3.7	MW	NRC	3.7	2230
2008	01	08	16	20	10	51.4290	-131.1400	10.0	3.6	MW	NRC	3.6	2231
2008	01	08	18	35	7	51.4420	-131.1100	10.0	3.6	MW	PGC	3.6	2232
2008	01	08	19	22	33	51.2840	-131.2990	10.0	3.5	MW	NRC	3.5	2233
2008	01	08	20	39	26	51.5680	-131.4100	10.0	3.4	MW	NRC	3.4	2234
2008	01	08	21	44	52	51.4830	-131.4770	10.0	3.6	MW	NRC	3.6	2235
2008	01	08	21	59	56	51.3650	-131.2380	10.0	3.7	MW	NRC	3.7	2236
2008	01	08	23	03	56	51.4050	-131.2560	10.0	3.6	MW	NRC	3.6	2237
2008	01	09	00	20	25	51.2440	-131.4490	10.0	4.0	MW	NRC	4.0	2238

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID
2008	01	09	01	50	35	51.3650	-131.2240	10.0	3.8	MW	NRC	3.8	2239
2008	01	09	03	03	49	51.0410	-131.0480	10.0	3.7	MW	NRC	3.7	2240
2008	01	09	09	55	25	51.3620	-131.1840	10.0	3.8	MW	NRC	3.8	2241
2008	01	09	14	40	0	51.6490	-131.1830	10.0	6.1	MW	UCM	6.1	2242
2008	01	09	14	46	26	51.5490	-131.1880	10.0	4.7	MW	NRC	4.7	2243
2008	01	09	14	57	15	50.4730	-130.3530	10.0	3.5	MW	NRC	3.5	2244
2008	01	09	14	59	53	51.5320	-131.4000	10.0	3.6	MW	NRC	3.6	2245
2008	01	09	15	01	5	51.5310	-131.3450	10.0	3.7	MW	PGC	3.7	2246
2008	01	09	15	46	53	51.5120	-131.3720	10.0	3.8	MW	NRC	3.8	2247
2008	01	09	16	00	59	51.3100	-131.3010	10.0	3.7	MW	NRC	3.7	2248
2008	01	09	16	11	58	51.4670	-131.4590	10.0	3.7	MW	NRC	3.7	2249
2008	01	09	16	31	23	51.5060	-131.3950	10.0	3.8	MW	PGC	3.8	2250
2008	01	09	16	35	45	51.4820	-131.4640	10.0	3.7	MW	NRC	3.7	2251
2008	01	09	16	51	42	51.4280	-131.4240	10.0	3.6	MW	NRC	3.6	2252
2008	01	09	17	46	56	51.5440	-131.2610	10.0	3.6	MW	NRC	3.6	2253
2008	01	09	17	50	31	51.4580	-131.3940	10.0	3.7	MW	NRC	3.7	2254
2008	01	09	18	12	36	51.4610	-131.5080	10.0	3.7	MW	NRC	3.7	2255
2008	01	09	20	06	19	51.5060	-131.5540	10.0	3.6	MW	NRC	3.6	2256
2008	01	09	20	56	10	51.0670	-130.4490	10.0	3.9	MW	NRC	3.9	2257
2008	01	09	21	10	42	51.0970	-130.3760	10.0	3.5	MW	NRC	3.5	2258
2008	01	09	22	17	45	51.4020	-131.1040	10.0	3.5	MW	NRC	3.5	2259
2008	01	10	10	06	43	51.1140	-131.2410	10.0	3.8	MW	NRC	3.8	2260
2008	01	10	13	10	8	51.4670	-131.4560	10.0	3.5	MW	PGC	3.5	2261
2008	01	10	16	53	15	51.3490	-131.0040	10.0	3.5	MW	NRC	3.5	2262
2008	01	11	05	40	12	51.3900	-131.2210	10.0	3.5	MW	NRC	3.5	2263
2008	01	11	13	08	50	51.1290	-130.3180	10.0	3.7	MW	NRC	3.7	2264
2008	01	12	15	26	30	51.5320	-131.3430	10.0	3.3	MW	NRC	3.3	2265
2008	01	13	14	22	31	52.1540	-131.7370	10.0	3.1	ML	PGC	3.1	2266
2008	01	14	14	28	53	51.6230	-131.3940	10.0	3.5	MW	NRC	3.5	2267
2008	01	14	16	19	12	51.3370	-131.2960	10.0	3.7	MW	NRC	3.7	2268
2008	01	15	17	42	55	50.8560	-130.6810	10.0	3.2	MW	NRC	3.2	2269
2008	01	17	12	49	31	55.1310	-135.4780	10.0	3.3	ML	PGC	3.3	2270
2008	01	17	20	20	3	51.4960	-131.5560	10.0	3.3	MW	PGC	3.3	2271
2008	01	18	00	36	9	55.8290	-128.6500	1.0	3.2	ML	PGC	3.2	2272
2008	01	18	14	40	31	55.9440	-129.7550	5.0	3.1	ML	PGC	3.1	2273
2008	01	18	16	00	49	51.1800	-131.1410	10.0	3.2	MW	NRC	3.2	2274
2008	01	19	12	21	22	50.6830	-130.5680	10.0	3.9	MW	NRC	3.9	2275
2008	01	19	22	23	29	50.9880	-130.3870	10.0	3.3	MW	NRC	3.3	2276
2008	01	20	23	28	5	51.2290	-130.2710	10.0	3.1	MW	PGC	3.1	2277
2008	01	22	09	09	2	51.2640	-131.1770	10.0	2.9	MW	PGC	2.9	2278
2008	01	22	20	39	0	51.4240	-131.2820	10.0	3.3	MW	PGC	3.3	2279
2008	01	23	04	51	18	51.4080	-131.3360	10.0	3.0	MW	NRC	3.0	2280
2008	01	24	18	24	5	53.7830	-133.3820	20.0	2.9	ML	PGC	2.9	2281
2008	01	25	05	59	4	51.2360	-131.3250	10.0	3.3	MW	PGC	3.3	2282
2008	01	25	09	23	43	50.2660	-129.8400	10.0	3.4	MW	NRC	3.4	2283
2008	01	26	10	31	37	53.0320	-134.9930	10.0	3.4	MW	NRC	3.4	2284
2008	01	28	09	47	47	53.5180	-133.2510	20.0	3.2	ML	PGC	3.2	2285
2008	02	01	04	11	10	51.4790	-131.0750	10.0	3.6	MW	NRC	3.6	2286
2008	02	02	11	26	41	51.4810	-131.3010	10.0	3.2	MW	NRC	3.2	2287
2008	02	04	00	53	52	51.1660	-131.1790	10.0	3.1	MW	NRC	3.1	2288
2008	02	05	12	19	6	50.7500	-129.2490	10.0	3.0	MW	PGC	3.0	2289
2008	02	05	22	08	37	50.5710	-129.2030	10.0	3.0	MW	NRC	3.0	2290
2008	02	07	13	25	48	51.4950	-131.3930	10.0	3.5	MW	NRC	3.5	2291
2008	02	09	09	50	30	51.8440	-131.8160	20.0	2.9	ML	PGC	2.9	2292
2008	02	10	17	31	4	50.3970	-130.0770	10.0	3.6	MW	PGC	3.6	2293
2008	02	10	21	12	40	57.1010	-137.4660	10.0	3.6	ML	PGC	3.6	2294

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID
2008	02	11	10	12	4	57.4000	-125.5470	1.0	4.1	ML	PGC	4.1	2295
2008	02	12	08	39	37	50.7510	-129.7270	10.0	3.0	MW	NRC	3.0	2296
2008	02	12	09	54	0	50.6570	-130.4200	10.0	3.3	MW	PGC	3.3	2297
2008	02	12	13	07	18	51.5110	-131.3340	10.0	3.6	MW	NRC	3.6	2298
2008	02	13	07	39	52	50.5300	-130.1520	10.0	3.2	MW	NRC	3.2	2299
2008	02	16	03	24	57	51.0250	-130.9300	10.0	3.9	MW	NRC	3.9	2300
2008	02	19	03	59	35	50.5860	-130.4560	10.0	3.5	MW	NRC	3.5	2301
2008	02	20	03	33	10	50.0040	-130.1310	10.0	3.3	MW	NRC	3.3	2302
2008	02	20	16	04	7	50.0670	-130.1310	10.0	3.1	MW	PGC	3.1	2303
2008	02	22	15	06	41	50.5040	-130.2330	10.0	3.0	MW	NRC	3.0	2304
2008	02	23	12	47	54	50.5190	-130.2690	10.0	3.2	MW	NRC	3.2	2305
2008	02	24	16	29	4	51.5030	-131.3140	10.0	3.0	MW	PGC	3.0	2306
2008	02	24	21	42	53	51.4780	-131.4000	10.0	3.1	MW	NRC	3.1	2307
2008	02	25	00	25	31	51.5160	-131.3280	10.0	3.0	MW	NRC	3.0	2308
2008	02	25	22	43	53	52.6200	-132.1130	20.0	3.0	ML	PGC	3.0	2309
2008	02	27	05	59	3	50.7290	-130.4680	10.0	3.3	MW	PGC	3.3	2310
2008	02	28	04	41	54	50.5350	-130.2160	10.0	3.3	MW	NRC	3.3	2311
2008	02	28	09	07	32	50.2930	-129.8850	10.0	3.0	MW	NRC	3.0	2312
2008	02	28	10	35	5	50.7300	-130.5460	10.0	3.1	MW	PGC	3.1	2313
2008	02	29	08	41	13	50.4530	-130.0140	10.0	2.9	MW	NRC	2.9	2314
2008	03	01	07	19	35	50.6540	-130.3590	10.0	3.1	MW	NRC	3.1	2315
2008	03	01	23	08	21	51.3390	-131.1480	10.0	3.3	MW	NRC	3.3	2316
2008	03	02	12	47	48	51.2520	-131.0190	10.0	3.2	MW	NRC	3.2	2317
2008	03	04	17	01	35	50.8780	-130.5710	10.0	3.2	MW	NRC	3.2	2318
2008	03	05	09	45	24	51.3070	-131.2000	10.0	3.0	MW	NRC	3.0	2319
2008	03	07	07	01	36	50.7460	-130.4410	10.0	3.2	MW	NRC	3.2	2320
2008	03	08	10	12	12	50.6620	-130.4410	10.0	3.1	MW	NRC	3.1	2321
2008	03	09	04	45	14	50.6830	-130.4300	10.0	3.1	MW	NRC	3.1	2322
2008	03	11	22	05	23	50.4710	-130.1070	10.0	3.3	MW	NRC	3.3	2323
2008	03	12	22	27	2	50.9260	-130.7550	10.0	3.2	MW	PGC	3.2	2324
2008	03	13	03	37	13	50.4960	-130.1650	10.0	3.0	MW	NRC	3.0	2325
2008	03	13	21	55	50	50.5380	-130.2350	10.0	2.9	MW	NRC	2.9	2326
2008	03	18	01	29	28	50.1860	-130.3460	10.0	3.5	MW	NRC	3.5	2327
2008	03	18	02	18	11	50.1850	-130.3060	10.0	3.3	MW	NRC	3.3	2328
2008	03	18	02	20	4	50.1850	-130.3280	10.0	3.7	MW	PGC	3.7	2329
2008	03	18	21	28	1	51.0890	-131.6150	10.0	3.4	MW	PGC	3.4	2330
2008	03	19	12	15	39	50.1970	-130.2310	10.0	3.1	MW	NRC	3.1	2331
2008	03	19	13	19	49	51.0640	-131.6520	10.0	3.2	MW	NRC	3.2	2332
2008	03	19	14	28	25	50.3210	-130.1670	10.0	2.9	MW	NRC	2.9	2333
2008	03	19	14	41	54	51.5480	-131.4310	10.0	3.1	MW	NRC	3.1	2334
2008	03	20	22	58	18	50.4710	-130.1600	10.0	3.2	MW	NRC	3.2	2335
2008	03	23	03	00	54	51.1760	-130.9320	10.0	3.7	MW	NRC	3.7	2336
2008	03	27	21	59	56	50.6290	-130.3800	10.0	3.1	MW	NRC	3.1	2337
2008	03	28	03	29	40	50.5050	-130.1830	10.0	2.9	MW	NRC	2.9	2338
2008	04	05	16	25	48	51.4450	-131.3500	10.0	3.2	MW	NRC	3.2	2339
2008	04	06	08	48	20	51.4530	-131.3990	10.0	3.3	MW	NRC	3.3	2340
2008	04	06	18	48	53	50.5770	-130.3250	10.0	3.2	MW	NRC	3.2	2341
2008	04	06	20	32	42	50.5880	-130.3880	10.0	3.5	MW	NRC	3.5	2342
2008	04	06	20	39	39	50.5780	-130.3240	10.0	3.2	MW	NRC	3.2	2343
2008	04	07	01	40	28	50.5500	-130.0540	10.0	3.0	MW	NRC	3.0	2344
2008	04	13	05	34	48	51.5020	-131.2490	10.0	3.4	MW	NRC	3.4	2345
2008	04	14	08	59	26	50.5550	-130.3440	10.0	2.9	MW	NRC	2.9	2346
2008	04	14	19	50	45	51.5790	-131.1350	10.0	3.1	MW	NRC	3.1	2347
2008	04	15	10	32	2	50.4450	-130.1560	10.0	3.1	MW	PGC	3.1	2348
2008	04	16	00	29	55	51.4490	-131.3470	10.0	3.3	MW	NRC	3.3	2349
2008	04	27	11	03	1	51.2660	-131.2850	10.0	3.4	MW	PGC	3.4	2350

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID
2008	04	29	05	47	28	50.8940	-130.6190	10.0	3.0	MW	NRC	3.0	2351
2008	04	29	06	37	44	50.7000	-130.4080	10.0	2.9	MW	NRC	2.9	2352
2008	05	02	22	31	7	50.7080	-130.2620	10.0	3.2	MW	PGC	3.2	2353
2008	05	04	07	31	40	51.4040	-131.0430	10.0	3.3	MW	NRC	3.3	2354
2008	05	06	02	33	33	50.5270	-130.2270	10.0	3.4	MW	NRC	3.4	2355
2008	05	08	12	11	25	51.4910	-131.3430	10.0	3.1	MW	NRC	3.1	2356
2008	05	08	19	20	25	51.4370	-131.4090	10.0	3.4	MW	NRC	3.4	2357
2008	05	09	16	45	58	51.5100	-131.2530	10.0	2.9	MW	NRC	2.9	2358
2008	05	09	20	43	40	51.1750	-131.1830	10.0	3.4	MW	NRC	3.4	2359
2008	05	10	09	38	26	50.4300	-130.1390	10.0	3.2	MW	NRC	3.2	2360
2008	05	10	09	50	31	50.6350	-130.3870	10.0	3.0	MW	NRC	3.0	2361
2008	05	10	20	18	9	50.6340	-130.4350	10.0	3.2	MW	PGC	3.2	2362
2008	05	13	06	08	30	50.8960	-130.5690	10.0	3.2	MW	NRC	3.2	2363
2008	05	16	01	43	56	50.4680	-130.1540	10.0	2.9	MW	NRC	2.9	2364
2008	05	16	14	22	30	52.7100	-132.3310	20.0	2.9	ML	PGC	2.9	2365
2008	05	16	21	52	55	50.6430	-129.9460	7.3	3.1	MS	ISC	3.1	2366
2008	05	20	19	52	47	50.9140	-130.6500	10.0	3.1	MW	NRC	3.1	2367
2008	05	30	12	38	29	50.4580	-130.4100	10.0	5.0	MW	GCM	5.0	2368
2008	06	04	07	33	19	50.5780	-130.2450	10.0	3.0	MW	NRC	3.0	2369
2008	06	07	18	01	28	50.6570	-130.3800	10.0	3.0	MW	NRC	3.0	2370
2008	06	11	04	41	23	51.3420	-131.2130	10.0	3.0	MW	NRC	3.0	2371
2008	06	21	18	28	22	51.2530	-131.0530	10.0	3.7	MW	NRC	3.7	2372
2008	06	22	04	52	28	51.3090	-131.1410	10.0	3.1	MW	NRC	3.1	2373
2008	06	28	15	49	37	53.0650	-135.3850	10.0	2.9	ML	PGC	2.9	2374
2008	07	01	04	55	42	50.0190	-128.7090	10.0	3.6	MW	NRC	3.6	2375
2008	07	13	14	25	39	51.6590	-131.0530	10.0	4.0	MW	NRC	4.0	2376
2008	07	15	00	23	52	50.5350	-130.3370	10.0	3.2	MW	NRC	3.2	2377
2008	07	20	09	11	2	50.8970	-130.5920	10.0	3.0	MW	PGC	3.0	2378
2008	07	22	18	01	31	50.5740	-130.3280	10.0	2.9	MW	NRC	2.9	2379
2008	07	29	02	07	56	50.7040	-130.4690	10.0	3.5	MW	NRC	3.5	2380
2008	07	30	00	03	12	50.6560	-130.5170	10.0	3.5	MW	NRC	3.5	2381
2008	07	30	10	23	43	50.6780	-129.9240	10.0	2.9	MW	NRC	2.9	2382
2008	08	04	04	48	18	51.4270	-131.0780	10.0	2.9	MW	NRC	2.9	2383
2008	08	04	15	52	18	50.8860	-130.8160	10.0	3.3	MW	NRC	3.3	2384
2008	08	04	18	54	1	50.4750	-130.2030	10.0	3.0	MW	NRC	3.0	2385
2008	08	08	11	43	8	51.5930	-131.6620	10.0	3.1	ML	PGC	3.1	2386
2008	08	08	15	41	31	51.5370	-131.7040	10.0	4.2	ML	PGC	4.2	2387
2008	08	11	11	57	12	50.5480	-130.3370	10.0	3.2	MW	NRC	3.2	2388
2008	08	14	03	50	8	51.6150	-131.4050	10.0	3.8	MW	PGC	3.8	2389
2008	08	14	18	56	14	51.0260	-130.6130	10.0	3.0	MW	NRC	3.0	2390
2008	08	15	17	55	43	50.5600	-130.3430	10.0	3.0	MW	NRC	3.0	2391
2008	08	19	21	02	13	50.5780	-130.3390	10.0	3.0	MW	NRC	3.0	2392
2008	08	21	15	37	42	50.8590	-130.2280	10.0	2.9	MW	NRC	2.9	2393
2008	08	24	08	55	2	52.1650	-131.2750	20.0	2.9	ML	PGC	2.9	2394
2008	08	25	07	13	41	57.8100	-137.7520	5.0	2.9	ML	PGC	2.9	2395
2008	08	27	06	52	23	50.0430	-129.8740	10.0	4.2	MB	ISC	4.2	2396
2008	08	27	07	44	57	50.0200	-130.0830	10.0	3.9	MB	GS	3.9	2397
2008	08	27	07	48	4	50.0110	-130.2520	10.0	3.8	MB	GS	3.8	2398
2008	08	27	08	33	40	50.0190	-130.0230	10.0	3.8	MB	ISC	3.8	2399
2008	08	27	12	43	46	50.0650	-129.5590	10.0	3.2	MS	ISC	3.2	2400
2008	08	27	16	45	4	50.0640	-130.1620	10.0	3.4	MW	PGC	3.4	2401
2008	08	27	17	44	24	50.0620	-130.1790	10.0	3.5	MW	NRC	3.5	2402
2008	08	27	18	47	9	50.2800	-129.7260	10.0	4.6	MB	ISC	4.6	2403
2008	08	27	19	19	8	50.1220	-129.6820	5.9	4.0	MB	ISC	4.0	2404
2008	08	27	19	54	11	50.1780	-129.5580	10.0	3.8	MB	ISC	3.8	2405
2008	08	27	19	59	22	50.1900	-129.8110	10.0	5.0	MW	GCM	5.0	2406

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID
2008	08	27	20	15	10	50.3540	-129.2720	10.0	4.1	MB	GS	4.1	2407
2008	08	27	20	17	35	50.2280	-130.0350	10.0	5.4	MW	GCM	5.4	2408
2008	08	27	20	24	14	50.2990	-129.6550	10.0	3.5	MB	ISC	3.6	2409
2008	08	27	20	49	34	50.2930	-129.9690	10.0	4.2	MB	GS	4.2	2410
2008	08	27	21	00	53	50.1490	-129.8160	10.0	4.1	MB	GS	4.1	2411
2008	08	27	21	22	24	50.3290	-130.7600	10.0	4.3	MB	GS	4.3	2412
2008	08	27	21	25	31	50.2360	-130.1010	10.0	3.5	MW	NRC	3.5	2413
2008	08	27	21	35	9	50.0330	-130.1200	10.0	3.5	MW	PGC	3.5	2414
2008	08	27	22	18	22	50.3170	-129.8040	10.0	4.2	MB	ISC	4.2	2415
2008	08	27	22	22	49	50.2710	-130.3910	10.0	4.2	MB	GS	4.2	2416
2008	08	27	23	47	48	50.3220	-129.7730	10.4	4.1	MB	ISC	4.1	2417
2008	08	28	00	01	19	50.0440	-129.9220	10.0	3.4	MW	NRC	3.4	2418
2008	08	28	00	25	8	50.2670	-129.7000	25.8	4.3	MB	ISC	4.3	2419
2008	08	28	00	42	18	50.0800	-129.4200	10.0	3.6	MS	ISC	3.6	2420
2008	08	28	00	54	4	50.1150	-130.1860	10.0	3.8	MW	PGC	3.8	2421
2008	08	28	02	08	28	50.1050	-129.6810	10.0	4.4	MB	ISC	4.4	2422
2008	08	28	02	44	5	50.2520	-129.2460	10.0	3.8	MB	GS	3.8	2423
2008	08	28	03	15	42	50.0050	-130.0400	10.0	4.7	MW	NRC	4.7	2424
2008	08	28	03	26	44	50.3430	-129.2920	10.0	3.9	MB	GS	3.9	2425
2008	08	28	03	33	30	50.1190	-129.6480	10.0	4.2	MB	GS	4.2	2426
2008	08	28	03	39	11	50.1190	-129.6560	12.3	4.2	MB	ISC	4.2	2427
2008	08	28	03	56	3	50.1750	-129.7020	10.0	3.6	MB	ISC	3.6	2428
2008	08	28	04	14	36	50.1260	-129.6770	10.0	4.1	MB	GS	4.1	2429
2008	08	28	04	47	53	50.1270	-129.6990	10.0	4.8	MW	GCM	4.8	2430
2008	08	28	05	38	25	50.1020	-129.6040	10.0	4.1	MB	GS	4.1	2431
2008	08	28	07	59	53	50.1550	-129.5210	10.0	4.0	MB	GS	4.0	2432
2008	08	28	08	01	40	50.1360	-129.7370	0.4	3.9	MB	ISC	3.9	2433
2008	08	28	09	20	30	50.1470	-129.6790	10.0	5.0	MW	GCM	5.0	2434
2008	08	28	10	47	11	50.1890	-129.7330	11.0	3.9	MB	ISC	3.9	2435
2008	08	28	11	43	43	50.2420	-129.3960	10.0	4.3	MB	GS	4.3	2436
2008	08	28	11	52	57	50.2090	-130.1380	10.0	3.9	MB	GS	3.9	2437
2008	08	28	12	16	49	50.2170	-129.4710	10.0	3.5	MB	ISC	3.6	2438
2008	08	28	12	24	20	50.2450	-129.6030	10.0	4.4	MB	GS	4.4	2439
2008	08	28	12	35	59	50.2340	-129.6060	10.0	3.9	MB	GS	3.9	2440
2008	08	28	13	14	53	50.1520	-129.6460	10.0	3.9	MB	ISC	3.9	2441
2008	08	28	13	58	20	50.3990	-129.3550	10.0	4.0	MB	GS	4.0	2442
2008	08	28	14	13	13	50.1420	-129.6780	10.0	4.1	MB	GS	4.1	2443
2008	08	28	15	20	37	50.1480	-129.6600	10.0	4.2	MB	ISC	4.2	2444
2008	08	28	15	59	35	50.2140	-129.6890	10.0	4.0	MB	ISC	4.0	2445
2008	08	28	16	20	41	50.1920	-129.5630	10.0	4.1	MB	GS	4.1	2446
2008	08	28	20	08	47	50.1710	-129.3670	10.0	3.5	MB	ISC	3.6	2447
2008	08	28	22	18	12	50.0910	-129.7990	10.0	4.0	MB	GS	4.0	2448
2008	08	29	04	32	44	50.1530	-129.7670	3.8	3.8	MB	ISC	3.8	2449
2008	08	29	05	41	0	50.0360	-129.4580	10.0	3.7	MB	ISC	3.7	2450
2008	08	29	10	19	31	51.0830	-130.8420	10.0	2.9	MW	NRC	2.9	2451
2008	08	29	12	07	56	50.1810	-129.3100	10.0	3.7	MB	ISC	3.7	2452
2008	08	29	14	46	40	50.0470	-130.3000	10.0	3.9	MW	NRC	3.9	2453
2008	08	29	20	16	33	50.1940	-129.5960	16.9	4.1	MB	ISC	4.1	2454
2008	08	31	17	02	42	50.9810	-130.5260	10.0	3.1	MW	NRC	3.1	2455
2008	09	03	01	19	12	50.5730	-130.2850	10.0	3.4	MW	NRC	3.4	2456
2008	09	05	03	33	58	50.2670	-130.1920	10.0	3.0	MW	NRC	3.0	2457
2008	09	08	14	02	48	50.9910	-129.4020	1.0	3.1	MW	NRC	3.1	2458
2008	09	10	07	52	28	50.5870	-130.4330	10.0	3.0	MW	NRC	3.0	2459
2008	09	13	10	57	45	54.2410	-134.2630	20.0	3.1	ML	PGC	3.1	2460
2008	09	14	10	59	54	50.4840	-130.2250	10.0	3.1	MW	NRC	3.1	2461
2008	09	18	00	45	40	50.5570	-130.3750	10.0	3.8	MW	NRC	3.8	2462

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID
2008	09	18	01	06	41	50.5640	-130.4190	10.0	3.9	MW	NRC	3.9	2463
2008	09	19	03	06	31	51.2120	-130.8600	10.0	3.5	MW	NRC	3.5	2464
2008	09	23	08	04	33	50.6600	-129.5630	10.0	3.1	MW	NRC	3.1	2465
2008	09	23	12	06	49	50.9620	-130.5780	10.0	3.2	MW	NRC	3.2	2466
2008	09	25	12	57	37	50.5680	-130.3200	10.0	2.9	MW	NRC	2.9	2467
2008	10	02	15	39	44	55.8010	-134.2040	20.0	3.0	ML	PGC	3.0	2468
2008	10	03	22	38	6	51.2560	-131.0940	10.0	3.2	MW	PGC	3.2	2469
2008	10	05	20	22	15	50.5640	-130.2790	10.0	3.1	MW	NRC	3.1	2470
2008	10	05	21	58	22	53.1500	-132.8280	20.0	3.0	ML	PGC	3.0	2471
2008	10	06	12	32	21	50.6200	-130.4060	10.0	3.1	MW	NRC	3.1	2472
2008	10	06	17	43	31	51.2710	-131.2950	10.0	3.2	MW	NRC	3.2	2473
2008	10	06	22	10	1	50.9410	-129.9720	10.0	3.2	MW	PGC	3.2	2474
2008	10	10	08	48	8	50.5310	-130.3750	10.0	3.0	MW	PGC	3.0	2475
2008	10	10	23	45	44	56.8940	-137.0350	10.0	3.5	ML	PGC	3.5	2476
2008	10	11	23	36	55	50.4600	-130.2750	10.0	3.7	MW	NRC	3.7	2477
2008	10	15	19	36	59	50.3090	-130.2340	10.0	3.0	MW	NRC	3.0	2478
2008	10	17	22	04	6	50.7020	-130.4200	10.0	3.1	MW	PGC	3.1	2479
2008	10	19	08	59	50	50.4530	-130.1000	10.0	3.2	MW	NRC	3.2	2480
2008	10	19	22	34	17	55.4510	-136.9440	10.0	3.6	ML	PGC	3.6	2481
2008	10	21	21	08	16	50.3290	-130.2720	10.0	3.3	MW	NRC	3.3	2482
2008	10	25	06	17	41	50.6330	-130.3210	10.0	3.2	MW	NRC	3.2	2483
2008	10	29	05	04	49	52.6260	-133.1230	20.0	3.4	ML	PGC	3.4	2484
2008	11	04	00	48	32	52.8310	-132.6710	20.0	3.5	ML	PGC	3.5	2485
2008	11	08	13	19	9	50.5310	-130.1840	10.0	2.9	MW	PGC	2.9	2486
2008	11	09	01	01	26	52.6540	-132.3970	20.0	3.6	ML	PGC	3.6	2487
2008	11	09	21	56	8	51.3670	-131.1700	10.0	3.3	MW	PGC	3.3	2488
2008	11	09	22	59	27	51.3190	-131.2950	10.0	3.0	MW	NRC	3.0	2489
2008	11	09	23	58	49	50.5690	-130.3250	10.0	2.9	MW	NRC	2.9	2490
2008	11	10	01	06	38	50.4430	-130.1000	10.0	3.4	MW	NRC	3.4	2491
2008	11	10	20	13	4	50.5930	-130.4350	10.0	3.4	MW	PGC	3.4	2492
2008	11	11	06	25	26	55.8050	-130.3080	1.0	3.4	ML	PGC	3.4	2493
2008	11	12	02	14	20	50.6420	-130.1100	10.0	3.4	MW	NRC	3.4	2494
2008	11	14	05	25	51	50.0510	-128.0930	27.0	3.8	ML	PGC	3.8	2495
2008	11	15	10	08	41	50.5540	-130.2640	10.0	3.2	MW	NRC	3.2	2496
2008	11	19	12	21	40	52.2950	-131.7380	20.0	4.0	ML	PGC	4.0	2497
2008	11	19	14	19	41	52.2890	-131.7510	20.0	3.9	ML	PGC	3.9	2498
2008	11	20	13	52	1	52.2960	-131.7820	20.0	3.1	ML	PGC	3.1	2499
2008	11	24	01	21	17	50.6140	-130.3050	10.0	3.4	MW	NRC	3.4	2500
2008	11	30	09	35	41	55.7300	-135.6990	10.0	3.4	ML	PGC	3.4	2501
2008	11	30	13	10	14	50.7730	-130.2440	10.0	3.1	MW	NRC	3.1	2502
2008	12	01	04	29	12	52.1830	-132.0890	20.0	4.2	ML	PGC	4.2	2503
2008	12	02	18	49	58	50.7100	-130.4530	10.0	3.1	MW	NRC	3.1	2504
2008	12	11	15	45	29	50.1600	-130.2350	10.0	3.0	MW	NRC	3.0	2505
2008	12	12	07	49	16	50.6590	-130.4060	10.0	2.9	MW	NRC	2.9	2506
2008	12	14	01	14	32	50.5370	-130.1870	10.0	3.1	MW	NRC	3.1	2507
2008	12	23	00	00	39	55.9320	-133.6520	10.0	2.9	ML	PGC	2.9	2508
2008	12	29	13	10	9	50.4870	-130.2850	10.0	3.2	MW	PGC	3.2	2509
2008	12	29	23	25	33	53.9500	-133.6520	20.0	3.1	ML	PGC	3.1	2510
2009	01	01	05	28	56	50.3700	-130.1850	10.0	3.2	MW	NRC	3.2	2511
2009	01	03	10	00	42	50.8420	-130.1510	10.0	3.3	MW	NRC	3.3	2512
2009	01	03	18	32	30	50.4300	-130.2380	10.0	3.1	MW	NRC	3.1	2513
2009	01	04	02	53	16	50.5250	-129.3210	10.0	2.9	MW	NRC	2.9	2514
2009	01	05	05	48	23	50.5560	-130.3590	10.0	3.6	MW	NRC	3.6	2515
2009	01	06	06	12	0	50.2090	-129.6400	10.0	3.0	MW	PGC	3.0	2516
2009	01	08	14	39	7	50.9360	-130.6190	10.0	3.3	MW	PGC	3.3	2517
2009	01	08	19	19	42	56.5560	-134.3900	1.0	3.1	ML	PGC	3.1	2518

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID
2009	01	09	10	30	57	52.3600	-131.8100	20.0	3.0	ML	PGC	3.0	2519
2009	01	10	06	05	51	50.7400	-129.4190	10.0	3.1	MW	NRC	3.1	2520
2009	01	12	10	30	49	50.5020	-130.2950	10.0	2.9	MW	NRC	2.9	2521
2009	01	15	13	04	26	56.0310	-135.4320	10.0	3.4	ML	PGC	3.4	2522
2009	01	16	08	12	35	50.6150	-130.0890	10.0	3.5	MW	NRC	3.5	2523
2009	01	16	18	35	6	50.4430	-130.0910	10.0	2.9	MW	PGC	2.9	2524
2009	01	17	08	21	7	52.3160	-132.1730	5.4	4.1	MB	ISC	4.1	2525
2009	01	19	20	11	7	56.0880	-128.1260	1.0	3.0	ML	PGC	3.0	2526
2009	01	27	01	29	3	50.4450	-130.3230	10.0	3.2	MW	PGC	3.2	2527
2009	01	30	19	01	25	50.5200	-129.9840	10.0	3.3	MW	NRC	3.3	2528
2009	01	31	04	37	12	50.7340	-130.4330	10.0	3.2	MW	NRC	3.2	2529
2009	02	04	16	12	30	51.5130	-131.3390	10.0	3.3	MW	NRC	3.3	2530
2009	02	06	08	51	6	50.5650	-130.2900	10.0	2.9	MW	PGC	2.9	2531
2009	02	11	23	26	51	51.3640	-131.0050	10.0	3.2	MW	NRC	3.2	2532
2009	02	12	19	04	48	50.5010	-130.2390	10.0	3.0	MW	NRC	3.0	2533
2009	02	21	13	23	13	50.6560	-130.3190	10.0	2.9	MW	NRC	2.9	2534
2009	02	21	16	50	22	50.5530	-130.3980	10.0	3.4	MW	NRC	3.4	2535
2009	02	26	13	51	15	50.6290	-130.3800	10.0	2.9	MW	NRC	2.9	2536
2009	02	26	14	39	11	50.9740	-130.5420	10.0	2.9	MW	NRC	2.9	2537
2009	02	26	16	57	6	50.9760	-130.6320	10.0	3.0	MW	PGC	3.0	2538
2009	02	27	03	59	25	52.8790	-132.5510	20.0	2.9	ML	PGC	2.9	2539
2009	03	01	13	21	30	51.1930	-130.8600	10.0	3.3	MW	NRC	3.3	2540
2009	03	08	20	00	51	50.5970	-130.3450	10.0	3.0	MW	NRC	3.0	2541
2009	03	11	16	00	54	50.5850	-130.4570	10.0	3.5	MW	NRC	3.5	2542
2009	03	16	02	09	59	50.4520	-130.1680	10.0	3.0	MW	NRC	3.0	2543
2009	03	16	21	04	10	50.3920	-130.2070	10.0	3.1	MW	NRC	3.1	2544
2009	03	18	12	18	2	50.7190	-130.4940	10.0	3.4	MW	PGC	3.4	2545
2009	03	20	00	19	24	50.5820	-130.3150	10.0	3.0	MW	NRC	3.0	2546
2009	03	20	00	21	21	50.5530	-130.3360	10.0	3.0	MW	NRC	3.0	2547
2009	03	20	08	17	9	56.1510	-127.7790	10.0	3.0	ML	PGC	3.0	2548
2009	03	20	18	35	1	51.1040	-130.9210	10.0	3.2	MW	PGC	3.2	2549
2009	03	22	06	10	57	55.3360	-134.9510	20.0	3.1	ML	PGC	3.1	2550
2009	03	23	03	34	35	50.9950	-130.5100	10.0	2.9	MW	NRC	2.9	2551
2009	03	23	05	10	54	50.9930	-131.1570	10.0	3.1	MW	NRC	3.1	2552
2009	03	23	20	27	50	53.8870	-132.2410	1.0	2.9	ML	PGC	2.9	2553
2009	03	29	07	49	53	51.3620	-130.7410	10.0	3.0	MW	NRC	3.0	2554
2009	03	30	16	12	54	50.5140	-130.1970	10.0	3.1	MW	NRC	3.1	2555
2009	03	30	18	38	36	51.2780	-131.3560	10.0	3.5	MW	NRC	3.5	2556
2009	04	02	04	52	27	50.9310	-129.9210	10.0	3.2	MW	NRC	3.2	2557
2009	04	03	12	56	58	50.6080	-130.3570	10.0	3.2	MW	NRC	3.2	2558
2009	04	03	14	12	8	50.5550	-130.2060	10.0	3.0	MW	PGC	3.0	2559
2009	04	05	16	02	28	50.4190	-130.1060	10.0	3.5	MW	NRC	3.5	2560
2009	04	06	04	51	16	50.5800	-130.4160	10.0	3.0	MW	NRC	3.0	2561
2009	04	06	06	38	3	50.1760	-130.1360	10.0	2.9	MW	PGC	2.9	2562
2009	04	06	07	34	47	50.3890	-130.1490	10.0	3.0	MW	NRC	3.0	2563
2009	04	06	07	39	39	50.4370	-130.1080	10.0	3.3	MW	NRC	3.3	2564
2009	04	06	08	18	39	50.4470	-130.1140	10.0	2.9	MW	NRC	2.9	2565
2009	04	06	08	44	47	50.4280	-130.1260	10.0	3.5	MW	NRC	3.5	2566
2009	04	06	08	47	10	50.4570	-130.1740	10.0	3.0	MW	NRC	3.0	2567
2009	04	06	09	58	22	50.4340	-130.1120	10.0	3.1	MW	NRC	3.1	2568
2009	04	08	21	53	34	56.1770	-134.6570	5.0	2.9	ML	PGC	2.9	2569
2009	04	08	23	45	43	54.4590	-137.0010	10.0	3.0	ML	PGC	3.0	2570
2009	04	10	17	14	16	51.3870	-131.0270	10.0	4.0	MW	NRC	4.0	2571
2009	04	11	11	38	3	50.9440	-130.6480	10.0	2.9	MW	PGC	2.9	2572
2009	04	12	08	18	54	50.9750	-130.5120	10.0	3.0	MW	NRC	3.0	2573
2009	04	13	19	44	18	50.5160	-130.2440	10.0	2.9	MW	NRC	2.9	2574

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID
2009	04	19	08	36	1	50.5780	-130.2730	10.0	2.9	MW	PGC	2.9	2575
2009	04	19	16	50	50	51.4420	-131.2600	10.0	3.1	MW	NRC	3.1	2576
2009	04	24	19	54	29	50.2230	-130.1330	10.0	3.4	MW	NRC	3.4	2577
2009	04	25	20	45	29	51.2620	-131.1950	10.0	3.2	MW	NRC	3.2	2578
2009	04	26	18	53	15	50.6500	-130.4470	10.0	2.9	MW	NRC	2.9	2579
2009	05	03	02	50	16	50.6550	-130.3360	14.0	3.6	MS	ISC	3.6	2580
2009	05	03	02	53	55	50.5380	-130.2110	10.0	3.0	MW	NRC	3.0	2581
2009	05	03	16	47	35	51.1130	-131.0330	10.0	3.2	MW	NRC	3.2	2582
2009	05	05	12	27	20	50.7270	-130.4320	10.0	3.3	MW	NRC	3.3	2583
2009	05	07	22	30	32	50.7110	-130.4750	10.0	3.2	MW	NRC	3.2	2584
2009	05	08	06	01	2	51.2750	-131.2450	10.0	2.9	MW	PGC	2.9	2585
2009	05	08	07	15	59	51.1860	-131.2140	10.0	3.0	MW	NRC	3.0	2586
2009	05	12	02	14	43	50.5000	-130.2970	10.0	3.4	MW	NRC	3.4	2587
2009	05	28	21	33	11	50.5270	-130.4090	10.0	3.7	MW	NRC	3.7	2588
2009	06	05	21	06	4	50.3730	-130.3920	10.0	2.9	MW	PGC	2.9	2589
2009	06	10	05	21	57	50.6700	-130.4770	10.0	3.0	MW	NRC	3.0	2590
2009	06	17	04	29	11	50.4140	-130.1690	10.0	3.3	MW	NRC	3.3	2591
2009	06	18	20	03	34	50.3900	-130.1060	10.0	2.9	MW	NRC	2.9	2592
2009	06	21	06	30	24	50.4020	-130.1960	10.0	3.0	MW	NRC	3.0	2593
2009	06	21	16	51	56	50.7020	-130.6270	10.0	2.9	MW	NRC	2.9	2594
2009	06	21	16	54	8	50.6780	-130.5770	10.0	3.3	MW	PGC	3.3	2595
2009	06	21	17	29	35	50.3610	-130.1640	10.0	3.3	MW	NRC	3.3	2596
2009	06	27	02	47	25	50.3230	-130.1670	10.0	2.9	MW	NRC	2.9	2597
2009	07	02	22	49	7	50.5860	-130.3840	10.0	3.6	MW	PGC	3.6	2598
2009	07	03	03	06	41	53.7830	-131.4780	12.5	4.3	MB	ISC	4.3	2599
2009	07	03	06	21	22	50.6720	-130.4870	10.0	3.4	MW	NRC	3.4	2600
2009	07	09	13	18	14	50.6630	-130.5560	10.0	3.1	MW	NRC	3.1	2601
2009	07	15	07	44	49	50.6230	-129.6280	10.0	3.8	MW	NRC	3.8	2602
2009	07	18	11	11	3	50.4970	-130.3000	10.0	3.5	MW	PGC	3.5	2603
2009	07	18	12	06	46	50.5100	-130.2550	10.0	3.4	MW	NRC	3.4	2604
2009	07	19	17	32	7	50.5240	-130.2390	10.0	3.3	MW	PGC	3.3	2605
2009	08	02	17	16	3	51.2620	-131.3330	10.0	3.1	MW	PGC	3.1	2606
2009	08	06	22	39	37	50.5160	-130.3740	10.0	4.2	MW	PGC	4.2	2607
2009	08	12	06	25	34	50.4410	-130.1340	10.0	3.0	MW	NRC	3.0	2608
2009	08	14	13	32	20	50.0500	-130.1580	10.0	3.2	MW	NRC	3.2	2609
2009	08	14	17	22	18	50.0950	-130.1870	10.0	3.4	MW	NRC	3.4	2610
2009	08	14	22	42	32	50.0650	-130.0920	10.0	3.0	MW	NRC	3.0	2611
2009	08	18	06	25	41	50.9210	-130.5850	10.0	3.3	MW	NRC	3.3	2612
2009	08	20	14	07	30	50.8200	-130.6450	10.0	2.9	MW	NRC	2.9	2613
2009	08	27	17	55	18	51.4350	-131.1460	10.0	4.1	MW	NRC	4.1	2614
2009	08	27	17	57	4	51.4640	-131.2420	10.0	3.3	MW	PGC	3.3	2615
2009	08	29	11	31	49	51.2230	-131.1360	10.0	3.0	MW	NRC	3.0	2616
2009	09	05	03	32	25	51.3090	-130.8600	10.0	3.0	MW	NRC	3.0	2617
2009	09	05	04	55	52	51.4480	-131.1170	10.0	3.2	MW	NRC	3.2	2618
2009	09	07	18	24	25	50.5550	-130.2580	10.0	2.9	MW	NRC	2.9	2619
2009	09	09	13	38	20	51.3770	-130.8650	10.0	3.1	MW	NRC	3.1	2620
2009	09	10	23	30	8	51.1760	-130.5450	10.0	3.2	MW	PGC	3.2	2621
2009	09	12	23	02	51	50.9920	-130.5430	10.0	3.1	MW	NRC	3.1	2622
2009	09	12	23	18	1	51.0340	-130.5680	10.0	3.2	MW	PGC	3.2	2623
2009	09	21	21	15	10	50.6850	-130.5190	10.0	3.0	MW	NRC	3.0	2624
2009	09	24	07	40	29	55.6740	-135.4130	20.0	3.6	ML	PGC	3.6	2625
2009	09	24	09	56	25	55.6730	-135.3050	20.0	3.4	ML	PGC	3.4	2626
2009	09	29	04	52	33	50.6310	-130.4070	10.0	2.9	MW	NRC	2.9	2627
2009	09	30	05	25	55	50.9970	-130.5830	10.0	3.0	MW	NRC	3.0	2628
2009	09	30	17	51	43	51.1110	-131.0640	10.0	3.1	MW	NRC	3.1	2629
2009	10	06	22	06	45	50.9040	-130.7620	10.0	3.0	MW	NRC	3.0	2630

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID
2009	10	07	23	24	56	50.5000	-130.1380	10.0	3.6	MW	NRC	3.6	2631
2009	10	09	18	42	44	52.8580	-132.4100	20.0	3.3	ML	PGC	3.3	2632
2009	10	10	07	56	23	55.4750	-134.6640	1.0	3.2	ML	PGC	3.2	2633
2009	10	12	11	10	3	50.4690	-130.2020	10.0	4.4	MW	PGC	4.4	2634
2009	10	12	20	36	35	50.6000	-130.3430	10.0	3.0	MW	NRC	3.0	2635
2009	10	12	20	47	8	50.5840	-130.3630	10.0	2.9	MW	PGC	2.9	2636
2009	10	12	21	58	52	50.6990	-130.3600	10.0	3.0	MW	NRC	3.0	2637
2009	10	13	07	14	0	50.3950	-130.2880	10.0	3.0	MW	PGC	3.0	2638
2009	10	13	10	17	0	50.4370	-130.2290	10.0	3.1	MW	PGC	3.1	2639
2009	10	16	08	23	43	50.0640	-127.9830	21.9	3.2	ML	PGC	3.2	2640
2009	10	18	06	08	15	50.5030	-130.2230	10.0	3.8	MW	NRC	3.8	2641
2009	10	18	18	27	39	51.3490	-131.0020	10.0	2.9	MW	NRC	2.9	2642
2009	10	18	18	57	29	51.3690	-131.0040	10.0	3.0	MW	NRC	3.0	2643
2009	10	20	01	51	50	56.5590	-135.6900	10.0	2.9	ML	PGC	2.9	2644
2009	10	20	03	50	24	57.8510	-133.1970	1.0	2.9	ML	PGC	2.9	2645
2009	10	21	12	36	33	50.5520	-130.2800	10.0	3.2	MW	NRC	3.2	2646
2009	10	21	12	43	38	50.5450	-130.2510	10.0	3.2	MW	NRC	3.2	2647
2009	10	21	13	12	33	50.6030	-130.3490	10.0	3.2	MW	NRC	3.2	2648
2009	10	23	15	17	47	52.3980	-131.8670	20.0	3.0	ML	PGC	3.0	2649
2009	10	24	03	57	42	50.5410	-130.2770	10.0	3.0	MW	NRC	3.0	2650
2009	10	28	11	35	15	50.0570	-130.1190	10.0	2.9	MW	NRC	2.9	2651
2009	10	29	14	51	55	51.8310	-131.8400	20.0	3.4	ML	PGC	3.4	2652
2009	10	31	17	26	28	50.0730	-130.2680	10.0	4.1	MW	NRC	4.1	2653
2009	11	05	21	01	29	50.2140	-129.9850	10.0	3.3	MW	NRC	3.3	2654
2009	11	07	01	58	37	50.6630	-130.3090	10.0	3.5	MW	NRC	3.5	2655
2009	11	08	11	08	8	50.6790	-130.3580	10.0	3.4	MW	PGC	3.4	2656
2009	11	08	20	18	33	54.8980	-132.5680	20.0	4.2	ML	OTT	4.2	2657
2009	11	08	20	54	42	54.9450	-132.7890	14.9	4.2	ML	PGC	4.2	2658
2009	11	08	22	49	16	54.9040	-132.6130	25.0	3.5	ML	OTT	3.5	2659
2009	11	09	04	07	6	57.6990	-132.4970	1.0	3.5	ML	PGC	3.5	2660
2009	11	12	05	07	49	50.4580	-130.0730	10.0	3.1	MW	NRC	3.1	2661
2009	11	13	21	08	24	50.5660	-130.3350	10.0	3.2	MW	NRC	3.2	2662
2009	11	14	00	27	1	55.3630	-135.4860	10.0	6.4	MW	OTT	6.4	2663
2009	11	14	08	19	53	50.5670	-130.3880	10.0	3.0	MW	NRC	3.0	2664
2009	11	14	09	17	19	55.1870	-134.5470	20.0	3.0	ML	PGC	3.0	2665
2009	11	17	02	09	6	51.3560	-131.1740	10.0	3.4	MW	PGC	3.4	2666
2009	11	17	08	03	38	50.4670	-130.1190	10.0	3.4	MW	NRC	3.4	2667
2009	11	17	15	30	45	52.1310	-131.3970	3.3	6.6	MW	GCM	6.6	2668
2009	11	17	15	37	43	52.0890	-131.5630	16.7	6.1	MS	ISC	6.0	2669
2009	11	17	15	54	27	51.9110	-131.8300	20.0	3.8	ML	PGC	3.8	2670
2009	11	17	16	26	26	52.0160	-131.3160	14.7	5.4	MS	ISC	5.3	2671
2009	11	17	16	36	45	51.7900	-131.7810	20.0	3.7	ML	PGC	3.7	2672
2009	11	17	16	40	9	51.9570	-131.2020	20.0	3.0	ML	PGC	3.0	2673
2009	11	17	18	02	48	52.0220	-131.3920	23.0	3.3	MB	ISC	3.4	2674
2009	11	17	19	04	11	51.8670	-131.7430	20.0	4.7	MW	NRC	4.7	2675
2009	11	17	19	30	55	51.8510	-131.7950	20.0	2.9	ML	PGC	2.9	2676
2009	11	17	19	52	41	51.8840	-131.8390	20.0	3.6	MW	NRC	3.6	2677
2009	11	17	20	15	0	51.8820	-131.9320	20.0	3.6	ML	PGC	3.6	2678
2009	11	17	20	50	5	52.0900	-131.3590	23.0	3.7	MB	ISC	3.7	2679
2009	11	18	00	59	38	51.9070	-132.1360	20.0	2.9	MW	NRC	2.9	2680
2009	11	18	01	39	52	51.9020	-131.6650	20.0	3.8	ML	PGC	3.8	2681
2009	11	18	02	14	6	51.9960	-131.6230	23.0	3.5	MB	ISC	3.6	2682
2009	11	18	03	16	34	51.8110	-131.6830	20.0	4.6	MW	NRC	4.6	2683
2009	11	18	08	06	7	52.2220	-131.6620	10.0	4.3	MB	GS	4.3	2684
2009	11	18	10	33	2	51.9840	-131.5780	20.0	3.8	ML	PGC	3.8	2685
2009	11	18	18	29	6	51.9560	-131.2710	20.0	3.5	ML	PGC	3.5	2686

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID
2009	11	19	00	45	45	51.9050	-131.9170	20.0	3.0	ML	PGC	3.0	2687
2009	11	19	05	29	8	51.8870	-131.8730	20.0	2.9	ML	PGC	2.9	2688
2009	11	19	09	39	10	51.7810	-131.7420	20.0	3.8	ML	PGC	3.8	2689
2009	11	19	09	56	20	51.7920	-131.7870	20.0	3.1	ML	PGC	3.1	2690
2009	11	19	12	23	12	51.8830	-131.8130	20.0	3.0	ML	PGC	3.0	2691
2009	11	19	12	38	55	51.9290	-131.8490	20.0	3.0	ML	PGC	3.0	2692
2009	11	19	16	04	38	51.8280	-131.6110	20.0	2.9	ML	PGC	2.9	2693
2009	11	19	17	02	19	51.9050	-131.3700	20.0	3.0	ML	PGC	3.0	2694
2009	11	21	00	24	53	52.0270	-131.3190	20.0	2.9	ML	PGC	2.9	2695
2009	11	22	15	33	14	51.8700	-131.8000	20.0	3.1	ML	PGC	3.1	2696
2009	11	24	00	13	1	51.8590	-131.9330	20.0	3.6	ML	PGC	3.6	2697
2009	11	24	13	35	49	51.9410	-131.8790	20.0	2.9	ML	PGC	2.9	2698
2009	11	25	05	48	47	50.3160	-130.1960	10.0	3.4	MW	NRC	3.4	2699
2009	11	25	10	43	6	50.5770	-130.2830	10.0	3.3	MW	PGC	3.3	2700
2009	11	25	13	36	9	51.8280	-131.5310	20.0	3.0	ML	PGC	3.0	2701
2009	11	27	00	42	23	50.5570	-130.2880	10.0	3.1	MW	NRC	3.1	2702
2009	11	27	23	41	35	50.5690	-130.2510	10.0	3.0	MW	NRC	3.0	2703
2009	11	28	01	48	50	51.9880	-131.3680	22.8	2.9	ML	PGC	2.9	2704
2009	11	29	02	41	27	51.9550	-131.4730	20.0	3.0	ML	PGC	3.0	2705
2009	12	12	04	31	11	57.9340	-137.7870	10.0	3.0	MW	NRC	3.0	2706
2009	12	16	14	49	54	52.0040	-131.3200	20.0	4.3	MW	NRC	4.3	2707
2009	12	18	14	59	58	52.3100	-131.7710	20.0	2.9	ML	PGC	2.9	2708
2009	12	22	06	33	34	50.5640	-130.3530	10.0	3.0	MW	NRC	3.0	2709
2009	12	23	08	08	31	50.5490	-130.3650	10.0	4.2	ML	PGC	4.2	2710
2009	12	28	05	53	45	50.4520	-130.0530	10.0	2.9	MW	NRC	2.9	2711
2009	12	31	00	26	51	50.5330	-129.9250	10.0	2.9	MW	NRC	2.9	2712
2010	01	02	04	54	50	50.6500	-130.3980	10.0	3.3	MW	NRC	3.3	2713
2010	01	02	20	51	46	50.6010	-130.2960	10.0	3.3	MW	NRC	3.3	2714
2010	01	10	03	06	54	50.2520	-132.4760	20.0	3.1	ML	PGC	3.1	2715
2010	01	11	01	25	18	50.7070	-130.4000	10.0	3.5	MW	NRC	3.5	2716
2010	01	11	03	59	21	51.9300	-131.3730	20.0	3.3	ML	PGC	3.3	2717
2010	01	11	23	52	55	51.4130	-130.8690	10.0	3.4	MW	NRC	3.4	2718
2010	01	12	07	56	5	51.3570	-131.1550	10.0	3.5	MW	PGC	3.5	2719
2010	01	13	05	00	57	50.2850	-130.1750	10.0	3.3	MW	NRC	3.3	2720
2010	01	14	22	15	36	50.7150	-130.3330	10.0	3.3	MW	NRC	3.3	2721
2010	01	15	21	49	12	52.0170	-131.3750	20.0	2.9	ML	PGC	2.9	2722
2010	01	20	07	12	2	50.3140	-130.2110	10.0	3.3	MW	PGC	3.3	2723
2010	01	21	12	15	42	50.5980	-130.3970	10.0	3.1	MW	NRC	3.1	2724
2010	01	22	08	45	25	51.2460	-131.0670	10.0	3.1	MW	NRC	3.1	2725
2010	01	22	23	05	23	50.4120	-129.1370	10.0	2.9	MW	NRC	2.9	2726
2010	01	22	23	48	10	50.6600	-130.4300	10.0	3.2	MW	NRC	3.2	2727
2010	01	23	10	14	12	56.2550	-134.6650	20.0	3.2	ML	PGC	3.2	2728
2010	01	25	13	31	56	50.5390	-130.2960	10.0	3.3	MW	NRC	3.3	2729
2010	01	27	16	18	58	50.4820	-130.1880	10.0	3.1	MW	NRC	3.1	2730
2010	01	30	12	19	15	51.3900	-130.7910	10.0	3.1	MW	NRC	3.1	2731
2010	01	31	14	06	24	50.9750	-130.3970	10.0	3.0	MW	NRC	3.0	2732
2010	02	03	13	49	3	50.6410	-130.4300	10.0	2.9	MW	PGC	2.9	2733
2010	02	04	13	43	8	50.4260	-130.1280	10.0	2.9	MW	PGC	2.9	2734
2010	02	07	06	35	49	50.2750	-130.2160	10.0	3.1	MW	NRC	3.1	2735
2010	02	11	01	40	47	50.7220	-130.4550	10.0	3.3	MW	NRC	3.3	2736
2010	02	15	00	11	45	50.5710	-130.3700	10.0	4.0	MW	NRC	4.0	2737
2010	02	15	04	12	2	50.5920	-130.3080	10.0	3.5	MW	PGC	3.5	2738
2010	02	16	19	55	40	50.4760	-130.2610	10.0	3.2	MW	NRC	3.2	2739
2010	02	17	23	03	58	51.9280	-131.4800	20.0	3.0	ML	PGC	3.0	2740
2010	02	22	07	59	49	50.5830	-130.4060	10.0	3.8	MW	NRC	3.8	2741
2010	02	22	17	03	23	51.3010	-130.8500	10.0	2.9	MW	NRC	2.9	2742

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID
2010	02	22	19	30	12	51.3140	-131.2570	10.0	3.1	MW	NRC	3.1	2743
2010	02	23	21	00	16	50.5930	-130.3620	10.0	3.3	MW	NRC	3.3	2744
2010	03	04	16	59	21	50.6570	-130.3880	10.0	3.0	MW	NRC	3.0	2745
2010	03	04	22	29	14	51.1310	-130.6630	10.0	4.4	MW	NRC	4.4	2746
2010	03	06	05	24	19	50.5600	-130.3360	10.0	3.0	MW	NRC	3.0	2747
2010	03	06	23	44	58	51.3890	-130.9960	10.0	3.2	MW	NRC	3.2	2748
2010	03	10	17	01	53	50.4950	-130.0620	10.0	3.3	MW	NRC	3.3	2749
2010	03	10	17	49	38	50.4980	-130.1110	10.0	3.2	MW	NRC	3.2	2750
2010	03	10	22	25	43	51.3890	-130.7680	10.0	3.5	MW	NRC	3.5	2751
2010	03	20	14	30	26	50.7470	-130.5280	10.0	3.0	MW	NRC	3.0	2752
2010	03	23	00	12	38	51.3670	-131.2100	10.0	3.1	MW	NRC	3.1	2753
2010	03	25	22	55	13	50.7330	-130.4990	10.0	3.0	MW	NRC	3.0	2754
2010	03	27	13	31	20	51.9320	-131.7540	20.0	3.0	ML	PGC	3.0	2755
2010	03	28	14	26	49	51.2240	-130.9020	10.0	4.5	MW	PGC	4.5	2756
2010	03	28	14	40	17	51.2330	-130.6500	10.0	3.6	MW	NRC	3.6	2757
2010	03	28	14	47	38	51.2420	-130.7850	10.0	3.6	MW	NRC	3.6	2758
2010	03	28	14	56	0	51.2780	-130.8370	10.0	3.9	MW	PGC	3.9	2759
2010	03	28	15	57	3	51.3940	-130.7250	10.0	3.5	MW	PGC	3.5	2760
2010	03	28	17	03	0	51.4360	-130.5380	10.0	3.3	MW	PGC	3.3	2761
2010	03	28	17	21	49	51.3430	-130.4380	10.0	3.4	MW	NRC	3.4	2762
2010	03	29	00	04	13	51.3220	-130.5100	10.0	3.4	MW	NRC	3.4	2763
2010	03	29	00	31	53	51.3400	-130.4670	10.0	3.5	MW	NRC	3.5	2764
2010	03	29	11	09	54	51.3310	-130.6570	10.0	3.7	MW	NRC	3.7	2765
2010	03	29	11	38	7	51.2590	-130.8320	10.0	4.7	MW	PGC	4.7	2766
2010	03	29	17	50	0	51.3740	-130.6840	10.0	3.3	MW	PGC	3.3	2767
2010	03	29	18	00	3	51.2830	-130.6320	10.0	3.4	MW	PGC	3.4	2768
2010	03	29	18	14	5	51.3370	-130.8610	10.0	3.4	MW	PGC	3.4	2769
2010	03	29	18	23	49	51.3690	-130.6340	10.0	3.4	MW	NRC	3.4	2770
2010	03	29	19	30	29	51.3970	-130.7240	10.0	3.6	MW	NRC	3.6	2771
2010	03	30	01	51	45	51.3820	-130.6980	10.0	3.3	MW	NRC	3.3	2772
2010	03	30	04	31	18	51.4520	-130.7400	10.0	3.2	MW	NRC	3.2	2773
2010	03	30	06	24	5	51.3760	-130.5330	10.0	3.5	MW	PGC	3.5	2774
2010	03	31	00	56	14	50.4970	-130.2060	10.0	3.2	MW	NRC	3.2	2775
2010	03	31	02	00	49	51.4280	-130.9390	10.0	3.5	MW	NRC	3.5	2776
2010	03	31	03	03	46	53.3960	-135.0450	10.0	3.5	ML	PGC	3.5	2777
2010	03	31	08	36	40	51.2880	-130.6520	10.0	3.2	MW	NRC	3.2	2778
2010	03	31	10	28	3	51.3360	-130.4970	10.0	3.2	MW	PGC	3.2	2779
2010	03	31	16	31	23	51.4410	-130.5500	10.0	3.2	MW	NRC	3.2	2780
2010	03	31	22	38	28	50.1380	-130.4040	10.0	3.5	MW	NRC	3.5	2781
2010	04	02	05	33	42	50.6740	-130.4330	10.0	3.4	MW	NRC	3.4	2782
2010	04	02	19	11	47	50.5580	-130.2630	10.0	3.7	MW	NRC	3.7	2783
2010	04	03	19	21	42	50.4490	-130.2670	10.0	3.6	MW	NRC	3.6	2784
2010	04	04	05	53	24	50.6250	-130.3780	10.0	3.3	MW	NRC	3.3	2785
2010	04	05	00	41	46	50.6020	-130.4570	10.0	3.5	MW	NRC	3.5	2786
2010	04	06	08	54	40	55.2670	-134.0430	10.0	3.6	ML	PGC	3.6	2787
2010	04	06	16	21	9	50.8860	-130.7190	10.0	3.2	MW	PGC	3.2	2788
2010	04	06	20	38	20	51.3400	-130.6970	10.0	3.4	MW	NRC	3.4	2789
2010	04	09	18	12	16	50.2310	-130.1410	10.0	3.2	MW	NRC	3.2	2790
2010	04	09	23	34	37	51.2050	-131.0840	10.0	3.1	MW	NRC	3.1	2791
2010	04	12	03	13	23	50.0610	-130.2650	10.0	3.1	MW	NRC	3.1	2792
2010	04	13	19	44	54	50.6000	-130.3830	10.0	3.0	MW	NRC	3.0	2793
2010	04	14	16	05	13	51.2850	-130.8850	10.0	3.2	MW	NRC	3.2	2794
2010	04	17	07	02	59	50.4460	-130.2100	10.0	3.2	MW	NRC	3.2	2795
2010	04	24	02	20	33	50.5260	-130.2080	10.0	3.3	MW	NRC	3.3	2796
2010	04	25	03	08	19	51.8560	-131.5890	10.0	3.8	MW	NRC	3.8	2797
2010	04	25	07	51	4	51.3680	-130.3430	10.0	3.0	MW	PGC	3.0	2798

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID
2010	04	26	07	24	8	50.6430	-130.3710	10.0	3.2	MW	PGC	3.2	2799
2010	04	27	12	13	58	50.6750	-130.5040	10.0	3.5	MW	NRC	3.5	2800
2010	04	29	13	18	28	57.9030	-137.9510	1.0	2.9	ML	PGC	2.9	2801
2010	05	04	02	54	15	50.9800	-130.6510	10.0	3.1	MW	NRC	3.1	2802
2010	05	04	22	56	22	50.4470	-130.0690	10.0	3.1	MW	NRC	3.1	2803
2010	05	04	23	31	55	50.4090	-130.0970	10.0	3.7	MW	NRC	3.7	2804
2010	05	04	23	38	36	50.4370	-130.0520	10.0	3.4	MW	NRC	3.4	2805
2010	05	05	01	34	13	50.9660	-130.6410	10.0	3.1	MW	NRC	3.1	2806
2010	05	05	18	26	37	55.0690	-136.2940	10.0	2.9	ML	PGC	2.9	2807
2010	05	06	11	38	0	50.1430	-129.9680	12.0	3.6	MB	ISC	3.6	2808
2010	05	08	10	42	25	50.6040	-130.2140	14.0	3.7	MB	ISC	3.7	2809
2010	05	08	10	52	13	50.5120	-130.3870	10.0	3.8	MW	NRC	3.8	2810
2010	05	13	00	28	0	50.3980	-130.1430	10.0	3.2	MW	PGC	3.2	2811
2010	05	13	11	20	15	50.4400	-130.0510	10.0	3.0	MW	NRC	3.0	2812
2010	05	15	09	35	23	51.3010	-131.3790	10.0	3.0	MW	NRC	3.0	2813
2010	05	16	17	14	50	50.4740	-130.2230	10.0	3.8	MW	NRC	3.8	2814
2010	05	20	23	26	36	51.1420	-130.9830	10.0	3.6	MW	NRC	3.6	2815
2010	05	21	06	06	12	51.8380	-131.4530	20.0	3.7	ML	PGC	3.7	2816
2010	05	21	07	08	20	51.0910	-129.8400	10.0	3.0	MW	NRC	3.0	2817
2010	05	22	02	25	48	50.9490	-130.9990	10.0	3.1	MW	NRC	3.1	2818
2010	05	23	19	53	38	50.6890	-130.5630	10.0	3.5	MW	NRC	3.5	2819
2010	05	25	09	54	0	50.8460	-129.7950	10.0	3.2	MW	PGC	3.2	2820
2010	05	27	01	39	0	50.5310	-130.2250	10.0	3.4	MW	PGC	3.4	2821
2010	06	01	18	48	23	50.0640	-129.9840	10.0	2.9	MW	NRC	2.9	2822
2010	06	03	02	09	17	50.5060	-130.2430	10.0	3.0	MW	NRC	3.0	2823
2010	06	03	05	02	11	50.6050	-130.4250	10.0	3.4	MW	NRC	3.4	2824
2010	06	03	05	14	22	50.5110	-130.2250	10.0	3.2	MW	NRC	3.2	2825
2010	06	13	09	34	55	50.5610	-130.4200	10.0	3.3	MW	NRC	3.3	2826
2010	06	14	00	33	2	50.5310	-130.2290	10.0	2.9	MW	PGC	2.9	2827
2010	06	14	08	21	13	50.2140	-129.7670	10.0	3.3	MW	NRC	3.3	2828
2010	06	14	13	38	26	50.5520	-130.1750	10.0	2.9	MW	NRC	2.9	2829
2010	06	16	08	11	36	50.5680	-130.3100	10.0	3.2	MW	NRC	3.2	2830
2010	06	17	03	14	5	50.6710	-130.4900	10.0	3.2	MW	PGC	3.2	2831
2010	06	17	14	28	28	50.7220	-130.5320	10.0	3.6	MW	NRC	3.6	2832
2010	06	19	22	16	51	54.8400	-134.3450	20.0	4.4	MW	OTT	4.4	2833
2010	06	22	12	01	40	51.4560	-131.0230	10.0	2.9	MW	NRC	2.9	2834
2010	06	25	02	08	8	51.0650	-130.5430	10.0	2.9	MW	PGC	2.9	2835
2010	06	25	02	22	41	51.0620	-130.1440	10.0	3.8	MW	NRC	3.8	2836
2010	06	25	02	30	25	50.7390	-130.5250	10.0	2.9	MW	NRC	2.9	2837
2010	06	25	03	08	34	50.8110	-130.4730	10.0	3.7	MW	NRC	3.7	2838
2010	06	25	04	11	10	50.6880	-130.5650	10.0	2.9	MW	NRC	2.9	2839
2010	06	25	04	40	34	50.6910	-130.5220	10.0	2.9	MW	NRC	2.9	2840
2010	06	26	18	16	48	51.1400	-131.1380	10.0	2.9	MW	NRC	2.9	2841
2010	06	29	08	48	23	50.2290	-129.8410	10.0	3.5	MW	NRC	3.5	2842
2010	06	29	13	45	26	50.2180	-129.8170	10.0	3.1	MW	NRC	3.1	2843
2010	07	02	07	57	59	52.6040	-132.1110	28.7	4.0	ML	PGC	4.0	2844
2010	07	03	13	14	44	50.4200	-130.3600	10.0	4.4	MW	PGC	4.4	2845
2010	07	03	13	19	30	50.4980	-130.2190	10.0	3.4	MW	NRC	3.4	2846
2010	07	03	13	30	26	50.4810	-130.2010	10.0	3.2	MW	NRC	3.2	2847
2010	07	03	13	46	36	50.4990	-130.1530	10.0	3.1	MW	NRC	3.1	2848
2010	07	03	16	08	30	50.4620	-130.3000	10.0	3.6	MW	NRC	3.6	2849
2010	07	04	07	13	8	50.4890	-130.2690	10.0	2.9	MW	PGC	2.9	2850
2010	07	04	12	50	49	50.5030	-130.2570	10.0	3.5	MW	NRC	3.5	2851
2010	07	05	02	26	37	52.5910	-132.1590	20.0	3.2	ML	PGC	3.2	2852
2010	07	05	22	42	11	50.6220	-130.3920	10.0	2.9	MW	NRC	2.9	2853
2010	07	06	10	29	1	50.4020	-130.2620	10.0	3.2	MW	PGC	3.2	2854

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID
2010	07	07	21	55	44	50.5960	-130.4500	10.0	2.9	MW	NRC	2.9	2855
2010	07	09	18	47	21	51.6970	-126.5390	0.0	2.9	ML	PGC	2.9	2856
2010	07	11	06	19	15	50.1050	-130.1730	10.0	3.0	MW	NRC	3.0	2857
2010	07	11	06	22	5	50.1670	-130.1300	10.0	4.0	MB	ISC	4.0	2858
2010	07	11	10	54	26	50.0620	-130.2140	10.0	3.5	MW	NRC	3.5	2859
2010	07	11	15	44	1	50.0320	-130.1520	10.0	3.0	MW	PGC	3.0	2860
2010	07	11	19	58	44	50.0770	-130.2440	10.0	3.9	MW	NRC	3.9	2861
2010	07	11	22	08	29	50.0790	-130.1180	10.0	3.1	MW	NRC	3.1	2862
2010	07	12	03	37	20	50.0570	-130.1880	10.0	3.2	MW	NRC	3.2	2863
2010	07	12	10	11	9	50.1370	-130.1450	10.0	3.0	MW	PGC	3.0	2864
2010	07	12	12	24	12	50.6850	-130.5730	10.0	3.1	MW	NRC	3.1	2865
2010	07	13	09	44	57	50.4830	-130.1660	10.0	3.0	MW	NRC	3.0	2866
2010	07	19	10	12	6	50.1700	-130.2050	10.0	2.9	MW	PGC	2.9	2867
2010	07	21	11	44	3	51.0420	-130.6710	10.0	3.1	MW	PGC	3.1	2868
2010	07	25	18	44	27	50.4320	-130.0780	10.0	3.2	MW	NRC	3.2	2869
2010	07	26	10	14	51	50.0360	-130.0990	10.0	3.6	MW	NRC	3.6	2870
2010	07	26	21	28	49	50.5290	-130.1910	10.0	2.9	MW	NRC	2.9	2871
2010	07	26	22	16	50	50.5510	-130.3340	10.0	2.9	MW	NRC	2.9	2872
2010	07	28	06	28	14	51.2710	-130.8280	10.0	3.1	MW	NRC	3.1	2873
2010	07	29	04	12	12	52.3760	-126.8750	6.4	3.5	ML	PGC	3.5	2874
2010	07	31	02	27	35	50.2630	-130.1240	10.0	3.1	MW	NRC	3.1	2875
2010	07	31	11	14	13	50.2540	-130.1970	10.0	3.0	MW	NRC	3.0	2876
2010	07	31	13	28	21	50.2340	-130.2460	10.0	3.1	MW	NRC	3.1	2877
2010	08	01	10	32	17	50.2060	-130.2760	10.0	3.0	MW	NRC	3.0	2878
2010	08	01	10	39	39	50.2140	-130.2150	10.0	3.0	MW	NRC	3.0	2879
2010	08	03	00	04	54	54.9820	-135.5490	10.0	3.1	ML	PGC	3.1	2880
2010	08	03	13	31	55	50.4020	-130.1610	10.0	2.9	MW	NRC	2.9	2881
2010	08	06	04	59	18	50.4660	-130.3390	10.0	3.0	MW	NRC	3.0	2882
2010	08	11	17	19	11	51.8690	-131.8990	20.0	3.1	ML	PGC	3.1	2883
2010	08	13	22	28	18	50.8720	-130.6110	10.0	2.9	MW	NRC	2.9	2884
2010	08	17	11	37	53	50.5680	-130.4020	10.0	4.6	MW	NRC	4.6	2885
2010	08	17	20	58	58	50.5750	-130.2780	10.0	2.9	MW	NRC	2.9	2886
2010	08	24	04	24	50	55.6190	-135.3970	10.0	3.1	ML	PGC	3.1	2887
2010	08	26	02	02	11	50.5110	-130.2060	10.0	3.0	MW	NRC	3.0	2888
2010	08	27	15	04	39	54.7580	-135.2750	10.0	2.9	ML	PGC	2.9	2889
2010	08	28	06	32	29	50.4180	-130.1420	10.0	3.0	MW	NRC	3.0	2890
2010	08	30	09	12	19	56.2120	-134.9390	10.0	3.9	MW	OTT	3.9	2891
2010	08	30	10	12	28	57.0450	-137.6250	10.0	3.5	ML	PGC	3.5	2892
2010	09	06	00	54	3	50.0240	-130.2730	10.0	3.4	MW	PGC	3.4	2893
2010	09	06	00	58	7	50.0590	-130.1770	10.0	3.2	MW	PGC	3.2	2894
2010	09	06	01	15	26	50.1060	-129.9750	10.0	4.3	MB	ISC	4.3	2895
2010	09	06	01	42	0	50.0360	-130.2210	10.0	3.9	MW	PGC	3.9	2896
2010	09	06	01	45	9	50.0850	-130.0220	10.0	3.0	MW	PGC	3.0	2897
2010	09	06	01	48	3	50.1010	-130.1370	10.0	3.3	MW	PGC	3.3	2898
2010	09	06	02	20	22	50.0640	-130.1230	10.0	3.4	MW	NRC	3.4	2899
2010	09	06	02	41	1	50.1270	-130.1070	10.0	3.0	MW	PGC	3.0	2900
2010	09	06	02	51	21	50.0820	-130.0960	10.0	3.0	MW	NRC	3.0	2901
2010	09	06	10	21	17	50.0760	-130.1140	10.0	3.2	MW	NRC	3.2	2902
2010	09	06	10	33	43	50.1010	-130.1030	10.0	2.9	MW	NRC	2.9	2903
2010	09	06	10	37	28	50.0220	-130.1430	10.0	3.4	MW	NRC	3.4	2904
2010	09	06	10	46	17	50.0600	-130.1820	10.0	3.2	MW	NRC	3.2	2905
2010	09	07	02	36	10	50.5690	-130.3680	10.0	3.2	MW	NRC	3.2	2906
2010	09	07	03	41	52	50.0100	-130.2090	10.0	3.2	MW	NRC	3.2	2907
2010	09	07	03	44	40	50.0420	-130.1780	10.0	3.2	MW	NRC	3.2	2908
2010	09	07	03	46	46	50.0250	-130.2220	10.0	3.5	MW	NRC	3.5	2909
2010	09	07	12	26	30	50.4260	-130.2790	10.0	3.0	MW	NRC	3.0	2910

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID
2010	09	11	01	56	51	50.5980	-130.4070	10.0	3.0	MW	NRC	3.0	2911
2010	09	13	13	16	17	52.8440	-132.5160	20.0	2.9	MW	NRC	2.9	2912
2010	09	13	23	42	31	50.7110	-130.5610	10.0	3.2	MW	NRC	3.2	2913
2010	09	16	00	39	49	50.0960	-130.0580	10.0	3.1	MW	NRC	3.1	2914
2010	09	18	14	11	42	53.2510	-133.1350	20.0	2.9	ML	PGC	2.9	2915
2010	09	19	19	04	38	50.2410	-130.2450	10.0	2.9	MW	NRC	2.9	2916
2010	09	20	15	31	32	56.8330	-134.6250	1.0	3.8	ML	PGC	3.8	2917
2010	09	24	02	56	34	50.4520	-130.1060	10.0	3.4	MW	NRC	3.4	2918
2010	09	24	07	36	32	50.9400	-129.7410	10.0	3.0	MW	NRC	3.0	2919
2010	09	28	14	32	45	57.5950	-136.9640	5.0	3.6	ML	PGC	3.6	2920
2010	09	29	06	44	7	50.2540	-130.2700	10.0	3.2	MW	PGC	3.2	2921
2010	09	30	07	24	33	51.0230	-130.6230	10.0	3.1	MW	NRC	3.1	2922
2010	10	04	18	26	22	50.5960	-130.4340	10.0	3.3	MW	NRC	3.3	2923
2010	10	06	16	09	35	50.5070	-130.0790	10.0	3.2	MW	NRC	3.2	2924
2010	10	07	09	44	3	52.3190	-126.8680	1.1	3.4	ML	PGC	3.4	2925
2010	10	08	05	09	17	50.6200	-130.4150	10.0	3.5	MW	NRC	3.5	2926
2010	10	09	20	50	41	53.1530	-135.5460	20.0	2.9	ML	PGC	2.9	2927
2010	10	10	08	35	35	50.5190	-130.3030	10.0	4.1	MW	PGC	4.1	2928
2010	10	11	01	21	5	50.7120	-130.4440	10.0	4.3	MW	PGC	4.3	2929
2010	10	17	01	05	15	50.9130	-130.6140	10.0	2.9	MW	NRC	2.9	2930
2010	10	19	00	50	20	51.9950	-131.7030	20.0	2.9	ML	PGC	2.9	2931
2010	10	21	05	41	31	50.4400	-130.1160	10.0	3.0	MW	NRC	3.0	2932
2010	10	22	00	48	20	50.4390	-130.0180	10.0	3.1	MW	NRC	3.1	2933
2010	10	31	22	52	26	51.0300	-130.6340	10.0	3.3	MW	NRC	3.3	2934
2010	11	01	02	09	35	50.5250	-130.4490	10.0	3.4	MW	NRC	3.4	2935
2010	11	01	11	19	50	53.0470	-133.3250	20.0	3.8	ML	PGC	3.8	2936
2010	11	02	15	46	46	51.2730	-130.8840	10.0	3.6	MW	NRC	3.6	2937
2010	11	07	00	24	53	54.5860	-134.1840	20.0	3.2	ML	PGC	3.2	2938
2010	11	18	02	15	55	50.5050	-130.1910	10.0	3.8	MW	NRC	3.8	2939
2010	11	18	13	41	26	51.6630	-130.6780	10.0	2.9	ML	PGC	2.9	2940
2010	11	27	00	36	47	51.2700	-130.8420	10.0	3.2	MW	NRC	3.2	2941
2010	11	27	06	47	26	50.4770	-130.1570	10.0	3.1	MW	NRC	3.1	2942
2010	11	28	16	18	31	55.4130	-134.9970	10.0	2.9	ML	PGC	2.9	2943
2010	11	28	17	47	33	51.2300	-130.8980	10.0	3.0	MW	NRC	3.0	2944
2010	12	03	20	08	24	50.5270	-130.1800	10.0	2.9	MW	NRC	2.9	2945
2010	12	04	13	39	5	51.2650	-131.0390	10.0	3.0	MW	PGC	3.0	2946
2010	12	05	17	23	39	50.5320	-130.2290	10.0	3.3	MW	NRC	3.3	2947
2010	12	05	19	13	43	50.4190	-130.2050	10.0	2.9	MW	NRC	2.9	2948
2010	12	06	02	07	50	50.4650	-130.1960	10.0	3.0	MW	NRC	3.0	2949
2010	12	06	04	05	44	50.3330	-130.2510	10.0	3.4	MW	NRC	3.4	2950
2010	12	06	12	50	44	50.4660	-130.1320	10.0	3.1	MW	NRC	3.1	2951
2010	12	08	18	40	58	56.6170	-134.0120	10.0	3.0	ML	PGC	3.0	2952
2010	12	09	01	15	49	51.3930	-130.8460	10.0	4.0	MW	NRC	4.0	2953
2010	12	09	13	11	40	50.2100	-129.9210	10.0	3.4	MW	NRC	3.4	2954
2010	12	09	23	45	38	50.3100	-130.2970	10.0	3.4	MW	NRC	3.4	2955
2010	12	10	01	42	12	50.4840	-130.1700	10.0	3.5	MW	NRC	3.5	2956
2010	12	11	00	14	42	50.4090	-130.2600	10.0	3.8	MW	NRC	3.8	2957
2010	12	14	16	37	50	54.3300	-135.1930	20.0	2.9	ML	PGC	2.9	2958
2010	12	14	20	38	59	50.4540	-130.2450	10.0	3.8	MW	NRC	3.8	2959
2010	12	15	08	50	30	50.3420	-130.3380	10.0	3.0	ML	PGC	3.0	2960
2010	12	19	07	33	58	50.6190	-130.3510	10.0	3.5	MW	NRC	3.5	2961
2010	12	19	23	02	55	50.3620	-130.2580	10.0	3.1	MW	NRC	3.1	2962
2010	12	20	16	18	16	50.5380	-130.3900	10.0	3.1	MW	NRC	3.1	2963
2010	12	21	04	45	8	50.5640	-130.2960	10.0	3.2	MW	PGC	3.2	2964
2010	12	21	14	21	28	50.4560	-130.1730	10.0	3.2	MW	NRC	3.2	2965
2010	12	22	17	46	43	50.6430	-130.3410	10.0	3.6	MW	NRC	3.6	2966

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID
2010	12	23	12	38	0	50.4370	-130.2690	10.0	3.7	MW	PGC	3.7	2967
2010	12	23	12	47	17	50.4670	-130.2360	10.0	3.7	MW	NRC	3.7	2968
2010	12	23	20	47	8	50.4350	-130.1350	10.0	3.4	MW	PGC	3.4	2969
2010	12	28	11	23	7	50.2810	-130.1450	10.0	2.9	MW	PGC	2.9	2970
2010	12	28	11	57	16	50.3110	-130.4260	10.0	3.2	MW	NRC	3.2	2971
2010	12	28	12	38	57	50.6610	-130.4890	10.0	3.4	MW	NRC	3.4	2972
2010	12	29	00	55	49	50.5380	-130.1970	10.0	3.6	MW	NRC	3.6	2973
2010	12	30	06	22	55	50.5990	-130.2820	10.0	3.0	MW	NRC	3.0	2974
2010	12	30	18	23	6	54.9280	-134.8420	20.0	3.0	ML	PGC	3.0	2975
2010	12	31	09	49	34	50.9520	-130.7550	10.0	3.8	MW	NRC	3.8	2976
2011	01	01	09	56	51	51.5880	-131.4070	20.0	2.9	ML	PGC	2.9	2977
2011	01	02	11	54	26	50.5310	-130.2240	10.0	3.3	MW	NRC	3.3	2978
2011	01	03	05	30	32	50.5850	-130.4030	10.0	3.4	MW	NRC	3.4	2979
2011	01	03	09	32	38	50.7170	-130.3770	10.0	3.2	MW	NRC	3.2	2980
2011	01	03	23	45	33	57.5490	-132.8710	10.0	2.9	ML	PGC	2.9	2981
2011	01	04	20	20	1	50.3990	-130.2550	10.0	4.2	MW	PGC	4.2	2982
2011	01	07	08	57	8	50.6090	-130.2930	10.0	3.5	MW	PGC	3.5	2983
2011	01	08	07	51	14	51.2920	-131.0600	10.0	3.2	MW	NRC	3.2	2984
2011	01	18	22	52	48	51.3050	-130.9510	10.0	3.5	MW	NRC	3.5	2985
2011	01	20	23	01	21	50.2570	-130.1170	10.0	3.4	ML	PGC	3.4	2986
2011	01	22	07	52	44	50.3770	-130.2020	10.0	3.1	MW	NRC	3.1	2987
2011	01	22	08	39	52	50.4090	-130.1520	10.0	3.1	MW	NRC	3.1	2988
2011	01	22	22	00	58	50.5500	-130.1850	10.0	3.1	MW	NRC	3.1	2989
2011	01	23	03	25	7	50.4340	-130.2140	10.0	3.6	MW	PGC	3.6	2990
2011	01	23	07	34	13	50.4520	-130.1760	10.0	3.2	MW	NRC	3.2	2991
2011	01	26	23	31	48	51.0120	-131.0560	10.0	3.6	MW	NRC	3.6	2992
2011	01	27	14	47	53	50.5290	-130.3910	10.0	3.9	MW	NRC	3.9	2993
2011	01	27	15	16	10	50.6290	-130.3950	10.0	3.2	MW	NRC	3.2	2994
2011	01	27	16	59	43	50.5920	-130.2410	10.0	3.1	MW	NRC	3.1	2995
2011	01	29	07	48	36	50.4190	-130.1280	10.0	2.9	MW	NRC	2.9	2996
2011	01	29	07	58	28	50.6240	-130.4240	10.0	4.7	MW	NRC	4.7	2997
2011	01	30	13	59	12	50.4410	-130.1540	10.0	2.9	MW	NRC	2.9	2998
2011	01	31	18	36	40	50.4380	-130.2980	10.0	3.0	MW	NRC	3.0	2999
2011	02	03	07	52	17	50.7480	-130.2980	10.0	4.6	MW	NRC	4.6	3000
2011	02	04	20	12	39	51.0810	-130.9220	10.0	3.6	MW	NRC	3.6	3001
2011	02	06	03	40	36	56.1660	-135.7470	10.0	3.5	ML	PGC	3.5	3002
2011	02	06	14	37	2	50.4790	-130.0050	10.0	3.3	MW	PGC	3.3	3003
2011	02	06	21	49	33	50.4670	-130.1670	10.0	3.8	MW	NRC	3.8	3004
2011	02	06	22	15	11	50.8850	-130.2480	10.0	3.3	MW	NRC	3.3	3005
2011	02	07	07	07	39	50.8580	-130.2060	10.0	3.5	MW	NRC	3.5	3006
2011	02	09	00	50	40	50.5400	-130.2000	10.0	3.0	MW	NRC	3.0	3007
2011	02	10	21	29	18	50.3520	-130.2940	10.0	3.2	MW	NRC	3.2	3008
2011	02	12	07	37	35	50.5980	-130.3220	10.0	3.5	MW	NRC	3.5	3009
2011	02	12	09	32	27	50.3700	-130.1990	10.0	3.4	MW	NRC	3.4	3010
2011	02	13	13	40	53	50.5550	-130.3180	10.0	3.3	MW	NRC	3.3	3011
2011	02	13	21	40	41	50.7370	-130.4570	10.0	3.9	MW	NRC	3.9	3012
2011	02	14	15	26	16	50.0540	-130.1730	10.0	3.4	MW	NRC	3.4	3013
2011	02	15	16	00	25	50.5170	-130.2260	10.0	3.4	MW	NRC	3.4	3014
2011	02	16	05	22	35	57.1820	-132.9000	1.0	2.9	ML	PGC	2.9	3015
2011	02	16	05	56	49	50.5450	-130.3230	10.0	3.2	MW	NRC	3.2	3016
2011	02	16	11	11	18	51.9640	-131.3480	20.0	3.5	ML	PGC	3.5	3017
2011	02	17	00	50	24	50.4310	-130.2380	10.0	3.2	MW	NRC	3.2	3018
2011	02	17	01	13	57	50.1750	-130.1730	10.0	3.4	MW	NRC	3.4	3019
2011	02	17	05	40	59	50.1450	-130.2600	10.0	3.4	MW	NRC	3.4	3020
2011	02	17	12	32	27	50.4670	-130.1040	10.0	3.1	MW	NRC	3.1	3021
2011	02	17	19	55	50	50.5690	-130.2410	10.0	3.2	MW	NRC	3.2	3022

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID
2011	02	17	20	28	39	50.5680	-130.1800	10.0	3.2	MW	NRC	3.2	3023
2011	02	18	15	04	21	51.0500	-130.6690	10.0	3.3	MW	NRC	3.3	3024
2011	02	19	05	23	21	50.4090	-130.2340	10.0	3.5	MW	NRC	3.5	3025
2011	02	19	05	33	15	50.4150	-130.1800	10.0	3.5	MW	NRC	3.5	3026
2011	02	20	00	53	37	50.3820	-130.3040	10.0	3.4	MW	NRC	3.4	3027
2011	02	20	03	48	20	50.4070	-130.3110	10.0	3.0	MW	NRC	3.0	3028
2011	02	20	04	41	28	50.6090	-130.3790	10.0	3.1	MW	NRC	3.1	3029
2011	02	21	04	43	10	50.4030	-130.3170	10.0	3.5	MW	NRC	3.5	3030
2011	02	21	13	50	38	50.5970	-130.4360	10.0	3.1	MW	NRC	3.1	3031
2011	02	21	13	52	12	50.5660	-130.3550	10.0	3.1	MW	NRC	3.1	3032
2011	02	21	15	54	48	50.2190	-129.7650	10.0	3.1	MW	NRC	3.1	3033
2011	02	21	16	58	6	50.1770	-129.7930	10.0	3.1	MW	PGC	3.1	3034
2011	02	23	22	16	27	50.4730	-130.3300	10.0	3.4	MW	NRC	3.4	3035
2011	02	24	01	25	27	50.1680	-129.8430	10.0	2.9	MW	NRC	2.9	3036
2011	02	24	02	22	8	50.5600	-130.3590	10.0	3.3	MW	PGC	3.3	3037
2011	02	24	13	35	39	57.5290	-137.2630	10.0	3.6	MW	NRC	3.6	3038
2011	02	26	17	00	50	55.2810	-134.4880	10.0	3.3	ML	PGC	3.3	3039
2011	02	27	12	13	9	50.6500	-130.5080	10.0	3.5	MW	PGC	3.5	3040
2011	02	28	01	55	46	51.9170	-131.3770	20.0	4.1	MW	NRC	4.1	3041
2011	02	28	03	14	54	50.3310	-130.2720	10.0	3.0	MW	NRC	3.0	3042
2011	03	01	07	49	46	50.5410	-130.2320	10.0	3.4	MW	NRC	3.4	3043
2011	03	01	10	12	26	50.7520	-130.5540	10.0	3.8	MW	NRC	3.8	3044
2011	03	01	21	17	42	50.2440	-130.2060	10.0	3.4	MW	NRC	3.4	3045
2011	03	02	19	37	35	57.7580	-136.9660	20.0	3.2	MW	NRC	3.2	3046
2011	03	03	03	54	59	50.2430	-130.2300	10.0	4.6	MW	NRC	4.6	3047
2011	03	03	14	06	4	50.5050	-130.2420	10.0	3.3	MW	PGC	3.3	3048
2011	03	03	17	05	6	50.3430	-130.0950	5.0	3.4	MW	PGC	3.4	3049
2011	03	03	22	30	17	50.2130	-130.1770	10.0	3.1	MW	NRC	3.1	3050
2011	03	06	07	55	8	50.1830	-129.6660	10.0	3.3	MW	PGC	3.3	3051
2011	03	07	09	00	5	50.6130	-130.3980	10.0	3.2	MW	PGC	3.2	3052
2011	03	07	11	34	13	50.7950	-130.5430	10.0	3.3	MW	NRC	3.3	3053
2011	03	14	15	49	19	53.1590	-129.1060	10.0	3.0	ML	PGC	3.0	3054
2011	03	15	21	41	19	53.3160	-133.2030	20.0	3.5	ML	PGC	3.5	3055
2011	03	17	07	11	46	53.0980	-132.7890	20.0	3.8	ML	PGC	3.8	3056
2011	03	19	15	01	15	51.3880	-131.3080	10.0	3.5	MW	NRC	3.5	3057
2011	03	20	09	55	0	50.8930	-130.6570	10.0	3.0	MW	PGC	3.0	3058
2011	03	21	04	03	51	51.0630	-130.7610	10.0	3.4	MW	NRC	3.4	3059
2011	03	23	20	43	43	50.1480	-129.7930	10.0	2.9	MW	NRC	2.9	3060
2011	03	24	11	55	24	51.3700	-131.3180	10.0	3.2	MW	NRC	3.2	3061
2011	03	25	23	23	47	55.2470	-135.3160	25.0	3.6	ML	OTT	3.6	3062
2011	03	26	18	09	27	51.2700	-131.2280	10.0	3.1	MW	NRC	3.1	3063
2011	03	27	10	00	5	50.5240	-130.2240	10.0	3.3	MW	PGC	3.3	3064
2011	03	29	06	43	44	50.5180	-130.1230	10.0	3.2	MW	NRC	3.2	3065
2011	03	30	10	19	47	50.5320	-130.3650	10.0	3.3	MW	NRC	3.3	3066
2011	04	06	00	57	23	50.6100	-130.3880	10.0	3.5	MW	NRC	3.5	3067
2011	04	06	01	28	0	57.7670	-133.3570	1.0	2.9	ML	PGC	2.9	3068
2011	04	06	05	25	36	50.6900	-130.4400	10.0	3.2	MW	NRC	3.2	3069
2011	04	06	06	11	21	50.7630	-130.5310	10.0	3.9	MW	NRC	3.9	3070
2011	04	06	09	39	41	50.0910	-130.1440	10.0	3.4	MW	NRC	3.4	3071
2011	04	06	19	01	55	50.3940	-130.2080	10.0	3.2	MW	NRC	3.2	3072
2011	04	07	14	23	26	50.7870	-130.3840	10.0	3.1	MW	NRC	3.1	3073
2011	04	07	15	23	45	50.2150	-129.5920	10.0	2.9	MW	NRC	2.9	3074
2011	04	08	01	51	20	50.4800	-130.1560	10.0	3.2	MW	NRC	3.2	3075
2011	04	09	06	12	22	50.6340	-130.5030	10.0	3.1	MW	NRC	3.1	3076
2011	04	09	14	35	0	50.7670	-130.4600	10.0	3.3	MW	PGC	3.3	3077
2011	04	11	04	08	47	50.7660	-129.8510	10.0	3.2	MW	NRC	3.2	3078

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID
2011	04	13	14	59	35	50.5060	-130.3160	10.0	3.9	MW	NRC	3.9	3079
2011	04	13	15	02	46	50.5380	-130.2200	10.0	3.0	MW	NRC	3.0	3080
2011	04	13	20	43	1	51.2150	-131.1050	10.0	3.3	MW	PGC	3.3	3081
2011	04	26	21	47	17	50.4300	-130.1600	10.0	3.3	MW	NRC	3.3	3082
2011	04	26	23	07	14	50.4250	-130.2290	10.0	3.6	MW	NRC	3.6	3083
2011	04	27	18	51	47	56.5080	-134.9990	1.0	2.9	ML	PGC	2.9	3084
2011	04	28	16	32	7	50.6340	-130.4370	10.0	3.4	MW	PGC	3.4	3085
2011	04	29	00	03	4	51.2960	-131.3200	10.0	3.2	MW	PGC	3.2	3086
2011	05	03	09	17	15	50.5610	-130.3350	10.0	3.5	MW	NRC	3.5	3087
2011	05	04	04	39	4	50.2480	-130.1810	10.0	3.1	MW	PGC	3.1	3088
2011	05	04	05	17	48	50.2310	-130.1790	10.0	3.1	MW	NRC	3.1	3089
2011	05	04	09	39	58	55.1030	-134.4180	8.5	3.6	ML	PGC	3.6	3090
2011	05	06	01	41	31	50.5350	-130.2520	10.0	3.4	MW	NRC	3.4	3091
2011	05	07	09	47	29	50.7160	-130.5100	10.0	3.3	MW	NRC	3.3	3092
2011	05	08	01	47	13	50.3890	-130.1180	10.0	3.1	MW	NRC	3.1	3093
2011	05	09	08	47	1	50.4150	-130.1300	10.0	2.9	MW	PGC	2.9	3094
2011	05	10	20	39	54	50.5550	-130.3190	10.0	3.3	MW	NRC	3.3	3095
2011	05	10	20	44	42	50.5600	-130.2760	10.0	3.4	MW	NRC	3.4	3096
2011	05	13	01	02	59	55.2980	-135.0540	10.0	3.0	ML	PGC	3.0	3097
2011	05	14	02	17	36	50.1900	-130.3110	10.0	2.9	MW	NRC	2.9	3098
2011	05	15	20	04	55	51.3700	-131.3630	10.0	3.2	ML	PGC	3.2	3099
2011	05	16	05	59	52	52.0420	-132.0510	20.0	4.6	MW	NRC	4.6	3100
2011	05	16	08	28	33	52.0610	-132.0230	20.0	3.1	ML	PGC	3.1	3101
2011	05	16	21	56	43	50.5130	-130.2980	10.0	3.5	MW	NRC	3.5	3102
2011	05	22	22	35	59	50.9460	-130.2240	10.0	3.1	MW	NRC	3.1	3103
2011	05	24	07	46	15	50.7000	-130.3890	10.0	3.0	MW	NRC	3.0	3104
2011	05	24	14	51	9	51.0190	-130.6750	10.0	3.0	MW	PGC	3.0	3105
2011	05	25	13	56	25	50.4790	-130.1540	10.0	3.0	MW	NRC	3.0	3106
2011	05	30	03	56	51	50.6330	-130.4280	10.0	2.9	MW	NRC	2.9	3107
2011	05	31	00	21	38	51.2150	-131.1160	10.0	2.9	MW	NRC	2.9	3108
2011	06	03	22	59	54	52.5360	-132.2330	20.0	4.0	MW	NRC	4.0	3109
2011	06	07	05	16	58	50.2980	-130.1660	10.0	3.0	MW	NRC	3.0	3110
2011	06	08	16	59	42	51.8880	-131.5000	20.0	3.9	ML	PGC	3.9	3111
2011	06	08	20	17	12	50.5110	-130.2620	10.0	3.4	MW	NRC	3.4	3112
2011	06	14	04	02	31	50.4510	-130.2640	10.0	3.1	MW	NRC	3.1	3113
2011	06	14	21	33	18	57.8580	-137.9930	1.0	2.9	ML	PGC	2.9	3114
2011	06	17	02	22	19	51.7370	-131.6180	20.0	4.9	MW	NRC	4.9	3115
2011	06	21	01	08	30	51.7660	-131.8010	20.0	2.9	ML	PGC	2.9	3116
2011	06	23	10	56	5	57.9330	-137.2000	1.0	3.3	ML	OTT	3.3	3117
2011	06	27	14	34	1	50.8530	-130.6360	10.0	3.0	MW	PGC	3.0	3118
2011	06	29	00	58	30	51.3660	-130.7930	10.0	2.9	MW	NRC	2.9	3119
2011	06	30	08	17	28	54.0970	-124.4270	1.0	3.3	ML	PGC	3.3	3120
2011	07	03	15	45	8	52.5380	-132.2960	20.0	2.9	ML	PGC	2.9	3121
2011	07	10	01	24	58	52.6800	-133.1900	20.0	3.4	ML	PGC	3.4	3122
2011	07	21	18	53	55	52.6190	-132.1550	20.0	3.3	ML	PGC	3.3	3123
2011	07	27	21	07	46	52.2450	-131.7800	20.0	3.0	ML	PGC	3.0	3124
2011	07	28	15	09	4	50.6930	-130.5200	10.0	3.0	MW	PGC	3.0	3125
2011	07	29	07	37	52	52.9490	-132.5780	20.0	3.3	ML	PGC	3.3	3126
2011	07	29	09	56	56	51.7600	-131.0350	20.0	3.9	ML	PGC	3.9	3127
2011	07	29	11	52	46	50.5970	-130.2210	10.0	2.9	MW	NRC	2.9	3128
2011	07	31	12	55	54	57.7420	-137.1900	1.0	3.3	ML	PGC	3.3	3129
2011	08	10	01	49	6	50.7640	-129.8130	10.0	3.8	MW	PGC	3.8	3130
2011	08	15	20	39	47	50.7730	-129.9110	10.0	2.9	MW	NRC	2.9	3131
2011	08	18	15	35	42	51.4200	-131.0100	10.0	4.9	MW	OTT	4.9	3132
2011	08	18	15	37	40	51.7470	-130.7170	10.0	4.6	MB	GS	4.6	3133
2011	08	18	15	50	45	51.3390	-131.0820	10.0	4.0	MW	NRC	4.0	3134

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID
2011	08	18	15	56	26	51.4570	-131.0640	10.0	3.3	MW	NRC	3.3	3135
2011	08	18	16	02	53	51.4190	-131.0360	10.0	4.2	MW	NRC	4.2	3136
2011	08	20	06	39	46	51.4180	-130.9660	10.0	3.0	MW	NRC	3.0	3137
2011	08	20	11	25	40	51.5170	-131.0080	10.0	3.4	MW	NRC	3.4	3138
2011	08	22	03	52	30	50.0290	-130.1350	10.0	3.4	MW	NRC	3.4	3139
2011	08	24	12	11	35	50.5290	-130.2230	10.0	2.9	MW	NRC	2.9	3140
2011	08	26	23	16	43	51.2640	-130.9660	10.0	2.9	MW	NRC	2.9	3141
2011	08	30	00	17	6	50.0390	-130.1640	10.0	2.9	MW	PGC	2.9	3142
2011	08	30	12	28	42	51.2400	-130.8450	10.0	2.9	MW	NRC	2.9	3143
2011	08	31	10	52	13	50.5740	-130.3870	10.0	2.9	MW	NRC	2.9	3144
2011	09	06	01	50	17	51.3900	-131.0570	10.0	4.5	MW	NRC	4.5	3145
2011	09	06	16	07	48	50.7360	-130.4800	10.0	3.3	MW	NRC	3.3	3146
2011	09	07	00	42	36	50.6120	-130.2750	10.0	3.0	MW	NRC	3.0	3147
2011	09	08	08	13	22	54.6370	-129.3530	1.0	3.0	MW	NRC	3.0	3148
2011	09	08	11	44	3	50.6140	-130.3890	10.0	3.3	MW	PGC	3.3	3149
2011	09	09	17	50	24	50.4540	-130.1770	10.0	3.4	MW	NRC	3.4	3150
2011	09	10	09	35	59	57.6580	-133.8050	5.0	3.4	MW	NRC	3.4	3151
2011	09	12	09	37	25	50.5800	-130.3450	10.0	4.6	MW	NRC	4.6	3152
2011	09	13	05	46	16	50.5420	-130.3680	10.0	3.1	MW	NRC	3.1	3153
2011	09	15	16	44	14	57.4790	-134.0360	10.0	3.2	ML	PGC	3.2	3154
2011	09	17	08	15	27	50.4580	-130.0220	10.0	3.1	MW	NRC	3.1	3155
2011	09	18	14	19	44	50.6120	-130.3620	10.0	3.4	MW	NRC	3.4	3156
2011	09	19	19	08	13	50.5640	-130.3500	10.0	3.9	MW	NRC	3.9	3157
2011	09	25	22	02	37	50.8660	-130.4580	10.0	3.6	MW	NRC	3.6	3158
2011	09	28	13	31	7	50.7680	-130.4790	10.0	3.3	MW	PGC	3.3	3159
2011	09	29	05	19	50	50.0960	-130.2080	10.0	3.3	MW	NRC	3.3	3160
2011	10	01	16	30	47	55.2400	-134.4600	10.0	3.4	ML	OTT	3.4	3161
2011	10	02	00	46	22	50.7890	-130.4560	10.0	3.1	MW	NRC	3.1	3162
2011	10	05	00	50	51	51.3750	-131.0240	10.0	3.0	MW	NRC	3.0	3163
2011	10	08	03	13	1	50.6080	-130.4700	10.0	3.1	MW	PGC	3.1	3164
2011	10	10	05	39	23	50.4900	-130.3600	10.0	4.4	MW	OTT	4.4	3165
2011	10	14	00	50	0	53.4670	-131.6890	15.1	2.9	ML	PGC	2.9	3166
2011	10	15	18	58	44	57.5400	-137.3120	8.4	3.7	ML	AEI	3.7	3167
2011	10	20	06	57	20	50.7380	-130.4380	10.0	2.9	MW	NRC	2.9	3168
2011	10	25	04	11	16	50.5790	-130.2010	10.0	3.0	MW	NRC	3.0	3169
2011	10	25	04	54	23	50.5150	-130.2960	10.0	3.4	MW	NRC	3.4	3170
2011	10	25	06	17	40	50.5390	-130.2270	10.0	2.9	MW	NRC	2.9	3171
2011	10	26	23	06	45	57.8950	-132.6250	5.0	2.9	ML	PGC	2.9	3172
2011	10	28	07	49	58	50.5490	-130.2920	10.0	3.8	MW	NRC	3.8	3173
2011	10	30	01	56	56	50.5270	-130.2370	10.0	3.2	MW	NRC	3.2	3174
2011	10	31	23	10	47	50.5400	-130.3980	10.0	3.8	MW	NRC	3.8	3175
2011	10	31	23	25	23	50.5960	-130.3410	10.0	3.3	MW	NRC	3.3	3176
2011	11	01	13	46	7	50.5860	-130.4090	10.0	3.1	MW	PGC	3.1	3177
2011	11	02	17	53	17	50.7260	-130.4110	10.0	3.7	MW	NRC	3.7	3178
2011	11	02	21	06	21	50.6150	-130.4020	10.0	3.8	MW	NRC	3.8	3179
2011	11	03	10	18	49	50.4460	-130.1030	10.0	3.5	MW	NRC	3.5	3180
2011	11	03	17	13	19	50.7030	-130.3570	10.0	3.0	MW	NRC	3.0	3181
2011	11	03	19	54	30	50.6080	-130.4140	10.0	3.3	MW	NRC	3.3	3182
2011	11	05	20	46	43	56.6790	-135.8200	10.0	4.6	MW	NRC	4.6	3183
2011	11	06	02	45	22	50.5850	-130.3360	10.0	3.5	MW	NRC	3.5	3184
2011	11	06	10	10	35	50.1570	-130.2170	10.0	3.5	MW	NRC	3.5	3185
2011	11	06	13	26	59	50.1390	-130.1560	10.0	3.2	MW	NRC	3.2	3186
2011	11	06	16	31	36	50.5440	-130.2120	10.0	3.5	MW	NRC	3.5	3187
2011	11	06	17	42	10	50.5080	-130.2050	10.0	3.3	MW	NRC	3.3	3188
2011	11	06	17	49	41	50.5280	-130.2550	10.0	3.1	MW	NRC	3.1	3189
2011	11	07	07	47	14	50.5610	-130.2710	10.0	3.2	MW	NRC	3.2	3190

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID
2011	11	08	09	14	9	50.8670	-130.6210	10.0	3.8	MW	PGC	3.8	3191
2011	11	09	08	31	34	50.4820	-130.1340	10.0	3.2	MW	NRC	3.2	3192
2011	11	10	04	19	32	50.7350	-129.8380	10.0	3.3	MW	NRC	3.3	3193
2011	11	10	10	59	39	50.7700	-129.6900	10.0	3.1	MW	NRC	3.1	3194
2011	11	10	12	16	45	53.1120	-132.7620	20.0	3.2	ML	PGC	3.2	3195
2011	11	10	12	48	8	53.1210	-132.6300	20.0	3.9	ML	PGC	3.9	3196
2011	11	12	05	04	38	50.6360	-130.5410	20.0	3.4	MW	NRC	3.4	3197
2011	11	15	14	02	34	50.5710	-130.2350	10.0	3.1	MW	NRC	3.1	3198
2011	11	15	14	59	30	54.1170	-131.6500	0.0	3.3	ML	PGC	3.3	3199
2011	11	15	15	03	47	54.1100	-131.6910	0.0	3.2	ML	PGC	3.2	3200
2011	11	16	06	53	1	50.6650	-130.3560	10.0	3.1	MW	PGC	3.1	3201
2011	11	17	02	28	14	50.7540	-130.4960	10.0	3.7	MW	NRC	3.7	3202
2011	11	19	00	38	16	50.5690	-130.0410	10.0	3.1	MW	NRC	3.1	3203
2011	11	19	12	43	25	50.9720	-130.6450	10.0	3.2	MW	NRC	3.2	3204
2011	11	20	02	17	14	50.5050	-130.3190	10.0	3.0	MW	NRC	3.0	3205
2011	11	20	22	15	14	50.6900	-130.5580	10.0	3.6	MW	NRC	3.6	3206
2011	11	22	05	32	52	51.1510	-131.1390	10.0	3.6	MW	NRC	3.6	3207
2011	11	23	23	02	41	50.4500	-130.1300	10.0	4.9	MW	PGC	4.9	3208
2011	11	23	23	38	46	50.4890	-130.0660	10.0	3.4	MW	NRC	3.4	3209
2011	11	24	20	10	9	52.8800	-132.1320	20.0	3.1	ML	PGC	3.1	3210
2011	11	25	09	47	1	50.4590	-130.1570	10.0	3.4	MW	PGC	3.4	3211
2011	11	29	21	00	11	51.7140	-131.2930	20.0	3.2	ML	PGC	3.2	3212
2011	12	01	03	23	57	50.4710	-130.2460	10.0	3.3	MW	NRC	3.3	3213
2011	12	10	02	37	41	50.5980	-130.1370	10.0	2.9	MW	NRC	2.9	3214
2011	12	18	01	12	35	50.5600	-130.1710	10.0	3.5	MW	NRC	3.5	3215
2011	12	19	08	12	42	51.0330	-130.6500	10.0	4.5	MW	NRC	4.5	3216
2011	12	19	08	23	3	50.9560	-130.5300	10.0	3.3	MW	PGC	3.3	3217
2011	12	19	10	16	9	50.9470	-130.5250	10.0	3.1	MW	PGC	3.1	3218
2011	12	19	11	15	19	50.9370	-130.3860	10.0	3.1	MW	NRC	3.1	3219
2011	12	19	23	45	24	50.9220	-130.5050	10.0	3.5	MW	NRC	3.5	3220
2011	12	24	01	56	55	57.6020	-132.8060	10.0	2.9	ML	PGC	2.9	3221
2011	12	25	05	27	52	57.6930	-132.1320	20.5	3.1	ML	PGC	3.1	3222
2011	12	26	16	17	26	54.7180	-132.9670	20.0	3.4	ML	PGC	3.4	3223
2011	12	29	11	56	10	50.7840	-129.7560	10.0	3.4	MW	NRC	3.4	3224
2011	12	30	22	22	26	50.7950	-130.5820	10.0	3.4	MW	NRC	3.4	3225
2012	01	02	07	48	28	51.1070	-130.2350	10.0	3.5	MW	NRC	3.5	3226
2012	01	03	13	12	28	51.0060	-130.0240	10.0	3.3	MW	NRC	3.3	3227
2012	01	06	09	39	50	50.8880	-130.6060	10.0	3.4	MW	NRC	3.4	3228
2012	01	06	14	23	21	57.1850	-131.9380	1.0	3.5	ML	PGC	3.5	3229
2012	01	08	21	46	5	50.5650	-130.2910	10.0	3.5	MW	PGC	3.5	3230
2012	01	09	01	49	19	51.2000	-127.3530	10.0	2.9	MW	NRC	2.9	3231
2012	01	09	05	24	2	50.7670	-128.7640	10.0	3.4	MW	PGC	3.4	3232
2012	01	10	15	18	38	50.2990	-130.1880	10.0	3.5	MW	NRC	3.5	3233
2012	01	13	19	46	4	51.0760	-130.7200	10.0	5.3	MW	PGC	5.3	3234
2012	01	13	21	08	35	51.0740	-130.7400	10.0	3.4	MW	NRC	3.4	3235
2012	01	13	21	18	18	51.0090	-130.8860	10.0	3.4	MW	NRC	3.4	3236
2012	01	14	12	49	21	50.6580	-130.4460	10.0	3.4	MW	NRC	3.4	3237
2012	01	17	06	22	56	50.7020	-130.3830	10.0	3.0	MW	NRC	3.0	3238
2012	01	17	09	45	49	50.7450	-130.5300	10.0	3.9	MW	NRC	3.9	3239
2012	01	17	12	45	37	50.7120	-130.5660	10.0	3.2	MW	NRC	3.2	3240
2012	01	17	17	11	16	50.6460	-130.3650	10.0	2.9	MW	NRC	2.9	3241
2012	01	21	10	24	16	50.5530	-130.3000	10.0	3.4	MW	NRC	3.4	3242
2012	01	21	22	24	53	50.5130	-130.2600	10.0	3.9	MW	NRC	3.9	3243
2012	01	23	08	08	28	50.7810	-129.7870	10.0	3.4	MW	NRC	3.4	3244
2012	01	29	02	01	45	52.3720	-132.1230	20.0	4.0	ML	PGC	4.0	3245
2012	02	01	08	22	26	52.6630	-131.8110	20.0	3.3	ML	PGC	3.3	3246

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID
2012	02	12	20	19	15	50.6830	-130.4870	10.0	3.7	MW	NRC	3.7	3247
2012	02	13	05	52	38	51.3540	-131.0970	10.0	3.3	MW	NRC	3.3	3248
2012	02	13	06	05	42	50.4480	-129.0640	10.0	3.8	MW	NRC	3.8	3249
2012	02	16	12	07	6	50.1870	-127.8190	17.4	2.9	ML	PGC	2.9	3250
2012	02	21	22	26	45	50.2490	-129.9640	10.0	3.5	MW	NRC	3.5	3251
2012	02	22	01	48	40	50.1740	-130.1190	10.0	3.3	MW	NRC	3.3	3252
2012	02	23	01	38	12	50.3120	-130.1740	10.0	3.2	MW	NRC	3.2	3253
2012	02	23	09	15	22	50.7310	-130.4270	10.0	3.3	MW	NRC	3.3	3254
2012	02	23	13	44	47	50.2840	-130.1760	10.0	3.8	MW	NRC	3.8	3255
2012	02	24	05	11	30	50.3440	-130.1660	10.0	2.9	MW	NRC	2.9	3256
2012	02	26	21	36	42	50.5430	-130.2480	10.0	3.4	MW	NRC	3.4	3257
2012	02	29	15	37	37	54.7970	-134.9990	20.0	3.5	ML	PGC	3.5	3258
2012	03	01	00	47	29	50.4930	-129.8460	10.0	3.2	MW	NRC	3.2	3259
2012	03	01	03	08	41	50.4670	-130.1070	10.0	3.5	MW	NRC	3.5	3260
2012	03	01	04	48	12	50.3630	-130.3180	10.0	3.8	MW	NRC	3.8	3261
2012	03	01	05	01	2	50.4620	-130.2010	10.0	4.1	MW	NRC	4.1	3262
2012	03	01	05	15	14	50.5100	-130.0540	10.0	3.9	MW	NRC	3.9	3263
2012	03	01	05	38	9	50.5090	-129.9890	10.0	3.2	MW	PGC	3.2	3264
2012	03	01	05	47	2	50.4570	-130.0930	10.0	3.2	MW	PGC	3.2	3265
2012	03	01	11	06	44	50.4550	-130.1700	10.0	3.2	MW	NRC	3.2	3266
2012	03	04	05	23	30	50.3860	-130.3870	10.0	3.1	MW	NRC	3.1	3267
2012	03	07	08	26	4	50.5890	-130.1990	10.0	3.1	MW	PGC	3.1	3268
2012	03	13	23	14	22	52.2170	-127.0820	4.7	2.9	ML	PGC	2.9	3269
2012	03	26	07	32	30	50.9830	-130.8620	10.0	3.1	MW	NRC	3.1	3270
2012	03	30	05	51	40	50.7570	-130.4870	10.0	3.6	MW	NRC	3.6	3271
2012	03	30	08	51	34	55.1390	-134.0030	20.0	3.1	ML	PGC	3.1	3272
2012	03	31	10	10	12	51.3060	-131.3320	10.0	3.8	MW	NRC	3.8	3273
2012	03	31	10	16	16	51.4100	-131.1370	10.0	3.6	MW	PGC	3.6	3274
2012	03	31	12	03	55	51.3600	-131.1390	10.0	3.6	MW	NRC	3.6	3275
2012	04	02	06	16	1	50.6960	-130.5040	10.0	3.3	MW	PGC	3.3	3276
2012	04	08	06	15	41	50.3860	-130.1810	10.0	3.3	MW	NRC	3.3	3277
2012	04	08	07	20	59	50.4130	-130.2340	10.0	3.2	MW	NRC	3.2	3278
2012	04	08	08	44	20	50.4230	-130.1890	10.0	3.2	MW	NRC	3.2	3279
2012	04	13	01	58	34	50.5090	-130.0920	10.0	3.0	MW	NRC	3.0	3280
2012	04	13	12	16	52	50.6920	-130.2630	10.0	2.9	MW	NRC	2.9	3281
2012	04	22	05	11	49	50.4420	-130.1130	10.0	3.2	MW	NRC	3.2	3282
2012	04	22	08	36	15	50.3950	-130.2640	10.0	4.7	MW	NRC	4.7	3283
2012	04	22	13	16	3	50.3530	-130.2390	10.0	2.9	MW	PGC	2.9	3284
2012	04	25	06	23	57	50.5500	-130.1600	10.0	4.0	MW	OTT	4.0	3285
2012	04	25	07	14	53	50.4350	-130.2680	10.0	3.0	MW	NRC	3.0	3286
2012	04	25	21	54	53	50.5100	-130.2450	10.0	3.5	MW	NRC	3.5	3287
2012	04	25	22	18	51	50.4460	-130.1120	10.0	3.1	MW	NRC	3.1	3288
2012	04	25	22	43	45	50.5350	-130.2990	10.0	3.4	MW	NRC	3.4	3289
2012	04	27	12	52	42	50.4940	-130.0640	10.0	4.9	MW	PGC	4.9	3290
2012	04	27	16	14	47	50.4200	-130.1900	10.0	4.5	MW	PGC	4.5	3291
2012	04	27	16	20	13	50.4580	-130.1880	10.0	4.4	MW	NRC	4.4	3292
2012	04	27	16	22	30	50.4860	-130.1080	10.0	4.7	MW	PGC	4.7	3293
2012	04	27	23	41	31	50.4820	-130.0810	10.0	3.5	MW	NRC	3.5	3294
2012	04	28	03	42	19	50.4280	-130.1710	10.0	4.7	MW	NRC	4.7	3295
2012	04	28	14	16	7	50.4170	-130.2530	10.0	3.7	MW	PGC	3.7	3296
2012	04	28	18	53	18	53.9220	-133.7560	20.0	4.2	ML	PGC	4.2	3297
2012	04	29	03	44	50	50.3210	-130.1540	10.0	3.2	MW	NRC	3.2	3298
2012	04	29	04	35	8	50.6820	-129.6030	35.0	4.0	MB	GS	4.0	3299
2012	04	29	05	12	17	50.3670	-130.2310	10.0	4.1	MW	PGC	4.1	3300
2012	04	29	05	18	47	50.4250	-130.2350	10.0	3.8	MW	NRC	3.8	3301
2012	04	29	05	38	45	50.3980	-130.2260	10.0	3.7	MW	NRC	3.7	3302

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID
2012	04	29	05	54	22	50.4510	-130.0610	10.0	3.2	MW	NRC	3.2	3303
2012	04	29	06	01	33	50.4580	-130.0100	10.0	3.0	MW	NRC	3.0	3304
2012	04	29	07	41	57	50.4390	-130.1530	10.0	3.1	MW	NRC	3.1	3305
2012	04	29	11	57	29	50.3720	-130.1940	10.0	3.2	MW	NRC	3.2	3306
2012	04	29	17	34	54	50.4230	-130.1310	10.0	3.0	MW	NRC	3.0	3307
2012	04	29	20	10	39	50.3900	-130.1700	10.0	2.9	MW	NRC	2.9	3308
2012	04	30	04	22	57	50.4100	-130.1870	10.0	3.1	MW	NRC	3.1	3309
2012	04	30	11	12	6	50.4750	-130.1160	10.0	3.5	MW	PGC	3.5	3310
2012	04	30	11	42	14	50.3610	-130.0620	10.0	3.0	MW	NRC	3.0	3311
2012	04	30	12	33	55	50.3390	-130.0910	10.0	3.4	MW	NRC	3.4	3312
2012	04	30	14	12	43	50.3910	-130.1620	10.0	2.9	MW	NRC	2.9	3313
2012	04	30	14	31	22	50.3460	-130.2300	10.0	3.3	MW	NRC	3.3	3314
2012	04	30	19	38	38	50.4160	-130.1020	10.0	3.0	MW	NRC	3.0	3315
2012	04	30	19	48	4	50.3960	-130.2310	10.0	3.1	MW	PGC	3.1	3316
2012	04	30	20	10	32	50.4520	-130.1120	10.0	2.9	MW	NRC	2.9	3317
2012	04	30	22	43	14	50.4740	-130.0800	10.0	3.0	MW	NRC	3.0	3318
2012	04	30	23	27	23	50.3750	-130.0950	10.0	3.2	MW	NRC	3.2	3319
2012	05	01	08	55	5	50.4340	-130.0990	10.0	3.1	MW	PGC	3.1	3320
2012	05	01	22	53	42	50.5660	-130.3390	10.0	4.8	MW	NRC	4.8	3321
2012	05	02	12	33	26	50.4580	-130.2140	10.0	4.2	MW	PGC	4.2	3322
2012	05	02	13	14	18	50.4690	-130.0660	10.0	3.1	MW	NRC	3.1	3323
2012	05	02	13	57	34	50.4270	-130.1960	10.0	2.9	MW	NRC	2.9	3324
2012	05	03	00	13	24	50.4260	-130.1570	10.0	3.1	MW	NRC	3.1	3325
2012	05	03	11	47	2	50.4300	-130.2240	10.0	3.2	MW	PGC	3.2	3326
2012	05	03	16	40	43	50.3940	-130.2050	10.0	2.9	MW	NRC	2.9	3327
2012	05	03	18	16	15	50.3070	-130.2420	10.0	3.2	MW	NRC	3.2	3328
2012	05	04	09	05	3	50.3800	-130.2370	10.0	3.0	MW	PGC	3.0	3329
2012	05	04	10	55	37	50.6480	-130.2410	10.0	5.0	MW	NRC	5.0	3330
2012	05	04	16	23	21	50.6760	-130.5310	10.0	3.0	MW	NRC	3.0	3331
2012	05	05	04	09	10	50.7760	-129.6920	10.0	3.7	MW	NRC	3.7	3332
2012	05	05	14	32	43	50.3990	-130.1790	10.0	3.5	MW	NRC	3.5	3333
2012	05	05	14	56	0	50.3770	-130.2410	10.0	3.2	MW	PGC	3.2	3334
2012	05	05	20	18	52	50.3850	-130.1330	10.0	3.1	MW	NRC	3.1	3335
2012	05	07	09	43	31	50.5370	-130.2380	10.0	2.9	MW	NRC	2.9	3336
2012	05	08	14	51	45	55.0820	-134.8300	20.0	3.7	ML	PGC	3.7	3337
2012	05	11	18	26	0	50.3980	-130.2450	10.0	3.4	MW	PGC	3.4	3338
2012	05	12	00	26	29	50.3150	-130.3890	10.0	3.2	MW	NRC	3.2	3339
2012	05	12	00	28	34	50.3630	-130.2190	10.0	3.0	MW	NRC	3.0	3340
2012	05	12	00	44	15	50.3960	-130.1710	10.0	3.0	MW	NRC	3.0	3341
2012	05	12	00	58	1	50.4740	-130.1170	10.0	4.7	MW	PGC	4.7	3342
2012	05	12	01	05	28	50.3810	-130.1570	10.0	3.1	MW	NRC	3.1	3343
2012	05	12	01	11	31	50.2960	-130.4750	10.0	2.9	MW	PGC	2.9	3344
2012	05	12	01	14	34	50.3780	-130.2270	10.0	2.9	MW	NRC	2.9	3345
2012	05	12	01	24	18	50.3740	-130.1790	10.0	3.3	MW	NRC	3.3	3346
2012	05	12	01	27	12	50.3500	-130.2670	10.0	3.5	MW	NRC	3.5	3347
2012	05	12	01	37	0	50.3890	-130.2060	10.0	3.6	MW	PGC	3.6	3348
2012	05	12	02	12	14	50.3970	-130.1420	10.0	3.2	MW	NRC	3.2	3349
2012	05	12	02	37	30	50.3000	-130.1420	10.0	3.0	MW	NRC	3.0	3350
2012	05	12	03	10	59	50.3740	-130.2140	10.0	2.9	MW	NRC	2.9	3351
2012	05	12	03	22	5	50.3330	-130.2130	10.0	3.4	MW	PGC	3.4	3352
2012	05	12	03	52	21	50.4030	-130.2230	10.0	3.0	MW	NRC	3.0	3353
2012	05	12	04	35	36	50.4200	-130.1380	10.0	3.1	MW	NRC	3.1	3354
2012	05	12	06	38	54	50.4320	-130.1750	10.0	2.9	MW	NRC	2.9	3355
2012	05	12	17	46	11	50.1350	-130.6110	10.0	3.3	MW	NRC	3.3	3356
2012	05	12	18	17	49	50.3570	-130.1570	10.0	3.2	MW	NRC	3.2	3357
2012	05	12	21	50	29	50.4200	-130.1150	10.0	3.0	MW	NRC	3.0	3358

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID
2012	05	12	22	15	42	50.5540	-130.3440	10.0	3.4	MW	PGC	3.4	3359
2012	05	13	09	08	25	50.3050	-130.2010	10.0	2.9	MW	NRC	2.9	3360
2012	05	13	22	06	35	50.3680	-130.2260	10.0	3.6	MW	PGC	3.6	3361
2012	05	18	00	56	18	50.4760	-130.0490	10.0	3.9	MW	NRC	3.9	3362
2012	05	25	07	26	18	50.0410	-130.2560	10.0	4.4	MW	NRC	4.4	3363
2012	05	25	10	09	35	50.3550	-130.1830	10.0	2.9	MW	NRC	2.9	3364
2012	05	27	23	29	8	50.3640	-130.2680	10.0	3.0	MW	PGC	3.0	3365
2012	05	30	09	42	10	51.8930	-131.7820	20.0	3.3	ML	PGC	3.3	3366
2012	05	30	19	03	47	50.4510	-130.0960	10.0	3.1	MW	NRC	3.1	3367
2012	05	31	04	52	16	50.4280	-130.1670	10.0	3.1	MW	NRC	3.1	3368
2012	06	02	00	37	5	50.5310	-130.3230	10.0	4.1	MW	PGC	4.1	3369
2012	06	04	12	43	21	50.8930	-130.7120	10.0	3.0	MW	NRC	3.0	3370
2012	06	07	23	19	23	57.7970	-124.8440	0.0	4.4	MW	NRC	4.4	3371
2012	06	08	21	11	54	50.6200	-130.4320	10.0	3.1	MW	NRC	3.1	3372
2012	06	09	19	13	17	50.1700	-129.6910	10.0	3.0	MW	NRC	3.0	3373
2012	06	15	20	54	34	52.6730	-131.7030	18.0	2.9	ML	PGC	2.9	3374
2012	06	17	01	26	51	50.4400	-130.1270	10.0	3.1	MW	NRC	3.1	3375
2012	06	17	16	09	48	55.7050	-133.2040	1.0	3.0	ML	PGC	3.0	3376
2012	06	19	19	30	33	50.5820	-130.2770	10.0	2.9	MW	NRC	2.9	3377
2012	06	20	09	46	48	50.7870	-129.5220	10.0	2.9	MW	NRC	2.9	3378
2012	06	28	08	56	54	50.4180	-130.1390	10.0	2.9	MW	NRC	2.9	3379
2012	06	28	21	18	44	50.2060	-130.2050	10.0	3.1	MW	NRC	3.1	3380
2012	07	01	13	58	35	50.5480	-130.4100	10.0	3.7	MW	NRC	3.7	3381
2012	07	04	13	35	43	50.4640	-130.1470	10.0	4.6	MW	NRC	4.6	3382
2012	07	06	10	15	19	50.4140	-130.0830	10.0	3.0	MW	NRC	3.0	3383
2012	07	06	13	21	59	50.6900	-130.5390	10.0	3.2	MW	NRC	3.2	3384
2012	07	06	15	02	23	50.4390	-130.0550	10.0	3.8	MW	NRC	3.8	3385
2012	07	17	14	02	56	50.5970	-130.3040	10.0	3.5	MW	NRC	3.5	3386
2012	07	30	09	54	20	50.7780	-130.4320	10.0	2.9	MW	NRC	2.9	3387
2012	08	08	03	52	5	53.1900	-132.9430	20.0	3.7	ML	PGC	3.7	3388
2012	08	14	02	33	39	50.4430	-130.1830	10.0	3.0	MW	NRC	3.0	3389
2012	08	14	04	52	50	50.4110	-130.0130	10.0	3.1	MW	NRC	3.1	3390
2012	08	17	16	13	43	50.5770	-130.4030	10.0	3.3	MW	NRC	3.3	3391
2012	08	20	02	10	49	51.2860	-130.9920	10.0	3.1	MW	NRC	3.1	3392
2012	08	23	04	48	59	50.9760	-130.6450	10.0	3.3	MW	NRC	3.3	3393
2012	09	01	08	49	49	50.6340	-130.3990	10.0	2.9	MW	NRC	2.9	3394
2012	09	04	01	29	25	50.5040	-130.0890	10.0	3.1	MW	NRC	3.1	3395
2012	09	13	23	39	1	50.4920	-130.0910	10.0	2.9	MW	PGC	2.9	3396
2012	09	26	13	30	32	50.5410	-130.3040	10.0	2.9	MW	NRC	2.9	3397
2012	09	28	08	36	4	50.5640	-130.2990	10.0	3.4	MW	PGC	3.4	3398
2012	10	02	03	56	44	50.2390	-130.0700	10.0	3.2	MW	NRC	3.2	3399
2012	10	03	04	21	37	50.6700	-130.3610	10.0	3.1	MW	NRC	3.1	3400
2012	10	05	02	25	13	50.2430	-130.1560	10.0	2.9	MW	NRC	2.9	3401
2012	10	05	13	31	19	50.1740	-128.5600	10.0	3.4	MW	NRC	3.4	3402
2012	10	08	10	52	39	51.2020	-131.1590	10.0	3.5	MW	NRC	3.5	3403
2012	10	11	01	12	36	51.0060	-130.4390	10.0	3.3	MW	NRC	3.3	3404
2012	10	11	08	54	24	51.0080	-130.3790	10.0	3.0	MW	NRC	3.0	3405
2012	10	13	11	29	24	50.6080	-130.4950	10.0	3.0	MW	NRC	3.0	3406
2012	10	13	11	43	15	50.6530	-130.5670	10.0	3.2	MW	NRC	3.2	3407
2012	10	14	17	00	12	50.7390	-129.9470	10.0	3.5	MW	NRC	3.5	3408
2012	10	21	00	57	12	53.3440	-132.2580	20.0	2.9	MW	NRC	2.9	3409
2012	10	25	09	15	24	53.1690	-132.8820	20.0	3.2	MW	NRC	3.2	3410
2012	10	28	03	04	8	52.7880	-132.1010	14.0	7.8	MW	UCM	7.8	3411
2012	10	28	03	32	39	52.5450	-131.8350	19.7	4.3	MW	NRC	4.3	3412
2012	10	28	03	34	48	52.4070	-131.9810	10.0	4.3	MB	GS	4.3	3413
2012	10	28	03	38	10	52.4810	-131.8140	26.0	4.8	MW	NRC	4.8	3414

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID
2012	10	28	03	52	15	52.2360	-132.2300	17.7	5.5	MW	NRC	5.5	3415
2012	10	28	04	21	52	52.5240	-131.8470	20.0	4.0	MW	NRC	4.0	3416
2012	10	28	04	25	28	52.6240	-132.4900	10.0	5.2	MB	GS	5.2	3417
2012	10	28	04	29	49	52.5220	-131.8030	20.0	3.7	MW	NRC	3.7	3418
2012	10	28	04	33	41	52.7010	-132.2530	10.0	4.7	MB	GS	4.7	3419
2012	10	28	04	40	58	52.3460	-132.3380	10.0	5.3	MW	NRC	5.3	3420
2012	10	28	04	49	10	52.4770	-131.8810	15.8	4.4	MW	NRC	4.4	3421
2012	10	28	04	51	47	52.5320	-132.0600	12.5	4.3	MW	NRC	4.3	3422
2012	10	28	04	53	14	52.6390	-131.9650	1.0	4.3	ML	PGC	4.3	3423
2012	10	28	05	02	46	52.3300	-132.0260	24.0	4.9	MW	NRC	4.9	3424
2012	10	28	05	04	28	52.5490	-132.8730	10.0	4.4	MB	GS	4.4	3425
2012	10	28	05	09	3	52.3530	-131.9730	10.0	4.3	MB	GS	4.3	3426
2012	10	28	05	15	9	52.1880	-132.2610	21.4	4.4	MW	NRC	4.4	3427
2012	10	28	05	18	40	52.6370	-132.9270	10.0	4.2	MB	GS	4.2	3428
2012	10	28	05	21	31	52.3900	-131.8200	30.1	4.3	MW	NRC	4.3	3429
2012	10	28	05	24	50	52.6200	-132.6830	10.0	4.4	MB	GS	4.4	3430
2012	10	28	05	27	54	52.8180	-131.3230	10.0	4.2	MB	GS	4.2	3431
2012	10	28	05	29	4	52.8680	-131.3870	10.0	4.2	MB	GS	4.2	3432
2012	10	28	05	35	24	52.3970	-131.6920	10.0	4.0	MB	GS	4.0	3433
2012	10	28	05	38	37	51.9430	-131.9880	10.0	4.1	MB	GS	4.1	3434
2012	10	28	05	41	24	52.6240	-132.5510	10.0	4.0	MB	GS	4.0	3435
2012	10	28	05	47	2	52.2170	-131.6630	1.0	5.2	MW	NRC	5.2	3436
2012	10	28	05	51	17	52.8100	-132.7200	10.0	4.5	MB	GS	4.5	3437
2012	10	28	05	56	9	52.7420	-132.7680	10.0	4.1	MB	GS	4.1	3438
2012	10	28	06	01	34	52.6910	-132.5880	10.0	4.1	MB	GS	4.1	3439
2012	10	28	06	04	0	52.4230	-132.4680	10.0	4.4	MB	GS	4.4	3440
2012	10	28	06	16	48	52.1900	-131.2630	2.8	5.2	MW	NRC	5.2	3441
2012	10	28	06	28	8	52.6730	-131.7460	10.0	4.0	MB	GS	4.0	3442
2012	10	28	06	33	8	52.0880	-132.9530	10.3	4.0	MB	GS	4.0	3443
2012	10	28	06	35	37	52.3190	-131.5790	10.0	4.0	MB	GS	4.0	3444
2012	10	28	06	37	54	52.5140	-131.9290	13.4	4.0	MW	NRC	4.0	3445
2012	10	28	06	59	47	52.1300	-132.3710	9.9	4.0	MB	GS	4.0	3446
2012	10	28	07	02	18	51.9760	-131.8210	10.0	4.4	MB	GS	4.4	3447
2012	10	28	07	09	28	52.3600	-131.9420	10.0	4.0	MB	GS	4.0	3448
2012	10	28	07	12	8	52.3890	-132.1350	28.6	4.9	MW	NRC	4.9	3449
2012	10	28	07	16	37	52.7730	-132.5550	10.0	4.9	MB	GS	4.9	3450
2012	10	28	07	25	16	52.1060	-131.6750	11.9	5.2	MW	NRC	5.2	3451
2012	10	28	07	39	5	51.9750	-131.2510	10.0	4.0	MB	GS	4.0	3452
2012	10	28	07	43	25	52.6480	-132.4630	32.0	4.2	MW	NRC	4.2	3453
2012	10	28	07	56	26	52.6430	-132.0550	10.0	4.0	MB	GS	4.0	3454
2012	10	28	08	01	26	52.0400	-132.6310	10.0	4.0	MB	GS	4.0	3455
2012	10	28	08	05	51	52.7580	-132.2900	14.3	3.9	MW	NRC	3.9	3456
2012	10	28	08	15	46	52.4120	-131.6820	10.0	4.2	MB	GS	4.2	3457
2012	10	28	08	22	4	52.0940	-132.0740	10.0	4.3	MB	GS	4.3	3458
2012	10	28	08	48	52	52.6890	-132.7210	10.0	4.4	MB	GS	4.4	3459
2012	10	28	08	54	38	52.5820	-132.0950	10.0	4.1	MB	GS	4.1	3460
2012	10	28	09	15	46	52.2820	-131.9050	10.0	4.2	MB	GS	4.2	3461
2012	10	28	09	17	26	52.1670	-131.8800	10.7	5.3	MW	NRC	5.3	3462
2012	10	28	09	22	50	52.5460	-131.1980	10.0	4.4	MB	GS	4.4	3463
2012	10	28	09	26	36	52.0810	-132.2730	10.0	4.1	MB	GS	4.1	3464
2012	10	28	09	36	35	52.3600	-132.3710	15.0	4.7	ML	PGC	4.7	3465
2012	10	28	09	40	37	51.7910	-131.6820	1.0	4.7	MW	NRC	4.7	3466
2012	10	28	09	45	36	52.7710	-132.3390	20.5	4.9	MW	NRC	4.9	3467
2012	10	28	09	52	59	52.9350	-131.6140	10.0	4.1	MB	GS	4.1	3468
2012	10	28	10	04	34	52.7990	-132.3520	24.6	5.1	MW	NRC	5.1	3469
2012	10	28	10	10	25	52.3600	-132.3710	15.0	4.6	ML	PGC	4.6	3470

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID
2012	10	28	10	15	54	52.5560	-132.3600	1.0	4.1	MW	NRC	4.1	3471
2012	10	28	10	24	15	52.3000	-131.8320	10.0	4.6	MB	GS	4.6	3472
2012	10	28	10	26	12	52.3680	-131.2190	10.0	4.1	MB	GS	4.1	3473
2012	10	28	10	31	16	52.7740	-132.4810	31.5	3.8	MW	NRC	3.8	3474
2012	10	28	10	43	22	52.0060	-132.1010	10.0	4.0	MB	GS	4.0	3475
2012	10	28	10	45	49	52.5350	-132.5470	0.5	5.1	MW	NRC	5.1	3476
2012	10	28	10	50	31	52.4840	-132.2310	5.0	4.5	ML	PGC	4.5	3477
2012	10	28	10	59	14	52.4210	-131.9420	10.0	4.0	MB	GS	4.0	3478
2012	10	28	11	17	16	52.4000	-132.4200	5.0	4.5	ML	PGC	4.5	3479
2012	10	28	11	23	42	52.6080	-132.2340	20.0	4.1	ML	PGC	4.1	3480
2012	10	28	11	27	42	52.2550	-132.2960	24.5	5.2	MW	NRC	5.2	3481
2012	10	28	11	34	44	52.3860	-132.3810	17.0	3.8	MW	NRC	3.8	3482
2012	10	28	11	53	18	52.3480	-132.3910	24.0	5.1	MW	NRC	5.1	3483
2012	10	28	12	09	40	52.6440	-132.4500	10.0	4.0	MB	GS	4.0	3484
2012	10	28	12	17	56	52.5060	-132.0400	10.0	4.4	ML	PGC	4.4	3485
2012	10	28	12	22	42	52.8210	-132.4080	11.7	3.0	MW	NRC	3.0	3486
2012	10	28	12	38	43	52.6260	-132.4740	5.0	4.5	ML	PGC	4.5	3487
2012	10	28	12	53	5	52.4630	-132.2780	20.0	4.1	ML	PGC	4.1	3488
2012	10	28	13	07	3	52.0440	-132.4850	10.0	4.2	MB	GS	4.2	3489
2012	10	28	13	09	12	52.2480	-132.1680	28.6	5.1	MW	NRC	5.1	3490
2012	10	28	13	12	4	52.8440	-132.3130	15.0	3.6	MW	NRC	3.6	3491
2012	10	28	13	34	20	52.9370	-132.1130	13.7	3.4	MW	NRC	3.4	3492
2012	10	28	13	40	23	52.9850	-132.5210	19.2	3.0	MW	NRC	3.0	3493
2012	10	28	13	45	48	51.1360	-130.2920	10.0	4.1	MB	GS	4.1	3494
2012	10	28	13	50	3	52.7410	-132.3020	15.0	3.8	MW	NRC	3.8	3495
2012	10	28	14	01	5	52.4880	-132.3920	17.0	3.5	MW	NRC	3.5	3496
2012	10	28	14	04	28	52.6750	-132.3270	10.0	4.8	ML	PGC	4.8	3497
2012	10	28	14	14	28	52.5930	-131.4510	10.0	4.5	ML	PGC	4.5	3498
2012	10	28	14	16	24	52.2580	-132.7860	1.0	3.3	MW	NRC	3.3	3499
2012	10	28	14	41	1	52.6080	-132.2340	25.0	4.2	ML	PGC	4.2	3500
2012	10	28	14	46	3	50.7940	-129.7770	10.0	4.5	MW	NRC	4.5	3501
2012	10	28	14	48	8	51.5970	-130.4310	1.0	5.0	MW	NRC	5.0	3502
2012	10	28	14	52	25	52.6470	-132.1450	19.0	3.2	MW	NRC	3.2	3503
2012	10	28	15	02	43	52.9380	-131.9750	1.0	3.0	MW	NRC	3.0	3504
2012	10	28	15	06	53	52.2810	-132.3770	15.2	4.4	MW	NRC	4.4	3505
2012	10	28	15	10	34	52.5020	-132.0870	10.0	4.0	MB	GS	4.0	3506
2012	10	28	15	24	21	52.8760	-132.0470	10.0	4.3	MB	GS	4.3	3507
2012	10	28	15	28	15	52.7910	-132.3330	24.8	4.1	MW	NRC	4.1	3508
2012	10	28	15	35	49	52.9620	-132.0920	0.0	3.5	MW	NRC	3.5	3509
2012	10	28	15	42	21	52.4280	-131.3790	10.0	4.0	MB	GS	4.0	3510
2012	10	28	15	44	58	52.3060	-132.4220	10.0	4.4	MB	GS	4.4	3511
2012	10	28	15	48	45	52.4270	-132.2600	10.0	4.4	MB	GS	4.4	3512
2012	10	28	15	57	16	52.6830	-132.6890	11.9	4.8	ML	PGC	4.8	3513
2012	10	28	15	59	11	52.7900	-132.5650	10.0	4.7	MB	GS	4.7	3514
2012	10	28	16	09	43	51.3540	-130.8570	1.0	5.2	MW	NRC	5.2	3515
2012	10	28	16	17	3	52.5210	-131.5590	10.0	4.7	ML	PGC	4.7	3516
2012	10	28	16	27	55	52.7690	-131.9680	10.0	4.3	ML	PGC	4.3	3517
2012	10	28	17	05	10	51.5740	-133.6850	30.0	5.0	MW	NRC	5.0	3518
2012	10	28	17	22	11	52.7520	-132.2930	18.5	3.2	MW	NRC	3.2	3519
2012	10	28	17	28	40	52.1030	-133.2170	1.0	4.2	MW	NRC	4.2	3520
2012	10	28	17	30	3	52.7810	-132.5760	0.2	3.4	MW	NRC	3.4	3521
2012	10	28	17	34	49	52.5800	-131.9590	10.0	4.5	ML	PGC	4.5	3522
2012	10	28	18	41	6	52.0640	-131.5770	16.4	4.6	MW	NRC	4.6	3523
2012	10	28	18	54	16	52.4800	-132.7930	20.0	6.3	MW	NRC	6.3	3524
2012	10	28	18	57	31	52.4720	-132.3740	10.0	5.3	MB	GS	5.3	3525
2012	10	28	19	01	53	52.2330	-132.8070	24.9	4.8	MW	NRC	4.8	3526

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID
2012	10	28	19	03	21	52.8340	-132.6670	10.0	5.4	MB	GS	5.4	3527
2012	10	28	19	09	53	52.2940	-132.0820	10.0	5.8	MW	GCM	5.8	3528
2012	10	28	19	16	48	52.4790	-132.6590	16.2	5.2	MW	NRC	5.2	3529
2012	10	28	20	02	43	52.3410	-132.1750	10.0	5.2	ML	PGC	5.2	3530
2012	10	28	21	06	31	52.6930	-132.4130	3.0	3.0	MW	NRC	3.0	3531
2012	10	28	21	16	17	52.0450	-133.2550	1.0	3.5	MW	NRC	3.5	3532
2012	10	28	21	29	4	52.4020	-132.1210	10.0	4.6	MB	GS	4.6	3533
2012	10	28	21	32	13	52.0440	-132.6090	29.0	3.4	MW	NRC	3.4	3534
2012	10	28	21	38	20	52.6470	-132.4060	14.1	5.1	ML	PGC	5.1	3535
2012	10	28	21	56	20	52.5670	-132.0940	12.0	3.3	MW	NRC	3.3	3536
2012	10	28	22	23	13	52.7830	-132.6910	18.0	3.7	MW	NRC	3.7	3537
2012	10	28	22	35	41	51.9200	-130.9310	10.0	4.0	MB	GS	4.0	3538
2012	10	28	22	41	27	52.3910	-131.9700	10.0	4.6	MB	GS	4.6	3539
2012	10	28	23	11	16	52.6630	-131.8730	16.0	4.2	MW	NRC	4.2	3540
2012	10	28	23	24	36	52.5130	-132.2020	13.9	4.1	ML	PGC	4.1	3541
2012	10	28	23	26	50	52.7270	-132.4640	10.0	4.9	MB	GS	4.9	3542
2012	10	28	23	31	41	52.4830	-131.8290	22.3	4.2	MW	NRC	4.2	3543
2012	10	28	23	34	20	52.4450	-132.4680	24.0	4.7	MW	NRC	4.7	3544
2012	10	28	23	46	41	52.9340	-132.5920	30.0	3.1	MW	NRC	3.1	3545
2012	10	28	23	55	2	52.9150	-131.4700	10.0	4.1	MB	GS	4.1	3546
2012	10	29	00	18	44	52.1930	-132.0960	8.0	4.3	MW	NRC	4.3	3547
2012	10	29	00	26	43	52.4230	-132.5370	19.0	4.3	MW	NRC	4.3	3548
2012	10	29	00	38	44	52.5990	-132.0200	20.0	3.7	MW	NRC	3.7	3549
2012	10	29	01	09	0	52.7950	-132.4230	2.0	2.9	MW	NRC	2.9	3550
2012	10	29	01	23	40	52.5420	-132.5120	25.0	3.6	MW	NRC	3.6	3551
2012	10	29	01	30	0	52.7930	-132.3100	13.0	3.4	MW	NRC	3.4	3552
2012	10	29	01	48	57	52.2750	-132.3980	18.0	5.1	MW	NRC	5.1	3553
2012	10	29	02	25	10	52.4370	-132.3860	12.0	3.8	MW	NRC	3.8	3554
2012	10	29	02	40	52	52.3970	-132.4870	10.0	4.0	MB	GS	4.0	3555
2012	10	29	02	45	47	52.2260	-132.8440	10.0	4.1	MB	GS	4.1	3556
2012	10	29	03	01	37	51.4110	-131.4640	5.0	4.4	MW	NRC	4.4	3557
2012	10	29	03	04	53	51.7410	-132.4970	30.0	4.0	MW	NRC	4.0	3558
2012	10	29	03	09	3	52.5440	-132.5190	30.0	4.1	MW	NRC	4.1	3559
2012	10	29	03	25	51	51.8100	-132.4740	30.0	4.3	MW	NRC	4.3	3560
2012	10	29	03	35	9	52.3890	-132.4960	4.0	3.1	MW	NRC	3.1	3561
2012	10	29	03	47	53	52.4210	-132.4230	16.0	4.1	MW	NRC	4.1	3562
2012	10	29	04	06	9	52.3350	-132.4820	0.1	4.2	MW	NRC	4.2	3563
2012	10	29	04	09	37	52.4790	-132.7730	1.0	3.4	MW	NRC	3.4	3564
2012	10	29	04	19	54	52.6690	-132.1030	19.0	3.3	MW	NRC	3.3	3565
2012	10	29	04	57	52	52.8670	-132.4740	18.8	2.9	MW	NRC	2.9	3566
2012	10	29	05	28	34	52.6420	-132.4070	23.0	3.3	MW	NRC	3.3	3567
2012	10	29	05	32	35	51.2700	-132.2980	1.0	4.7	MW	NRC	4.7	3568
2012	10	29	05	44	28	53.0160	-132.4080	23.0	2.9	MW	NRC	2.9	3569
2012	10	29	05	58	39	52.4410	-133.0040	30.2	4.1	MW	NRC	4.1	3570
2012	10	29	06	03	50	52.8270	-132.3500	14.0	4.6	MW	NRC	4.6	3571
2012	10	29	06	16	34	52.3700	-132.4170	17.0	3.9	MW	NRC	3.9	3572
2012	10	29	06	18	56	52.3540	-132.4540	22.0	3.5	MW	NRC	3.5	3573
2012	10	29	06	57	10	52.8320	-132.4310	15.0	3.2	MW	NRC	3.2	3574
2012	10	29	07	14	42	52.1680	-132.5110	2.0	3.4	MW	NRC	3.4	3575
2012	10	29	07	28	46	52.4790	-132.7730	2.0	3.2	MW	NRC	3.2	3576
2012	10	29	07	39	5	52.3580	-131.7860	10.0	4.7	ML	PGC	4.7	3577
2012	10	29	07	53	3	52.4430	-131.4570	10.0	4.4	ML	PGC	4.4	3578
2012	10	29	08	19	8	52.4060	-131.6700	10.0	4.3	ML	PGC	4.3	3579
2012	10	29	08	31	57	52.1630	-132.2830	2.0	3.1	MW	NRC	3.1	3580
2012	10	29	08	56	7	52.8180	-132.7330	29.0	3.3	MW	NRC	3.3	3581
2012	10	29	08	58	30	52.4470	-132.0390	10.0	4.6	ML	PGC	4.6	3582

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID
2012	10	29	09	15	49	52.6310	-131.9460	2.0	3.2	MW	NRC	3.2	3583
2012	10	29	09	34	13	52.6570	-131.6420	6.0	2.9	MW	NRC	2.9	3584
2012	10	29	09	48	46	51.3890	-130.7920	1.0	5.0	MW	NRC	5.0	3585
2012	10	29	10	00	6	52.8250	-132.2340	2.0	3.6	MW	NRC	3.6	3586
2012	10	29	10	09	6	52.5830	-132.7120	1.0	4.3	MW	NRC	4.3	3587
2012	10	29	10	17	24	52.0630	-133.3320	1.0	3.9	MW	NRC	3.9	3588
2012	10	29	10	44	47	52.4570	-131.8560	18.9	3.1	MW	NRC	3.1	3589
2012	10	29	10	50	15	52.3510	-132.3390	12.0	3.7	MW	NRC	3.7	3590
2012	10	29	10	59	2	52.2450	-131.4930	10.0	3.8	MW	NRC	3.8	3591
2012	10	29	11	07	15	51.9520	-131.1820	10.0	5.0	ML	PGC	5.0	3592
2012	10	29	11	12	46	52.4810	-131.4360	1.0	4.3	MW	NRC	4.3	3593
2012	10	29	11	16	52	52.6090	-132.4810	30.0	2.9	MW	NRC	2.9	3594
2012	10	29	11	19	51	52.6930	-132.8120	28.6	3.8	MW	NRC	3.8	3595
2012	10	29	11	28	8	52.8470	-132.4280	24.2	3.1	MW	NRC	3.1	3596
2012	10	29	11	32	57	53.0090	-132.5470	31.0	2.9	MW	NRC	2.9	3597
2012	10	29	11	50	41	52.2650	-133.2430	2.0	3.4	MW	NRC	3.4	3598
2012	10	29	11	55	4	52.2490	-132.3290	14.0	3.4	MW	NRC	3.4	3599
2012	10	29	12	01	36	52.5990	-132.8630	24.0	3.7	MW	NRC	3.7	3600
2012	10	29	12	05	14	52.5770	-132.5740	10.0	4.8	ML	PGC	4.8	3601
2012	10	29	12	33	35	52.5690	-132.3120	21.1	3.0	MW	NRC	3.0	3602
2012	10	29	12	42	11	52.5980	-132.9010	32.4	3.7	MW	NRC	3.7	3603
2012	10	29	12	55	1	52.2680	-132.4070	18.0	3.6	MW	NRC	3.6	3604
2012	10	29	13	16	11	52.6290	-132.0420	30.0	4.0	ML	PGC	4.0	3605
2012	10	29	13	25	17	52.0630	-133.3320	1.0	4.1	MW	NRC	4.1	3606
2012	10	29	14	01	28	52.6150	-131.9830	20.0	3.1	MW	NRC	3.1	3607
2012	10	29	14	12	50	52.4460	-132.0060	24.0	3.4	MW	NRC	3.4	3608
2012	10	29	14	30	56	52.6500	-132.8680	24.0	3.8	MW	NRC	3.8	3609
2012	10	29	14	39	49	52.7420	-132.2720	23.7	3.3	MW	NRC	3.3	3610
2012	10	29	14	47	4	52.4210	-132.4230	2.0	3.8	MW	NRC	3.8	3611
2012	10	29	14	56	1	52.1680	-131.1840	16.0	3.5	MW	NRC	3.5	3612
2012	10	29	14	58	38	52.7650	-132.5680	23.6	3.0	MW	NRC	3.0	3613
2012	10	29	15	01	6	52.0130	-131.7570	10.0	4.0	MB	GS	4.0	3614
2012	10	29	15	03	35	52.5100	-131.8590	13.0	3.8	MW	NRC	3.8	3615
2012	10	29	15	10	38	52.7720	-132.7920	28.2	3.8	MW	NRC	3.8	3616
2012	10	29	15	15	1	51.9860	-132.2740	10.0	4.0	MB	GS	4.0	3617
2012	10	29	15	38	29	52.0840	-132.1410	10.0	4.0	MB	GS	4.0	3618
2012	10	29	15	40	31	52.2240	-132.1930	10.0	4.0	MB	GS	4.0	3619
2012	10	29	15	42	53	51.6600	-131.2590	6.0	4.9	MW	NRC	4.9	3620
2012	10	29	15	51	34	51.7840	-132.0570	1.0	4.5	MW	NRC	4.5	3621
2012	10	29	16	08	3	52.3860	-131.8210	11.4	4.7	ML	PGC	4.7	3622
2012	10	29	16	19	34	51.9700	-132.8300	4.0	4.3	MW	NRC	4.3	3623
2012	10	29	16	23	28	52.7270	-131.7250	23.0	3.0	MW	NRC	3.0	3624
2012	10	29	16	33	8	52.2640	-131.8970	7.3	4.3	ML	PGC	4.3	3625
2012	10	29	16	37	7	52.5870	-132.4210	11.6	3.4	MW	NRC	3.4	3626
2012	10	29	16	47	55	52.3400	-132.8290	15.4	3.3	MW	NRC	3.3	3627
2012	10	29	17	36	2	52.1660	-131.8930	10.0	4.4	MB	GS	4.4	3628
2012	10	29	18	04	36	52.1600	-133.5040	1.0	3.9	MW	NRC	3.9	3629
2012	10	29	18	21	23	52.1260	-133.0290	1.0	4.3	MW	NRC	4.3	3630
2012	10	29	18	42	16	52.3110	-132.0690	14.0	3.7	MW	NRC	3.7	3631
2012	10	29	18	47	40	52.8550	-132.5100	17.6	2.9	MW	NRC	2.9	3632
2012	10	29	18	57	55	52.1820	-132.3600	6.0	3.7	MW	NRC	3.7	3633
2012	10	29	19	00	31	52.6830	-131.9230	12.9	3.4	MW	NRC	3.4	3634
2012	10	29	19	06	12	51.7040	-132.0270	20.0	4.2	MW	NRC	4.2	3635
2012	10	29	19	08	27	52.4160	-131.9950	10.0	4.5	ML	PGC	4.5	3636
2012	10	29	19	29	40	52.6160	-132.8260	10.0	3.1	MW	NRC	3.1	3637
2012	10	29	19	35	17	52.8810	-132.4710	17.0	2.9	MW	NRC	2.9	3638

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID
2012	10	29	19	51	51	53.2650	-133.0560	14.0	3.0	MW	NRC	3.0	3639
2012	10	29	19	53	35	52.4510	-131.8350	10.0	4.4	MB	GS	4.4	3640
2012	10	29	19	57	13	52.2650	-133.2430	9.0	3.3	MW	NRC	3.3	3641
2012	10	29	20	12	53	53.2630	-132.9390	23.0	3.5	MW	NRC	3.5	3642
2012	10	29	20	14	26	52.5600	-132.6850	10.0	4.2	MB	GS	4.2	3643
2012	10	29	20	19	46	53.2820	-133.0190	1.0	2.9	MW	NRC	2.9	3644
2012	10	29	20	21	9	52.5520	-132.4350	10.0	4.3	ML	PGC	4.3	3645
2012	10	29	20	27	10	53.1780	-134.0420	1.0	3.7	MW	NRC	3.7	3646
2012	10	29	20	35	12	52.6120	-131.8680	2.0	3.3	MW	NRC	3.3	3647
2012	10	29	20	40	16	52.4750	-131.8170	12.0	3.4	MW	NRC	3.4	3648
2012	10	29	20	49	46	52.3790	-131.4910	10.0	5.1	ML	PGC	5.1	3649
2012	10	29	20	57	51	52.7940	-132.7740	27.5	3.2	MW	NRC	3.2	3650
2012	10	29	21	05	52	52.3050	-131.2320	1.0	3.1	MW	NRC	3.1	3651
2012	10	29	21	16	58	51.7880	-131.4170	15.0	4.2	MW	NRC	4.2	3652
2012	10	29	21	24	48	52.5520	-132.8050	22.2	3.0	MW	NRC	3.0	3653
2012	10	29	22	00	30	52.4580	-132.5790	17.0	4.8	MW	NRC	4.8	3654
2012	10	29	22	09	14	53.3390	-133.4940	13.0	3.9	MW	NRC	3.9	3655
2012	10	29	22	35	49	52.4740	-132.5430	15.0	3.8	MW	NRC	3.8	3656
2012	10	29	22	42	32	52.4020	-132.3450	18.0	3.7	MW	NRC	3.7	3657
2012	10	29	23	19	57	52.6220	-132.4060	10.0	4.0	ML	PGC	4.0	3658
2012	10	29	23	24	34	52.4720	-132.4280	7.0	3.2	MW	NRC	3.2	3659
2012	10	29	23	30	32	51.9330	-131.2270	30.3	3.7	MW	NRC	3.7	3660
2012	10	29	23	51	1	52.5280	-133.1160	31.0	4.1	MW	NRC	4.1	3661
2012	10	30	00	32	14	52.3700	-132.4170	16.0	4.5	MW	NRC	4.5	3662
2012	10	30	00	35	9	52.4660	-131.6670	10.0	4.1	MB	GS	4.1	3663
2012	10	30	00	58	54	52.1550	-131.9410	10.0	3.9	MW	NRC	3.9	3664
2012	10	30	01	17	50	52.8730	-132.3950	24.2	3.6	MW	NRC	3.6	3665
2012	10	30	01	39	44	53.2140	-133.0500	20.0	4.0	MW	NRC	4.0	3666
2012	10	30	01	42	45	52.6600	-132.8180	32.9	3.4	MW	NRC	3.4	3667
2012	10	30	02	17	9	52.2150	-132.4150	20.0	4.5	ML	PGC	4.5	3668
2012	10	30	02	49	2	52.3650	-131.9020	9.0	6.2	MW	UCM	6.2	3669
2012	10	30	02	55	8	52.2220	-132.1170	19.2	5.3	MW	NRC	5.3	3670
2012	10	30	03	08	28	52.9090	-132.3550	20.0	2.9	ML	PGC	2.9	3671
2012	10	30	03	10	38	52.7330	-132.8830	20.0	3.1	ML	PGC	3.1	3672
2012	10	30	03	51	58	52.2700	-131.8540	9.5	4.1	MB	GS	4.1	3673
2012	10	30	03	59	38	52.2360	-132.3680	10.0	4.8	ML	PGC	4.8	3674
2012	10	30	04	15	59	52.3000	-132.3340	16.0	3.1	MW	NRC	3.1	3675
2012	10	30	04	39	57	51.3140	-131.6480	1.0	5.2	MW	NRC	5.2	3676
2012	10	30	05	07	57	52.3000	-132.3340	30.0	3.6	MW	NRC	3.6	3677
2012	10	30	05	46	38	52.6900	-132.2970	5.0	3.4	MW	NRC	3.4	3678
2012	10	30	06	01	34	52.8600	-132.2760	2.0	3.6	MW	NRC	3.6	3679
2012	10	30	06	05	16	52.1640	-131.0700	2.0	3.7	MW	NRC	3.7	3680
2012	10	30	07	33	13	52.2990	-131.6120	23.0	3.1	MW	NRC	3.1	3681
2012	10	30	08	24	56	52.3350	-132.3760	2.0	3.2	MW	NRC	3.2	3682
2012	10	30	09	48	59	51.2900	-132.3920	5.0	4.3	MW	NRC	4.3	3683
2012	10	30	09	53	29	52.2190	-131.1880	2.0	3.4	MW	NRC	3.4	3684
2012	10	30	10	42	54	52.5670	-132.0940	2.0	3.2	MW	NRC	3.2	3685
2012	10	30	11	08	37	52.6340	-132.0620	6.0	3.0	MW	NRC	3.0	3686
2012	10	30	11	16	15	52.6260	-132.9840	6.2	3.9	MW	NRC	3.9	3687
2012	10	30	11	25	9	51.9920	-133.1350	1.0	3.4	MW	NRC	3.4	3688
2012	10	30	11	27	57	52.4660	-133.0380	3.0	3.2	MW	NRC	3.2	3689
2012	10	30	12	16	49	52.8490	-133.7390	11.0	2.9	MW	NRC	2.9	3690
2012	10	30	12	22	21	52.0250	-132.4090	31.3	3.3	MW	NRC	3.3	3691
2012	10	30	12	44	14	52.3510	-132.3390	17.0	3.3	MW	NRC	3.3	3692
2012	10	30	13	25	40	51.8160	-131.9850	30.0	3.2	MW	NRC	3.2	3693
2012	10	30	14	03	46	51.3110	-132.3460	1.0	3.7	MW	NRC	3.7	3694

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID
2012	10	30	14	10	57	52.1420	-132.0850	28.2	5.1	MW	NRC	5.1	3695
2012	10	30	14	33	10	52.5480	-132.0150	15.0	2.9	MW	NRC	2.9	3696
2012	10	30	14	35	25	51.9260	-132.5020	1.0	3.4	MW	NRC	3.4	3697
2012	10	30	14	37	39	52.3380	-132.3590	9.5	3.7	MW	NRC	3.7	3698
2012	10	30	14	50	21	52.7440	-132.3040	21.0	2.9	MW	NRC	2.9	3699
2012	10	30	15	20	48	52.5670	-132.8710	25.5	4.1	MW	NRC	4.1	3700
2012	10	30	15	57	55	52.4000	-132.4200	5.0	4.1	ML	PGC	4.1	3701
2012	10	30	16	01	21	52.2170	-132.4020	18.0	3.5	MW	NRC	3.5	3702
2012	10	30	16	21	9	52.4210	-132.4230	17.0	3.1	MW	NRC	3.1	3703
2012	10	30	17	15	30	52.2190	-132.4140	16.1	3.1	MW	NRC	3.1	3704
2012	10	30	17	33	29	52.4050	-132.6870	10.0	4.1	MB	GS	4.1	3705
2012	10	30	18	38	38	52.6340	-132.9050	16.0	3.2	MW	NRC	3.2	3706
2012	10	30	18	52	17	52.3330	-132.2620	15.0	3.1	MW	NRC	3.1	3707
2012	10	30	19	03	0	52.3920	-131.8860	19.0	3.4	MW	NRC	3.4	3708
2012	10	30	19	46	8	52.2650	-132.4040	17.9	3.5	MW	NRC	3.5	3709
2012	10	30	20	38	15	52.7660	-132.7280	0.0	2.9	MW	NRC	2.9	3710
2012	10	30	21	06	13	52.6690	-132.1030	28.0	4.2	MW	NRC	4.2	3711
2012	10	30	21	22	13	52.7270	-132.7890	24.8	3.9	MW	NRC	3.9	3712
2012	10	30	21	41	14	52.6340	-132.9050	2.0	3.3	MW	NRC	3.3	3713
2012	10	30	22	01	37	52.5770	-131.8270	1.0	3.3	MW	NRC	3.3	3714
2012	10	30	22	06	49	51.8490	-131.1350	5.0	4.3	MW	NRC	4.3	3715
2012	10	30	22	45	19	52.8460	-132.4290	15.0	3.2	MW	NRC	3.2	3716
2012	10	30	23	29	57	52.4380	-132.7660	24.6	3.4	MW	NRC	3.4	3717
2012	10	30	23	35	45	52.4440	-132.7310	3.0	3.7	MW	NRC	3.7	3718
2012	10	31	00	32	25	52.5450	-131.9000	21.0	3.5	MW	NRC	3.5	3719
2012	10	31	00	53	16	52.7140	-132.2290	13.8	3.0	MW	NRC	3.0	3720
2012	10	31	00	58	0	52.1900	-133.6030	15.8	4.1	MW	NRC	4.1	3721
2012	10	31	01	13	44	52.1460	-131.5990	1.0	3.2	MW	NRC	3.2	3722
2012	10	31	01	15	16	52.7920	-132.3080	2.0	2.9	MW	NRC	2.9	3723
2012	10	31	01	49	15	51.9920	-133.1350	1.0	3.9	MW	NRC	3.9	3724
2012	10	31	03	15	57	52.2170	-132.4020	18.0	3.0	MW	NRC	3.0	3725
2012	10	31	03	17	22	52.4770	-132.6580	18.0	3.3	MW	NRC	3.3	3726
2012	10	31	03	31	37	52.7390	-132.4010	0.1	3.0	MW	NRC	3.0	3727
2012	10	31	03	43	27	52.3140	-132.1840	18.0	2.9	MW	NRC	2.9	3728
2012	10	31	04	28	29	52.7060	-132.2610	16.0	3.3	MW	NRC	3.3	3729
2012	10	31	04	48	38	52.3660	-132.5500	10.0	4.7	MW	NRC	4.7	3730
2012	10	31	05	04	4	52.6020	-132.2620	20.1	3.0	MW	NRC	3.0	3731
2012	10	31	05	09	29	52.5190	-132.5760	0.0	3.8	MW	NRC	3.8	3732
2012	10	31	05	16	43	52.2290	-132.1900	11.7	3.4	MW	NRC	3.4	3733
2012	10	31	05	43	7	52.5580	-133.0460	30.0	4.3	MW	NRC	4.3	3734
2012	10	31	06	33	34	52.3740	-132.6470	27.0	3.0	MW	NRC	3.0	3735
2012	10	31	07	08	33	52.3030	-132.4490	18.0	3.5	MW	NRC	3.5	3736
2012	10	31	07	49	13	52.5990	-132.0200	6.0	3.0	MW	NRC	3.0	3737
2012	10	31	08	00	45	52.5580	-132.4750	17.0	3.7	MW	NRC	3.7	3738
2012	10	31	08	25	25	51.6010	-131.0300	6.0	3.4	MW	NRC	3.4	3739
2012	10	31	08	53	28	52.6180	-132.0980	2.0	3.2	MW	NRC	3.2	3740
2012	10	31	09	15	26	51.9210	-132.9380	1.0	4.4	MW	NRC	4.4	3741
2012	10	31	09	48	19	52.3670	-132.3030	17.0	2.9	MW	NRC	2.9	3742
2012	10	31	09	58	2	52.8530	-132.3870	15.4	3.5	MW	NRC	3.5	3743
2012	10	31	11	04	59	51.7890	-132.2840	1.0	3.3	MW	NRC	3.3	3744
2012	10	31	11	36	34	52.3110	-131.9350	19.1	3.2	MW	NRC	3.2	3745
2012	10	31	11	45	8	52.6300	-132.6740	18.0	3.6	MW	NRC	3.6	3746
2012	10	31	11	57	12	52.4880	-132.3920	16.0	2.9	MW	NRC	2.9	3747
2012	10	31	12	17	10	52.0380	-132.1620	10.0	3.5	MW	NRC	3.5	3748
2012	10	31	12	36	18	52.3750	-131.8170	19.6	2.9	MW	NRC	2.9	3749
2012	10	31	13	14	45	52.7280	-132.4550	14.0	3.0	MW	NRC	3.0	3750

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID
2012	10	31	13	30	46	52.5550	-133.3170	30.0	2.9	MW	NRC	2.9	3751
2012	10	31	13	36	47	52.9990	-133.5270	13.0	3.1	MW	NRC	3.1	3752
2012	10	31	14	30	54	52.7110	-132.4910	25.0	3.3	MW	NRC	3.3	3753
2012	10	31	14	41	38	52.3330	-132.3780	18.0	4.1	MW	NRC	4.1	3754
2012	10	31	14	43	59	52.4670	-132.1980	23.0	3.4	MW	NRC	3.4	3755
2012	10	31	15	04	53	52.5720	-131.9360	0.1	2.9	MW	NRC	2.9	3756
2012	10	31	15	18	35	52.7550	-132.2930	12.3	2.9	MW	NRC	2.9	3757
2012	10	31	15	25	12	52.2980	-133.3270	21.8	3.7	MW	NRC	3.7	3758
2012	10	31	15	37	57	52.5110	-132.7000	17.0	3.6	MW	NRC	3.6	3759
2012	10	31	16	25	27	52.6530	-132.9730	10.0	4.0	ML	PGC	4.0	3760
2012	10	31	16	48	32	52.5130	-131.9740	19.0	3.3	MW	NRC	3.3	3761
2012	10	31	17	28	41	52.5460	-132.7420	21.0	3.8	MW	NRC	3.8	3762
2012	10	31	18	00	44	52.5120	-133.1520	30.3	2.9	MW	NRC	2.9	3763
2012	10	31	18	34	43	52.7920	-132.3080	14.0	3.4	MW	NRC	3.4	3764
2012	10	31	18	41	4	52.4140	-132.4130	0.0	3.2	MW	NRC	3.2	3765
2012	10	31	18	52	54	51.8630	-132.6420	30.0	2.9	MW	NRC	2.9	3766
2012	10	31	19	05	16	52.8110	-132.3860	18.0	3.1	MW	NRC	3.1	3767
2012	10	31	19	11	26	51.7970	-131.6480	31.6	3.1	MW	NRC	3.1	3768
2012	10	31	19	14	46	52.4430	-132.1820	5.0	3.1	MW	NRC	3.1	3769
2012	10	31	19	22	28	52.7290	-132.5240	30.0	3.0	MW	NRC	3.0	3770
2012	10	31	19	51	42	52.4780	-131.9320	4.0	3.7	MW	NRC	3.7	3771
2012	10	31	19	55	30	52.1160	-131.9390	30.0	3.0	MW	NRC	3.0	3772
2012	10	31	20	38	5	52.6800	-132.6810	0.3	3.0	MW	NRC	3.0	3773
2012	10	31	20	53	30	52.3350	-132.3760	7.0	3.1	MW	NRC	3.1	3774
2012	10	31	22	58	9	52.1170	-131.2810	28.8	2.9	MW	NRC	2.9	3775
2012	10	31	23	07	6	52.4220	-132.7950	30.6	3.0	MW	NRC	3.0	3776
2012	10	31	23	12	43	51.5440	-130.8930	9.1	3.6	MW	NRC	3.6	3777
2012	10	31	23	18	4	51.5710	-131.7010	5.0	3.1	MW	NRC	3.1	3778
2012	10	31	23	50	59	52.0100	-133.2130	1.0	3.3	MW	NRC	3.3	3779
2012	10	31	23	59	29	52.6340	-132.9800	27.2	3.4	MW	NRC	3.4	3780
2012	11	01	00	07	54	52.6650	-132.8140	29.0	3.1	MW	NRC	3.1	3781
2012	11	01	00	15	36	51.4830	-131.2820	20.0	2.9	MW	NRC	2.9	3782
2012	11	01	01	09	36	52.6150	-131.9830	2.0	2.9	MW	NRC	2.9	3783
2012	11	01	01	11	13	51.8470	-130.7110	1.0	3.0	MW	NRC	3.0	3784
2012	11	01	01	59	28	52.4770	-133.9570	1.0	3.2	MW	NRC	3.2	3785
2012	11	01	02	03	37	52.7850	-132.3560	16.7	3.0	MW	NRC	3.0	3786
2012	11	01	02	31	48	52.2680	-132.4070	21.0	3.9	MW	NRC	3.9	3787
2012	11	01	03	15	56	52.2940	-132.2710	24.6	5.2	MW	NRC	5.2	3788
2012	11	01	03	23	36	52.2840	-132.3710	17.0	3.9	MW	NRC	3.9	3789
2012	11	01	03	27	10	52.2410	-132.2460	19.8	4.6	MW	NRC	4.6	3790
2012	11	01	03	43	22	52.4940	-131.9930	15.6	2.9	MW	NRC	2.9	3791
2012	11	01	03	49	24	52.2680	-132.4070	18.0	3.2	MW	NRC	3.2	3792
2012	11	01	04	10	25	52.3190	-132.4120	14.0	3.3	MW	NRC	3.3	3793
2012	11	01	04	43	12	52.5290	-131.9370	26.0	3.6	MW	NRC	3.6	3794
2012	11	01	05	10	17	52.3540	-132.4540	2.0	3.0	MW	NRC	3.0	3795
2012	11	01	05	14	1	51.8320	-131.9490	17.0	3.5	MW	NRC	3.5	3796
2012	11	01	05	26	4	52.5670	-132.0940	11.0	3.4	MW	NRC	3.4	3797
2012	11	01	06	02	22	52.2120	-132.2910	16.1	2.9	MW	NRC	2.9	3798
2012	11	01	06	09	47	52.4210	-132.4230	16.0	3.3	MW	NRC	3.3	3799
2012	11	01	06	24	28	51.6280	-132.4470	24.2	4.6	MW	NRC	4.6	3800
2012	11	01	06	26	49	52.3860	-132.3810	13.0	3.7	MW	NRC	3.7	3801
2012	11	01	06	43	32	53.0130	-132.2920	0.1	3.2	MW	NRC	3.2	3802
2012	11	01	07	56	14	52.3510	-132.3390	18.0	3.2	MW	NRC	3.2	3803
2012	11	01	08	03	57	52.7320	-132.6860	11.0	3.2	MW	NRC	3.2	3804
2012	11	01	10	05	31	51.5540	-131.1390	6.0	3.0	MW	NRC	3.0	3805
2012	11	01	10	48	26	52.3700	-132.4170	15.0	3.0	MW	NRC	3.0	3806

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID
2012	11	01	10	55	19	51.7840	-132.0570	1.0	3.5	MW	NRC	3.5	3807
2012	11	01	11	11	33	51.5610	-131.2290	5.0	3.0	MW	NRC	3.0	3808
2012	11	01	11	57	15	52.4320	-132.1570	4.0	3.0	MW	NRC	3.0	3809
2012	11	01	14	17	43	52.8480	-132.5440	1.0	3.4	MW	NRC	3.4	3810
2012	11	01	14	35	34	52.7970	-132.5390	2.0	3.4	MW	NRC	3.4	3811
2012	11	01	14	52	52	52.7580	-132.3250	11.8	3.0	MW	NRC	3.0	3812
2012	11	01	16	51	36	51.5660	-130.9900	7.0	3.2	MW	NRC	3.2	3813
2012	11	01	17	06	28	52.8910	-132.4580	18.7	3.3	MW	NRC	3.3	3814
2012	11	01	17	14	53	52.4480	-132.1200	10.0	2.9	MW	NRC	2.9	3815
2012	11	01	17	34	45	52.8620	-132.8320	26.0	4.4	MW	NRC	4.4	3816
2012	11	01	18	50	27	52.6990	-132.2690	24.1	4.2	MW	NRC	4.2	3817
2012	11	01	19	20	18	52.2440	-132.9370	4.0	3.0	MW	NRC	3.0	3818
2012	11	01	19	30	55	52.2840	-132.3710	14.0	3.2	MW	NRC	3.2	3819
2012	11	01	19	47	57	52.2760	-132.0280	16.0	2.9	MW	NRC	2.9	3820
2012	11	01	20	24	26	50.5270	-132.9310	30.0	4.0	MW	NRC	4.0	3821
2012	11	01	21	13	14	52.1490	-132.4330	2.0	2.9	MW	NRC	2.9	3822
2012	11	02	00	47	10	52.7790	-132.4600	17.0	3.7	MW	NRC	3.7	3823
2012	11	02	02	54	56	51.7160	-130.8290	20.0	4.3	MW	NRC	4.3	3824
2012	11	02	07	15	40	52.1920	-131.9420	6.1	4.8	ML	PGC	4.8	3825
2012	11	02	08	15	11	52.2430	-132.2790	23.9	3.8	MW	NRC	3.8	3826
2012	11	02	08	19	55	52.1840	-132.3080	20.0	5.0	MW	NRC	5.0	3827
2012	11	02	08	37	7	52.2610	-132.3300	20.0	4.8	MW	NRC	4.8	3828
2012	11	02	15	53	48	52.8320	-132.5810	16.0	3.0	MW	NRC	3.0	3829
2012	11	02	21	05	13	52.8360	-131.9690	26.0	3.4	MW	NRC	3.4	3830
2012	11	02	23	33	32	52.6130	-133.0300	26.6	3.7	MW	NRC	3.7	3831
2012	11	03	02	15	3	52.0700	-132.7270	18.0	3.6	MW	NRC	3.6	3832
2012	11	03	02	25	56	52.5040	-133.3110	9.0	2.9	MW	NRC	2.9	3833
2012	11	03	04	25	16	52.3450	-132.2670	31.2	4.5	MW	NRC	4.5	3834
2012	11	03	09	48	23	52.5330	-132.6470	10.0	4.0	MB	GS	4.0	3835
2012	11	03	10	36	56	52.6950	-132.0550	24.3	3.4	MW	NRC	3.4	3836
2012	11	03	12	18	42	52.3950	-132.3920	26.2	4.6	MW	NRC	4.6	3837
2012	11	03	17	25	56	52.5480	-132.3600	10.0	4.0	MB	GS	4.0	3838
2012	11	03	17	44	10	51.9260	-133.2780	2.0	3.2	MW	NRC	3.2	3839
2012	11	03	17	49	9	52.3250	-132.3720	25.7	4.5	MW	NRC	4.5	3840
2012	11	04	00	21	45	52.5180	-132.2030	4.0	3.6	MW	NRC	3.6	3841
2012	11	04	05	07	47	52.3170	-131.9460	18.2	4.3	MW	NRC	4.3	3842
2012	11	04	07	42	11	52.5090	-131.9820	8.7	4.6	MW	NRC	4.6	3843
2012	11	04	08	51	41	52.5070	-131.5970	10.0	4.0	MB	GS	4.0	3844
2012	11	04	08	55	6	52.4510	-131.7870	10.0	4.0	MB	GS	4.0	3845
2012	11	04	09	14	49	52.3470	-131.3030	10.0	4.0	MB	GS	4.0	3846
2012	11	04	12	05	12	51.6980	-132.7300	1.0	4.2	ML	PGC	4.2	3847
2012	11	04	12	27	36	52.4280	-131.8110	39.2	5.1	MW	NRC	5.1	3848
2012	11	04	13	17	11	52.4540	-131.7020	10.0	4.0	MB	GS	4.0	3849
2012	11	04	16	10	12	52.9570	-132.9040	14.0	3.1	MW	NRC	3.1	3850
2012	11	04	18	27	16	52.4630	-132.4210	8.9	4.8	MW	NRC	4.8	3851
2012	11	05	08	12	51	51.5190	-130.9020	1.0	5.5	MW	NRC	5.5	3852
2012	11	05	08	49	0	52.7510	-132.3330	5.0	3.8	MW	NRC	3.8	3853
2012	11	05	12	40	16	52.1780	-131.6550	20.0	4.0	MW	NRC	4.0	3854
2012	11	05	12	49	3	52.8320	-132.4310	10.0	3.3	MW	NRC	3.3	3855
2012	11	05	13	02	41	52.2160	-132.2730	25.0	3.4	MW	NRC	3.4	3856
2012	11	05	13	53	57	52.5470	-132.0890	30.0	3.7	MW	NRC	3.7	3857
2012	11	05	14	08	32	52.2570	-132.3210	25.0	3.8	MW	NRC	3.8	3858
2012	11	05	15	00	56	52.4840	-132.2310	5.0	2.9	MW	NRC	2.9	3859
2012	11	05	16	52	17	51.8830	-132.7360	1.0	3.2	MW	NRC	3.2	3860
2012	11	05	20	15	58	52.2100	-134.0760	1.0	4.9	MW	NRC	4.9	3861
2012	11	05	20	20	47	53.2580	-133.0260	20.0	3.0	MW	NRC	3.0	3862

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID
2012	11	05	20	22	36	53.2360	-133.0740	20.0	3.8	MW	NRC	3.8	3863
2012	11	06	10	26	59	52.1660	-131.5360	14.9	4.7	MW	NRC	4.7	3864
2012	11	06	15	47	56	52.6780	-132.9030	10.0	4.3	MB	GS	4.3	3865
2012	11	07	15	04	21	52.6460	-132.8720	27.0	4.5	MW	NRC	4.5	3866
2012	11	11	21	55	56	52.0630	-131.6680	21.0	4.1	MW	NRC	4.1	3867
2012	11	11	22	22	1	52.1940	-132.0000	35.0	2.9	MW	NRC	2.9	3868
2012	11	12	03	30	11	52.6170	-132.1070	25.6	2.9	MW	NRC	2.9	3869
2012	11	12	06	15	51	52.4300	-132.4650	22.3	3.1	MW	NRC	3.1	3870
2012	11	12	06	23	2	52.2990	-131.6120	12.0	3.0	MW	NRC	3.0	3871
2012	11	12	06	48	55	52.0490	-131.7870	33.0	2.9	MW	NRC	2.9	3872
2012	11	12	06	50	40	52.1540	-131.8030	31.1	4.3	MW	NRC	4.3	3873
2012	11	12	06	58	26	52.0750	-131.7420	34.4	3.7	MW	NRC	3.7	3874
2012	11	12	07	08	48	51.8570	-133.1940	14.0	3.0	MW	NRC	3.0	3875
2012	11	12	07	25	50	51.6870	-132.2740	3.0	4.4	MW	NRC	4.4	3876
2012	11	12	08	17	54	52.1300	-133.3030	1.0	3.5	MW	NRC	3.5	3877
2012	11	12	08	27	14	51.9180	-131.8900	29.3	3.4	MW	NRC	3.4	3878
2012	11	12	10	09	58	52.0560	-131.9370	31.0	3.3	MW	NRC	3.3	3879
2012	11	12	17	59	29	52.1230	-132.8470	14.0	2.9	MW	NRC	2.9	3880
2012	11	12	20	43	46	53.1180	-133.5040	4.0	4.0	MW	NRC	4.0	3881
2012	11	12	21	31	12	51.8610	-133.5340	2.0	2.9	MW	NRC	2.9	3882
2012	11	13	01	43	11	52.9730	-132.0170	20.0	3.5	MW	NRC	3.5	3883
2012	11	13	04	29	38	52.4340	-133.1430	24.3	3.7	MW	NRC	3.7	3884
2012	11	13	04	31	20	52.4520	-133.1090	25.2	4.3	MW	NRC	4.3	3885
2012	11	13	04	41	49	52.4440	-133.1100	24.9	3.9	MW	NRC	3.9	3886
2012	11	13	04	46	51	52.4910	-133.0000	28.0	4.3	MW	NRC	4.3	3887
2012	11	13	04	55	45	52.7050	-132.0330	22.3	5.3	ML	PGC	5.3	3888
2012	11	13	05	55	36	52.7250	-132.5310	27.6	3.1	MW	NRC	3.1	3889
2012	11	13	05	57	46	52.6200	-132.2140	19.0	3.3	MW	NRC	3.3	3890
2012	11	13	07	34	17	52.7570	-132.4630	42.8	4.7	MW	NRC	4.7	3891
2012	11	13	07	40	5	52.4550	-133.1110	25.1	3.9	MW	NRC	3.9	3892
2012	11	13	07	42	3	52.5710	-132.9290	29.0	3.1	MW	NRC	3.1	3893
2012	11	13	08	00	47	52.5830	-132.8990	1.0	3.7	MW	NRC	3.7	3894
2012	11	13	08	11	19	50.9650	-133.5560	35.0	3.3	MW	NRC	3.3	3895
2012	11	13	09	12	56	52.9030	-131.9330	7.0	3.0	MW	NRC	3.0	3896
2012	11	13	19	15	34	51.9350	-132.7880	2.0	3.1	MW	NRC	3.1	3897
2012	11	13	20	16	35	52.0170	-132.6080	6.0	3.0	MW	NRC	3.0	3898
2012	11	13	20	43	31	52.0170	-132.6080	6.0	3.4	MW	NRC	3.4	3899
2012	11	13	21	29	24	52.2630	-132.1790	30.0	3.0	MW	NRC	3.0	3900
2012	11	14	03	04	45	51.8290	-130.6540	10.0	4.7	MB	GS	4.7	3901
2012	11	14	15	11	0	51.7820	-132.7720	2.0	3.2	MW	NRC	3.2	3902
2012	11	14	15	53	8	52.2400	-132.5870	29.9	3.0	MW	NRC	3.0	3903
2012	11	14	16	08	17	52.1240	-132.2650	31.9	3.1	MW	NRC	3.1	3904
2012	11	14	17	24	3	51.6400	-131.1830	19.0	3.4	MW	NRC	3.4	3905
2012	11	14	21	17	11	52.3190	-133.5850	19.4	3.4	MW	NRC	3.4	3906
2012	11	15	02	10	17	52.3890	-131.7720	23.0	2.9	MW	NRC	2.9	3907
2012	11	15	04	11	59	52.0820	-132.3050	29.0	3.1	MW	NRC	3.1	3908
2012	11	15	05	03	21	52.0390	-132.4760	24.4	3.3	MW	NRC	3.3	3909
2012	11	15	09	38	52	52.3940	-131.7900	20.4	3.0	MW	NRC	3.0	3910
2012	11	15	12	32	25	52.2260	-132.0940	38.7	3.3	MW	NRC	3.3	3911
2012	11	15	12	40	42	52.1660	-132.1240	34.1	3.1	MW	NRC	3.1	3912
2012	11	15	14	28	45	52.7550	-132.1730	24.8	3.8	ML	PGC	3.8	3913
2012	11	15	15	16	32	52.2880	-132.2000	29.6	3.1	ML	PGC	3.1	3914
2012	11	15	15	57	55	51.9310	-131.2420	24.0	3.3	MW	NRC	3.3	3915
2012	11	15	20	23	31	52.7430	-132.2720	13.7	3.3	MW	NRC	3.3	3916
2012	11	15	20	37	13	52.7720	-132.2300	0.0	3.3	MW	NRC	3.3	3917
2012	11	15	22	09	59	52.7340	-132.7380	34.2	3.3	MW	NRC	3.3	3918

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID
2012	11	15	22	43	53	50.9440	-133.4260	30.0	3.3	MW	NRC	3.3	3919
2012	11	16	03	47	33	52.7480	-132.6490	29.0	3.0	MW	NRC	3.0	3920
2012	11	16	06	24	30	53.8140	-132.6530	3.8	3.6	MW	NRC	3.6	3921
2012	11	16	09	46	37	52.6160	-132.9820	30.5	3.5	MW	NRC	3.5	3922
2012	11	16	09	50	30	50.9590	-133.3850	30.0	3.1	MW	NRC	3.1	3923
2012	11	16	10	33	10	52.6520	-132.9840	30.0	2.9	MW	NRC	2.9	3924
2012	11	16	12	09	40	52.5440	-131.9010	0.1	3.7	MW	NRC	3.7	3925
2012	11	16	13	06	29	51.6880	-131.0740	7.0	3.4	MW	NRC	3.4	3926
2012	11	16	13	52	37	52.5000	-132.9640	30.1	2.9	MW	NRC	2.9	3927
2012	11	16	14	25	22	52.8420	-132.5410	14.6	3.2	MW	NRC	3.2	3928
2012	11	16	14	42	6	52.1600	-132.1690	27.0	2.9	MW	NRC	2.9	3929
2012	11	16	15	43	14	52.1200	-131.9000	13.0	3.1	MW	NRC	3.1	3930
2012	11	16	16	22	39	52.8110	-132.3860	20.0	3.5	MW	NRC	3.5	3931
2012	11	16	16	50	18	51.5220	-131.2110	1.0	3.1	MW	NRC	3.1	3932
2012	11	16	19	54	49	52.0610	-133.2190	5.0	3.0	MW	NRC	3.0	3933
2012	11	16	20	00	0	52.8700	-132.5150	0.1	3.0	MW	NRC	3.0	3934
2012	11	16	21	10	32	52.3350	-132.3760	25.0	2.9	MW	NRC	2.9	3935
2012	11	17	06	12	23	52.3400	-131.2730	2.0	3.1	MW	NRC	3.1	3936
2012	11	17	07	02	9	52.8090	-132.4160	18.0	3.0	MW	NRC	3.0	3937
2012	11	17	07	54	11	52.7420	-132.2820	12.6	3.0	MW	NRC	3.0	3938
2012	11	17	08	44	10	51.7810	-131.9440	1.0	3.5	MW	NRC	3.5	3939
2012	11	17	11	01	7	52.4810	-133.0530	30.4	3.0	MW	NRC	3.0	3940
2012	11	17	11	11	1	52.4020	-132.3450	19.0	3.2	MW	NRC	3.2	3941
2012	11	17	12	34	54	52.1360	-131.8630	27.0	3.4	MW	NRC	3.4	3942
2012	11	17	12	56	9	52.0820	-133.5240	1.0	3.3	MW	NRC	3.3	3943
2012	11	17	13	46	22	52.1450	-131.6970	17.3	3.2	ML	PGC	3.2	3944
2012	11	17	14	10	14	51.9070	-132.2570	17.0	3.2	MW	NRC	3.2	3945
2012	11	17	14	18	14	52.1620	-132.3230	28.6	3.8	ML	PGC	3.8	3946
2012	11	17	19	09	41	52.4910	-131.8840	20.2	3.0	MW	NRC	3.0	3947
2012	11	17	19	26	26	52.5310	-132.6590	31.7	3.1	MW	NRC	3.1	3948
2012	11	17	19	35	42	52.4760	-132.6510	32.6	3.2	MW	NRC	3.2	3949
2012	11	18	01	18	23	52.4230	-132.5370	19.0	3.1	MW	NRC	3.1	3950
2012	11	18	01	34	18	52.2270	-132.9730	18.0	2.9	MW	NRC	2.9	3951
2012	11	18	01	42	41	51.9850	-132.3600	23.3	3.0	MW	NRC	3.0	3952
2012	11	18	02	01	47	52.4800	-133.1510	28.7	2.9	MW	NRC	2.9	3953
2012	11	18	04	17	0	52.5450	-131.9000	7.0	2.9	MW	NRC	2.9	3954
2012	11	18	04	47	46	52.3720	-131.8740	10.8	3.3	ML	PGC	3.3	3955
2012	11	18	05	11	17	52.4850	-132.9600	30.5	3.0	MW	NRC	3.0	3956
2012	11	18	11	41	5	52.2680	-132.3380	24.3	3.8	ML	PGC	3.8	3957
2012	11	18	17	04	47	52.4350	-132.3580	35.1	3.6	ML	PGC	3.6	3958
2012	11	18	18	35	0	52.1200	-131.9000	30.0	3.3	MW	NRC	3.3	3959
2012	11	18	18	45	18	52.1770	-131.8910	33.1	3.0	MW	NRC	3.0	3960
2012	11	18	19	18	18	52.4150	-132.5420	9.9	4.0	MW	NRC	4.0	3961
2012	11	18	21	26	34	52.3540	-132.4540	30.0	3.2	MW	NRC	3.2	3962
2012	11	18	21	31	52	52.0850	-131.8590	29.0	3.0	MW	NRC	3.0	3963
2012	11	19	01	00	39	52.2280	-132.6970	27.9	2.9	MW	NRC	2.9	3964
2012	11	19	01	06	31	51.5270	-134.1290	29.0	3.3	MW	NRC	3.3	3965
2012	11	19	08	47	44	52.7600	-132.3810	17.0	2.9	MW	NRC	2.9	3966
2012	11	19	09	59	5	51.6060	-131.1860	10.0	3.4	ML	PGC	3.4	3967
2012	11	19	12	33	17	52.1380	-132.0220	0.6	3.1	MW	NRC	3.1	3968
2012	11	19	16	03	46	52.7970	-132.2100	25.4	3.2	MW	NRC	3.2	3969
2012	11	19	19	37	48	51.3560	-133.9180	29.0	3.2	MW	NRC	3.2	3970
2012	11	19	21	02	19	52.8320	-132.3730	21.8	3.4	ML	PGC	3.4	3971
2012	11	19	23	07	59	52.7350	-132.2270	25.2	3.0	ML	PGC	3.0	3972
2012	11	19	23	33	32	52.6400	-132.8000	32.8	3.0	MW	NRC	3.0	3973
2012	11	20	08	09	59	50.5600	-130.3210	10.0	3.1	MW	NRC	3.1	3974

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID
2012	11	21	01	31	56	52.4520	-131.8910	5.2	3.5	MW	NRC	3.5	3975
2012	11	21	03	22	2	52.4760	-131.9300	0.1	2.9	MW	NRC	2.9	3976
2012	11	21	10	29	35	52.6900	-132.2970	19.0	3.0	MW	NRC	3.0	3977
2012	11	21	10	55	2	52.2120	-132.1740	30.0	3.0	MW	NRC	3.0	3978
2012	11	21	14	46	32	52.4010	-131.8260	10.0	4.0	MB	GS	4.0	3979
2012	11	21	15	00	58	52.1770	-132.1320	28.0	3.3	MW	NRC	3.3	3980
2012	11	21	15	09	34	52.1950	-132.2100	24.0	2.9	MW	NRC	2.9	3981
2012	11	21	16	50	43	53.0220	-132.7560	17.0	3.2	MW	NRC	3.2	3982
2012	11	21	20	17	6	52.5830	-132.7000	32.6	3.1	MW	NRC	3.1	3983
2012	11	21	20	29	35	52.3030	-133.5140	4.0	3.2	MW	NRC	3.2	3984
2012	11	21	20	41	30	51.6820	-132.0480	2.0	2.9	MW	NRC	2.9	3985
2012	11	21	21	14	22	52.2910	-132.1380	35.0	3.2	MW	NRC	3.2	3986
2012	11	21	23	35	48	51.8210	-133.0390	2.0	2.9	MW	NRC	2.9	3987
2012	11	22	01	02	25	52.2570	-132.0940	34.5	3.3	ML	PGC	3.3	3988
2012	11	22	04	05	46	52.2610	-132.1490	33.2	3.1	ML	PGC	3.1	3989
2012	11	22	04	25	48	52.7430	-132.2500	16.5	2.9	MW	NRC	2.9	3990
2012	11	22	08	07	40	51.9440	-133.3560	3.0	3.0	MW	NRC	3.0	3991
2012	11	22	09	01	27	50.5710	-130.3630	10.0	3.1	MW	NRC	3.1	3992
2012	11	22	09	09	25	52.1710	-131.9040	28.0	3.3	MW	NRC	3.3	3993
2012	11	22	13	02	42	52.8370	-132.3440	12.1	3.8	ML	PGC	3.8	3994
2012	11	23	00	15	36	52.3620	-132.3590	36.7	3.4	MW	NRC	3.4	3995
2012	11	23	04	47	18	52.2250	-132.1430	30.5	3.4	MW	NRC	3.4	3996
2012	11	23	06	04	10	52.1930	-132.0960	30.0	2.9	MW	NRC	2.9	3997
2012	11	23	07	02	26	52.5560	-132.3940	35.0	3.1	MW	NRC	3.1	3998
2012	11	23	10	03	16	52.7580	-132.2660	1.0	3.0	MW	NRC	3.0	3999
2012	11	23	12	35	9	52.8310	-132.4060	23.0	3.6	ML	PGC	3.6	4000
2012	11	23	15	09	18	52.1390	-131.9770	30.0	3.5	MW	NRC	3.5	4001
2012	11	23	15	33	37	52.7340	-132.2340	21.3	3.7	ML	PGC	3.7	4002
2012	11	23	15	40	35	52.3490	-132.2250	30.0	3.1	MW	NRC	3.1	4003
2012	11	23	18	41	50	52.1940	-132.0690	33.5	3.0	MW	NRC	3.0	4004
2012	11	24	03	36	48	52.5930	-132.6690	33.1	3.1	MW	NRC	3.1	4005
2012	11	24	03	39	59	52.1590	-131.4480	18.0	3.5	MW	NRC	3.5	4006
2012	11	24	03	54	20	52.4120	-132.6950	32.0	3.2	MW	NRC	3.2	4007
2012	11	24	06	21	49	52.5430	-132.0390	17.6	3.1	MW	NRC	3.1	4008
2012	11	24	06	23	46	52.4420	-132.6160	29.0	2.9	MW	NRC	2.9	4009
2012	11	24	07	02	14	51.9210	-132.9380	1.0	3.1	MW	NRC	3.1	4010
2012	11	24	09	05	58	52.4910	-132.5060	30.0	2.9	MW	NRC	2.9	4011
2012	11	24	09	43	40	52.0900	-132.5890	25.6	3.3	MW	NRC	3.3	4012
2012	11	24	10	02	24	52.1330	-132.4690	28.0	3.2	MW	NRC	3.2	4013
2012	11	24	10	36	55	57.1660	-136.2150	3.2	3.6	ML	PGC	3.6	4014
2012	11	24	13	43	13	52.0040	-134.3850	2.0	3.7	MW	NRC	3.7	4015
2012	11	24	14	10	45	52.3490	-133.1770	16.0	3.0	MW	NRC	3.0	4016
2012	11	24	21	36	46	51.5100	-132.7800	2.0	3.1	MW	NRC	3.1	4017
2012	11	25	00	09	12	52.2190	-132.2460	34.5	3.0	MW	NRC	3.0	4018
2012	11	25	06	06	20	52.5970	-132.7470	21.0	3.4	MW	NRC	3.4	4019
2012	11	25	11	26	51	52.8360	-132.3990	23.9	3.4	MW	NRC	3.4	4020
2012	11	25	16	48	55	51.6030	-133.3900	30.3	3.2	MW	NRC	3.2	4021
2012	11	25	17	52	35	52.2570	-134.0790	1.0	2.9	MW	NRC	2.9	4022
2012	11	25	18	53	17	52.3470	-132.7820	33.8	2.9	MW	NRC	2.9	4023
2012	11	26	02	39	54	53.5120	-133.8300	2.0	3.1	MW	NRC	3.1	4024
2012	11	26	08	06	33	50.7010	-133.1340	29.0	3.5	MW	NRC	3.5	4025
2012	11	26	13	55	34	52.7700	-132.2790	22.5	2.9	MW	NRC	2.9	4026
2012	11	26	15	52	55	52.5410	-131.8970	18.9	3.0	ML	PGC	3.0	4027
2012	11	26	16	45	55	52.5230	-131.8830	20.1	3.1	ML	PGC	3.1	4028
2012	11	26	18	10	34	52.4220	-132.3430	22.7	3.0	MW	NRC	3.0	4029
2012	11	26	20	38	30	52.4200	-132.7920	30.6	3.2	MW	NRC	3.2	4030

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID
2012	11	27	04	10	8	52.5910	-131.9890	20.3	2.9	ML	PGC	2.9	4031
2012	11	27	08	35	46	52.5580	-132.6960	32.4	3.1	MW	NRC	3.1	4032
2012	11	27	11	36	33	51.6330	-130.9580	1.0	3.2	MW	NRC	3.2	4033
2012	11	27	11	48	10	52.4870	-132.9520	30.7	3.0	MW	NRC	3.0	4034
2012	11	27	13	26	38	52.8000	-132.3300	20.8	3.0	MW	NRC	3.0	4035
2012	11	27	20	46	38	52.6150	-131.9830	20.0	3.0	MW	NRC	3.0	4036
2012	11	28	00	49	10	51.5710	-132.4120	1.0	3.8	MW	NRC	3.8	4037
2012	11	28	06	26	47	52.6340	-132.7240	33.5	3.0	MW	NRC	3.0	4038
2012	11	28	09	19	13	52.6070	-132.8180	32.2	2.9	MW	NRC	2.9	4039
2012	11	28	10	29	22	52.2840	-132.3710	17.0	4.0	MW	NRC	4.0	4040
2012	11	28	11	50	41	52.6690	-132.1030	9.0	3.1	MW	NRC	3.1	4041
2012	11	28	17	26	48	52.5590	-131.9360	16.2	2.9	MW	NRC	2.9	4042
2012	11	28	20	02	26	52.4930	-131.8840	7.3	3.1	MW	NRC	3.1	4043
2012	11	28	22	45	43	52.2320	-132.2390	34.3	3.5	MW	NRC	3.5	4044
2012	11	29	01	55	45	52.7850	-132.2830	17.4	2.9	MW	NRC	2.9	4045
2012	11	29	03	06	11	52.4580	-132.5790	30.0	3.2	MW	NRC	3.2	4046
2012	11	29	04	20	35	52.5640	-131.9780	19.0	3.8	MW	NRC	3.8	4047
2012	11	29	04	29	11	52.4500	-131.5100	1.0	3.0	MW	NRC	3.0	4048
2012	11	29	04	52	32	52.3180	-133.1350	25.7	3.0	MW	NRC	3.0	4049
2012	11	29	11	37	30	52.0630	-132.3860	22.0	3.0	MW	NRC	3.0	4050
2012	11	29	13	48	29	51.7650	-134.4260	30.0	3.2	MW	NRC	3.2	4051
2012	11	29	14	03	47	51.9080	-134.0260	7.4	3.3	MW	NRC	3.3	4052
2012	11	29	16	44	13	52.7280	-132.6930	32.8	3.2	MW	NRC	3.2	4053
2012	11	29	21	39	30	52.7460	-132.5330	19.0	2.9	MW	NRC	2.9	4054
2012	11	30	01	59	36	52.5860	-131.9980	12.6	3.4	ML	PGC	3.4	4055
2012	11	30	03	03	13	53.0110	-132.5170	22.2	4.5	MW	NRC	4.5	4056
2012	11	30	05	08	3	51.6960	-132.7250	2.0	3.1	MW	NRC	3.1	4057
2012	11	30	05	16	5	52.5880	-132.0200	5.2	2.9	MW	NRC	2.9	4058
2012	11	30	11	40	46	52.6880	-132.0510	18.7	3.0	ML	PGC	3.0	4059
2012	11	30	14	42	25	52.6140	-131.9610	9.9	3.2	ML	PGC	3.2	4060
2012	11	30	18	10	47	52.7200	-132.0850	23.9	2.9	ML	PGC	2.9	4061
2012	11	30	19	26	38	53.0570	-132.7990	17.0	2.9	MW	NRC	2.9	4062
2012	11	30	20	45	30	51.8030	-130.9740	34.6	3.0	ML	PGC	3.0	4063
2012	11	30	22	18	2	52.5880	-132.2870	30.0	2.9	MW	NRC	2.9	4064
2012	11	30	22	56	36	52.6630	-131.8730	16.9	2.9	MW	NRC	2.9	4065
2012	12	01	02	32	10	52.2070	-132.2540	21.0	3.3	ML	PGC	3.3	4066
2012	12	01	05	18	12	52.7740	-132.1790	23.3	3.1	ML	PGC	3.1	4067
2012	12	01	08	38	45	52.1750	-131.8070	34.5	3.0	ML	PGC	3.0	4068
2012	12	01	12	17	19	52.1410	-132.7430	19.9	2.9	MW	NRC	2.9	4069
2012	12	01	17	30	55	53.1860	-133.4740	1.0	2.9	MW	NRC	2.9	4070
2012	12	01	21	44	19	53.2320	-133.2980	20.0	2.9	ML	PGC	2.9	4071
2012	12	02	06	06	3	52.7060	-132.2610	15.0	2.9	MW	NRC	2.9	4072
2012	12	02	08	41	30	52.6840	-132.0890	23.9	3.4	ML	PGC	3.4	4073
2012	12	02	09	34	3	52.0930	-132.2910	32.9	3.0	MW	NRC	3.0	4074
2012	12	02	12	11	50	52.6790	-132.0060	25.2	2.9	ML	PGC	2.9	4075
2012	12	02	17	56	32	52.6900	-132.0080	24.3	3.5	ML	PGC	3.5	4076
2012	12	03	00	44	45	52.7800	-132.2950	17.3	2.9	ML	PGC	2.9	4077
2012	12	03	13	12	13	52.1380	-131.2870	27.0	3.3	ML	PGC	3.3	4078
2012	12	03	13	32	37	52.1100	-131.2940	26.0	3.1	ML	PGC	3.1	4079
2012	12	03	14	41	16	52.6290	-132.9390	30.6	2.9	MW	NRC	2.9	4080
2012	12	03	22	00	53	51.6360	-134.3730	31.0	3.0	MW	NRC	3.0	4081
2012	12	03	23	05	57	52.6640	-132.2050	14.4	2.9	MW	NRC	2.9	4082
2012	12	03	23	07	54	52.8200	-132.2960	24.6	3.4	MW	NRC	3.4	4083
2012	12	04	02	01	57	52.2220	-132.1560	30.9	3.3	ML	PGC	3.3	4084
2012	12	04	02	18	36	52.2130	-133.1230	1.0	3.5	MW	NRC	3.5	4085
2012	12	04	09	57	24	52.8190	-132.3180	22.9	3.1	MW	NRC	3.1	4086

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID
2012	12	04	11	24	0	52.7730	-132.2300	19.8	2.9	MW	NRC	2.9	4087
2012	12	04	18	31	59	52.7000	-132.2340	22.9	4.2	MW	NRC	4.2	4088
2012	12	04	20	14	35	52.8970	-132.4340	23.0	3.0	MW	NRC	3.0	4089
2012	12	04	23	05	51	52.8440	-132.3430	19.7	3.1	MW	NRC	3.1	4090
2012	12	05	00	45	42	50.4330	-130.3260	10.0	3.6	MW	NRC	3.6	4091
2012	12	05	06	29	55	52.1900	-131.6230	24.2	3.1	MW	NRC	3.1	4092
2012	12	05	07	49	47	51.9030	-132.8600	1.0	3.0	MW	NRC	3.0	4093
2012	12	05	08	11	44	52.7640	-132.3720	24.1	3.6	ML	PGC	3.6	4094
2012	12	05	13	02	43	51.8190	-130.5400	16.5	2.9	MW	NRC	2.9	4095
2012	12	06	02	22	23	52.6160	-132.8260	30.0	2.9	MW	NRC	2.9	4096
2012	12	06	05	27	59	52.8570	-132.4630	21.2	4.8	ML	PGC	4.8	4097
2012	12	06	07	53	55	52.9600	-133.1360	18.0	3.1	MW	NRC	3.1	4098
2012	12	06	15	26	53	52.7460	-132.2440	22.5	3.0	ML	PGC	3.0	4099
2012	12	06	23	44	39	52.8900	-132.6720	16.1	3.3	ML	PGC	3.3	4100
2012	12	07	02	28	59	52.3540	-132.0060	16.2	3.2	ML	PGC	3.2	4101
2012	12	07	03	00	27	52.3700	-132.0080	20.1	3.3	ML	PGC	3.3	4102
2012	12	07	03	12	46	50.5470	-130.3890	10.0	3.5	MW	NRC	3.5	4103
2012	12	07	08	27	39	52.1600	-134.9470	31.1	3.8	MW	NRC	3.8	4104
2012	12	07	08	40	30	52.2530	-135.0400	29.8	3.1	MW	NRC	3.1	4105
2012	12	07	15	58	53	52.8220	-132.3760	19.7	3.4	ML	PGC	3.4	4106
2012	12	07	16	21	7	52.0210	-132.8360	19.0	3.4	MW	NRC	3.4	4107
2012	12	07	17	00	21	52.0390	-134.6550	29.9	2.9	MW	NRC	2.9	4108
2012	12	08	00	05	16	52.0760	-133.0690	17.0	2.9	MW	NRC	2.9	4109
2012	12	08	00	47	11	52.6610	-132.2140	13.3	3.8	MW	NRC	3.8	4110
2012	12	08	01	17	52	52.8020	-132.3540	21.3	3.3	MW	NRC	3.3	4111
2012	12	08	12	06	4	52.7280	-132.2580	18.6	2.9	MW	NRC	2.9	4112
2012	12	08	12	48	34	50.7130	-130.5700	10.0	3.6	MW	NRC	3.6	4113
2012	12	08	13	22	16	52.7230	-132.6920	23.2	2.9	MW	NRC	2.9	4114
2012	12	08	20	26	5	52.4990	-132.6370	25.4	3.5	MW	NRC	3.5	4115
2012	12	09	06	48	31	52.8310	-132.4140	17.0	3.3	MW	NRC	3.3	4116
2012	12	09	08	04	21	50.6090	-133.1200	34.9	3.7	MW	NRC	3.7	4117
2012	12	09	10	36	19	51.7980	-132.7360	4.0	3.1	MW	NRC	3.1	4118
2012	12	09	10	40	31	52.7890	-132.3580	19.9	3.1	MW	NRC	3.1	4119
2012	12	09	13	04	8	52.8530	-132.3240	24.2	4.1	MW	NRC	4.1	4120
2012	12	09	15	06	42	52.8500	-132.3450	22.0	3.5	MW	NRC	3.5	4121
2012	12	09	15	35	24	52.5880	-132.0320	18.6	3.6	MW	NRC	3.6	4122
2012	12	09	21	00	57	51.9170	-132.7110	1.0	2.9	MW	NRC	2.9	4123
2012	12	09	21	11	27	52.3810	-132.1520	16.0	3.0	MW	NRC	3.0	4124
2012	12	10	00	37	53	52.8100	-132.3320	21.9	3.5	MW	NRC	3.5	4125
2012	12	10	07	46	46	53.0810	-132.7740	21.5	3.0	ML	PGC	3.0	4126
2012	12	10	13	23	6	52.3290	-131.8490	17.1	3.0	ML	PGC	3.0	4127
2012	12	14	02	23	45	50.5570	-130.3010	10.0	3.6	MW	NRC	3.6	4128
2012	12	14	11	34	40	52.5470	-132.6580	26.8	3.1	ML	PGC	3.1	4129
2012	12	15	16	38	13	50.6360	-130.2920	10.0	3.5	MW	NRC	3.5	4130
2012	12	16	02	50	57	52.7200	-132.2340	21.4	4.6	MW	NRC	4.6	4131
2012	12	16	08	00	28	52.6900	-132.2140	23.0	3.0	MW	NRC	3.0	4132
2012	12	17	00	35	8	52.6550	-132.1070	15.9	4.8	MW	NRC	4.8	4133
2012	12	17	01	32	28	52.8450	-132.3490	22.0	2.9	MW	NRC	2.9	4134
2012	12	18	04	07	58	52.4960	-131.9120	23.2	3.7	ML	PGC	3.7	4135
2012	12	18	18	57	17	52.5990	-132.1470	21.6	3.4	ML	PGC	3.4	4136
2012	12	18	19	57	11	52.4440	-132.0450	10.0	4.3	MB	GS	4.3	4137
2012	12	18	22	14	40	52.5440	-132.5200	34.2	3.3	MW	NRC	3.3	4138
2012	12	19	03	52	31	50.6200	-130.2630	10.0	3.6	MW	NRC	3.6	4139
2012	12	19	09	54	48	52.1020	-131.5730	23.5	3.3	ML	PGC	3.3	4140
2012	12	20	15	00	15	52.5420	-131.9350	16.5	3.5	MW	NRC	3.5	4141
2012	12	20	17	13	7	52.5180	-131.9560	5.0	2.9	MW	NRC	2.9	4142

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID
2012	12	20	21	12	15	50.1840	-129.6860	10.0	3.7	MW	NRC	3.7	4143
2012	12	22	04	02	48	52.6540	-132.1000	21.2	3.8	ML	PGC	3.8	4144
2012	12	22	06	59	32	52.1810	-131.9840	31.2	3.2	ML	PGC	3.2	4145
2012	12	23	06	44	54	52.8970	-132.4400	22.8	3.3	ML	PGC	3.3	4146
2012	12	23	07	53	5	52.5520	-132.7720	28.0	3.1	MW	NRC	3.1	4147
2012	12	23	19	08	34	50.5010	-130.2860	10.0	4.5	MW	NRC	4.5	4148
2012	12	23	21	31	13	50.5500	-130.2610	10.0	3.3	MW	NRC	3.3	4149
2012	12	24	00	52	23	50.4980	-130.2780	10.0	3.1	MW	NRC	3.1	4150
2012	12	24	01	59	49	52.7570	-132.2420	21.9	3.4	MW	NRC	3.4	4151
2012	12	24	08	41	15	52.0150	-131.3550	0.0	3.3	MW	NRC	3.3	4152
2012	12	24	16	28	54	52.5350	-132.7690	23.7	2.9	MW	NRC	2.9	4153
2012	12	25	05	21	32	53.2410	-133.0290	21.8	3.0	MW	NRC	3.0	4154
2012	12	25	08	00	17	52.7780	-132.2990	23.3	3.1	MW	NRC	3.1	4155
2012	12	25	17	35	45	50.0170	-130.0380	10.0	3.5	MW	NRC	3.5	4156
2012	12	25	17	39	26	50.2120	-129.8060	10.0	4.1	MB	GS	4.1	4157
2012	12	25	23	34	40	50.0360	-130.1030	10.0	3.7	MW	NRC	3.7	4158
2012	12	26	08	05	25	50.0180	-130.1540	10.0	3.6	MW	NRC	3.6	4159
2012	12	26	15	50	58	52.2350	-132.2670	30.2	3.2	MW	NRC	3.2	4160
2012	12	26	21	40	0	52.5090	-131.8820	12.1	3.2	MW	NRC	3.2	4161
2012	12	27	06	33	8	51.2120	-131.0910	10.0	3.5	MW	PGC	3.5	4162
2012	12	27	17	08	21	52.7580	-132.3040	23.7	3.1	ML	PGC	3.1	4163
2012	12	27	17	14	52	50.6560	-130.3990	10.0	3.2	MW	NRC	3.2	4164
2012	12	27	22	27	0	52.5460	-131.9540	11.7	3.2	ML	PGC	3.2	4165
2012	12	28	04	50	41	50.2230	-129.7870	10.0	3.1	MW	NRC	3.1	4166
2013	01	01	01	28	11	51.5410	-131.1320	3.8	2.9	MW	NRC	2.9	4167
2013	01	01	03	40	53	50.7180	-130.4030	10.0	3.2	MW	NRC	3.2	4168
2013	01	01	07	34	57	52.0200	-131.9880	22.3	3.0	MW	NRC	3.0	4169
2013	01	04	09	05	7	52.7320	-132.2440	22.0	3.5	ML	PGC	3.5	4170
2013	01	05	08	58	17	55.1800	-134.9950	10.0	7.5	MW	NRC	7.5	4171
2013	01	05	09	12	6	55.6490	-135.6470	11.8	4.7	ML	AEI	4.7	4172
2013	01	05	09	17	58	55.9450	-135.0470	10.0	4.0	ML	AEI	4.0	4173
2013	01	05	09	24	6	55.9040	-135.2860	15.0	3.3	ML	AEI	3.3	4174
2013	01	05	09	27	20	55.6040	-135.1960	20.0	4.7	MB	GS	4.7	4175
2013	01	05	09	32	6	55.1190	-134.8510	0.7	4.6	ML	AEI	4.6	4176
2013	01	05	09	41	27	55.7490	-135.2280	10.0	4.1	ML	AEI	4.1	4177
2013	01	05	09	55	7	55.6210	-135.2490	10.0	3.6	ML	AEI	3.6	4178
2013	01	05	09	59	1	55.6760	-135.0680	10.0	3.3	ML	AEI	3.3	4179
2013	01	05	10	05	10	55.9350	-135.1660	10.0	2.9	ML	AEI	2.9	4180
2013	01	05	10	11	18	55.8290	-135.2960	10.0	4.7	MB	GS	4.7	4181
2013	01	05	10	18	42	55.4290	-134.7740	20.0	3.2	ML	AEI	3.2	4182
2013	01	05	10	39	51	55.4630	-134.9070	5.3	3.1	ML	AEI	3.1	4183
2013	01	05	10	45	32	55.3330	-134.6200	12.2	3.2	ML	AEI	3.2	4184
2013	01	05	11	05	16	55.9130	-135.1650	10.0	2.9	ML	AEI	2.9	4185
2013	01	05	11	10	23	55.4320	-135.1280	22.8	3.4	ML	AEI	3.4	4186
2013	01	05	11	12	1	55.3310	-134.7390	18.7	3.0	ML	AEI	3.0	4187
2013	01	05	11	18	42	55.5230	-135.2250	12.8	3.1	ML	AEI	3.1	4188
2013	01	05	11	20	26	55.4230	-135.4680	3.1	3.4	ML	AEI	3.4	4189
2013	01	05	11	25	58	55.2990	-134.8570	10.0	2.9	ML	AEI	2.9	4190
2013	01	05	11	29	25	55.9670	-135.9590	3.3	3.0	ML	AEI	3.0	4191
2013	01	05	11	39	36	55.5080	-135.1470	20.0	4.5	ML	AEI	4.5	4192
2013	01	05	12	05	54	55.9350	-135.4040	20.6	3.9	MB	GS	3.9	4193
2013	01	05	12	08	32	55.5540	-135.4790	10.0	2.9	ML	AEI	2.9	4194
2013	01	05	12	24	44	55.5750	-135.1530	18.8	3.7	MB	GS	3.7	4195
2013	01	05	12	28	27	55.0810	-134.6950	10.0	5.4	MW	RMT	5.4	4196
2013	01	05	12	36	13	56.1150	-135.1310	4.4	3.8	ML	AEI	3.8	4197
2013	01	05	12	39	17	55.7240	-135.0960	10.0	3.2	ML	AEI	3.2	4198

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID
2013	01	05	13	16	22	56.0630	-135.2450	6.3	3.4	ML	AEI	3.4	4199
2013	01	05	13	45	14	55.4200	-135.0290	10.0	3.5	ML	AEI	3.5	4200
2013	01	05	15	32	13	55.4650	-135.0450	20.0	4.1	ML	AEI	4.1	4201
2013	01	05	15	41	41	55.6430	-135.2550	13.4	4.0	MB	GS	4.0	4202
2013	01	05	15	53	21	55.7430	-135.2860	10.0	3.0	ML	AEI	3.0	4203
2013	01	05	16	00	19	55.0480	-134.4810	20.0	3.1	MW	NRC	3.1	4204
2013	01	05	16	02	27	55.4580	-135.3260	10.0	3.7	ML	AEI	3.7	4205
2013	01	05	16	07	56	55.7900	-135.1390	20.0	2.9	ML	AEI	2.9	4206
2013	01	05	16	25	6	55.5930	-135.1020	20.0	3.5	ML	AEI	3.5	4207
2013	01	05	16	27	20	55.4940	-135.0000	20.0	3.3	ML	AEI	3.3	4208
2013	01	05	16	29	5	55.1840	-134.6580	23.6	2.9	ML	AEI	2.9	4209
2013	01	05	17	10	8	55.1710	-134.7480	20.0	3.4	ML	AEI	3.4	4210
2013	01	05	17	15	25	55.5460	-135.0390	20.0	3.5	ML	AEI	3.5	4211
2013	01	05	18	06	55	55.7750	-134.7900	10.0	2.9	ML	AEI	2.9	4212
2013	01	05	19	16	24	55.7530	-135.0000	20.0	2.9	ML	AEI	2.9	4213
2013	01	05	19	18	10	55.2680	-134.6860	20.0	3.0	ML	AEI	3.0	4214
2013	01	05	19	39	51	52.6120	-132.7050	32.1	3.5	ML	PGC	3.5	4215
2013	01	05	19	53	22	55.5710	-135.0700	5.2	3.9	ML	AEI	3.9	4216
2013	01	05	20	41	48	55.8120	-134.9620	10.0	2.9	ML	AEI	2.9	4217
2013	01	05	20	43	18	55.4610	-135.3820	10.4	4.2	MB	GS	4.2	4218
2013	01	05	21	26	54	55.2450	-134.7100	20.0	4.0	MB	GS	4.0	4219
2013	01	05	21	56	3	55.5880	-135.0550	20.0	3.2	ML	AEI	3.2	4220
2013	01	05	23	14	16	55.5640	-134.9400	20.0	2.9	ML	AEI	2.9	4221
2013	01	06	00	02	21	55.4000	-134.9400	20.0	3.2	ML	AEI	3.2	4222
2013	01	06	00	55	30	55.5370	-134.7510	20.0	3.1	ML	AEI	3.1	4223
2013	01	06	02	06	56	55.6390	-135.0430	20.0	3.2	ML	AEI	3.2	4224
2013	01	06	02	16	26	55.4780	-135.0340	20.0	2.9	ML	AEI	2.9	4225
2013	01	06	04	21	56	55.7580	-134.9750	20.0	3.2	ML	AEI	3.2	4226
2013	01	06	06	04	8	55.9990	-135.1520	17.6	3.0	ML	AEI	3.0	4227
2013	01	06	06	22	53	55.4570	-135.1060	10.5	3.6	ML	PGC	3.6	4228
2013	01	06	07	21	38	55.6000	-134.9670	20.0	2.9	ML	AEI	2.9	4229
2013	01	06	08	37	28	55.7340	-135.1700	20.0	4.9	ML	PGC	4.9	4230
2013	01	06	09	40	52	56.0190	-135.3440	20.0	2.9	ML	AEI	2.9	4231
2013	01	06	10	29	6	55.5740	-135.0400	19.0	3.1	ML	AEI	3.1	4232
2013	01	06	11	44	6	55.5540	-135.1320	20.0	2.9	ML	AEI	2.9	4233
2013	01	06	12	14	33	55.4070	-135.3060	10.0	4.2	ML	PGC	4.2	4234
2013	01	06	13	49	45	55.4800	-134.9430	20.0	3.3	ML	AEI	3.3	4235
2013	01	06	19	43	51	55.6250	-135.2890	20.0	3.0	ML	AEI	3.0	4236
2013	01	07	00	33	13	55.4050	-134.7950	20.0	2.9	ML	AEI	2.9	4237
2013	01	07	05	24	48	55.2550	-134.6920	20.0	3.1	ML	AEI	3.1	4238
2013	01	07	07	44	34	55.6780	-134.8830	20.0	3.0	ML	AEI	3.0	4239
2013	01	07	11	04	19	55.4160	-135.7500	20.0	2.9	ML	AEI	2.9	4240
2013	01	07	15	07	35	55.3820	-134.8070	20.0	4.0	ML	AEI	4.0	4241
2013	01	08	12	23	31	55.2920	-134.7850	10.0	4.0	ML	PGC	4.0	4242
2013	01	08	12	40	22	52.4400	-132.4840	27.3	3.5	ML	PGC	3.5	4243
2013	01	08	13	20	24	55.3720	-134.8810	20.0	3.7	ML	PGC	3.7	4244
2013	01	08	14	46	35	56.0040	-135.3280	10.0	4.6	MW	NRC	4.6	4245
2013	01	08	18	45	2	55.3180	-134.9130	10.0	5.1	ML	PGC	5.1	4246
2013	01	08	21	26	2	55.7300	-135.0880	20.0	3.0	ML	AEI	3.0	4247
2013	01	09	04	12	48	55.3430	-134.8660	10.6	4.4	MW	RMT	4.4	4248
2013	01	09	08	49	43	55.4360	-136.7930	20.0	2.9	ML	AEI	2.9	4249
2013	01	09	14	47	32	55.3550	-134.7810	20.0	4.2	MB	GS	4.2	4250
2013	01	09	20	17	24	55.6200	-135.0050	20.0	3.3	ML	AEI	3.3	4251
2013	01	09	23	16	3	55.1320	-134.6570	20.0	3.0	ML	AEI	3.0	4252
2013	01	10	05	57	23	55.7070	-135.0280	20.0	3.3	ML	AEI	3.3	4253
2013	01	10	07	48	58	55.1510	-134.4720	20.0	3.1	MW	NRC	3.1	4254

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID
2013	01	10	13	52	46	50.7490	-130.4290	10.0	3.5	MW	NRC	3.5	4255
2013	01	10	17	52	12	55.1870	-134.5250	20.0	2.9	ML	AEI	2.9	4256
2013	01	11	04	58	40	52.5350	-131.9100	8.5	3.7	ML	PGC	3.7	4257
2013	01	11	08	23	41	52.5310	-131.9290	10.3	3.8	ML	PGC	3.8	4258
2013	01	11	10	30	25	55.5840	-135.0540	20.0	3.5	ML	AEI	3.5	4259
2013	01	11	11	30	30	52.5660	-131.9620	7.9	3.4	MW	NRC	3.4	4260
2013	01	12	04	57	43	56.0060	-135.2700	20.0	3.1	ML	AEI	3.1	4261
2013	01	12	07	34	52	52.5430	-131.9170	10.2	3.3	MW	NRC	3.3	4262
2013	01	12	16	05	38	50.6450	-130.3790	10.0	3.8	MW	NRC	3.8	4263
2013	01	12	16	24	46	50.6530	-130.3630	10.0	3.2	MW	NRC	3.2	4264
2013	01	12	22	20	29	55.1050	-134.7000	20.0	3.5	ML	AEI	3.5	4265
2013	01	14	03	23	30	52.7550	-132.2500	17.3	3.0	MW	NRC	3.0	4266
2013	01	14	14	55	51	55.1630	-134.5480	4.0	5.5	MW	GS0	5.5	4267
2013	01	14	16	00	53	54.9870	-134.3380	20.0	2.9	MW	NRC	2.9	4268
2013	01	14	17	06	30	55.5910	-134.9910	20.0	3.2	ML	AEI	3.2	4269
2013	01	15	02	56	41	55.0570	-134.7560	10.0	4.1	ML	AEI	4.1	4270
2013	01	16	10	47	1	52.5020	-132.4360	34.6	3.5	ML	PGC	3.5	4271
2013	01	17	13	00	39	56.0430	-135.1610	10.0	3.3	ML	PGC	3.3	4272
2013	01	17	23	43	14	52.5470	-131.9680	21.0	3.2	ML	PGC	3.2	4273
2013	01	18	01	42	7	50.8610	-130.7090	10.0	4.3	MW	NRC	4.3	4274
2013	01	18	20	17	1	55.3740	-134.8640	20.0	3.2	ML	AEI	3.2	4275
2013	01	18	23	14	16	55.2680	-135.6010	19.8	3.3	ML	AEI	3.3	4276
2013	01	19	07	12	35	55.4020	-134.9020	20.0	3.7	ML	PGC	3.7	4277
2013	01	19	08	27	12	55.7950	-135.0890	10.0	3.3	MW	NRC	3.3	4278
2013	01	21	01	37	54	55.2520	-134.8570	5.0	3.2	ML	PGC	3.2	4279
2013	01	21	06	30	25	50.9320	-130.7300	10.0	3.1	MW	NRC	3.1	4280
2013	01	22	06	45	21	52.3170	-132.2260	26.0	3.0	MW	NRC	3.0	4281
2013	01	22	16	38	45	55.6250	-135.1600	15.8	3.6	ML	AEI	3.6	4282
2013	01	22	21	30	28	55.5870	-135.5880	17.8	3.3	ML	AEI	3.3	4283
2013	01	25	13	36	30	55.9880	-135.2110	26.1	3.5	ML	AEI	3.5	4284
2013	01	27	01	09	37	50.5170	-130.2240	10.0	3.1	MW	NRC	3.1	4285
2013	01	27	01	49	1	50.5430	-130.3740	10.0	3.2	MW	PGC	3.2	4286
2013	01	27	03	30	25	50.5000	-130.3720	10.0	3.1	MW	NRC	3.1	4287
2013	01	27	15	17	7	50.4590	-130.2930	10.0	3.2	MW	PGC	3.2	4288
2013	01	28	04	43	14	52.5540	-131.9690	12.8	3.1	MW	NRC	3.1	4289
2013	01	28	18	10	39	52.1290	-131.7810	21.5	3.0	MW	NRC	3.0	4290
2013	01	31	09	53	39	55.3910	-134.8610	1.1	5.9	MW	NRC	5.9	4291
2013	01	31	10	17	34	55.3690	-134.7870	5.0	3.7	MW	NRC	3.7	4292
2013	01	31	10	47	11	55.4030	-135.0240	20.0	3.1	ML	AEI	3.1	4293
2013	01	31	11	39	42	55.4350	-135.0040	20.0	3.0	ML	AEI	3.0	4294
2013	01	31	13	38	53	55.4940	-135.0060	20.0	3.3	ML	AEI	3.3	4295
2013	01	31	22	03	7	55.4120	-135.0790	20.0	3.0	ML	AEI	3.0	4296
2013	02	02	03	15	22	52.1720	-131.9800	28.8	2.9	ML	PGC	2.9	4297
2013	02	02	03	23	0	52.3510	-131.6670	23.3	3.2	ML	PGC	3.2	4298
2013	02	02	03	40	39	52.7950	-132.2190	24.1	3.1	ML	PGC	3.1	4299
2013	02	03	10	34	42	52.7290	-132.2910	20.0	3.6	MW	NRC	3.6	4300
2013	02	04	09	26	34	55.4650	-134.8130	20.0	3.1	MW	NRC	3.1	4301
2013	02	04	16	23	48	55.5910	-135.1100	10.0	3.3	ML	PGC	3.3	4302
2013	02	05	23	18	42	55.3510	-135.5220	10.0	3.1	MW	NRC	3.1	4303
2013	02	06	20	50	42	55.5020	-134.9330	10.0	3.1	ML	AEI	3.1	4304
2013	02	06	21	54	58	52.4800	-132.4910	26.4	3.7	ML	PGC	3.7	4305
2013	02	07	00	23	34	52.8000	-132.3510	23.3	3.5	MW	NRC	3.5	4306
2013	02	07	08	57	45	55.4980	-135.3490	10.0	3.1	ML	AEI	3.1	4307
2013	02	07	11	16	32	55.9600	-135.2890	20.2	3.4	ML	AEI	3.4	4308
2013	02	07	18	15	35	50.5290	-130.3500	10.0	4.0	MW	NRC	4.0	4309
2013	02	08	03	16	0	52.1280	-132.4350	21.3	3.6	ML	PGC	3.6	4310

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID
2013	02	09	15	32	46	56.1230	-135.6360	1.0	3.5	ML	PGC	3.5	4311
2013	02	10	06	02	44	52.7570	-132.2550	22.5	3.1	ML	PGC	3.1	4312
2013	02	10	08	43	16	52.6750	-132.1460	20.3	3.3	ML	PGC	3.3	4313
2013	02	11	11	04	32	52.7950	-132.3220	24.9	3.5	ML	PGC	3.5	4314
2013	02	11	16	41	17	52.1760	-132.1060	31.8	3.8	ML	PGC	3.8	4315
2013	02	12	19	12	13	52.6650	-132.0850	19.4	2.9	ML	PGC	2.9	4316
2013	02	13	01	48	32	52.6570	-132.1110	20.6	3.6	ML	PGC	3.6	4317
2013	02	13	18	43	21	50.4830	-130.2690	10.0	3.5	MW	NRC	3.5	4318
2013	02	14	05	32	45	50.6970	-130.2980	10.0	3.1	MW	NRC	3.1	4319
2013	02	14	16	29	4	51.0610	-130.3690	10.0	3.1	MW	PGC	3.1	4320
2013	02	14	21	02	37	50.4730	-130.1680	10.0	3.5	MW	NRC	3.5	4321
2013	02	15	02	24	47	50.4730	-130.2950	10.0	3.6	MW	NRC	3.6	4322
2013	02	15	07	25	35	52.7570	-132.2240	22.4	3.2	ML	PGC	3.2	4323
2013	02	16	00	43	23	50.5110	-130.1900	10.0	2.9	MW	NRC	2.9	4324
2013	02	16	04	47	37	50.5470	-130.3210	10.0	3.3	MW	NRC	3.3	4325
2013	02	18	02	17	47	55.3100	-134.5870	10.0	3.1	ML	AEI	3.1	4326
2013	02	19	10	14	10	55.0480	-136.1060	10.0	3.4	MW	NRC	3.4	4327
2013	02	20	02	32	4	55.5490	-135.3940	20.0	3.0	ML	AEI	3.0	4328
2013	02	20	15	31	14	52.8200	-132.3500	8.5	3.0	ML	PGC	3.0	4329
2013	02	21	09	41	36	52.5640	-131.9930	18.6	3.1	ML	PGC	3.1	4330
2013	02	21	15	39	57	52.2050	-132.0560	33.7	2.9	ML	PGC	2.9	4331
2013	02	21	18	45	50	52.8040	-132.3310	22.7	3.2	MW	NRC	3.2	4332
2013	02	22	01	34	30	50.6990	-130.5090	10.0	3.5	MW	NRC	3.5	4333
2013	02	24	10	48	39	51.0450	-130.6200	10.0	3.5	MW	NRC	3.5	4334
2013	02	24	12	14	41	52.6600	-132.1520	24.0	3.4	ML	PGC	3.4	4335
2013	02	24	15	12	29	55.3800	-134.9750	1.0	3.8	ML	PGC	3.8	4336
2013	02	24	15	32	40	52.7360	-132.2680	23.8	3.9	ML	PGC	3.9	4337
2013	02	25	13	41	26	52.6880	-132.2500	22.4	4.9	MW	NRC	4.9	4338
2013	02	27	12	53	45	52.4800	-131.8990	12.1	3.2	ML	PGC	3.2	4339
2013	03	01	00	50	47	52.2580	-131.9180	15.0	3.0	ML	PGC	3.0	4340
2013	03	02	02	54	31	55.3120	-134.8950	20.0	3.3	MW	NRC	3.3	4341
2013	03	02	08	49	48	54.9700	-136.2220	20.0	3.3	MW	NRC	3.3	4342
2013	03	03	09	34	19	52.6820	-132.1750	20.7	3.2	ML	PGC	3.2	4343
2013	03	05	11	06	26	51.3610	-130.9770	10.0	3.2	MW	NRC	3.2	4344
2013	03	05	11	09	18	52.7570	-132.2680	19.2	3.1	ML	PGC	3.1	4345
2013	03	06	02	20	58	50.2990	-130.1070	10.0	3.2	MW	NRC	3.2	4346
2013	03	06	09	05	30	52.6200	-132.0690	11.9	3.2	ML	PGC	3.2	4347
2013	03	07	11	25	1	52.8780	-132.9860	18.1	3.5	ML	PGC	3.5	4348
2013	03	09	11	27	38	52.2410	-132.2900	24.9	3.2	ML	PGC	3.2	4349
2013	03	09	11	56	50	55.5000	-134.8450	20.0	3.1	ML	AEI	3.1	4350
2013	03	11	21	21	51	50.2440	-130.2490	10.0	3.2	MW	NRC	3.2	4351
2013	03	11	21	52	50	50.2100	-130.2070	10.0	3.0	MW	NRC	3.0	4352
2013	03	12	03	08	1	54.9700	-134.4300	20.0	4.2	MW	NRC	4.2	4353
2013	03	13	09	38	41	50.6910	-130.5490	10.0	3.3	MW	NRC	3.3	4354
2013	03	13	12	46	38	55.4420	-134.9610	14.8	3.5	ML	AEI	3.5	4355
2013	03	13	18	39	19	50.5290	-130.2000	10.0	3.1	MW	NRC	3.1	4356
2013	03	14	05	50	33	50.2870	-130.1830	10.0	3.1	MW	NRC	3.1	4357
2013	03	14	09	46	35	50.5350	-130.2950	10.0	3.3	MW	NRC	3.3	4358
2013	03	14	16	18	38	52.5780	-132.6550	26.7	3.8	ML	PGC	3.8	4359
2013	03	14	18	00	57	54.6460	-135.2210	10.0	2.9	ML	PGC	2.9	4360
2013	03	15	00	04	58	52.3080	-132.2850	21.5	4.5	MW	NRC	4.5	4361
2013	03	15	00	46	52	52.5630	-131.8650	10.0	4.3	MB	GS	4.3	4362
2013	03	15	00	55	40	52.2850	-132.0430	33.2	4.5	MW	NRC	4.5	4363
2013	03	15	01	04	9	52.2670	-132.2410	18.8	3.6	MW	NRC	3.6	4364
2013	03	15	02	27	57	52.3090	-132.2760	24.0	4.5	MW	NRC	4.5	4365
2013	03	15	23	05	17	52.2700	-132.1840	33.6	3.0	MW	NRC	3.0	4366

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID
2013	03	16	07	09	22	52.1640	-132.3820	22.0	3.1	ML	PGC	3.1	4367
2013	03	19	02	13	18	50.5570	-130.2480	10.0	3.0	MW	NRC	3.0	4368
2013	03	20	04	04	7	55.5490	-134.9690	20.0	3.1	ML	PGC	3.1	4369
2013	03	20	06	38	43	52.8570	-132.4660	20.4	3.0	ML	PGC	3.0	4370
2013	03	20	13	17	55	52.2400	-132.1400	30.1	3.6	MW	NRC	3.6	4371
2013	03	20	17	21	52	51.0420	-130.9260	10.0	4.3	MW	NRC	4.3	4372
2013	03	20	21	17	16	52.1910	-132.2750	23.4	3.3	MW	NRC	3.3	4373
2013	03	21	12	13	41	50.3950	-130.1860	10.0	3.2	MW	NRC	3.2	4374
2013	03	21	22	26	30	54.8990	-134.6200	20.0	2.9	ML	PGC	2.9	4375
2013	03	22	20	57	35	55.4900	-135.0590	24.9	3.0	ML	AEI	3.0	4376
2013	03	25	00	41	21	50.9250	-129.8840	10.0	4.0	MW	NRC	4.0	4377
2013	03	25	00	48	35	50.9720	-129.9050	10.0	2.9	MW	NRC	2.9	4378
2013	03	25	13	02	0	50.9550	-129.7530	10.0	3.1	MW	PGC	3.1	4379
2013	03	25	16	54	30	52.5350	-132.0070	10.7	3.7	MW	NRC	3.7	4380
2013	03	25	18	38	56	50.9000	-129.9980	10.0	3.0	MW	NRC	3.0	4381
2013	03	25	19	21	33	52.5690	-131.9470	11.8	3.4	ML	PGC	3.4	4382
2013	03	26	01	15	35	52.7500	-132.1790	22.5	3.3	MW	NRC	3.3	4383
2013	03	26	12	23	47	55.4790	-135.1770	1.0	3.4	MW	NRC	3.4	4384
2013	03	26	15	49	8	52.3550	-131.6660	24.2	3.7	ML	PGC	3.7	4385
2013	03	27	00	15	48	55.0880	-134.5050	20.0	3.3	ML	PGC	3.3	4386
2013	03	27	05	32	32	50.2240	-130.2290	10.0	3.5	MW	NRC	3.5	4387
2013	03	28	04	03	29	55.5320	-135.2520	1.0	3.7	ML	PGC	3.7	4388
2013	03	31	03	00	7	52.5330	-132.7370	25.4	3.3	MW	NRC	3.3	4389
2013	04	03	01	06	10	50.5860	-130.3520	10.0	2.9	MW	NRC	2.9	4390
2013	04	03	01	14	28	50.5830	-130.3890	10.0	3.4	MW	NRC	3.4	4391
2013	04	03	23	42	32	50.7180	-130.6180	10.0	3.0	MW	NRC	3.0	4392
2013	04	07	19	30	44	50.2020	-130.1530	10.0	2.9	MW	NRC	2.9	4393
2013	04	09	17	45	46	52.3910	-132.1010	32.0	3.1	ML	PGC	3.1	4394
2013	04	11	10	21	40	50.5430	-130.2320	10.0	2.9	MW	NRC	2.9	4395
2013	04	12	17	27	9	50.5500	-130.4150	10.0	3.6	MW	PGC	3.6	4396
2013	04	13	09	39	31	52.7500	-132.2220	22.2	4.3	MW	NRC	4.3	4397
2013	04	13	10	36	33	52.5190	-131.9120	3.3	2.9	ML	PGC	2.9	4398
2013	04	14	22	09	26	52.7300	-132.2660	21.3	3.7	ML	PGC	3.7	4399
2013	04	15	11	20	58	55.4290	-134.9170	10.0	3.2	ML	AEI	3.2	4400
2013	04	15	20	38	26	50.2000	-130.1910	10.0	3.2	MW	NRC	3.2	4401
2013	04	18	07	19	18	55.4680	-135.0120	5.0	3.0	ML	PGC	3.0	4402
2013	04	20	23	43	14	52.5260	-131.9020	13.4	3.4	ML	PGC	3.4	4403
2013	04	21	20	49	0	50.4100	-130.1850	10.0	2.9	MW	PGC	2.9	4404
2013	04	22	22	51	17	52.9760	-132.5470	25.3	3.1	MW	NRC	3.1	4405
2013	04	25	02	02	45	52.9700	-132.6030	20.0	3.8	MW	NRC	3.8	4406
2013	04	27	21	24	59	50.5000	-129.0810	10.0	3.3	MW	NRC	3.3	4407
2013	04	27	21	41	39	50.4830	-129.1230	10.0	3.4	MW	NRC	3.4	4408
2013	04	28	01	34	10	50.4660	-129.1910	10.0	2.9	MW	NRC	2.9	4409
2013	04	29	20	19	50	56.3240	-131.2320	5.0	4.3	MB	GS	4.3	4410
2013	05	01	18	48	54	50.5540	-130.2910	10.0	3.2	MW	NRC	3.2	4411
2013	05	02	12	51	22	50.4560	-130.3120	10.0	2.9	MW	NRC	2.9	4412
2013	05	02	13	08	14	50.5890	-130.3830	10.0	3.0	MW	NRC	3.0	4413
2013	05	02	20	34	9	50.5350	-130.1720	10.0	3.2	MW	PGC	3.2	4414
2013	05	04	16	15	35	51.0580	-130.6480	10.0	2.9	MW	NRC	2.9	4415
2013	05	05	04	46	28	50.3590	-130.0310	10.0	3.0	MW	NRC	3.0	4416
2013	05	06	10	34	6	50.6340	-130.3700	10.0	2.9	MW	PGC	2.9	4417
2013	05	07	15	34	55	52.3220	-132.0850	1.4	3.5	ML	PGC	3.5	4418
2013	05	07	15	36	37	52.3210	-132.0940	0.0	3.7	ML	PGC	3.7	4419
2013	05	09	13	31	52	52.8200	-132.2620	24.4	3.3	ML	PGC	3.3	4420
2013	05	09	13	56	57	54.6860	-135.1620	10.0	3.1	ML	PGC	3.1	4421
2013	05	10	06	30	24	52.1370	-131.8390	32.3	2.9	ML	PGC	2.9	4422

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID
2013	05	12	16	31	38	55.6200	-135.2740	20.0	3.0	ML	AEI	3.0	4423
2013	05	14	02	50	9	50.6120	-130.4190	10.0	3.0	MW	PGC	3.0	4424
2013	05	15	00	44	20	50.1550	-130.0640	10.0	3.1	MW	NRC	3.1	4425
2013	05	17	23	47	48	50.7390	-130.5420	10.0	3.2	MW	NRC	3.2	4426
2013	05	18	00	33	34	50.7160	-130.5850	10.0	3.3	MW	NRC	3.3	4427
2013	05	19	21	45	45	50.7320	-130.4700	10.0	3.3	MW	NRC	3.3	4428
2013	05	20	08	51	45	52.9670	-132.6290	22.4	3.4	ML	PGC	3.4	4429
2013	05	21	04	34	3	50.4560	-130.3280	10.0	2.9	MW	PGC	2.9	4430
2013	05	21	07	51	49	50.6150	-130.3420	10.0	3.2	MW	NRC	3.2	4431
2013	05	21	07	53	37	50.5660	-130.3920	10.0	3.2	MW	NRC	3.2	4432
2013	05	21	09	40	6	50.5670	-130.4730	10.0	3.0	MW	PGC	3.0	4433
2013	05	22	19	52	16	50.5380	-130.1350	10.0	2.9	MW	NRC	2.9	4434
2013	05	27	03	50	55	55.4780	-134.7440	10.0	4.9	MD	PGC	4.9	4435
2013	05	27	04	00	59	55.5710	-134.4860	5.0	3.2	ML	PGC	3.2	4436
2013	06	07	04	26	24	50.8020	-130.4680	10.0	2.9	MW	NRC	2.9	4437
2013	06	07	05	18	42	51.0580	-130.5970	10.0	3.1	MW	NRC	3.1	4438
2013	06	07	18	46	4	52.4920	-132.5560	23.8	2.9	ML	PGC	2.9	4439
2013	06	08	05	51	55	50.3040	-130.2590	10.0	3.2	MW	NRC	3.2	4440
2013	06	11	03	55	54	52.2750	-131.8160	20.4	2.9	MW	NRC	2.9	4441
2013	06	11	19	29	56	50.6180	-130.4330	10.0	2.9	MW	NRC	2.9	4442
2013	06	12	05	51	9	55.4120	-135.0180	5.0	3.2	ML	PGC	3.2	4443
2013	06	12	19	32	20	52.7980	-132.3440	24.2	3.4	ML	PGC	3.4	4444
2013	06	14	15	56	4	50.7580	-130.5180	10.0	4.1	MW	PGC	4.1	4445
2013	06	15	15	13	2	50.7230	-130.5230	10.0	3.0	MW	PGC	3.0	4446
2013	06	16	00	48	11	50.7420	-130.5180	10.0	3.0	MW	NRC	3.0	4447
2013	06	16	01	57	30	50.6990	-130.5610	10.0	3.3	MW	PGC	3.3	4448
2013	06	20	01	03	15	55.1180	-137.6180	10.0	3.5	ML	PGC	3.5	4449
2013	06	20	08	38	45	55.3470	-134.8730	5.0	3.0	ML	PGC	3.0	4450
2013	06	25	07	37	12	55.5510	-135.0930	10.0	3.0	MW	NRC	3.0	4451
2013	06	26	13	04	39	50.5230	-130.2100	10.0	2.9	MW	NRC	2.9	4452
2013	06	26	19	59	44	51.2560	-124.8100	1.0	2.9	ML	PGC	2.9	4453
2013	06	30	14	05	50	50.8090	-130.5860	10.0	2.9	MW	NRC	2.9	4454
2013	07	02	18	17	5	55.2550	-135.1670	1.0	3.1	ML	PGC	3.1	4455
2013	07	03	06	45	53	52.8230	-134.3460	10.0	2.9	ML	PGC	2.9	4456
2013	07	04	04	44	45	52.7300	-132.2380	22.2	2.9	MW	NRC	2.9	4457
2013	07	05	13	39	28	50.2240	-129.9330	10.0	2.9	MW	NRC	2.9	4458
2013	07	05	13	52	35	50.0880	-130.2700	10.0	3.3	MW	NRC	3.3	4459
2013	07	06	17	17	9	50.5020	-130.6570	10.0	3.5	MW	PGC	3.5	4460
2013	07	09	06	52	11	52.7660	-132.2860	23.1	3.1	ML	PGC	3.1	4461
2013	07	09	18	34	35	52.7690	-132.2640	22.7	3.2	ML	PGC	3.2	4462
2013	07	11	03	22	43	52.5120	-131.8670	21.8	3.1	ML	PGC	3.1	4463
2013	07	11	04	17	35	50.2710	-130.1880	10.0	2.9	MW	NRC	2.9	4464
2013	07	11	10	18	3	50.2540	-130.2490	10.0	3.0	MW	PGC	3.0	4465
2013	07	14	14	54	2	53.2120	-133.0300	23.5	3.1	MW	NRC	3.1	4466
2013	07	16	23	26	28	52.4740	-132.5100	24.8	3.8	ML	PGC	3.8	4467
2013	07	19	00	10	33	52.9890	-132.5860	22.9	3.4	ML	PGC	3.4	4468
2013	07	19	15	15	4	52.6670	-132.0620	16.5	3.1	ML	PGC	3.1	4469
2013	07	20	04	27	8	50.0220	-130.2630	10.0	3.0	MW	NRC	3.0	4470
2013	07	25	20	24	52	51.4840	-130.8980	20.0	3.7	ML	PGC	3.7	4471
2013	07	26	10	17	41	50.2580	-130.2070	10.0	3.1	MW	NRC	3.1	4472
2013	07	26	12	57	22	50.2420	-130.2240	10.0	5.2	MW	NRC	5.2	4473
2013	07	26	16	23	57	50.2790	-130.1820	10.0	3.4	MW	NRC	3.4	4474
2013	07	27	05	14	26	50.2100	-130.1860	10.0	3.0	MW	NRC	3.0	4475
2013	07	27	07	53	42	50.7110	-130.4690	10.0	3.1	MW	NRC	3.1	4476
2013	07	27	14	41	25	51.5550	-130.7470	20.0	3.3	ML	PGC	3.3	4477
2013	07	27	18	48	28	50.2520	-130.2110	10.0	3.9	MW	NRC	3.9	4478

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID
2013	07	27	19	10	58	50.2190	-130.2550	10.0	4.1	MW	NRC	4.1	4479
2013	07	28	02	52	57	50.1980	-130.2470	10.0	3.1	MW	NRC	3.1	4480
2013	07	28	16	54	43	50.7510	-130.5770	10.0	3.1	MW	NRC	3.1	4481
2013	07	29	04	15	10	50.6820	-130.4600	10.0	3.0	MW	NRC	3.0	4482
2013	07	29	08	32	14	50.1190	-130.0910	10.0	3.0	MW	NRC	3.0	4483
2013	08	03	12	26	26	52.7470	-132.3520	25.4	3.1	ML	PGC	3.1	4484
2013	08	03	19	38	10	50.0770	-130.2960	10.0	3.0	MW	NRC	3.0	4485
2013	08	04	15	57	40	50.5330	-130.4410	10.0	4.1	MW	NRC	4.1	4486
2013	08	07	01	32	46	50.4680	-130.3690	10.0	4.0	MW	NRC	4.0	4487
2013	08	13	16	15	35	52.1100	-131.8220	29.8	3.0	ML	PGC	3.0	4488
2013	08	14	13	18	35	52.6640	-132.7320	33.6	3.0	ML	PGC	3.0	4489
2013	08	15	10	15	55	50.1270	-130.1770	10.0	3.0	MW	NRC	3.0	4490
2013	08	15	17	23	6	50.1700	-129.7730	10.0	3.3	MW	PGC	3.3	4491
2013	08	17	02	19	15	52.5880	-132.0010	14.0	3.4	ML	PGC	3.4	4492
2013	08	20	13	11	30	50.5740	-130.3640	10.0	3.0	MW	NRC	3.0	4493
2013	08	22	14	09	41	51.3020	-130.6790	10.0	3.1	MW	NRC	3.1	4494
2013	08	23	15	37	36	55.4100	-135.2010	1.0	2.9	ML	PGC	2.9	4495
2013	08	26	01	08	30	52.2890	-132.1550	32.0	2.9	ML	PGC	2.9	4496
2013	08	26	01	18	31	52.2740	-132.1870	28.4	3.4	ML	PGC	3.4	4497
2013	08	26	04	29	28	52.2960	-132.1590	31.0	2.9	ML	PGC	2.9	4498
2013	08	26	12	15	51	52.0180	-131.4030	9.8	2.9	ML	PGC	2.9	4499
2013	08	26	16	51	0	50.5350	-130.2170	10.0	3.2	MW	PGC	3.2	4500
2013	08	27	08	21	32	50.4140	-130.0650	10.0	3.1	MW	NRC	3.1	4501

APPENDIX G1.2
SEISMICITY CATALOG (DECLUSTERED)

APPENDIX G1.2

NOTE: EVENTS WITHOUT ZONE ID ARE OUTSIDE OF MODELED SEISMIC SOURCES

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID	Zone ID
1880	10	26	22	20	0	57.000	-136.000	0.0	6.3	MI	DNG	6.3	1	
1910	11	6	20	29	0	53.000	-135.000	0.0	6.8	MS	ABE	6.7	2	
1912	3	11	10	17	30	51.000	-131.000	0.0	6.5	ML	PAS	6.5	3	G
1920	3	29	5	7	53	51.000	-129.000	0.0	6.4	ML	PAS	6.4	4	D
1921	4	10	13	40	16	54.000	-134.000	25.0	6.5	ML	PAS	6.5	5	E
1924	3	30	0	8	56	50.000	-130.200	0.0	6.0	ML	PAS	6.0	6	G
1927	10	24	15	59	55	57.500	-137.000	25.0	7.1	ML	PAS	7.1	7	
1929	3	1	7	31	13	51.500	-130.700	0.0	6.1	ML	PAS	6.1	8	G
1929	5	26	22	39	54	51.000	-131.000	0.0	7.0	ML	PAS	7.0	9	G
1930	7	1	1	9	15	52.500	-132.500	0.0	5.7	ML	PAS	5.7	11	F
1938	3	22	15	22	14	52.200	-132.000	0.0	6.3	ML	PAS	6.3	13	F
1942	1	31	6	49	7	51.000	-124.000	0.0	5.5	ML	PAS	5.5	15	
1942	3	19	11	59	19	50.500	-131.000	0.0	6.0	ML	PAS	6.0	16	
1944	8	10	1	52	50	51.200	-131.000	0.0	6.2	ML	PAS	6.2	17	G
1945	8	2	20	44	45	54.000	-133.000	0.0	6.2	ML	PAS	6.2	18	C
1945	11	16	18	2	22	58.000	-136.500	0.0	5.6	ML	PAS	5.6	19	
1949	8	22	0	0	0	53.764	-133.411	0.0	8.1	ML	SIG	8.1	20	E
1949	10	31	1	39	29	56.050	-135.690	0.0	6.2	ML	PAS	6.2	23	E
1956	2	19	2	18	0	52.000	-131.500	0.0	6.7	ML	PAS	6.7	24	F
1956	11	17	20	27	15	54.500	-134.000	0.0	6.5	ML	PAS	6.5	25	E
1957	3	24	8	22	22	50.800	-130.300	0.0	6.8	ML	PAS	6.8	28	G
1957	6	23	3	27	3	57.900	-137.700	16.0	6.0	ML	ROT	6.0	29	
1958	7	10	6	15	47	56.000	-136.000	0.0	7.7	ML	MOS	7.7	30	E
1960	7	4	13	10	5	51.800	-131.100	33.0	6.0	ML	ROT	6.0	34	F
1960	7	4	4	28	30	50.500	-131.000	0.0	6.7	ML	MOS	6.7	33	
1963	3	21	18	19	19	50.800	-129.200	6.0	4.0	MB	PDE	4.0	37	D
1963	3	30	0	34	36	51.000	-129.800	19.0	4.2	MB	PDE	4.2	39	H
1963	6	16	9	19	49	50.760	-129.630	0.0	5.1	MB	DNG	5.1	42	H
1963	6	23	13	11	28	51.900	-131.500	33.0	4.5	MB	PDE	4.5	43	F
1963	6	24	10	17	2	52.860	-131.890	0.0	4.0	MB	DNG	4.0	44	D
1963	7	8	2	15	5	57.000	-134.500	28.0	3.7	MB	PDE	3.7	45	B
1963	7	12	14	3	37	50.250	-129.860	0.0	4.8	MB	DNG	4.8	49	G
1963	9	3	19	31	16	50.800	-133.500	33.0	3.9	MB	PDE	3.9	53	
1963	10	5	18	40	46	50.900	-131.100	0.0	3.9	MB	DNG	3.9	57	G
1963	11	20	1	13	49	53.400	-130.600	39.0	4.0	MB	PDE	4.0	58	C
1963	12	2	6	52	19	54.100	-134.200	33.0	3.9	MB	PDE	3.9	59	E
1963	12	15	15	44	18	50.760	-129.390	0.0	4.0	MB	DNG	4.0	61	H
1964	1	31	17	7	43	51.300	-124.700	14.0	4.2	MB	PDE	4.2	62	
1964	3	31	9	1	30	50.800	-130.200	15.0	6.1	ML	ROT	6.1	64	G
1964	5	10	13	44	2	51.400	-129.200	33.0	4.1	MB	USC	4.1	65	D
1964	8	3	18	54	54	53.800	-132.100	33.0	4.2	MB	PDE	4.2	66	C
1964	8	28	22	57	58	51.500	-130.200	33.0	4.2	MB	PDE	4.2	67	H
1964	9	3	5	31	15	50.500	-129.500	29.0	5.0	MB	PDE	5.0	68	H
1964	11	1	4	55	47	51.800	-130.800	33.0	4.9	MB	PDE	4.9	69	F
1965	2	26	15	43	19	50.200	-130.000	33.0	4.5	MB	PDE	4.5	70	G
1965	8	31	1	9	15	50.500	-129.000	0.0	3.9	MB	DNG	3.9	74	H
1965	9	11	7	13	19	50.300	-129.500	0.0	5.0	MB	DNG	5.0	75	G
1966	1	20	19	51	14	51.300	-131.200	0.0	4.3	MB	DNG	4.3	78	G
1966	2	7	14	3	3	51.500	-129.400	33.0	3.9	MB	ISC	3.9	80	D
1966	2	7	8	48	35	51.200	-130.000	34.0	4.9	MB	PDE	4.9	79	H
1966	2	8	7	58	28	51.200	-129.200	33.0	4.9	MB	PDE	4.9	81	D
1966	3	25	21	59	26	56.600	-135.400	21.0	4.7	MB	PDE	4.7	82	
1966	4	16	22	49	38	56.700	-136.200	5.0	4.1	MB	PDE	4.1	83	

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID	Zone ID
1966	4	17	16	46	53	54.230	-133.200	33.0	4.9	ML	ISC	4.9	84	C
1966	5	20	23	58	51	50.200	-129.700	37.0	5.0	MB	PDE	5.0	86	G
1966	5	20	19	57	45	50.500	-129.600	40.0	3.7	ML	ISC	3.7	85	H
1966	7	23	19	34	57	54.500	-134.800	33.0	3.8	MB	PDE	3.8	88	E
1966	9	1	14	11	25	50.680	-129.400	37.0	4.4	MB	ISC	4.4	89	H
1966	10	10	21	17	34	57.400	-136.100	33.0	4.8	MB	PDE	4.8	90	
1967	2	16	2	58	43	51.300	-129.100	79.0	3.8	MB	ISC	3.8	92	D
1967	3	5	11	11	4	51.300	-130.100	62.0	4.0	MB	ISC	4.0	93	H
1967	4	12	0	54	40	56.121	-136.122	15.0	4.6	MB	PDE	4.6	94	
1967	4	19	18	12	26	52.710	-131.600	60.0	4.7	MB	ISC	4.7	95	D
1967	4	24	10	5	10	50.542	-129.234	33.0	3.7	MB	PDE	3.7	96	H
1967	4	29	0	4	45	51.135	-130.409	33.0	5.3	MB	PDE	5.3	97	G
1967	4	30	2	44	27	50.690	-129.600	16.0	4.0	ML	ISC	4.0	98	H
1967	8	28	12	43	54	50.390	-129.100	5.0	4.0	ML	ISC	4.0	108	H
1967	11	3	15	58	11	51.200	-128.000	50.0	3.9	MB	ISC	3.9	116	D
1968	1	15	12	24	29	52.180	-130.500	47.0	3.9	MB	ISC	3.9	119	D
1968	2	1	7	58	3	50.000	-129.800	14.0	5.4	MB	PDE	5.4	120	G
1968	2	15	18	27	30	51.600	-130.300	33.0	4.2	MB	PDE	4.2	121	D
1968	4	25	9	58	28	50.910	-129.670	16.0	4.5	MB	ISC	4.5	123	H
1968	6	13	8	51	29	51.490	-129.835	33.0	4.1	MB	PDE	4.1	124	D
1968	7	16	1	47	23	50.690	-129.300	28.0	4.1	MB	ISC	4.1	126	H
1968	8	4	6	11	57	52.500	-131.550	18.0	3.7	MB	DNG	3.7	128	F
1968	9	22	3	51	55	51.520	-130.730	33.0	4.6	MB	ISC	4.6	129	G
1968	11	1	10	24	36	51.020	-124.480	18.0	4.5	MB	EDS	4.5	130	
1968	11	20	8	24	49	50.720	-129.330	23.0	4.3	MB	ISC	4.3	131	H
1969	3	18	20	31	27	50.170	-129.880	33.0	5.1	MB	ISC	5.1	134	G
1969	3	19	2	48	54	50.570	-129.100	92.0	3.9	MB	DNG	3.9	136	H
1969	11	3	14	58	33	50.770	-129.520	40.0	4.6	MB	ISC	4.6	140	H
1969	12	11	9	54	49	51.800	-133.300	33.0	3.7	MB	ISC	3.7	141	
1970	2	1	23	2	31	50.400	-129.300	33.0	4.0	MB	USC	4.0	142	H
1970	2	18	9	23	2	52.400	-131.500	4.0	4.8	MB	USC	4.8	144	F
1970	2	18	2	7	40	50.200	-129.800	28.0	4.7	MB	USC	4.7	143	G
1970	2	19	8	9	17	53.265	-132.337	33.0	4.0	MB	PDE	4.0	145	C
1970	6	24	13	9	0	51.800	-131.000	12.0	7.5	ML	SIG	7.5	147	F
1970	7	25	15	19	50	57.200	-137.700	33.0	3.2	MB	DNG	3.3	152	
1970	9	8	13	4	1	50.600	-129.300	33.0	3.7	MB	USC	3.7	153	H
1970	9	16	2	25	44	50.900	-129.500	33.0	3.4	MB	ISC	3.5	154	D
1970	11	10	2	10	47	50.580	-129.200	49.0	4.5	MB	ISC	4.5	155	H
1970	12	31	1	27	7	50.200	-129.500	33.0	4.3	MB	USC	4.3	156	G
1971	2	11	6	24	42	54.394	-135.721	33.0	4.6	MB	ISC	4.6	158	
1971	3	13	23	51	35	50.603	-129.947	33.0	6.1	MS	PDE	6.0	159	G
1971	3	15	5	18	54	50.100	-129.600	35.0	4.8	MB	USN	4.8	162	G
1971	5	28	12	11	2	52.818	-132.887	33.0	4.7	MB	PDE	4.7	163	F
1971	6	29	6	28	25	51.255	-129.954	33.0	4.4	MB	ISC	4.4	164	H
1971	7	15	0	24	2	54.215	-133.734	33.0	5.2	MB	PDE	5.2	165	E
1971	12	9	0	23	0	57.000	-136.000	0.0	3.6	MI	DNG	3.6	168	
1972	7	23	19	13	9	50.149	-129.273	33.0	6.4	MS	PDE	6.3	175	H
1972	7	30	21	45	14	56.800	-135.700	25.0	7.9	ML	BDA	7.9	178	
1972	8	7	8	31	45	55.990	-136.380	26.0	3.0	MI	DNG	3.0	181	
1973	6	3	7	23	30	50.743	-129.940	28.0	4.5	MB	ISC	4.5	188	G
1973	7	1	13	33	34	57.840	-137.330	33.0	6.7	MS	PDE	6.6	189	
1973	9	6	17	15	47	51.199	-129.626	0.0	4.6	MB	ISC	4.6	201	D
1974	1	2	18	43	20	55.900	-135.770	0.0	3.4	ML	OTT	3.4	203	E
1974	1	25	19	5	4	50.850	-130.700	10.0	3.7	ML	OTT	3.7	204	G
1974	2	12	3	4	53	50.210	-127.610	0.0	3.4	ML	OTT	3.4	205	
1974	3	7	7	50	29	50.761	-129.765	33.0	4.2	MB	PDE	4.2	206	H

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID	Zone ID
1974	3	24	7	20	0	51.730	-130.980	10.0	2.9	ML	OTT	2.9	207	F
1974	3	27	11	44	32	50.150	-130.140	0.0	2.9	ML	OTT	2.9	208	G
1974	4	3	22	46	31	54.139	-132.870	0.0	4.5	ML	OTT	4.5	209	C
1974	4	8	23	24	40	54.053	-134.029	33.0	4.5	ML	OTT	4.5	210	E
1974	5	24	13	52	8	50.710	-130.380	10.0	3.6	ML	OTT	3.6	211	G
1974	5	25	14	0	47	51.530	-129.460	0.0	3.1	ML	OTT	3.1	212	D
1974	6	19	11	17	55	53.860	-132.150	0.0	3.3	ML	OTT	3.3	213	C
1974	7	13	16	39	37	50.350	-130.490	0.0	3.3	ML	OTT	3.3	214	G
1974	7	20	3	24	24	50.810	-130.710	0.0	3.2	ML	OTT	3.2	215	G
1974	8	1	22	10	47	50.662	-129.666	33.0	4.1	MB	PDE	4.1	217	H
1974	8	2	2	20	18	50.180	-130.360	0.0	3.0	ML	OTT	3.0	218	G
1974	8	15	18	4	37	50.710	-130.680	0.0	3.1	ML	OTT	3.1	219	G
1974	8	20	4	25	4	51.060	-130.700	10.0	4.3	ML	OTT	4.3	220	G
1974	9	20	11	33	49	50.110	-127.770	0.0	3.5	ML	OTT	3.5	221	
1974	11	23	23	52	34	50.625	-130.189	0.0	3.4	ML	OTT	3.4	222	G
1974	11	26	14	29	43	50.671	-129.641	33.0	4.5	MB	PDE	4.5	223	H
1974	12	11	12	28	7	52.190	-131.830	10.0	3.2	ML	OTT	3.2	225	F
1975	1	29	16	16	58	50.077	-129.346	33.0	4.5	MB	PDE	4.5	226	G
1975	2	14	12	15	6	52.670	-132.060	10.0	3.8	ML	OTT	3.8	230	F
1975	2	18	20	21	13	50.722	-129.934	33.0	4.2	MB	PDE	4.2	231	G
1975	2	21	16	43	26	51.021	-130.201	0.0	3.8	ML	OTT	3.8	233	G
1975	3	20	20	36	56	50.715	-129.242	10.0	4.3	MB	PDE	4.3	235	H
1975	4	7	1	47	45	51.620	-130.920	10.0	4.7	ML	OTT	4.7	236	F
1975	4	30	20	9	46	56.989	-136.897	0.0	3.8	ML	OTT	3.8	238	
1975	5	7	2	0	52	50.790	-130.750	0.0	3.3	ML	OTT	3.3	239	G
1975	5	23	15	12	30	51.220	-131.230	18.0	5.6	MS	DNG	5.5	244	G
1975	6	22	19	22	56	50.260	-130.300	10.0	3.4	ML	OTT	3.4	247	G
1975	7	14	18	19	25	51.460	-131.850	10.0	3.8	ML	OTT	3.8	248	
1975	7	22	17	37	31	50.340	-130.550	0.0	3.0	ML	OTT	3.0	251	G
1975	8	8	20	38	40	50.700	-130.870	10.0	3.6	ML	OTT	3.6	252	G
1975	8	31	7	37	30	53.920	-133.290	0.0	3.5	ML	OTT	3.5	254	E
1975	9	8	8	37	8	50.350	-130.050	10.0	2.9	ML	OTT	2.9	255	G
1975	9	28	0	33	59	53.650	-132.170	0.0	3.5	ML	OTT	3.5	256	C
1975	10	6	4	47	1	50.700	-130.070	10.0	3.4	ML	OTT	3.4	257	G
1975	11	22	14	27	32	50.630	-130.800	0.0	3.5	ML	OTT	3.5	260	G
1976	1	2	3	36	20	50.388	-129.827	23.0	5.1	MB	PDE	5.1	277	G
1976	2	23	15	14	16	51.420	-130.560	10.0	6.1	ML	OTT	6.1	283	G
1976	3	23	13	19	5	54.140	-133.360	10.0	3.6	ML	OTT	3.6	296	E
1976	4	7	1	53	34	57.640	-125.270	0.0	3.5	ML	OTT	3.5	298	
1976	5	1	10	53	23	55.740	-135.300	0.0	3.0	ML	OTT	3.0	299	E
1976	5	13	7	11	44	52.860	-132.240	10.0	4.8	ML	OTT	4.8	300	F
1976	6	18	9	19	24	53.920	-133.060	0.0	4.3	ML	OTT	4.3	302	E
1976	8	17	3	44	19	50.476	-130.981	0.0	3.2	ML	OTT	3.2	304	
1976	8	26	6	43	15	50.626	-129.434	33.0	4.4	MB	PDE	4.4	305	H
1976	9	3	10	1	29	50.350	-130.440	0.0	2.9	ML	OTT	2.9	306	G
1976	9	24	13	21	55	50.604	-130.404	0.0	3.1	ML	OTT	3.1	307	G
1976	10	15	20	29	31	54.655	-133.505	0.0	3.8	ML	OTT	3.8	308	B
1976	11	7	14	48	30	56.440	-137.977	10.0	3.2	DR	SCA	3.2	309	
1976	11	9	20	17	15	50.769	-129.670	0.0	4.9	MB	ISC	4.9	310	H
1976	12	31	18	5	26	50.257	-130.353	0.0	3.1	ML	OTT	3.1	313	G
1977	2	7	2	16	35	50.910	-130.740	10.0	3.4	ML	OTT	3.4	315	G
1977	2	13	4	28	40	54.370	-133.750	0.0	3.3	ML	OTT	3.3	316	E
1977	2	25	0	32	28	50.552	-128.947	0.0	3.1	ML	OTT	3.1	317	H
1977	3	14	16	9	34	53.266	-131.110	0.0	3.7	ML	OTT	3.7	319	C
1977	3	15	6	15	6	50.524	-130.350	0.0	3.4	ML	OTT	3.4	320	G
1977	4	3	18	45	45	50.669	-129.859	4.0	4.7	MB	PDE	4.7	322	G

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID	Zone ID
1977	4	25	15	49	25	50.441	-130.491	0.0	3.3	ML	OTT	3.3	323	G
1977	5	20	15	5	42	50.153	-130.092	0.0	3.0	ML	OTT	3.0	324	G
1977	5	26	6	49	47	51.169	-124.173	0.0	3.5	ML	OTT	3.5	325	
1977	7	9	8	4	18	50.860	-130.720	10.0	4.2	ML	OTT	4.2	326	G
1977	7	19	17	22	3	54.088	-133.761	0.0	4.6	ML	OTT	4.6	327	E
1977	7	25	11	7	57	56.540	-125.040	0.0	3.1	ML	OTT	3.1	328	A
1977	8	8	14	23	58	55.560	-135.260	0.0	4.6	ML	OTT	4.6	329	E
1977	9	17	19	5	50	53.330	-132.620	0.0	3.7	ML	OTT	3.7	330	F
1977	9	29	22	19	23	54.830	-126.970	0.0	3.3	ML	OTT	3.3	331	A
1977	12	25	7	20	59	50.616	-129.644	10.0	4.4	MB	PDE	4.4	332	H
1978	1	28	19	38	2	51.840	-131.320	10.0	3.2	ML	OTT	3.2	336	F
1978	2	26	10	33	35	50.890	-130.580	10.0	3.3	ML	OTT	3.3	337	G
1978	3	26	19	39	37	50.500	-129.793	10.0	3.9	MB	PDE	3.9	338	G
1978	3	29	9	58	45	50.017	-127.697	0.0	3.1	ML	OTT	3.1	339	
1978	5	7	13	57	11	50.895	-129.732	0.0	3.5	ML	OTT	3.5	340	H
1978	5	25	21	53	36	50.089	-128.305	0.0	3.3	ML	OTT	3.3	341	H
1978	5	26	20	1	57	51.166	-130.430	17.0	4.9	MB	PDE	4.9	345	G
1978	6	2	20	41	45	50.130	-127.640	10.0	5.7	ML	OTT	5.7	346	
1978	7	11	2	55	1	52.765	-132.104	10.0	5.4	MB	PDE	5.4	351	F
1978	7	12	18	53	35	56.695	-137.504	38.0	4.1	MB	PDE	4.1	353	
1978	7	19	10	13	40	50.574	-128.686	0.0	4.0	ML	OTT	4.0	354	D
1978	7	27	0	21	51	56.436	-133.456	18.0	3.3	DR	SCA	3.3	356	B
1978	8	18	9	44	59	56.360	-135.190	0.0	4.2	ML	OTT	4.2	357	
1978	10	7	4	55	15	50.496	-129.879	10.0	3.9	MB	PDE	3.9	358	G
1978	11	11	17	44	32	50.774	-129.767	0.0	4.1	MB	ISC	4.1	360	H
1979	1	15	19	48	22	57.830	-137.020	18.0	3.6	ML	OTT	3.6	361	
1979	1	16	17	29	29	57.490	-136.490	18.0	3.3	ML	OTT	3.3	362	
1979	1	20	12	57	51	51.530	-130.590	18.0	3.1	ML	OTT	3.1	363	F
1979	1	21	5	2	45	51.300	-131.060	18.0	3.2	ML	OTT	3.2	364	G
1979	2	27	12	3	54	52.620	-126.890	18.0	3.2	ML	OTT	3.2	366	A
1979	3	13	9	51	32	50.028	-129.713	10.0	5.3	MS	PDE	5.2	368	G
1979	4	8	9	42	38	50.684	-129.967	10.0	3.6	MB	PDE	3.6	398	G
1979	5	21	23	27	58	51.345	-132.510	18.0	3.8	MB	ISC	3.8	399	
1979	6	15	11	34	44	50.822	-125.637	10.0	3.9	ML	OTT	3.9	400	
1979	6	16	22	55	6	50.650	-130.050	18.0	3.4	ML	OTT	3.4	401	G
1979	6	17	4	9	0	51.220	-131.290	18.0	3.0	ML	OTT	3.0	402	G
1979	6	17	4	32	39	50.079	-133.048	18.0	3.3	ML	OTT	3.3	403	
1979	6	21	17	3	16	50.990	-131.039	18.0	5.3	MS	DNG	5.2	405	G
1979	6	23	18	39	22	57.987	-133.274	0.0	3.1	DR	SCA	3.1	406	
1979	7	11	12	28	4	55.410	-135.040	0.0	5.1	MS	OTT	5.0	407	E
1979	10	10	23	36	45	56.148	-135.745	33.0	4.4	MB	PDE	4.4	408	
1979	10	24	12	42	20	57.800	-137.140	18.0	3.3	ML	OTT	3.3	409	
1979	11	5	16	31	18	57.541	-137.357	18.0	3.8	ML	OTT	3.8	411	
1979	11	8	10	59	32	50.550	-130.090	18.0	4.3	MS	DNG	4.3	412	G
1979	12	12	1	48	19	50.753	-129.606	18.0	3.6	ML	OTT	3.6	413	H
1980	1	1	16	43	31	51.154	-129.871	10.0	4.4	MB	PDE	4.4	414	H
1980	1	8	23	44	46	50.505	-128.226	18.0	3.0	ML	OTT	3.0	415	D
1980	4	6	22	29	9	50.570	-130.190	18.0	3.4	ML	OTT	3.4	419	G
1980	4	6	16	21	6	50.870	-130.310	18.0	3.5	ML	OTT	3.5	418	G
1980	5	24	4	49	17	51.127	-124.399	18.0	3.4	ML	OTT	3.4	420	
1980	6	19	14	1	54	50.908	-130.514	18.0	3.7	ML	OTT	3.7	421	G
1980	7	12	3	44	25	51.151	-130.001	10.0	4.4	MB	PDE	4.4	422	H
1980	8	25	18	10	37	56.670	-136.399	25.0	3.7	ML	OTT	3.7	423	
1980	10	2	3	42	48	50.313	-130.043	10.0	5.3	MB	PDE	5.3	424	G
1980	10	17	10	29	0	57.161	-131.537	18.0	3.3	ML	OTT	3.3	425	A
1980	10	20	20	12	4	51.660	-130.380	18.0	3.0	ML	OTT	3.0	427	D

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID	Zone ID
1980	10	20	17	57	37	51.580	-131.030	18.0	3.8	ML	OTT	3.8	426	G
1980	11	6	7	54	4	50.927	-130.135	18.0	4.5	MB	ISC	4.5	428	G
1980	11	9	14	35	56	54.390	-133.590	18.0	3.6	ML	OTT	3.6	430	E
1980	11	9	4	55	15	50.590	-130.650	18.0	3.4	ML	OTT	3.4	429	G
1981	1	20	15	36	53	55.100	-134.570	18.0	4.5	MS	OTT	4.5	436	E
1981	4	8	17	46	44	51.000	-130.450	18.0	3.7	ML	OTT	3.7	439	G
1981	5	3	15	28	29	51.600	-130.870	18.0	4.2	MS	OTT	4.2	440	G
1981	5	13	19	18	41	51.000	-130.970	18.0	3.1	MS	OTT	3.1	442	G
1981	7	4	16	21	4	51.100	-130.500	18.0	3.1	MS	OTT	3.1	443	G
1981	7	5	21	9	51	51.600	-131.590	18.0	3.0	MS	OTT	3.1	444	G
1981	7	24	2	47	17	51.000	-124.590	18.0	3.0	MS	OTT	3.1	445	
1981	7	27	1	10	15	52.800	-132.350	18.0	3.3	MS	OTT	3.3	446	F
1981	7	30	6	59	45	51.500	-130.890	18.0	3.1	MS	OTT	3.1	447	G
1981	9	5	7	37	31	51.200	-130.790	10.0	3.0	MS	OTT	3.1	448	G
1981	9	8	19	43	31	54.200	-133.750	10.0	3.7	MS	OTT	3.7	449	E
1981	9	11	21	5	45	50.600	-130.480	10.0	3.0	MS	OTT	3.1	450	G
1981	9	13	4	14	43	51.000	-130.530	10.0	3.1	MS	OTT	3.1	451	G
1981	9	28	16	55	41	51.200	-130.970	10.0	3.4	MS	OTT	3.4	452	G
1981	10	17	13	43	1	55.536	-135.771	10.0	3.1	DR	SCA	3.1	453	
1981	10	29	17	51	16	50.500	-130.660	10.0	3.6	MS	OTT	3.6	454	G
1981	11	20	2	18	49	50.500	-129.900	10.0	3.2	MS	OTT	3.2	455	G
1981	11	30	5	23	39	54.000	-133.950	10.0	3.0	MS	OTT	3.1	456	E
1981	12	1	17	47	46	53.900	-133.460	18.0	3.7	MS	OTT	3.7	457	E
1981	12	15	3	37	59	51.000	-130.390	18.0	3.6	MS	OTT	3.6	458	G
1981	12	17	15	26	29	52.600	-132.100	18.0	3.8	MS	OTT	3.8	459	F
1981	12	24	13	46	19	50.600	-128.890	33.0	4.1	MB	DNG	4.1	460	D
1981	12	25	10	20	52	57.200	-136.250	18.0	4.1	MS	OTT	4.1	461	
1982	1	11	12	44	7	50.400	-130.310	10.0	3.2	ML	OTT	3.2	463	G
1982	1	11	20	18	40	50.300	-131.250	10.0	3.5	ML	OTT	3.5	464	
1982	1	23	12	39	48	53.800	-130.800	18.0	3.8	ML	OTT	3.8	466	C
1982	1	30	1	9	27	51.800	-131.580	18.0	3.7	ML	OTT	3.7	467	F
1982	2	2	6	22	20	50.600	-131.220	18.0	3.2	ML	OTT	3.2	468	
1982	2	13	7	45	46	50.721	-129.624	10.0	4.6	MB	ISC	4.6	470	H
1982	2	15	13	52	58	53.700	-133.250	18.0	3.0	ML	OTT	3.0	471	F
1982	2	27	22	46	38	50.600	-130.150	18.0	3.0	ML	OTT	3.0	472	G
1982	3	15	5	43	2	50.900	-130.890	10.0	3.1	ML	OTT	3.1	473	G
1982	3	27	14	5	32	57.916	-126.018	18.0	3.2	ML	OTT	3.2	474	
1982	3	30	8	53	53	54.700	-134.200	18.0	3.0	ML	OTT	3.0	475	E
1982	4	12	0	6	48	50.165	-130.778	10.0	3.3	ML	OTT	3.3	476	
1982	4	14	13	21	47	50.507	-130.042	10.0	3.7	MB	PDE	3.7	477	G
1982	5	14	10	0	54	54.400	-134.100	18.0	4.2	ML	OTT	4.2	478	E
1982	5	15	11	49	13	50.202	-130.579	10.0	3.0	ML	OTT	3.0	479	
1982	5	15	19	3	43	50.586	-131.776	10.0	3.1	ML	OTT	3.1	482	
1982	5	15	18	48	50	50.400	-129.960	10.0	5.8	MS	DNG	5.7	481	G
1982	5	28	11	26	10	53.900	-132.190	18.0	4.2	ML	OTT	4.2	491	C
1982	6	3	22	40	51	50.668	-131.241	10.0	3.8	ML	OTT	3.8	493	
1982	6	6	0	52	13	50.974	-130.395	10.0	4.9	MB	PDE	4.9	495	G
1982	6	13	14	24	25	56.700	-135.900	18.0	4.2	ML	OTT	4.2	501	
1982	6	14	7	9	46	52.000	-131.940	18.0	3.1	ML	OTT	3.1	502	F
1982	6	14	18	51	2	50.200	-127.700	18.0	3.0	ML	OTT	3.0	503	
1982	6	16	11	31	4	51.600	-131.580	18.0	3.0	ML	OTT	3.0	504	G
1982	7	9	1	38	15	51.781	-131.292	18.0	3.4	ML	OTT	3.4	505	F
1982	10	26	18	29	47	52.829	-132.540	18.0	3.3	ML	OTT	3.3	522	F
1982	11	16	21	17	44	51.464	-131.022	18.0	3.4	ML	OTT	3.4	524	G
1982	11	17	1	52	20	51.300	-131.400	18.0	3.5	ML	OTT	3.5	525	G
1982	11	25	19	19	4	57.200	-136.260	18.0	3.0	ML	OTT	3.0	526	

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID	Zone ID
1983	1	15	17	36	38	51.400	-130.950	10.0	4.4	ML	OTT	4.4	529	G
1983	2	6	23	58	11	50.700	-131.250	10.0	3.7	ML	OTT	3.7	530	
1983	2	10	6	20	47	50.667	-130.581	10.0	3.1	ML	OTT	3.1	531	G
1983	4	6	9	22	15	54.000	-133.820	18.0	5.3	ML	OTT	5.3	540	E
1983	4	22	16	28	31	52.700	-132.080	18.0	3.2	ML	OTT	3.2	543	F
1983	4	22	16	42	56	52.559	-132.394	18.0	3.6	ML	OTT	3.6	544	F
1983	5	7	9	1	47	56.718	-136.615	33.0	4.0	MB	PDE	4.0	545	
1983	5	14	9	44	10	50.295	-127.746	27.0	3.0	ML	OTT	3.0	546	D
1983	5	31	7	50	40	57.974	-134.270	18.0	3.4	ML	OTT	3.4	548	
1983	6	2	17	18	40	51.523	-131.722	18.0	3.5	ML	OTT	3.5	549	G
1983	6	21	14	31	33	52.657	-131.399	0.0	3.2	ML	OTT	3.2	550	D
1983	7	6	6	19	8	53.800	-132.000	18.0	4.0	ML	OTT	4.0	551	C
1983	7	13	20	45	50	50.755	-130.635	10.0	3.3	ML	OTT	3.3	552	G
1983	8	24	17	37	24	55.200	-134.840	18.0	3.0	ML	OTT	3.0	557	E
1983	8	27	19	53	35	57.838	-134.851	18.0	3.5	ML	OTT	3.5	558	
1983	8	28	16	37	58	50.500	-130.100	10.0	3.0	ML	OTT	3.0	560	G
1983	8	29	8	37	16	57.973	-134.341	18.0	3.3	ML	OTT	3.3	561	
1983	9	15	17	57	8	51.100	-130.590	18.0	4.2	ML	OTT	4.2	563	G
1983	9	22	13	22	9	53.800	-132.020	18.0	3.1	ML	OTT	3.1	565	C
1983	9	22	22	7	9	50.700	-130.560	10.0	3.6	ML	OTT	3.6	566	G
1983	9	25	5	10	59	57.983	-134.297	18.0	3.4	ML	OTT	3.4	567	
1983	10	10	18	16	24	54.000	-132.840	18.0	3.0	ML	OTT	3.0	568	C
1983	10	18	10	37	13	50.706	-129.874	10.0	3.0	ML	OTT	3.0	569	G
1983	11	14	14	46	44	51.200	-131.580	18.0	3.2	ML	OTT	3.2	571	
1983	11	30	16	46	56	54.000	-132.090	18.0	3.0	ML	OTT	3.0	572	C
1983	12	5	6	27	8	54.100	-132.560	18.0	3.0	ML	OTT	3.0	573	C
1983	12	7	15	37	15	50.671	-129.696	10.0	4.4	MB	PDE	4.4	575	H
1983	12	7	11	19	20	50.400	-130.430	10.0	3.0	ML	OTT	3.0	574	G
1983	12	10	0	20	17	50.480	-130.103	10.0	4.4	MB	ISC	4.4	576	G
1983	12	10	10	52	18	54.000	-133.530	18.0	3.5	ML	OTT	3.5	577	E
1983	12	24	16	47	52	51.700	-130.840	18.0	3.0	ML	OTT	3.0	578	F
1984	1	22	4	38	58	54.251	-136.408	18.0	4.1	MB	ISC	4.1	580	
1984	1	29	8	12	25	55.100	-133.200	18.0	3.3	ML	OTT	3.3	582	B
1984	2	19	15	7	15	52.300	-132.000	18.0	3.4	ML	OTT	3.4	584	F
1984	3	15	9	50	24	50.542	-130.332	10.0	4.1	MB	ISC	4.1	585	G
1984	4	1	19	1	59	54.000	-134.160	18.0	3.2	ML	OTT	3.2	586	E
1984	4	8	22	35	39	50.500	-128.890	18.0	3.3	ML	OTT	3.3	588	H
1984	4	14	0	5	27	54.000	-133.440	18.0	4.6	ML	OTT	4.6	589	E
1984	4	18	20	44	35	56.988	-137.675	10.0	3.5	DR	SCA	3.5	590	
1984	4	23	18	21	1	57.700	-137.610	18.0	3.4	ML	OTT	3.4	591	
1984	4	29	0	6	23	55.000	-133.000	18.0	3.7	ML	OTT	3.7	592	B
1984	5	2	18	59	6	55.400	-135.300	18.0	5.1	ML	OTT	5.1	593	E
1984	5	19	4	13	37	50.526	-130.325	10.0	3.6	MB	ISC	3.6	594	G
1984	5	25	22	24	41	57.700	-125.250	18.0	3.1	ML	OTT	3.1	595	
1984	6	24	21	33	10	51.100	-130.700	35.0	5.9	MS	PEK	5.8	596	G
1984	7	2	16	23	16	52.600	-132.310	18.0	3.1	LG	OTT	3.1	608	F
1984	8	12	1	40	31	50.210	-130.080	10.0	4.7	MB	DNG	4.7	610	G
1984	8	14	21	13	52	52.300	-132.650	18.0	3.4	ML	OTT	3.4	611	
1984	8	30	12	28	45	54.700	-134.200	25.0	5.9	MS	PEK	5.8	614	E
1984	9	6	18	9	57	53.900	-133.450	18.0	4.2	ML	OTT	4.2	619	E
1984	9	10	19	35	17	50.600	-129.170	18.0	3.0	ML	OTT	3.0	620	H
1984	9	12	19	48	58	50.299	-130.591	10.0	4.2	MB	PDE	4.2	621	
1984	9	22	20	16	29	51.200	-124.790	18.0	3.2	ML	OTT	3.2	622	
1984	10	29	3	13	17	51.700	-131.040	18.0	3.8	ML	OTT	3.8	628	F
1984	12	7	14	37	42	54.100	-133.540	18.0	3.3	ML	OTT	3.3	630	E
1984	12	22	13	40	28	55.300	-137.930	18.0	3.2	ML	OTT	3.2	632	

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID	Zone ID
1985	1	14	15	2	15	53.900	-133.580	18.0	3.0	ML	OTT	3.0	633	E
1985	1	19	3	51	15	53.574	-133.293	18.0	2.9	ML	OTT	2.9	634	F
1985	2	6	9	55	48	53.420	-131.601	18.0	3.0	ML	OTT	3.0	635	C
1985	3	19	15	4	21	52.315	-131.553	18.0	3.6	ML	OTT	3.6	638	F
1985	4	4	6	37	14	53.045	-133.787	10.0	4.4	ML	PMR	4.4	640	
1985	5	15	15	9	13	50.085	-127.815	43.0	3.1	ML	OTT	3.1	644	
1985	5	21	2	53	17	52.400	-132.300	18.0	3.3	ML	OTT	3.3	645	F
1985	5	27	2	32	35	50.243	-129.614	10.0	4.0	MB	ISC	4.0	646	G
1985	7	10	13	7	16	52.838	-135.745	18.0	3.6	ML	OTT	3.6	647	
1985	7	22	8	16	49	50.618	-129.629	10.0	4.2	MB	PDE	4.2	648	H
1985	8	18	19	47	39	52.543	-132.275	18.0	2.9	ML	OTT	2.9	654	F
1985	8	20	16	27	41	53.800	-132.720	18.0	3.2	ML	OTT	3.2	655	C
1985	9	2	11	14	10	54.015	-133.531	18.0	3.4	ML	OTT	3.4	657	E
1985	9	4	11	3	15	57.674	-125.534	18.0	3.1	ML	OTT	3.1	658	
1985	10	1	2	38	16	50.874	-130.102	10.0	4.3	MB	PDE	4.3	663	G
1985	10	24	23	13	40	53.800	-131.500	18.0	4.1	ML	OTT	4.1	669	C
1985	11	26	13	6	27	50.000	-130.060	10.0	3.0	ML	OTT	3.0	670	G
1985	11	30	17	55	13	56.700	-131.150	18.0	3.3	ML	OTT	3.3	673	A
1985	12	15	12	43	31	50.888	-134.466	10.0	4.7	MB	PDE	4.7	674	
1986	1	11	2	13	45	53.900	-133.450	18.0	3.0	ML	OTT	3.0	675	E
1986	1	12	7	46	57	51.500	-130.820	18.0	3.2	ML	OTT	3.2	676	G
1986	1	25	6	46	25	53.800	-131.690	18.0	3.1	ML	OTT	3.1	677	C
1986	2	1	5	0	29	57.700	-132.500	18.0	3.4	ML	OTT	3.4	678	
1986	2	7	23	17	5	53.800	-131.610	18.0	3.2	ML	OTT	3.2	680	C
1986	2	7	2	33	36	54.000	-133.750	18.0	3.1	ML	OTT	3.1	679	E
1986	2	19	17	1	35	50.100	-128.280	24.0	2.9	ML	OTT	2.9	682	H
1986	2	20	6	13	48	50.590	-129.980	10.0	2.9	ML	OTT	2.9	683	G
1986	3	19	11	22	4	50.900	-130.530	18.0	3.0	ML	OTT	3.0	684	G
1986	3	21	22	41	41	54.200	-132.890	10.0	3.2	ML	OTT	3.2	685	C
1986	3	27	3	28	27	52.800	-132.590	18.0	3.0	ML	OTT	3.0	686	F
1986	4	26	15	2	17	50.900	-130.450	10.0	3.0	ML	OTT	3.0	687	G
1986	4	28	8	45	7	53.800	-131.680	18.0	3.3	ML	OTT	3.3	689	C
1986	5	12	23	8	44	58.000	-137.440	18.0	3.8	ML	OTT	3.8	691	
1986	5	16	5	3	3	50.024	-127.730	0.0	2.9	ML	OTT	2.9	692	
1986	5	28	15	41	28	50.602	-130.283	10.0	2.9	ML	OTT	2.9	695	G
1986	5	28	1	0	6	50.500	-130.570	10.0	3.1	ML	OTT	3.1	694	G
1986	6	6	14	47	29	50.280	-129.650	10.0	4.5	ML	OTT	4.5	696	G
1986	7	29	2	9	39	53.216	-133.051	18.0	3.3	ML	OTT	3.3	697	F
1986	9	7	11	51	9	53.112	-132.799	18.0	3.4	ML	PGC	3.4	698	F
1986	10	4	4	11	40	57.845	-132.685	18.0	3.2	ML	OTT	3.2	699	
1986	10	8	13	13	42	51.065	-130.244	10.0	3.3	ML	OTT	3.3	701	G
1986	10	15	2	39	35	50.532	-130.025	10.0	3.0	ML	OTT	3.0	702	G
1986	10	27	10	49	41	50.889	-130.360	10.0	3.2	ML	OTT	3.2	703	G
1986	11	4	5	0	4	53.351	-127.044	18.0	3.5	ML	PGC	3.5	704	A
1986	11	4	6	38	25	54.483	-134.053	18.0	3.6	ML	OTT	3.6	705	E
1986	11	14	18	33	53	51.071	-133.897	10.0	3.1	ML	OTT	3.1	706	
1986	12	6	21	4	12	51.111	-130.582	18.0	4.5	ML	OTT	4.5	708	G
1986	12	9	12	56	9	57.890	-137.526	18.0	3.5	ML	PGC	3.5	709	
1986	12	14	10	59	32	52.194	-131.822	18.0	3.0	ML	OTT	3.0	710	F
1987	1	13	11	31	56	50.618	-130.326	10.0	3.7	ML	OTT	3.7	711	G
1987	1	31	14	25	48	50.292	-129.819	10.0	4.8	MB	ISC	4.8	722	G
1987	2	13	15	50	56	55.810	-135.515	18.0	3.5	ML	OTT	3.5	725	E
1987	3	9	11	49	16	52.531	-131.811	18.0	3.4	ML	OTT	3.4	726	F
1987	3	26	2	35	47	50.749	-129.918	10.0	4.7	MB	ISC	4.7	727	G
1987	5	15	23	3	23	54.105	-133.675	18.0	3.4	ML	OTT	3.4	728	E
1987	5	17	7	30	28	53.903	-131.705	18.0	3.0	ML	OTT	3.0	729	C

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID	Zone ID
1987	5	17	7	34	13	51.729	-131.517	18.0	2.9	ML	OTT	2.9	730	F
1987	7	2	2	28	21	50.987	-124.619	5.0	3.4	ML	OTT	3.4	732	
1987	7	3	1	32	53	54.086	-133.793	18.0	4.5	ML	OTT	4.5	733	E
1987	8	15	6	9	9	53.831	-133.316	18.0	3.5	ML	PGC	3.5	734	E
1987	8	17	6	16	52	50.832	-130.444	10.0	3.5	ML	OTT	3.5	737	G
1987	9	17	1	25	50	50.377	-128.358	10.0	3.8	MB	PDE	3.8	741	D
1987	9	17	18	4	50	51.007	-130.215	10.0	4.8	MS	ISC	4.8	745	G
1987	9	25	3	2	36	52.636	-133.118	18.0	3.0	ML	OTT	3.0	755	
1987	10	11	9	45	45	50.499	-130.298	10.0	3.0	ML	OTT	3.0	757	G
1987	10	13	9	23	43	52.857	-132.571	18.0	3.1	ML	OTT	3.1	758	F
1987	10	18	13	6	49	50.664	-129.604	10.0	4.4	MB	PDE	4.4	759	H
1987	10	20	9	32	54	56.210	-136.863	18.0	3.4	ML	OTT	3.4	760	
1987	11	14	22	10	28	50.539	-125.961	16.0	3.2	ML	OTT	3.2	761	
1987	12	3	15	57	43	52.439	-131.625	18.0	3.2	ML	OTT	3.2	763	F
1987	12	5	9	31	6	52.058	-133.773	10.0	3.1	ML	PGC	3.1	764	
1987	12	12	12	20	23	54.384	-133.700	18.0	3.2	ML	OTT	3.2	765	E
1987	12	18	18	26	47	54.051	-133.768	18.0	3.2	ML	OTT	3.2	766	E
1988	2	10	23	54	33	50.552	-130.192	10.0	3.3	ML	OTT	3.3	768	G
1988	2	11	14	16	34	51.641	-130.762	18.0	3.7	ML	OTT	3.7	770	F
1988	2	27	22	13	24	52.789	-132.640	18.0	3.0	ML	OTT	3.0	781	F
1988	3	16	9	26	46	52.517	-132.143	18.0	2.9	ML	OTT	2.9	782	F
1988	4	5	16	49	41	54.023	-133.748	18.0	3.8	ML	OTT	3.8	783	E
1988	4	29	5	43	32	51.207	-130.797	18.0	3.0	ML	OTT	3.0	785	G
1988	4	29	1	45	30	50.044	-127.988	35.0	3.5	ML	OTT	3.5	784	H
1988	4	30	7	58	21	50.536	-130.241	10.0	2.9	ML	OTT	2.9	786	G
1988	5	5	22	22	50	57.830	-136.489	18.0	3.7	ML	PGC	3.7	787	
1988	5	26	14	9	53	50.904	-130.506	10.0	2.9	ML	OTT	2.9	789	G
1988	6	7	1	24	4	53.232	-133.772	18.0	3.0	ML	PGC	3.0	790	F
1988	6	20	5	24	40	52.574	-132.490	18.0	3.4	ML	OTT	3.4	791	F
1988	7	19	10	54	47	50.900	-130.550	33.0	5.8	MB	MOS	5.8	793	G
1988	7	30	8	6	57	50.470	-130.176	10.0	4.5	ML	OTT	4.5	795	G
1988	8	20	10	37	48	50.009	-130.112	10.0	4.3	ML	OTT	4.3	798	G
1988	8	25	7	5	27	53.219	-135.454	10.0	3.7	ML	OTT	3.7	799	
1988	8	28	13	31	14	51.807	-130.821	18.0	3.2	ML	OTT	3.2	800	F
1988	9	2	14	13	35	52.737	-135.467	10.0	3.1	ML	OTT	3.1	801	
1988	9	4	2	11	9	53.880	-131.780	10.0	3.2	ML	PGC	3.2	802	C
1988	9	7	19	6	19	51.017	-133.819	10.0	2.9	ML	OTT	2.9	803	
1988	9	18	16	3	53	51.912	-128.384	18.0	3.5	ML	OTT	3.5	804	D
1988	10	1	11	19	47	50.173	-127.982	33.0	3.9	ML	OTT	3.9	805	D
1988	10	7	19	33	40	52.785	-132.556	18.0	3.1	ML	OTT	3.1	807	F
1988	10	27	18	51	25	53.898	-132.216	14.0	3.0	ML	OTT	3.0	810	C
1988	10	27	12	37	3	50.453	-130.121	10.0	3.1	ML	PGC	3.1	809	G
1989	1	13	10	2	25	53.383	-131.473	31.0	3.7	ML	OTT	3.7	833	C
1989	1	15	6	56	34	53.569	-133.313	18.0	3.4	ML	OTT	3.4	834	F
1989	2	7	3	48	48	52.421	-131.752	18.0	3.1	ML	OTT	3.1	836	F
1989	2	17	7	38	9	57.784	-137.886	10.0	4.7	MB	PGC	4.7	837	
1989	2	21	12	17	40	51.765	-131.424	18.0	3.8	ML	OTT	3.8	838	F
1989	2	26	4	42	14	52.543	-132.129	18.0	3.5	ML	OTT	3.5	840	F
1989	3	6	23	33	23	51.563	-130.672	18.0	3.1	ML	OTT	3.1	842	G
1989	3	12	8	55	50	51.356	-131.370	18.0	3.1	ML	OTT	3.1	844	G
1989	3	30	1	55	42	52.426	-131.618	18.0	3.0	ML	OTT	3.0	846	F
1989	3	31	23	18	32	53.096	-133.412	18.0	3.3	ML	OTT	3.3	847	F
1989	4	1	10	16	35	50.003	-127.791	10.0	4.2	MB	PDE	4.2	848	
1989	4	8	10	28	56	51.614	-130.797	18.0	3.6	ML	OTT	3.6	853	F
1989	4	9	0	51	9	54.722	-128.127	5.0	2.9	ML	OTT	2.9	854	A
1989	4	10	17	32	9	52.418	-131.981	18.0	3.9	ML	PGC	3.9	855	F

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID	Zone ID
1989	4	23	5	36	36	52.415	-132.656	18.0	2.9	ML	OTT	2.9	859	F
1989	5	2	0	51	5	52.758	-132.437	18.0	3.2	ML	PGC	3.2	861	F
1989	5	3	5	25	16	50.647	-129.555	17.5	4.7	MB	ISC	4.7	862	H
1989	5	20	7	29	48	55.308	-135.134	18.0	3.4	ML	OTT	3.4	865	E
1989	5	21	10	55	35	53.935	-132.141	5.0	3.5	ML	OTT	3.5	866	C
1989	6	2	12	17	37	52.628	-132.195	18.0	3.5	ML	OTT	3.5	868	F
1989	6	6	7	20	22	51.111	-124.543	20.0	3.6	ML	PGC	3.6	869	
1989	7	8	14	46	41	52.543	-132.206	18.0	3.9	MB	ISC	3.9	870	F
1989	8	1	22	0	48	50.089	-128.644	10.0	3.4	ML	OTT	3.4	873	H
1989	8	18	8	55	11	53.017	-133.304	18.0	3.1	ML	OTT	3.1	876	F
1989	8	30	3	33	1	51.616	-130.782	18.0	3.0	ML	PGC	3.0	880	F
1989	8	30	1	48	38	50.128	-130.130	10.0	3.3	ML	OTT	3.3	879	G
1989	9	24	1	12	47	50.906	-125.509	5.0	3.8	ML	OTT	3.8	883	
1989	10	2	9	8	36	50.825	-130.430	10.0	4.1	ML	PGC	4.1	884	G
1989	10	5	18	31	0	51.790	-128.399	18.0	3.1	ML	PGC	3.1	885	D
1989	10	9	1	38	40	51.639	-130.799	18.0	2.9	ML	OTT	2.9	886	F
1989	10	11	12	58	37	51.641	-131.244	18.0	3.1	ML	OTT	3.1	889	F
1989	10	11	8	50	17	57.426	-136.305	10.0	4.4	ML	OTT	4.4	887	
1989	10	17	18	23	39	53.216	-133.330	18.0	3.0	ML	OTT	3.0	891	F
1989	10	17	23	56	28	51.247	-130.822	18.0	4.1	ML	PGC	4.1	892	G
1989	11	12	19	56	48	50.492	-129.988	10.0	3.1	ML	OTT	3.1	896	G
1989	11	19	4	15	20	54.149	-133.738	18.0	2.9	ML	OTT	2.9	897	E
1989	11	26	16	31	21	50.789	-130.485	10.0	3.2	ML	OTT	3.2	898	G
1989	12	18	9	25	36	52.421	-132.087	18.0	3.1	ML	OTT	3.1	900	F
1989	12	26	6	54	14	50.568	-130.267	10.0	3.5	ML	OTT	3.5	904	G
1989	12	27	3	18	44	54.057	-133.733	18.0	3.0	ML	OTT	3.0	905	E
1990	1	12	22	17	10	53.980	-131.450	39.0	5.4	MB	MOS	5.4	906	C
1990	1	19	10	33	26	52.052	-131.190	18.0	3.5	ML	OTT	3.5	916	F
1990	1	22	0	48	33	54.942	-134.503	18.0	3.0	ML	OTT	3.0	917	E
1990	1	26	20	13	37	53.904	-132.214	14.0	4.5	ML	OTT	4.5	918	C
1990	1	27	23	56	20	50.738	-130.398	10.0	3.3	ML	OTT	3.3	921	G
1990	1	27	4	6	33	57.808	-137.852	10.0	2.9	ML	OTT	2.9	919	
1990	2	3	9	54	56	51.085	-130.167	10.0	5.4	MS	ISC	5.3	922	H
1990	2	4	23	52	24	50.275	-132.020	10.0	3.7	ML	OTT	3.7	929	
1990	2	18	8	48	45	50.086	-130.186	10.0	4.6	MW	NRC	4.6	934	G
1990	2	21	13	49	33	53.252	-133.357	18.0	2.9	ML	OTT	2.9	938	F
1990	2	26	0	26	16	51.816	-131.191	18.0	3.6	ML	OTT	3.6	939	F
1990	3	19	23	17	50	53.398	-131.486	5.0	3.8	ML	OTT	3.8	944	C
1990	3	28	6	54	36	55.096	-135.325	18.0	4.3	ML	OTT	4.3	946	E
1990	4	6	5	8	44	54.937	-134.607	18.0	2.9	ML	OTT	2.9	947	E
1990	4	16	10	32	7	50.509	-130.480	10.0	3.2	ML	PGC	3.2	948	G
1990	4	26	9	6	55	51.594	-130.678	18.0	2.9	ML	OTT	2.9	951	F
1990	5	11	1	24	18	51.552	-130.715	18.0	3.1	ML	OTT	3.1	952	G
1990	5	19	1	26	47	50.674	-130.330	10.0	3.5	ML	OTT	3.5	953	G
1990	6	4	16	35	4	50.107	-128.942	10.0	4.4	MB	GS	4.4	955	H
1990	6	10	19	36	9	52.623	-132.193	18.0	4.6	MW	NRC	4.6	956	F
1990	6	15	11	41	22	57.828	-137.069	10.0	3.4	ML	OTT	3.4	957	
1990	6	21	3	56	7	50.614	-130.308	10.0	4.1	MW	NRC	4.1	958	G
1990	6	23	4	11	49	50.502	-129.891	10.0	3.1	ML	OTT	3.1	959	G
1990	6	23	15	30	8	51.114	-124.410	5.0	3.0	ML	PGC	3.0	960	
1990	8	4	20	9	12	50.142	-130.180	10.0	3.4	ML	OTT	3.4	963	G
1990	8	14	3	31	53	53.386	-131.500	9.0	2.9	ML	OTT	2.9	964	C
1990	8	28	16	40	7	54.046	-133.667	18.0	3.2	ML	PGC	3.2	965	E
1990	9	5	16	1	46	50.584	-130.265	10.0	3.8	ML	OTT	3.8	966	G
1990	9	20	11	40	55	55.771	-135.855	10.0	4.2	ML	OTT	4.2	967	E
1990	9	28	1	14	56	52.849	-132.985	18.0	3.6	ML	OTT	3.6	968	F

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID	Zone ID
1990	10	6	17	12	28	54.025	-133.580	18.0	2.9	ML	OTT	2.9	969	E
1990	10	27	6	59	46	57.005	-137.783	10.0	3.0	ML	OTT	3.0	970	
1990	11	9	23	27	1	54.994	-133.599	18.0	2.9	ML	OTT	2.9	971	B
1990	11	10	4	19	7	51.293	-131.192	10.0	3.2	ML	PGC	3.2	972	G
1990	11	16	3	37	53	50.768	-130.282	10.0	3.1	ML	OTT	3.1	973	G
1990	12	13	14	10	44	50.876	-130.360	10.0	3.0	ML	OTT	3.0	974	G
1990	12	22	3	50	56	51.379	-130.971	18.0	3.3	ML	OTT	3.3	975	G
1990	12	26	12	36	2	50.581	-130.257	10.0	3.1	ML	PGC	3.1	976	G
1991	1	1	22	55	11	50.735	-130.542	10.0	3.0	ML	OTT	3.0	977	G
1991	1	3	16	24	6	50.155	-130.180	10.0	3.4	ML	PGC	3.4	978	G
1991	1	8	18	35	35	51.149	-130.590	10.0	4.0	ML	OTT	4.0	979	G
1991	1	28	10	24	5	57.895	-137.843	10.0	3.1	ML	OTT	3.1	986	
1991	2	12	18	38	53	54.083	-133.831	18.0	3.1	ML	OTT	3.1	987	E
1991	3	20	22	3	43	50.665	-129.982	10.0	4.4	MB	ISC	4.4	991	G
1991	3	29	18	13	24	50.786	-130.471	10.0	3.4	ML	OTT	3.4	993	G
1991	4	1	1	40	46	50.148	-129.958	10.0	3.7	MB	ISC	3.7	994	G
1991	4	3	16	29	41	53.909	-133.506	18.0	3.4	ML	OTT	3.4	996	E
1991	5	1	19	22	50	52.461	-131.927	18.0	3.0	ML	OTT	3.0	1002	F
1991	5	17	4	39	59	53.001	-135.728	10.0	3.0	ML	OTT	3.0	1004	
1991	6	11	23	27	51	50.151	-129.624	10.0	3.9	MB	ISC	3.9	1006	G
1991	6	28	23	38	23	54.039	-133.722	18.0	3.4	ML	OTT	3.4	1007	E
1991	7	11	9	11	54	51.318	-131.476	10.0	2.9	ML	OTT	2.9	1008	G
1991	7	17	20	14	32	53.486	-134.973	10.0	4.1	MB	GS	4.1	1014	
1991	7	17	7	12	8	50.590	-130.700	20.0	5.5	MS	BJI	5.4	1009	G
1991	7	18	17	59	38	50.959	-130.222	10.0	2.9	ML	OTT	2.9	1015	G
1991	7	30	8	49	28	50.633	-129.095	10.0	3.2	ML	OTT	3.2	1016	H
1991	8	19	2	42	8	52.644	-132.154	18.0	3.1	ML	PGC	3.1	1019	F
1991	9	16	11	16	7	51.071	-130.883	10.0	3.0	ML	PGC	3.0	1021	G
1991	10	10	22	55	50	55.374	-134.960	18.0	3.5	ML	OTT	3.5	1023	E
1991	10	12	18	45	13	51.249	-130.963	18.0	3.0	ML	OTT	3.0	1024	G
1991	10	29	13	39	15	52.458	-131.964	18.0	3.1	ML	OTT	3.1	1025	F
1991	10	30	3	12	58	52.795	-132.638	18.0	2.9	ML	OTT	2.9	1026	F
1991	11	3	9	51	17	54.789	-134.395	18.0	3.4	ML	OTT	3.4	1027	E
1991	11	15	18	35	8	57.762	-133.625	10.0	3.4	ML	PGC	3.4	1030	
1991	12	10	21	28	7	52.602	-132.227	18.0	3.2	ML	OTT	3.2	1032	F
1991	12	18	21	32	36	57.283	-136.253	10.0	3.0	ML	OTT	3.0	1033	
1992	1	1	7	13	26	50.369	-129.963	10.0	3.2	ML	OTT	3.2	1034	G
1992	1	13	20	56	13	57.791	-126.058	10.0	3.2	ML	OTT	3.2	1035	
1992	1	17	5	4	19	53.057	-133.088	10.0	3.9	ML	PGC	3.9	1036	F
1992	1	17	7	51	5	51.221	-131.134	10.0	2.9	ML	OTT	2.9	1037	G
1992	1	18	11	33	1	50.173	-127.946	30.0	3.5	ML	PGC	3.5	1038	D
1992	2	15	7	2	58	50.124	-129.721	1.3	4.6	MB	ISC	4.6	1039	G
1992	2	21	15	35	6	56.134	-134.447	10.0	3.1	ML	PGC	3.1	1041	B
1992	2	26	18	34	53	51.545	-130.962	18.0	2.9	ML	OTT	2.9	1042	G
1992	3	29	20	10	1	51.624	-130.837	10.0	2.9	ML	OTT	2.9	1045	F
1992	4	6	13	54	38	50.550	-130.460	10.0	6.8	ML	OTT	6.8	1046	G
1992	4	23	5	40	10	51.263	-131.169	10.0	5.8	MS	PGC	5.7	1075	G
1992	8	5	19	53	5	51.866	-131.259	18.0	3.1	ML	PGC	3.1	1099	F
1992	8	13	19	9	3	57.108	-130.954	10.0	3.4	ML	PGC	3.4	1100	A
1992	8	21	3	31	27	51.230	-135.761	10.0	3.7	ML	OTT	3.7	1102	
1992	9	3	2	50	10	52.702	-133.044	18.0	3.4	ML	OTT	3.4	1104	F
1992	9	29	13	5	37	53.568	-133.238	18.0	3.0	ML	OTT	3.0	1111	F
1992	10	18	12	42	21	54.207	-133.821	18.0	3.0	ML	OTT	3.0	1113	E
1992	10	22	22	16	28	53.234	-132.873	18.0	3.2	ML	OTT	3.2	1114	F
1993	1	11	18	53	33	53.840	-131.530	15.0	2.9	ML	PGC	2.9	1117	C
1993	2	12	2	13	41	53.449	-133.222	18.0	2.9	ML	PGC	2.9	1120	F

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID	Zone ID
1993	4	18	15	27	47	56.701	-137.885	10.0	3.4	MW	NRC	3.4	1124	
1993	5	4	4	51	8	56.050	-135.231	10.0	3.9	ML	PGC	3.9	1125	E
1993	6	21	9	14	13	53.220	-133.084	18.0	3.0	ML	PGC	3.0	1130	F
1993	6	25	10	17	34	53.631	-131.742	15.0	3.5	ML	PGC	3.5	1131	C
1993	8	3	7	30	42	51.221	-130.144	10.0	3.2	ML	PGC	3.2	1135	H
1993	8	3	13	3	57	51.297	-130.740	10.0	5.2	MS	GS	5.1	1139	G
1993	8	3	7	20	2	51.460	-131.540	5.0	6.2	MS	BJI	6.1	1134	G
1993	9	5	17	30	52	57.795	-137.847	0.0	4.1	MW	NRC	4.1	1149	
1993	9	29	3	6	6	53.862	-131.587	13.5	3.2	ML	PGC	3.2	1151	C
1993	11	9	0	11	16	57.566	-132.748	5.0	3.5	ML	PGC	3.5	1152	
1993	11	21	20	40	54	52.635	-132.376	18.0	3.1	ML	PGC	3.1	1153	F
1993	12	22	23	39	58	50.108	-129.661	10.0	3.3	ML	PGC	3.3	1157	G
1994	4	2	16	51	58	52.472	-131.872	18.0	3.3	ML	PGC	3.3	1166	F
1994	4	2	16	25	51	54.386	-137.873	10.0	3.4	MW	NRC	3.4	1165	
1994	5	14	15	37	48	52.668	-132.114	18.0	2.9	MW	NRC	2.9	1171	F
1994	6	13	22	35	6	53.792	-133.512	18.0	2.9	MW	NRC	2.9	1172	E
1994	7	7	21	7	58	53.914	-133.908	10.0	4.4	ML	PGC	4.4	1173	E
1994	7	15	22	20	50	57.968	-126.378	18.0	2.9	ML	PGC	2.9	1177	
1994	8	21	13	5	5	50.406	-130.397	10.0	4.4	MB	PGC	4.4	1178	G
1994	8	30	20	49	13	52.725	-132.272	18.0	3.0	ML	PGC	3.0	1179	F
1994	10	21	16	23	52	50.039	-130.297	10.0	4.3	MB	PGC	4.3	1183	G
1994	12	30	17	18	49	50.224	-130.300	10.0	3.1	ML	PGC	3.1	1186	G
1995	1	4	16	33	42	57.940	-137.690	5.0	3.9	ML	PGC	3.9	1188	
1995	1	9	6	50	12	51.012	-130.790	10.0	4.8	MW	NRC	4.8	1189	G
1995	1	13	7	52	18	53.169	-132.756	18.0	3.0	ML	PGC	3.0	1190	F
1995	1	16	7	1	27	50.273	-129.598	10.0	4.3	MB	ISC	4.3	1191	G
1995	1	17	14	42	30	50.000	-130.190	10.0	5.0	MS	GS	5.0	1197	G
1995	1	26	0	31	16	50.480	-130.240	10.0	3.4	ML	PGC	3.4	1199	G
1995	2	3	1	14	52	50.170	-127.931	22.0	2.9	ML	PGC	2.9	1200	D
1995	2	4	23	49	39	50.636	-129.737	10.0	4.3	MB	ISC	4.3	1201	H
1995	3	8	16	29	58	50.485	-130.246	10.0	4.9	MW	NRC	4.9	1202	G
1995	3	14	8	3	25	54.188	-133.779	18.0	3.0	ML	PGC	3.0	1203	E
1995	4	26	6	40	56	55.139	-133.255	10.0	3.0	ML	PGC	3.0	1208	B
1995	6	3	21	36	36	55.066	-134.971	0.0	3.4	ML	PGC	3.4	1210	E
1995	6	6	11	6	11	53.851	-131.511	8.8	4.4	ML	PGC	4.4	1211	C
1995	6	13	18	46	26	53.831	-132.101	0.3	4.1	MB	ISC	4.1	1213	C
1995	6	21	20	24	13	50.972	-130.673	10.0	5.4	MW	NRC	5.4	1215	G
1995	7	13	20	12	24	52.723	-132.850	18.0	3.7	MW	NRC	3.7	1220	F
1995	8	8	14	59	5	50.473	-130.305	10.0	3.7	MW	NRC	3.7	1222	G
1995	9	12	22	44	23	51.209	-131.225	10.0	5.3	MW	NRC	5.3	1226	G
1995	9	13	7	59	7	51.471	-130.532	10.0	5.0	MS	ISC	5.0	1232	F
1995	10	14	1	27	1	50.547	-130.363	10.0	2.9	MW	NRC	2.9	1238	G
1995	10	23	7	54	10	55.524	-135.181	5.0	4.3	MW	NRC	4.3	1242	E
1995	10	26	2	21	55	55.393	-136.028	10.0	3.1	MW	NRC	3.1	1248	
1995	10	31	19	40	51	50.557	-130.480	10.0	4.1	ML	PGC	4.1	1249	G
1995	11	12	4	32	4	55.800	-135.700	10.0	4.8	ML	GIA	4.8	1251	E
1995	12	1	3	29	23	50.352	-129.973	10.0	4.5	MW	NRC	4.5	1254	G
1996	1	14	5	56	49	50.573	-130.347	10.0	2.9	MW	NRC	2.9	1256	G
1996	1	28	16	15	20	52.206	-132.039	18.0	3.2	MW	NRC	3.2	1257	F
1996	3	16	23	18	37	50.464	-130.315	10.0	5.1	MW	NRC	5.1	1259	G
1996	3	23	10	17	25	52.505	-131.752	18.0	2.9	MW	NRC	2.9	1260	F
1996	3	27	5	41	15	50.227	-127.966	22.0	3.0	ML	PGC	3.0	1261	D
1996	4	4	2	41	13	53.928	-133.619	18.0	3.0	MW	NRC	3.0	1263	E
1996	4	18	14	47	25	56.811	-135.913	10.0	3.1	ML	PGC	3.1	1265	
1996	5	24	23	1	20	54.539	-134.806	10.0	3.6	ML	PGC	3.6	1267	E
1996	6	22	2	45	44	51.535	-130.852	10.0	3.2	MW	NRC	3.2	1268	G

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID	Zone ID
1996	7	21	19	23	8	57.495	-137.182	5.0	3.8	MW	NRC	3.8	1270	
1996	7	27	14	3	26	51.191	-124.931	0.0	2.9	MW	NRC	2.9	1271	
1996	8	16	3	41	9	51.062	-130.748	10.0	5.2	MW	NRC	5.2	1273	G
1996	8	29	6	32	46	57.904	-137.767	0.0	3.2	MW	NRC	3.2	1283	
1996	9	30	20	44	1	50.232	-129.706	10.0	3.1	ML	PGC	3.1	1285	G
1996	10	9	16	53	45	50.164	-129.217	33.0	3.9	MB	ISC	3.9	1286	H
1996	11	6	6	55	46	50.452	-130.189	10.0	4.5	MW	NRC	4.5	1288	G
1996	11	25	13	19	15	55.311	-134.945	10.0	3.1	ML	PGC	3.1	1289	E
1996	12	2	21	54	31	50.118	-129.051	10.0	4.4	MB	ISC	4.4	1290	H
1996	12	10	1	8	3	54.097	-131.776	13.0	3.5	ML	PGC	3.5	1292	B
1996	12	24	12	40	36	51.895	-131.620	15.5	4.4	ML	PGC	4.4	1294	F
1997	2	1	6	27	12	53.292	-131.564	11.6	3.1	MW	NRC	3.1	1297	C
1997	2	5	19	29	5	51.555	-131.464	29.1	5.3	MB	PGC	5.3	1299	G
1997	2	12	6	33	0	53.167	-133.250	18.0	3.2	MW	NRC	3.2	1302	F
1997	2	20	18	16	54	55.040	-134.526	10.0	3.5	MW	NRC	3.5	1303	E
1997	2	26	21	21	51	50.694	-129.474	10.0	3.7	MB	ISC	3.7	1304	H
1997	3	9	11	3	7	56.618	-136.017	10.0	3.8	ML	PGC	3.8	1305	
1997	3	29	5	45	42	50.475	-130.212	10.0	4.5	MW	NRC	4.5	1306	G
1997	4	5	12	56	57	53.938	-132.448	10.0	3.7	MW	NRC	3.7	1308	C
1997	4	18	19	42	6	55.520	-135.261	0.0	3.3	ML	PGC	3.3	1310	E
1997	6	3	8	26	43	52.568	-132.162	18.0	2.9	MW	NRC	2.9	1312	F
1997	7	23	17	10	49	50.673	-130.536	10.0	3.3	MW	NRC	3.3	1314	G
1997	8	16	5	10	24	50.384	-130.178	10.0	3.0	ML	PGC	3.0	1315	G
1997	8	16	20	14	59	55.816	-135.465	0.0	3.0	MW	NRC	3.0	1316	E
1997	8	27	10	46	15	51.197	-129.583	10.0	3.5	MB	ISC	3.6	1318	D
1997	9	3	3	17	14	50.797	-129.691	10.0	3.2	ML	PGC	3.2	1319	H
1997	9	20	4	39	53	50.758	-130.574	10.0	5.3	MW	NRC	5.3	1320	G
1997	10	15	23	48	20	54.383	-133.861	18.0	3.3	ML	PGC	3.3	1326	E
1997	11	2	5	19	45	55.418	-132.382	0.0	3.3	MW	NRC	3.3	1328	B
1997	12	28	5	6	10	52.834	-132.553	18.0	3.7	MW	NRC	3.7	1333	F
1998	1	31	5	44	34	50.532	-129.318	10.0	3.0	MW	NRC	3.0	1334	H
1998	4	28	9	53	39	57.797	-137.654	0.0	3.0	ML	PGC	3.0	1343	
1998	6	14	18	4	19	53.115	-132.683	20.0	2.9	MW	NRC	2.9	1344	F
1998	6	25	22	51	55	50.261	-130.028	10.0	5.4	MW	HRV	5.4	1345	G
1998	7	31	7	40	28	51.360	-130.776	10.0	4.7	MW	NRC	4.7	1350	G
1998	8	6	2	43	38	52.125	-131.634	20.0	4.4	MW	NRC	4.4	1352	F
1998	8	27	2	54	35	57.770	-136.500	5.0	3.9	ML	AEI	3.9	1359	
1998	8	30	11	33	33	50.909	-130.639	10.0	6.2	MW	NRC	6.2	1360	G
1998	9	3	10	54	34	53.900	-131.644	17.6	3.6	ML	PGC	3.6	1373	C
1998	9	9	14	48	41	54.158	-133.937	20.0	4.6	ML	PGC	4.6	1375	E
1998	9	13	17	4	12	56.321	-136.097	10.0	3.7	MW	NRC	3.7	1376	
1998	12	16	5	54	2	55.472	-135.139	10.0	4.6	MB	ISC	4.6	1383	E
1999	2	20	20	16	38	57.195	-136.308	0.0	3.8	ML	PGC	3.8	1390	
1999	3	7	23	7	6	52.743	-132.116	20.0	3.6	ML	PGC	3.6	1393	F
1999	3	7	3	42	14	53.391	-131.476	5.2	3.8	MW	NRC	3.8	1392	C
1999	5	22	12	47	24	52.578	-132.963	10.0	3.4	MW	NRC	3.4	1398	
1999	5	27	11	9	8	53.502	-133.457	20.0	3.0	MW	NRC	3.0	1399	F
1999	5	27	11	54	8	52.205	-133.816	20.0	2.9	MW	NRC	2.9	1400	
1999	6	20	19	55	3	52.603	-132.142	0.0	3.2	ML	PGC	3.2	1401	F
1999	7	6	3	24	46	55.620	-135.439	10.0	2.9	MW	NRC	2.9	1402	E
1999	7	7	11	53	16	57.703	-133.774	5.0	3.2	ML	PGC	3.2	1403	
1999	7	19	8	39	48	52.226	-132.008	20.0	3.2	ML	PGC	3.2	1404	F
1999	8	16	13	17	50	52.685	-132.026	20.0	3.1	MW	NRC	3.1	1406	F
1999	9	10	3	18	47	53.504	-131.587	6.0	3.0	MW	NRC	3.0	1407	C
1999	9	14	13	36	5	55.339	-134.540	10.0	2.9	ML	PGC	2.9	1409	E
1999	10	5	16	22	41	53.398	-131.424	1.1	3.6	MW	NRC	3.6	1410	C

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID	Zone ID
1999	10	14	8	29	25	50.467	-130.214	10.0	4.4	MW	NRC	4.4	1412	G
1999	10	19	5	49	0	58.000	-136.960	0.0	4.7	ML	PMR	4.7	1413	
1999	10	27	1	12	33	57.332	-136.204	10.0	3.3	ML	PGC	3.3	1414	
1999	12	6	5	1	37	52.334	-131.739	20.0	3.2	MW	NRC	3.2	1417	F
1999	12	13	2	5	11	57.972	-137.947	0.0	2.9	ML	PGC	2.9	1420	
1999	12	16	21	40	43	54.682	-130.473	10.0	2.9	MW	NRC	2.9	1421	A
1999	12	17	10	8	37	51.229	-124.192	20.0	3.4	ML	PGC	3.4	1422	
2000	1	13	0	55	25	54.151	-133.875	20.0	3.5	ML	PGC	3.5	1427	E
2000	1	23	5	53	58	52.246	-131.839	20.0	4.3	MW	NRC	4.3	1429	F
2000	2	10	18	9	30	50.072	-130.067	10.0	2.9	ML	PGC	2.9	1431	G
2000	4	9	12	32	0	55.148	-134.923	10.0	3.0	ML	PGC	3.0	1438	E
2000	4	30	10	54	6	51.375	-129.917	10.0	5.1	MW	NRC	5.1	1452	D
2000	5	8	23	9	34	52.507	-131.942	20.0	3.9	MW	NRC	3.9	1458	F
2000	5	15	5	12	57	50.329	-129.635	10.0	4.7	MB	ISC	4.7	1464	G
2000	5	15	7	11	48	50.110	-130.280	15.0	5.5	MW	HRV	5.5	1467	G
2000	5	26	16	37	23	51.504	-130.770	10.0	3.5	MW	NRC	3.5	1482	G
2000	5	27	23	14	59	51.319	-131.086	10.0	3.1	ML	PGC	3.1	1485	G
2000	6	1	13	8	47	51.802	-131.609	20.0	3.6	MW	NRC	3.6	1487	F
2000	6	25	0	49	26	51.157	-131.179	10.0	3.4	ML	PGC	3.4	1493	G
2000	7	7	17	49	29	57.493	-134.210	1.0	2.9	ML	PGC	2.9	1496	
2000	7	7	1	13	18	57.968	-133.905	1.0	3.1	ML	PGC	3.1	1495	
2000	8	1	11	1	11	57.921	-133.792	1.0	2.9	MW	NRC	2.9	1498	
2000	8	15	4	29	52	55.341	-134.834	20.0	3.1	MW	NRC	3.1	1502	E
2000	9	9	9	12	49	52.181	-131.709	20.0	2.9	MW	NRC	2.9	1503	F
2000	10	11	14	33	33	50.496	-128.962	10.0	3.2	ML	PGC	3.2	1508	H
2000	10	19	12	10	40	53.871	-133.498	20.0	3.3	ML	PGC	3.3	1511	E
2000	10	22	9	53	0	51.337	-130.966	10.0	4.0	MW	NRC	4.0	1512	G
2000	11	11	16	21	10	56.383	-131.072	1.0	3.4	MW	NRC	3.4	1515	A
2001	1	16	22	26	49	53.460	-133.267	20.0	3.5	MW	NRC	3.5	1543	F
2001	2	3	1	51	22	50.501	-129.544	10.0	3.6	MB	ISC	3.6	1555	H
2001	2	17	20	11	28	54.020	-133.696	20.0	6.3	MW	NRC	6.3	1559	E
2001	3	2	10	3	14	52.350	-132.021	20.0	3.1	MW	NRC	3.1	1566	F
2001	3	24	20	16	26	55.189	-134.727	1.0	3.9	MW	NRC	3.9	1569	E
2001	4	11	5	13	12	55.395	-137.744	10.0	3.4	MW	NRC	3.4	1575	
2001	4	14	5	8	9	53.655	-131.693	8.5	2.9	ML	PGC	2.9	1576	C
2001	5	5	4	56	25	50.108	-129.699	10.0	4.0	MB	ISC	4.0	1579	G
2001	5	16	9	26	40	51.666	-130.835	10.0	2.9	MW	NRC	2.9	1582	F
2001	5	25	6	14	23	54.799	-134.529	20.0	3.1	MW	NRC	3.1	1588	E
2001	5	26	17	46	55	55.403	-135.157	20.0	3.1	MW	NRC	3.1	1589	E
2001	6	17	4	17	52	56.638	-136.196	10.0	3.2	MW	NRC	3.2	1591	
2001	6	30	10	1	20	51.468	-131.126	10.0	3.1	ML	PGC	3.1	1594	G
2001	7	9	9	26	19	56.205	-135.080	15.0	4.9	MW	NRC	4.9	1597	
2001	8	5	11	11	42	50.009	-130.246	10.0	4.7	MW	NRC	4.7	1599	G
2001	9	2	22	9	31	52.772	-132.335	20.0	2.9	MW	NRC	2.9	1604	F
2001	9	13	2	21	20	52.621	-132.969	20.0	3.0	ML	PGC	3.0	1607	F
2001	9	16	16	11	25	56.630	-136.099	10.0	4.1	MW	NRC	4.1	1608	
2001	10	12	5	2	35	52.660	-132.126	20.0	6.3	MW	NRC	6.3	1610	F
2001	10	18	8	32	10	53.061	-132.809	20.0	3.2	MW	NRC	3.2	1629	F
2001	10	20	0	18	54	50.055	-127.779	38.3	4.1	MW	NRC	4.1	1631	
2001	11	11	1	31	50	50.400	-129.769	10.0	3.8	MB	ISC	3.8	1635	G
2001	12	20	13	6	23	50.941	-130.647	10.0	3.2	MW	NRC	3.2	1641	G
2001	12	23	20	47	17	50.571	-130.328	10.0	2.9	ML	PGC	2.9	1644	G
2001	12	25	20	28	18	55.362	-133.066	10.0	3.1	MW	NRC	3.1	1645	B
2002	1	12	4	54	22	51.125	-130.756	10.0	3.0	MW	NRC	3.0	1647	G
2002	1	16	5	46	27	51.776	-130.824	20.0	3.0	MW	NRC	3.0	1648	F
2002	1	18	4	37	58	55.874	-135.133	20.0	3.0	MW	NRC	3.0	1649	E

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID	Zone ID
2002	2	20	3	17	14	51.130	-131.100	10.0	5.1	MW	PGC	5.1	1654	G
2002	4	4	4	29	8	50.529	-130.414	10.0	5.0	MW	PGC	5.0	1658	G
2002	6	1	5	59	19	57.265	-134.790	10.0	2.9	ML	PGC	2.9	1662	
2002	6	6	15	37	54	50.081	-130.286	10.0	4.7	MW	NRC	4.7	1663	G
2002	6	9	7	11	39	50.844	-129.748	10.0	3.6	MW	NRC	3.6	1664	H
2002	6	12	10	42	16	54.346	-131.749	1.0	3.0	MW	NRC	3.0	1666	B
2002	6	22	15	8	33	56.590	-136.150	1.0	3.8	ML	PMR	3.8	1667	
2002	6	23	15	39	19	57.180	-137.260	10.0	4.0	ML	PMR	4.0	1668	
2002	7	10	3	53	40	57.657	-137.543	5.0	3.2	ML	PGC	3.2	1672	
2002	10	16	22	32	46	50.042	-129.513	15.0	4.3	MB	ISC	4.3	1680	G
2002	10	19	0	26	54	50.472	-130.132	10.0	2.9	ML	PGC	2.9	1682	G
2002	10	24	8	11	31	50.735	-130.429	10.0	2.9	ML	PGC	2.9	1683	G
2002	11	3	1	49	26	51.329	-130.951	10.0	5.8	MW	PGC	5.8	1685	G
2002	11	6	15	16	57	55.665	-134.222	10.0	2.9	ML	PGC	2.9	1697	B
2002	11	13	21	55	23	51.010	-130.396	10.0	3.1	MW	NRC	3.1	1698	G
2002	11	21	4	12	39	50.403	-130.406	10.0	3.1	ML	PGC	3.1	1699	G
2002	11	23	22	10	56	50.700	-130.560	10.0	4.5	MB	GS	4.5	1700	G
2002	12	11	17	13	1	55.350	-130.781	10.0	2.9	ML	PGC	2.9	1701	A
2002	12	13	15	51	31	50.174	-130.286	10.0	5.5	MW	PGC	5.5	1702	G
2003	1	25	17	47	26	57.752	-137.562	10.0	3.7	MW	NRC	3.7	1719	
2003	2	8	8	45	38	52.839	-127.587	1.0	2.9	ML	PGC	2.9	1721	A
2003	2	15	7	24	21	55.915	-136.054	10.0	3.4	ML	PGC	3.4	1722	
2003	2	22	4	20	31	54.272	-136.338	10.0	3.3	ML	PGC	3.3	1723	
2003	3	7	3	35	49	57.888	-137.975	1.0	3.9	MW	NRC	3.9	1726	
2003	4	23	12	28	18	57.745	-137.832	1.0	3.4	ML	PGC	3.4	1731	
2003	5	8	2	45	11	54.220	-131.650	17.0	3.5	ML	PGC	3.5	1733	B
2003	5	22	20	30	59	53.431	-135.551	10.0	3.2	ML	PGC	3.2	1736	
2003	7	22	3	52	5	57.490	-136.393	1.0	4.3	MW	PGC	4.3	1742	
2003	8	1	16	19	55	57.821	-132.865	1.0	3.2	ML	PGC	3.2	1747	
2003	9	22	10	52	46	53.260	-133.304	20.0	4.4	MW	NRC	4.4	1748	F
2003	10	6	19	26	2	53.606	-126.555	1.0	3.2	ML	PGC	3.2	1751	A
2003	10	20	18	38	4	50.010	-130.204	10.0	2.9	ML	PGC	2.9	1753	G
2003	11	11	15	55	2	50.115	-130.011	10.0	2.9	ML	PGC	2.9	1755	G
2003	11	28	23	19	38	51.833	-125.299	1.0	3.4	ML	PGC	3.4	1756	
2003	12	18	14	32	19	50.889	-129.830	10.0	3.1	ML	PGC	3.1	1758	H
2004	2	5	19	23	9	54.227	-133.982	20.0	4.2	MW	PGC	4.2	1764	E
2004	2	8	11	2	11	55.487	-135.069	15.0	5.3	MS	ISC	5.2	1765	E
2004	2	26	21	45	30	50.147	-129.776	10.0	4.1	MB	GS	4.1	1766	G
2004	2	28	2	5	17	50.952	-130.642	10.0	5.1	MW	NRC	5.1	1769	G
2004	3	10	8	30	37	51.416	-132.867	10.0	2.9	MW	NRC	2.9	1777	
2004	4	19	1	42	37	50.576	-130.477	10.0	3.7	ML	PGC	3.7	1778	G
2004	6	11	19	5	27	50.629	-129.861	10.0	3.9	MB	ISC	3.9	1779	G
2004	6	23	18	19	24	50.430	-130.250	10.0	4.0	MB	GS	4.0	1782	G
2004	6	24	14	52	21	50.249	-129.903	10.0	3.9	MB	ISC	3.9	1783	G
2004	6	28	9	49	46	54.795	-134.246	20.0	6.8	MW	NRC	6.8	1784	E
2004	7	3	23	7	20	50.030	-130.240	10.0	4.0	MB	GS	4.0	1790	G
2004	7	18	10	18	36	51.991	-131.355	20.0	4.2	ML	PGC	4.2	1794	F
2004	7	31	0	35	22	52.685	-132.067	20.0	4.9	MW	PGC	4.9	1798	F
2004	8	14	5	42	41	50.560	-130.400	10.0	3.2	ML	PGC	3.2	1799	G
2004	8	21	18	6	39	53.428	-131.669	12.2	3.8	MW	NRC	3.8	1800	C
2004	8	22	2	24	56	53.338	-133.238	20.0	2.9	ML	PGC	2.9	1802	F
2004	8	27	13	33	1	51.361	-131.334	10.0	3.5	ML	PGC	3.5	1804	G
2004	9	7	2	21	4	56.800	-131.370	5.0	4.2	ML	PMR	4.2	1806	A
2004	9	17	12	48	46	50.500	-130.315	10.0	3.4	ML	PGC	3.4	1808	G
2004	10	6	4	39	47	52.745	-127.308	1.0	4.2	MS	ISC	4.2	1809	A
2004	10	29	22	50	53	51.241	-131.089	10.0	3.4	MW	NRC	3.4	1810	G

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID	Zone ID
2004	11	2	17	20	53	50.962	-130.935	10.0	4.3	MW	NRC	4.3	1813	G
2004	11	10	1	16	6	56.985	-137.015	10.0	3.0	ML	PGC	3.0	1814	
2004	11	15	17	51	55	50.420	-130.211	10.0	5.0	MW	NRC	5.0	1816	G
2004	11	30	10	16	55	57.463	-133.178	1.0	3.6	MW	NRC	3.6	1819	
2005	3	3	8	24	15	53.779	-132.422	16.2	3.2	MW	NRC	3.2	1828	C
2005	3	11	15	28	21	50.311	-128.722	26.2	4.8	MW	NRC	4.8	1830	H
2005	3	15	10	35	19	50.731	-130.540	10.0	4.6	MW	PGC	4.6	1833	G
2005	3	23	22	10	9	50.853	-129.839	10.0	3.0	MW	PGC	3.0	1834	H
2005	3	27	23	53	32	53.787	-132.128	18.6	3.1	MW	NRC	3.1	1835	C
2005	6	9	14	0	46	51.448	-131.266	20.0	5.9	MW	NRC	5.9	1847	G
2005	6	28	3	57	18	55.301	-134.956	10.0	3.1	MW	NRC	3.1	1852	E
2005	8	11	15	44	5	56.991	-131.907	1.0	3.4	ML	PGC	3.4	1862	A
2005	8	11	7	24	38	50.068	-130.101	10.0	3.4	MW	NRC	3.4	1861	G
2005	9	27	16	52	23	52.724	-132.298	20.0	3.7	MW	NRC	3.7	1867	F
2005	10	24	3	54	27	52.809	-135.871	10.0	2.9	ML	PGC	2.9	1872	
2005	11	22	16	26	48	50.019	-130.030	10.0	3.6	MW	NRC	3.6	1874	G
2005	12	4	11	58	52	52.641	-132.403	20.0	3.1	MW	NRC	3.1	1877	F
2005	12	12	8	8	37	56.952	-131.898	10.0	2.9	ML	PGC	2.9	1878	A
2005	12	28	10	40	16	53.850	-131.442	22.1	4.3	MW	PGC	4.3	1881	C
2006	1	12	16	2	27	50.743	-130.456	10.0	3.0	MW	NRC	3.0	1882	G
2006	2	1	6	10	29	50.040	-129.572	10.0	3.7	MS	ISC	3.7	1883	G
2006	2	3	8	24	36	50.558	-130.310	10.0	3.4	MW	NRC	3.4	1884	G
2006	2	23	15	53	50	50.575	-130.375	10.0	3.0	MW	NRC	3.0	1886	G
2006	3	20	19	43	30	50.044	-130.223	10.0	3.5	MW	NRC	3.5	1890	G
2006	3	26	1	9	0	57.062	-136.583	5.0	3.9	ML	PGC	3.9	1892	
2006	3	29	4	10	19	50.028	-128.404	10.0	3.6	MW	NRC	3.6	1893	H
2006	5	10	12	57	57	50.062	-130.114	10.0	3.1	MW	NRC	3.1	1903	G
2006	6	4	8	56	30	50.658	-130.460	10.0	5.2	MW	NRC	5.2	1911	G
2006	6	8	9	57	26	56.934	-137.952	15.0	3.2	ML	AEI	3.2	1912	
2006	7	11	14	18	47	53.909	-133.452	20.0	3.1	ML	PGC	3.1	1929	E
2006	7	27	14	34	28	50.212	-130.209	10.0	3.2	MW	NRC	3.2	1936	G
2006	9	7	12	41	19	57.392	-132.615	1.0	3.6	MW	NRC	3.6	1947	A
2006	9	9	1	18	28	50.515	-129.316	10.0	3.3	MW	NRC	3.3	1949	H
2006	10	8	13	40	10	53.196	-133.013	20.0	3.1	MW	NRC	3.1	1969	F
2006	10	28	18	17	19	56.708	-137.004	10.0	3.5	ML	PGC	3.5	1977	
2006	11	17	1	7	25	57.533	-132.699	1.0	2.9	ML	PGC	2.9	1979	
2006	11	18	23	35	23	54.337	-137.569	20.0	3.7	ML	PGC	3.7	1981	
2006	11	28	10	37	16	52.301	-131.726	20.0	3.9	ML	PGC	3.9	1984	F
2006	12	10	10	7	45	53.737	-134.192	10.0	3.5	MB	ISC	3.6	1985	
2006	12	19	0	37	3	53.531	-135.498	35.0	3.8	MB	GS	3.8	1986	
2006	12	22	5	57	23	52.764	-132.397	20.0	3.0	ML	PGC	3.0	1993	F
2006	12	22	15	31	39	54.054	-133.836	20.0	2.9	MW	NRC	2.9	1994	E
2007	1	27	18	44	27	57.294	-136.794	20.0	3.8	MW	NRC	3.8	2009	
2007	2	14	3	14	10	50.066	-129.721	16.3	4.0	MB	ISC	4.0	2011	G
2007	3	7	3	38	9	55.558	-135.349	1.0	3.6	ML	PGC	3.6	2016	E
2007	3	8	8	0	14	57.898	-137.789	1.0	2.9	ML	PGC	2.9	2018	
2007	3	11	4	12	3	52.552	-132.457	20.0	3.0	ML	PGC	3.0	2022	F
2007	3	19	17	52	8	52.841	-132.859	20.0	3.2	ML	PGC	3.2	2024	F
2007	3	26	21	51	45	51.911	-131.801	20.0	2.9	ML	PGC	2.9	2025	F
2007	3	29	7	5	6	50.135	-130.350	10.0	3.5	MW	PGC	3.5	2027	G
2007	4	10	3	28	16	52.644	-132.363	20.0	3.0	ML	PGC	3.0	2029	F
2007	4	15	19	41	30	55.348	-134.929	20.0	3.2	ML	PGC	3.2	2031	E
2007	4	18	12	5	47	50.587	-129.934	10.0	3.0	MW	NRC	3.0	2033	G
2007	4	24	23	49	30	50.430	-130.356	10.0	3.4	MW	NRC	3.4	2034	G
2007	4	28	19	29	41	53.894	-133.643	20.0	4.7	ML	PGC	4.7	2037	E
2007	5	5	6	15	43	50.767	-130.049	10.0	5.0	MW	GCM	5.0	2038	G

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID	Zone ID
2007	5	27	8	36	44	56.178	-134.654	1.0	3.0	ML	PGC	3.0	2041	
2007	5	29	8	2	32	57.358	-137.003	10.0	3.3	ML	PGC	3.3	2042	
2007	5	30	9	43	26	52.687	-132.289	20.0	3.7	ML	PGC	3.7	2045	F
2007	6	11	1	14	18	50.246	-129.807	10.0	3.1	MW	NRC	3.1	2053	G
2007	6	24	5	38	29	57.345	-133.036	10.0	3.3	ML	PGC	3.3	2057	
2007	7	13	21	58	25	54.948	-129.168	5.0	3.2	MW	NRC	3.2	2063	A
2007	7	15	19	1	48	53.859	-131.686	27.3	4.3	MW	NRC	4.3	2064	C
2007	7	18	4	20	11	57.825	-133.672	20.0	3.4	MW	NRC	3.4	2065	
2007	8	5	23	34	42	52.461	-127.329	1.0	3.2	ML	PGC	3.2	2068	D
2007	8	8	20	45	51	53.166	-133.035	20.0	2.9	ML	PGC	2.9	2069	F
2007	8	14	12	21	7	57.859	-137.751	1.0	2.9	ML	PGC	2.9	2070	
2007	8	14	17	0	7	56.603	-135.530	5.0	3.4	ML	PGC	3.4	2071	
2007	8	21	8	53	22	57.330	-136.520	1.0	3.0	ML	PGC	3.0	2072	
2007	8	25	13	2	20	51.053	-131.001	10.0	3.0	MW	NRC	3.0	2073	G
2007	9	11	2	32	9	51.296	-130.848	10.0	3.4	MW	PGC	3.4	2079	G
2007	9	29	12	23	17	51.911	-126.491	1.0	3.5	ML	PGC	3.5	2082	A
2007	10	2	11	17	5	50.045	-130.233	10.0	4.2	MW	PGC	4.2	2090	G
2007	10	7	5	40	52	50.246	-129.576	10.0	4.5	MB	ISC	4.5	2095	G
2007	10	8	18	39	51	53.975	-133.712	20.0	3.4	MW	NRC	3.4	2096	E
2007	10	10	17	50	41	52.883	-124.073	26.7	3.9	MW	PGC	3.9	2097	A
2007	10	11	23	54	30	52.860	-133.294	10.0	3.4	MW	NRC	3.4	2099	F
2007	10	24	10	30	53	51.296	-130.877	10.0	2.9	ML	PGC	2.9	2100	G
2007	11	1	15	11	37	51.042	-130.595	10.0	3.1	ML	PGC	3.1	2103	G
2007	11	22	17	40	50	53.167	-135.489	10.0	3.2	MW	NRC	3.2	2105	
2007	12	5	15	1	50	51.111	-130.786	10.0	3.4	MW	NRC	3.4	2107	G
2007	12	8	3	59	53	51.375	-131.054	10.0	3.2	MW	NRC	3.2	2108	G
2007	12	12	23	39	59	52.102	-131.554	10.0	5.8	MW	GCM	5.8	2109	F
2007	12	22	4	51	46	54.655	-134.122	20.0	3.0	ML	PGC	3.0	2114	E
2007	12	26	16	59	50	53.332	-133.124	20.0	3.0	ML	PGC	3.0	2115	F
2008	1	5	11	1	6	51.254	-130.746	15.0	6.6	MW	GCM	6.6	2119	G
2008	1	17	12	49	31	55.131	-135.478	10.0	3.3	ML	PGC	3.3	2270	
2008	1	18	14	40	31	55.944	-129.755	5.0	3.1	ML	PGC	3.1	2273	A
2008	1	18	0	36	9	55.829	-128.650	1.0	3.2	ML	PGC	3.2	2272	A
2008	1	24	18	24	5	53.783	-133.382	20.0	2.9	ML	PGC	2.9	2281	E
2008	1	26	10	31	37	53.032	-134.993	10.0	3.4	MW	NRC	3.4	2284	
2008	1	28	9	47	47	53.518	-133.251	20.0	3.2	ML	PGC	3.2	2285	F
2008	2	5	12	19	6	50.750	-129.249	10.0	3.0	MW	PGC	3.0	2289	D
2008	2	10	21	12	40	57.101	-137.466	10.0	3.6	ML	PGC	3.6	2294	
2008	2	10	17	31	4	50.397	-130.077	10.0	3.6	MW	PGC	3.6	2293	G
2008	2	11	10	12	4	57.400	-125.547	1.0	4.1	ML	PGC	4.1	2295	
2008	2	12	8	39	37	50.751	-129.727	10.0	3.0	MW	NRC	3.0	2296	H
2008	2	20	3	33	10	50.004	-130.131	10.0	3.3	MW	NRC	3.3	2302	G
2008	2	25	22	43	53	52.620	-132.113	20.0	3.0	ML	PGC	3.0	2309	F
2008	3	18	2	20	4	50.185	-130.328	10.0	3.7	MW	PGC	3.7	2329	G
2008	5	6	2	33	33	50.527	-130.227	10.0	3.4	MW	NRC	3.4	2355	G
2008	5	16	14	22	30	52.710	-132.331	20.0	2.9	ML	PGC	2.9	2365	F
2008	6	28	15	49	37	53.065	-135.385	10.0	2.9	ML	PGC	2.9	2374	
2008	7	1	4	55	42	50.019	-128.709	10.0	3.6	MW	NRC	3.6	2375	H
2008	7	30	10	23	43	50.678	-129.924	10.0	2.9	MW	NRC	2.9	2382	G
2008	8	25	7	13	41	57.810	-137.752	5.0	2.9	ML	PGC	2.9	2395	
2008	8	27	20	17	35	50.228	-130.035	10.0	5.4	MW	GCM	5.4	2408	G
2008	9	8	14	2	48	50.991	-129.402	1.0	3.1	MW	NRC	3.1	2458	D
2008	9	13	10	57	45	54.241	-134.263	20.0	3.1	ML	PGC	3.1	2460	E
2008	9	23	8	4	33	50.660	-129.563	10.0	3.1	MW	NRC	3.1	2465	H
2008	10	2	15	39	44	55.801	-134.204	20.0	3.0	ML	PGC	3.0	2468	B
2008	10	5	21	58	22	53.150	-132.828	20.0	3.0	ML	PGC	3.0	2471	F

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID	Zone ID
2008	10	6	22	10	1	50.941	-129.972	10.0	3.2	MW	PGC	3.2	2474	H
2008	10	10	23	45	44	56.894	-137.035	10.0	3.5	ML	PGC	3.5	2476	
2008	10	19	22	34	17	55.451	-136.944	10.0	3.6	ML	PGC	3.6	2481	
2008	10	29	5	4	49	52.626	-133.123	20.0	3.4	ML	PGC	3.4	2484	
2008	11	4	0	48	32	52.831	-132.671	20.0	3.5	ML	PGC	3.5	2485	F
2008	11	9	1	1	26	52.654	-132.397	20.0	3.6	ML	PGC	3.6	2487	F
2008	11	11	6	25	26	55.805	-130.308	1.0	3.4	ML	PGC	3.4	2493	A
2008	11	14	5	25	51	50.051	-128.093	27.0	3.8	ML	PGC	3.8	2495	H
2008	11	30	9	35	41	55.730	-135.699	10.0	3.4	ML	PGC	3.4	2501	E
2008	12	23	0	0	39	55.932	-133.652	10.0	2.9	ML	PGC	2.9	2508	B
2008	12	29	23	25	33	53.950	-133.652	20.0	3.1	ML	PGC	3.1	2510	E
2009	1	4	2	53	16	50.525	-129.321	10.0	2.9	MW	NRC	2.9	2514	H
2009	1	8	19	19	42	56.556	-134.390	1.0	3.1	ML	PGC	3.1	2518	B
2009	1	10	6	5	51	50.740	-129.419	10.0	3.1	MW	NRC	3.1	2520	H
2009	1	15	13	4	26	56.031	-135.432	10.0	3.4	ML	PGC	3.4	2522	E
2009	1	19	20	11	7	56.088	-128.126	1.0	3.0	ML	PGC	3.0	2526	A
2009	2	27	3	59	25	52.879	-132.551	20.0	2.9	ML	PGC	2.9	2539	F
2009	3	20	8	17	9	56.151	-127.779	10.0	3.0	ML	PGC	3.0	2548	A
2009	3	22	6	10	57	55.336	-134.951	20.0	3.1	ML	PGC	3.1	2550	E
2009	3	23	20	27	50	53.887	-132.241	1.0	2.9	ML	PGC	2.9	2553	C
2009	4	2	4	52	27	50.931	-129.921	10.0	3.2	MW	NRC	3.2	2557	H
2009	4	8	21	53	34	56.177	-134.657	5.0	2.9	ML	PGC	2.9	2569	
2009	4	8	23	45	43	54.459	-137.001	10.0	3.0	ML	PGC	3.0	2570	
2009	7	3	3	6	41	53.783	-131.478	12.5	4.3	MB	ISC	4.3	2599	C
2009	7	15	7	44	49	50.623	-129.628	10.0	3.8	MW	NRC	3.8	2602	H
2009	8	14	17	22	18	50.095	-130.187	10.0	3.4	MW	NRC	3.4	2610	G
2009	9	24	7	40	29	55.674	-135.413	20.0	3.6	ML	PGC	3.6	2625	E
2009	10	9	18	42	44	52.858	-132.410	20.0	3.3	ML	PGC	3.3	2632	F
2009	10	10	7	56	23	55.475	-134.664	1.0	3.2	ML	PGC	3.2	2633	E
2009	10	12	11	10	3	50.469	-130.202	10.0	4.4	MW	PGC	4.4	2634	G
2009	10	16	8	23	43	50.064	-127.983	21.9	3.2	ML	PGC	3.2	2640	H
2009	10	20	1	51	50	56.559	-135.690	10.0	2.9	ML	PGC	2.9	2644	
2009	10	20	3	50	24	57.851	-133.197	1.0	2.9	ML	PGC	2.9	2645	
2009	10	23	15	17	47	52.398	-131.867	20.0	3.0	ML	PGC	3.0	2649	F
2009	10	31	17	26	28	50.073	-130.268	10.0	4.1	MW	NRC	4.1	2653	G
2009	11	8	20	18	33	54.898	-132.568	20.0	4.2	ML	OTT	4.2	2657	B
2009	11	9	4	7	6	57.699	-132.497	1.0	3.5	ML	PGC	3.5	2660	
2009	11	14	9	17	19	55.187	-134.547	20.0	3.0	ML	PGC	3.0	2665	E
2009	11	14	0	27	1	55.363	-135.486	10.0	6.4	MW	OTT	6.4	2663	E
2009	11	17	15	30	45	52.131	-131.397	3.3	6.6	MW	GCM	6.6	2668	F
2009	12	12	4	31	11	57.934	-137.787	10.0	3.0	MW	NRC	3.0	2706	
2010	1	10	3	6	54	50.252	-132.476	20.0	3.1	ML	PGC	3.1	2715	
2010	1	13	5	0	57	50.285	-130.175	10.0	3.3	MW	NRC	3.3	2720	G
2010	1	22	23	5	23	50.412	-129.137	10.0	2.9	MW	NRC	2.9	2726	H
2010	1	23	10	14	12	56.255	-134.665	20.0	3.2	ML	PGC	3.2	2728	
2010	3	31	3	3	46	53.396	-135.045	10.0	3.5	ML	PGC	3.5	2777	
2010	3	31	22	38	28	50.138	-130.404	10.0	3.5	MW	NRC	3.5	2781	G
2010	4	2	19	11	47	50.558	-130.263	10.0	3.7	MW	NRC	3.7	2783	G
2010	4	6	8	54	40	55.267	-134.043	10.0	3.6	ML	PGC	3.6	2787	B
2010	4	29	13	18	28	57.903	-137.951	1.0	2.9	ML	PGC	2.9	2801	
2010	5	5	18	26	37	55.069	-136.294	10.0	2.9	ML	PGC	2.9	2807	
2010	5	6	11	38	0	50.143	-129.968	12.0	3.6	MB	ISC	3.6	2808	G
2010	5	8	10	52	13	50.512	-130.387	10.0	3.8	MW	NRC	3.8	2810	G
2010	5	21	7	8	20	51.091	-129.840	10.0	3.0	MW	NRC	3.0	2817	H
2010	5	25	9	54	0	50.846	-129.795	10.0	3.2	MW	PGC	3.2	2820	H
2010	6	1	18	48	23	50.064	-129.984	10.0	2.9	MW	NRC	2.9	2822	G

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID	Zone ID
2010	6	19	22	16	51	54.840	-134.345	20.0	4.4	MW	OTT	4.4	2833	E
2010	6	25	3	8	34	50.811	-130.473	10.0	3.7	MW	NRC	3.7	2838	G
2010	6	25	2	22	41	51.062	-130.144	10.0	3.8	MW	NRC	3.8	2836	H
2010	7	2	7	57	59	52.604	-132.111	28.7	4.0	ML	PGC	4.0	2844	F
2010	7	9	18	47	21	51.697	-126.539	0.0	2.9	ML	PGC	2.9	2856	D
2010	7	21	11	44	3	51.042	-130.671	10.0	3.1	MW	PGC	3.1	2868	G
2010	7	28	6	28	14	51.271	-130.828	10.0	3.1	MW	NRC	3.1	2873	G
2010	7	29	4	12	12	52.376	-126.875	6.4	3.5	ML	PGC	3.5	2874	A
2010	8	13	22	28	18	50.872	-130.611	10.0	2.9	MW	NRC	2.9	2884	G
2010	8	17	11	37	53	50.568	-130.402	10.0	4.6	MW	NRC	4.6	2885	G
2010	8	27	15	4	39	54.758	-135.275	10.0	2.9	ML	PGC	2.9	2889	
2010	8	30	10	12	28	57.045	-137.625	10.0	3.5	ML	PGC	3.5	2892	
2010	8	30	9	12	19	56.212	-134.939	10.0	3.9	MW	OTT	3.9	2891	
2010	9	6	1	15	26	50.106	-129.975	10.0	4.3	MB	ISC	4.3	2895	G
2010	9	13	13	16	17	52.844	-132.516	20.0	2.9	MW	NRC	2.9	2912	F
2010	9	18	14	11	42	53.251	-133.135	20.0	2.9	ML	PGC	2.9	2915	F
2010	9	20	15	31	32	56.833	-134.625	1.0	3.8	ML	PGC	3.8	2917	
2010	9	24	7	36	32	50.940	-129.741	10.0	3.0	MW	NRC	3.0	2919	H
2010	9	28	14	32	45	57.595	-136.964	5.0	3.6	ML	PGC	3.6	2920	
2010	9	30	7	24	33	51.023	-130.623	10.0	3.1	MW	NRC	3.1	2922	G
2010	10	7	9	44	3	52.319	-126.868	1.1	3.4	ML	PGC	3.4	2925	A
2010	10	9	20	50	41	53.153	-135.546	20.0	2.9	ML	PGC	2.9	2927	
2010	10	31	22	52	26	51.030	-130.634	10.0	3.3	MW	NRC	3.3	2934	G
2010	11	1	11	19	50	53.047	-133.325	20.0	3.8	ML	PGC	3.8	2936	F
2010	11	2	15	46	46	51.273	-130.884	10.0	3.6	MW	NRC	3.6	2937	G
2010	11	7	0	24	53	54.586	-134.184	20.0	3.2	ML	PGC	3.2	2938	E
2010	11	18	13	41	26	51.663	-130.678	10.0	2.9	ML	PGC	2.9	2940	F
2010	12	8	18	40	58	56.617	-134.012	10.0	3.0	ML	PGC	3.0	2952	B
2010	12	9	13	11	40	50.210	-129.921	10.0	3.4	MW	NRC	3.4	2954	G
2010	12	9	1	15	49	51.393	-130.846	10.0	4.0	MW	NRC	4.0	2953	G
2010	12	14	16	37	50	54.330	-135.193	20.0	2.9	ML	PGC	2.9	2958	
2010	12	30	18	23	6	54.928	-134.842	20.0	3.0	ML	PGC	3.0	2975	E
2010	12	31	9	49	34	50.952	-130.755	10.0	3.8	MW	NRC	3.8	2976	G
2011	1	3	23	45	33	57.549	-132.871	10.0	2.9	ML	PGC	2.9	2981	
2011	1	29	7	58	28	50.624	-130.424	10.0	4.7	MW	NRC	4.7	2997	G
2011	2	6	3	40	36	56.166	-135.747	10.0	3.5	ML	PGC	3.5	3002	
2011	2	16	5	22	35	57.182	-132.900	1.0	2.9	ML	PGC	2.9	3015	A
2011	2	24	13	35	39	57.529	-137.263	10.0	3.6	MW	NRC	3.6	3038	
2011	2	26	17	0	50	55.281	-134.488	10.0	3.3	ML	PGC	3.3	3039	E
2011	3	2	19	37	35	57.758	-136.966	20.0	3.2	MW	NRC	3.2	3046	
2011	3	6	7	55	8	50.183	-129.666	10.0	3.3	MW	PGC	3.3	3051	G
2011	3	14	15	49	19	53.159	-129.106	10.0	3.0	ML	PGC	3.0	3054	D
2011	3	15	21	41	19	53.316	-133.203	20.0	3.5	ML	PGC	3.5	3055	F
2011	3	17	7	11	46	53.098	-132.789	20.0	3.8	ML	PGC	3.8	3056	F
2011	3	19	15	1	15	51.388	-131.308	10.0	3.5	MW	NRC	3.5	3057	G
2011	3	21	4	3	51	51.063	-130.761	10.0	3.4	MW	NRC	3.4	3059	G
2011	4	6	1	28	0	57.767	-133.357	1.0	2.9	ML	PGC	2.9	3068	
2011	4	7	15	23	45	50.215	-129.592	10.0	2.9	MW	NRC	2.9	3074	G
2011	4	13	20	43	1	51.215	-131.105	10.0	3.3	MW	PGC	3.3	3081	G
2011	4	27	18	51	47	56.508	-134.999	1.0	2.9	ML	PGC	2.9	3084	
2011	5	4	9	39	58	55.103	-134.418	8.5	3.6	ML	PGC	3.6	3090	E
2011	5	15	20	4	55	51.370	-131.363	10.0	3.2	ML	PGC	3.2	3099	G
2011	5	22	22	35	59	50.946	-130.224	10.0	3.1	MW	NRC	3.1	3103	G
2011	5	24	14	51	9	51.019	-130.675	10.0	3.0	MW	PGC	3.0	3105	G
2011	5	31	0	21	38	51.215	-131.116	10.0	2.9	MW	NRC	2.9	3108	G
2011	6	3	22	59	54	52.536	-132.233	20.0	4.0	MW	NRC	4.0	3109	F

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID	Zone ID
2011	6	8	20	17	12	50.511	-130.262	10.0	3.4	MW	NRC	3.4	3112	G
2011	6	14	21	33	18	57.858	-137.993	1.0	2.9	ML	PGC	2.9	3114	
2011	6	23	10	56	5	57.933	-137.200	1.0	3.3	ML	OTT	3.3	3117	
2011	6	27	14	34	1	50.853	-130.636	10.0	3.0	MW	PGC	3.0	3118	G
2011	6	29	0	58	30	51.366	-130.793	10.0	2.9	MW	NRC	2.9	3119	G
2011	6	30	8	17	28	54.097	-124.427	1.0	3.3	ML	PGC	3.3	3120	A
2011	7	10	1	24	58	52.680	-133.190	20.0	3.4	ML	PGC	3.4	3122	
2011	7	21	18	53	55	52.619	-132.155	20.0	3.3	ML	PGC	3.3	3123	F
2011	7	28	15	9	4	50.693	-130.520	10.0	3.0	MW	PGC	3.0	3125	G
2011	7	29	7	37	52	52.949	-132.578	20.0	3.3	ML	PGC	3.3	3126	F
2011	7	29	11	52	46	50.597	-130.221	10.0	2.9	MW	NRC	2.9	3128	G
2011	7	31	12	55	54	57.742	-137.190	1.0	3.3	ML	PGC	3.3	3129	
2011	8	10	1	49	6	50.764	-129.813	10.0	3.8	MW	PGC	3.8	3130	H
2011	8	18	15	37	40	51.747	-130.717	10.0	4.6	MB	GS	4.6	3133	F
2011	8	18	15	35	42	51.420	-131.010	10.0	4.9	MW	OTT	4.9	3132	G
2011	8	22	3	52	30	50.029	-130.135	10.0	3.4	MW	NRC	3.4	3139	G
2011	8	24	12	11	35	50.529	-130.223	10.0	2.9	MW	NRC	2.9	3140	G
2011	9	8	8	13	22	54.637	-129.353	1.0	3.0	MW	NRC	3.0	3148	A
2011	9	10	9	35	59	57.658	-133.805	5.0	3.4	MW	NRC	3.4	3151	
2011	9	29	5	19	50	50.096	-130.208	10.0	3.3	MW	NRC	3.3	3160	G
2011	10	1	16	30	47	55.240	-134.460	10.0	3.4	ML	OTT	3.4	3161	E
2011	10	14	0	50	0	53.467	-131.689	15.1	2.9	ML	PGC	2.9	3166	C
2011	10	15	18	58	44	57.540	-137.312	8.4	3.7	ML	AEI	3.7	3167	
2011	10	26	23	6	45	57.895	-132.625	5.0	2.9	ML	PGC	2.9	3172	
2011	11	5	20	46	43	56.679	-135.820	10.0	4.6	MW	NRC	4.6	3183	
2011	11	6	10	10	35	50.157	-130.217	10.0	3.5	MW	NRC	3.5	3185	G
2011	11	10	12	48	8	53.121	-132.630	20.0	3.9	ML	PGC	3.9	3196	F
2011	11	10	4	19	32	50.735	-129.838	10.0	3.3	MW	NRC	3.3	3193	H
2011	11	15	14	59	30	54.117	-131.650	0.0	3.3	ML	PGC	3.3	3199	B
2011	11	23	23	2	41	50.450	-130.130	10.0	4.9	MW	PGC	4.9	3208	G
2011	11	24	20	10	9	52.880	-132.132	20.0	3.1	ML	PGC	3.1	3210	F
2011	12	24	1	56	55	57.602	-132.806	10.0	2.9	ML	PGC	2.9	3221	
2011	12	25	5	27	52	57.693	-132.132	20.5	3.1	ML	PGC	3.1	3222	
2011	12	26	16	17	26	54.718	-132.967	20.0	3.4	ML	PGC	3.4	3223	B
2011	12	29	11	56	10	50.784	-129.756	10.0	3.4	MW	NRC	3.4	3224	H
2012	1	6	14	23	21	57.185	-131.938	1.0	3.5	ML	PGC	3.5	3229	A
2012	1	9	1	49	19	51.200	-127.353	10.0	2.9	MW	NRC	2.9	3231	D
2012	1	9	5	24	2	50.767	-128.764	10.0	3.4	MW	PGC	3.4	3232	D
2012	1	13	19	46	4	51.076	-130.720	10.0	5.3	MW	PGC	5.3	3234	G
2012	1	23	8	8	28	50.781	-129.787	10.0	3.4	MW	NRC	3.4	3244	H
2012	2	1	8	22	26	52.663	-131.811	20.0	3.3	ML	PGC	3.3	3246	F
2012	2	13	6	5	42	50.448	-129.064	10.0	3.8	MW	NRC	3.8	3249	H
2012	2	16	12	7	6	50.187	-127.819	17.4	2.9	ML	PGC	2.9	3250	D
2012	2	29	15	37	37	54.797	-134.999	20.0	3.5	ML	PGC	3.5	3258	E
2012	3	13	23	14	22	52.217	-127.082	4.7	2.9	ML	PGC	2.9	3269	D
2012	3	30	8	51	34	55.139	-134.003	20.0	3.1	ML	PGC	3.1	3272	B
2012	3	31	10	10	12	51.306	-131.332	10.0	3.8	MW	NRC	3.8	3273	G
2012	4	28	18	53	18	53.922	-133.756	20.0	4.2	ML	PGC	4.2	3297	E
2012	5	4	10	55	37	50.648	-130.241	10.0	5.0	MW	NRC	5.0	3330	G
2012	5	8	14	51	45	55.082	-134.830	20.0	3.7	ML	PGC	3.7	3337	E
2012	5	25	7	26	18	50.041	-130.256	10.0	4.4	MW	NRC	4.4	3363	G
2012	5	30	9	42	10	51.893	-131.782	20.0	3.3	ML	PGC	3.3	3366	F
2012	6	7	23	19	23	57.797	-124.844	0.0	4.4	MW	NRC	4.4	3371	
2012	6	9	19	13	17	50.170	-129.691	10.0	3.0	MW	NRC	3.0	3373	G
2012	6	15	20	54	34	52.673	-131.703	18.0	2.9	ML	PGC	2.9	3374	D
2012	6	17	16	9	48	55.705	-133.204	1.0	3.0	ML	PGC	3.0	3376	B

Year	Mo.	Day	Hr.	Min	Sec	Lat	Long	Depth (km)	Recorded M	Recorded M Scale	Agency	Mw	ID	Zone ID
2012	6	20	9	46	48	50.787	-129.522	10.0	2.9	MW	NRC	2.9	3378	H
2012	8	8	3	52	5	53.190	-132.943	20.0	3.7	ML	PGC	3.7	3388	F
2012	10	5	13	31	19	50.174	-128.560	10.0	3.4	MW	NRC	3.4	3402	H
2012	10	8	10	52	39	51.202	-131.159	10.0	3.5	MW	NRC	3.5	3403	G
2012	10	21	0	57	12	53.344	-132.258	20.0	2.9	MW	NRC	2.9	3409	C
2012	10	28	13	45	48	51.136	-130.292	10.0	4.1	MB	GS	4.1	3494	G
2012	10	28	3	4	8	52.788	-132.101	14.0	7.8	MW	UCM	7.8	3411	F
2012	10	28	14	46	3	50.794	-129.777	10.0	4.5	MW	NRC	4.5	3501	H
2012	10	28	17	5	10	51.574	-133.685	30.0	5.0	MW	NRC	5.0	3518	
2012	10	29	20	27	10	53.178	-134.042	1.0	3.7	MW	NRC	3.7	3646	
2012	10	29	5	32	35	51.270	-132.298	1.0	4.7	MW	NRC	4.7	3568	
2012	10	30	12	16	49	52.849	-133.739	11.0	2.9	MW	NRC	2.9	3690	
2012	10	30	4	39	57	51.314	-131.648	1.0	5.2	MW	NRC	5.2	3676	
2012	11	1	1	59	28	52.477	-133.957	1.0	3.2	MW	NRC	3.2	3785	
2012	11	1	20	24	26	50.527	-132.931	30.0	4.0	MW	NRC	4.0	3821	
2012	11	1	6	24	28	51.628	-132.447	24.2	4.6	MW	NRC	4.6	3800	
2012	11	5	8	12	51	51.519	-130.902	1.0	5.5	MW	NRC	5.5	3852	G
2012	11	5	20	15	58	52.210	-134.076	1.0	4.9	MW	NRC	4.9	3861	
2012	11	12	20	43	46	53.118	-133.504	4.0	4.0	MW	NRC	4.0	3881	F
2012	11	13	8	11	19	50.965	-133.556	35.0	3.3	MW	NRC	3.3	3895	
2012	11	16	6	24	30	53.814	-132.653	3.8	3.6	MW	NRC	3.6	3921	C
2012	11	20	8	9	59	50.560	-130.321	10.0	3.1	MW	NRC	3.1	3974	G
2012	11	24	10	36	55	57.166	-136.215	3.2	3.6	ML	PGC	3.6	4014	
2012	11	26	2	39	54	53.512	-133.830	2.0	3.1	MW	NRC	3.1	4024	E
2012	12	7	8	27	39	52.160	-134.947	31.1	3.8	MW	NRC	3.8	4104	
2012	12	23	19	8	34	50.501	-130.286	10.0	4.5	MW	NRC	4.5	4148	G
2012	12	25	17	39	26	50.212	-129.806	10.0	4.1	MB	GS	4.1	4157	G
2013	1	5	11	29	25	55.967	-135.959	3.3	3.0	ML	AEI	3.0	4191	E
2013	1	5	8	58	17	55.180	-134.995	10.0	7.5	MW	NRC	7.5	4171	E
2013	1	9	8	49	43	55.436	-136.793	20.0	2.9	ML	AEI	2.9	4249	
2013	1	18	1	42	7	50.861	-130.709	10.0	4.3	MW	NRC	4.3	4274	G
2013	3	25	0	41	21	50.925	-129.884	10.0	4.0	MW	NRC	4.0	4377	H
2013	3	27	5	32	32	50.224	-130.229	10.0	3.5	MW	NRC	3.5	4387	G
2013	4	12	17	27	9	50.550	-130.415	10.0	3.6	MW	PGC	3.6	4396	G
2013	4	27	21	41	39	50.483	-129.123	10.0	3.4	MW	NRC	3.4	4408	H
2013	4	29	20	19	50	56.324	-131.232	5.0	4.3	MB	GS	4.3	4410	A
2013	5	15	0	44	20	50.155	-130.064	10.0	3.1	MW	NRC	3.1	4425	G
2013	5	18	0	33	34	50.716	-130.585	10.0	3.3	MW	NRC	3.3	4427	G
2013	6	7	5	18	42	51.058	-130.597	10.0	3.1	MW	NRC	3.1	4438	G
2013	6	8	5	51	55	50.304	-130.259	10.0	3.2	MW	NRC	3.2	4440	G
2013	6	14	15	56	4	50.758	-130.518	10.0	4.1	MW	PGC	4.1	4445	G
2013	6	20	1	3	15	55.118	-137.618	10.0	3.5	ML	PGC	3.5	4449	
2013	6	26	19	59	44	51.256	-124.810	1.0	2.9	ML	PGC	2.9	4453	
2013	6	26	13	4	39	50.523	-130.210	10.0	2.9	MW	NRC	2.9	4452	G
2013	7	3	6	45	53	52.823	-134.346	10.0	2.9	ML	PGC	2.9	4456	
2013	7	5	13	39	28	50.224	-129.933	10.0	2.9	MW	NRC	2.9	4458	G
2013	7	5	13	52	35	50.088	-130.270	10.0	3.3	MW	NRC	3.3	4459	G
2013	7	26	12	57	22	50.242	-130.224	10.0	5.2	MW	NRC	5.2	4473	G

APPENDIX G2
TABLES OF ANNUAL HAZARD CURVES

NOTE: In the tables below the column labeled 'Haz' is the annual frequency of exceeding the corresponding Sa value at the project site.

Table G2-1. Site Class A Hazard Curves

Period (s) =	0		0.05		0.1		0.15		0.2		0.3	
Sa (g)	Haz	Sa (g)	Haz	Sa (g)	Haz	Sa (g)	Haz	Sa (g)	Haz	Sa (g)	Haz
0.0239	0.022943	0.0279	0.022705	0.0377	0.021978	0.0462	0.021565	0.0518	0.021468	0.0540	0.019865
0.0300	0.015831	0.0351	0.015634	0.0476	0.015040	0.0583	0.014777	0.0651	0.014791	0.0680	0.013730
0.0377	0.010481	0.0441	0.010370	0.0599	0.009960	0.0734	0.009796	0.0820	0.009810	0.0856	0.009186
0.0473	0.006675	0.0555	0.006587	0.0755	0.006340	0.0925	0.006251	0.1031	0.006288	0.1079	0.005929
0.0594	0.004074	0.0698	0.004025	0.0952	0.003885	0.1165	0.003857	0.1298	0.003879	0.1358	0.003712
0.0745	0.002398	0.0877	0.002370	0.1200	0.002302	0.1468	0.002296	0.1633	0.002312	0.1711	0.002239
0.0936	0.001354	0.1103	0.001344	0.1512	0.001324	0.1850	0.001325	0.2054	0.001331	0.2154	0.001306
0.1175	0.000739	0.1386	0.000740	0.1905	0.000741	0.2331	0.000741	0.2585	0.000738	0.2713	0.000730
0.1475	0.000389	0.1743	0.000396	0.2401	0.000405	0.2937	0.000403	0.3253	0.000395	0.3417	0.000390
0.1852	0.000197	0.2191	0.000207	0.3026	0.000217	0.3701	0.000213	0.4093	0.000205	0.4303	0.000200
0.2326	0.000096	0.2755	0.000107	0.3813	0.000116	0.4663	0.000111	0.5150	0.000102	0.5420	0.000096
0.2920	0.000046	0.3463	0.000055	0.4805	0.000061	0.5875	0.000056	0.6480	0.000049	0.6826	0.000044
Period (s) =	**0.5**		**0.75**		**1**		**1.5**		**2**		**3**	
Sa (g)	**Haz**	**Sa (g)**	**Haz**	**Sa (g)**	**Haz**	**Sa (g)**	**Haz**	**Sa (g)**	**Haz**	**Sa (g)**	**Haz**
0.0447	0.01877675	0.0394	0.01675775	0.0337	0.0157925	0.0223	0.01574925	0.0156	0.0158865	0.0093	0.01582475
0.0563	0.01313225	0.0497	0.0119025	0.0425	0.011314	0.0281	0.01138425	0.0197	0.011507	0.0117	0.011645
0.0708	0.00891825	0.0626	0.00821075	0.0536	0.00787775	0.0355	0.00794675	0.0248	0.00810125	0.0147	0.0082995
0.0891	0.00584025	0.0788	0.00549915	0.0675	0.005327575	0.0447	0.005391	0.0312	0.00551475	0.0185	0.00566925
0.1120	0.003697775	0.0993	0.003545025	0.0851	0.003475275	0.0563	0.003525625	0.0392	0.00360975	0.0233	0.0037125
0.1410	0.0022467	0.1250	0.002202925	0.1073	0.002181975	0.0709	0.002216	0.0494	0.002258875	0.0293	0.0023207
0.1773	0.001310575	0.1575	0.001303923	0.1353	0.001302468	0.0894	0.00132365	0.0622	0.001341925	0.0369	0.001373025
0.2231	0.000729188	0.1983	0.000732408	0.1706	0.000739213	0.1127	0.000746065	0.0783	0.000755298	0.0464	0.00076655
0.2807	0.000383628	0.2498	0.000386856	0.2151	0.000392494	0.1420	0.00039485	0.0985	0.000397883	0.0583	0.000400403
0.3532	0.000190276	0.3146	0.000190386	0.2712	0.000194067	0.1789	0.000194379	0.1240	0.000195233	0.0733	0.0001935
0.4444	8.81748E-05	0.3963	8.60988E-05	0.3419	8.7427E-05	0.2254	8.74265E-05	0.1561	8.69938E-05	0.0923	8.47905E-05
0.5591	3.76008E-05	0.4992	3.50112E-05	0.4311	3.52088E-05	0.2841	3.49442E-05	0.1965	3.48716E-05	0.1160	3.33893E-05

NOTE: In the tables below the column labeled 'Haz' is the annual frequency of exceeding the corresponding Sa value at the project site.

Table G2-1. Site Class A Hazard Curves continued

Period (s) =	4		5		6		7		8		9	
Sa (g)	Haz	Sa (g)	Haz	Sa (g)	Haz	Sa (g)	Haz	Sa (g)	Haz	Sa (g)	Haz
0.0063	0.0157525	0.0048	0.01558	0.0040	0.0150005	0.0034	0.014615	0.0029	0.01432025	0.0025	0.0139415
0.0079	0.0116845	0.0060	0.0116325	0.0050	0.0112575	0.0043	0.01086125	0.0037	0.01057025	0.0032	0.01025025
0.0099	0.00838025	0.0076	0.00821575	0.0063	0.00808125	0.0054	0.00786875	0.0047	0.0075495	0.0040	0.00752475
0.0125	0.00570775	0.0095	0.00570025	0.0079	0.0056215	0.0068	0.00547275	0.0059	0.0052895	0.0051	0.00517975
0.0157	0.0037595	0.0120	0.00373425	0.0100	0.0036835	0.0086	0.00361375	0.0074	0.00356575	0.0065	0.003419925
0.0198	0.002334675	0.0151	0.00233075	0.0126	0.002325375	0.0108	0.0023041	0.0094	0.00224455	0.0082	0.002196525
0.0249	0.00138355	0.0190	0.001383725	0.0159	0.001381975	0.0136	0.0013887	0.0118	0.0013738	0.0103	0.001358825
0.0313	0.000772075	0.0239	0.000775325	0.0200	0.000777175	0.0172	0.00077965	0.0149	0.0007827	0.0130	0.000790515
0.0393	0.000402778	0.0300	0.000407375	0.0251	0.000413558	0.0216	0.000416028	0.0188	0.000419675	0.0165	0.000427618
0.0494	0.000195238	0.0377	0.000197185	0.0316	0.000200685	0.0272	0.000204163	0.0237	0.0002103	0.0208	0.000219259
0.0621	8.55788E-05	0.0475	8.69928E-05	0.0398	8.92533E-05	0.0343	9.19178E-05	0.0299	9.63588E-05	0.0263	0.000104355
0.0781	0.000033694	0.0597	3.45825E-05	0.0501	3.58198E-05	0.0432	3.71249E-05	0.0377	4.01886E-05	0.0333	4.54401E-05

Period (s) =	10
Sa (g)	Haz
0.0022	0.0134425
0.0028	0.0099695
0.0036	0.00704675
0.0045	0.005015
0.0057	0.0033687
0.0072	0.0021878
0.0092	0.00132635
0.0116	0.000783523
0.0147	0.000434508
0.0186	0.000228253
0.0236	0.00011213
0.0299	5.09137E-05

Table G2-2. Site Class C Hazard Cuves

NOTE: In the tables below the column labeled 'Haz' is the annual frequency of exceeding the corresponding Sa value at the project site

Period (s) =	0		0.05		0.1		0.15		0.2		0.3	
Sa (g)	Haz	Sa (g)	Haz	Sa (g)	Haz	Sa (g)	Haz	Sa (g)	Haz	Sa (g)	Haz
0.0347	0.024095	0.0386	0.024170	0.0520	0.023325	0.0669	0.022675	0.0793	0.021893	0.0911	0.020014
0.0436	0.016686	0.0485	0.016754	0.0654	0.016139	0.0842	0.015670	0.0997	0.015156	0.1148	0.013840
0.0547	0.011128	0.0609	0.011172	0.0823	0.010733	0.1060	0.010445	0.1255	0.010104	0.1447	0.009270
0.0687	0.007116	0.0765	0.007148	0.1035	0.006883	0.1334	0.006704	0.1578	0.006505	0.1824	0.005998
0.0863	0.004364	0.0960	0.004393	0.1303	0.004230	0.1679	0.004143	0.1986	0.004024	0.2299	0.003748
0.1083	0.002576	0.1206	0.002584	0.1639	0.002510	0.2113	0.002470	0.2498	0.002400	0.2898	0.002264
0.1360	0.001460	0.1514	0.001462	0.2061	0.001438	0.2658	0.001420	0.3143	0.001376	0.3652	0.001318
0.1707	0.000793	0.1901	0.000796	0.2593	0.000794	0.3345	0.000785	0.3955	0.000757	0.4604	0.000737
0.2143	0.000413	0.2387	0.000418	0.3262	0.000424	0.4210	0.000417	0.4975	0.000398	0.5803	0.000393
0.2690	0.000205	0.2997	0.000212	0.4104	0.000220	0.5298	0.000214	0.6260	0.000200	0.7314	0.000199
0.3378	0.000097	0.3763	0.000105	0.5163	0.000112	0.6666	0.000106	0.7875	0.000096	0.9219	0.000095
0.4241	0.000044	0.4725	0.000051	0.6495	0.000056	0.8389	0.000051	0.9908	0.000044	1.1621	0.000042
Period (s) =	**0.5**		**0.75**		**1**		**1.5**		**2**		**3**	
Sa (g)	**Haz**	**Sa (g)**	**Haz**	**Sa (g)**	**Haz**	**Sa (g)**	**Haz**	**Sa (g)**	**Haz**	**Sa (g)**	**Haz**
0.0815	0.0184053	0.0666	0.0176875	0.0530	0.01763	0.0354	0.0178175	0.0254	0.018045	0.0160	0.01745
0.1026	0.0127705	0.0837	0.0123653	0.0665	0.0124108	0.0444	0.01268	0.0318	0.0130625	0.0200	0.0128175
0.1293	0.0085518	0.1052	0.0083123	0.0834	0.0083838	0.0556	0.0086498	0.0398	0.0090383	0.0250	0.0090398
0.1629	0.0055233	0.1322	0.0053548	0.1046	0.0053985	0.0696	0.0056153	0.0498	0.005976	0.0313	0.0060513
0.2052	0.0034303	0.1661	0.003291	0.1313	0.003295	0.0871	0.0034415	0.0623	0.003719	0.0392	0.0038385
0.2584	0.0020464	0.2087	0.0019231	0.1647	0.0018993	0.1091	0.0019808	0.0780	0.0021828	0.0491	0.0022863
0.3255	0.001171	0.2623	0.0010604	0.2067	0.0010266	0.1366	0.0010578	0.0976	0.0011864	0.0615	0.0012749
0.4100	0.0006378	0.3297	0.0005506	0.2593	0.0005169	0.1711	0.0005242	0.1221	0.0006036	0.0770	0.0006595
0.5165	0.0003285	0.4143	0.0002672	0.3254	0.0002405	0.2142	0.0002358	0.1527	0.0002763	0.0963	0.0003131
0.6505	0.0001599	0.5207	0.00012	0.4083	0.0001024	0.2682	9.494E-05	0.1911	0.0001146	0.1206	0.0001336
0.8194	7.227E-05	0.6544	4.951E-05	0.5123	3.918E-05	0.3358	3.344E-05	0.2391	4.041E-05	0.1510	4.914E-05
1.0322	3.002E-05	0.8224	1.838E-05	0.6428	1.334E-05	0.4205	9.822E-06	0.2992	1.209E-05	0.1891	1.544E-05

Table G2-2. Site Class C Hazard Curves continued

NOTE: In the tables below the column labeled 'Haz' is the annual frequency of exceeding the corresponding Sa value at the project site

Period (s) =	4		5		6		7		8		9	
Sa (g)	Haz	Sa (g)	Haz	Sa (g)	Haz	Sa (g)	Haz	Sa (g)	Haz	Sa (g)	Haz
0.0111	0.0174575	0.0087	0.01697	0.0072	0.01614	0.0062	0.0151425	0.0053	0.0145375	0.0046	0.01382
0.0139	0.0128875	0.0109	0.0125455	0.0091	0.0118585	0.0078	0.011239	0.0067	0.0107395	0.0058	0.0102445
0.0174	0.0091275	0.0137	0.0088693	0.0115	0.0083628	0.0099	0.0079248	0.0085	0.0076163	0.0074	0.0072208
0.0219	0.006108	0.0172	0.006003	0.0144	0.0057403	0.0125	0.0054058	0.0108	0.0051803	0.0095	0.0048533
0.0274	0.003919	0.0216	0.003855	0.0182	0.003701	0.0158	0.0035268	0.0137	0.0033928	0.0121	0.0031893
0.0343	0.0023673	0.0271	0.0023578	0.0229	0.0022878	0.0199	0.002216	0.0174	0.0021309	0.0154	0.0020291
0.0430	0.001338	0.0340	0.0013621	0.0289	0.0013362	0.0252	0.0013107	0.0221	0.0012824	0.0196	0.0012467
0.0539	0.0007002	0.0427	0.0007389	0.0364	0.0007404	0.0318	0.000746	0.0280	0.0007438	0.0250	0.0007354
0.0675	0.0003402	0.0536	0.0003685	0.0458	0.0003857	0.0402	0.000399	0.0356	0.0004087	0.0318	0.0004225
0.0846	0.0001483	0.0674	0.0001693	0.0578	0.0001858	0.0508	0.0002014	0.0451	0.0002161	0.0405	0.000233
0.1060	5.752E-05	0.0846	7.167E-05	0.0728	8.292E-05	0.0642	9.526E-05	0.0572	0.0001085	0.0516	0.0001243
0.1328	1.873E-05	0.1062	2.763E-05	0.0917	3.441E-05	0.0812	4.203E-05	0.0726	5.176E-05	0.0657	6.351E-05

Period (s) =	10
Sa (g)	Haz
0.0040	0.0133535
0.0052	0.0095178
0.0066	0.0067658
0.0084	0.0046425
0.0108	0.003043
0.0138	0.0019562
0.0177	0.001217
0.0226	0.0007407
0.0289	0.0004377
0.0370	0.0002501
0.0474	0.0001382
0.0606	7.346E-05

NOTE: In the tables below the column labeled 'Haz' is the annual frequency of exceeding the corresponding Sa value at the project site

Table G2-3. Site Class E Hazard Curves

Period (s) =	0		0.05		0.1		0.15		0.2		0.3	
Sa (g)	Haz	Sa (g)	Haz	Sa (g)	Haz	Sa (g)	Haz	Sa (g)	Haz	Sa (g)	Haz
0.0481	0.027860	0.0502	0.028663	0.0661	0.028090	0.0868	0.027720	0.1064	0.027090	0.1337	0.025173
0.0599	0.019515	0.0625	0.020120	0.0823	0.019698	0.1079	0.019503	0.1323	0.018998	0.1666	0.017528
0.0745	0.013123	0.0777	0.013540	0.1025	0.013220	0.1342	0.013152	0.1644	0.012798	0.2074	0.011736
0.0928	0.008393	0.0966	0.008679	0.1276	0.008472	0.1669	0.008467	0.2043	0.008236	0.2583	0.007526
0.1155	0.005113	0.1201	0.005271	0.1588	0.005164	0.2075	0.005181	0.2539	0.005030	0.3217	0.004596
0.1437	0.002951	0.1493	0.003026	0.1977	0.002972	0.2580	0.002994	0.3155	0.002895	0.4006	0.002664
0.1789	0.001597	0.1857	0.001622	0.2461	0.001606	0.3208	0.001616	0.3921	0.001553	0.4989	0.001451
0.2227	0.000802	0.2309	0.000808	0.3063	0.000812	0.3989	0.000805	0.4873	0.000765	0.6213	0.000735
0.2772	0.000370	0.2871	0.000372	0.3813	0.000381	0.4960	0.000367	0.6056	0.000339	0.7737	0.000340
0.3451	0.000154	0.3570	0.000158	0.4747	0.000165	0.6168	0.000151	0.7526	0.000133	0.9636	0.000141
0.4296	0.000057	0.4439	0.000062	0.5909	0.000066	0.7670	0.000055	0.9353	0.000045	1.2000	0.000051
0.5347	0.000018	0.5520	0.000022	0.7356	0.000024	0.9537	0.000018	1.1623	0.000012	1.4944	0.000015
Period (s) =	**0.5**		**0.75**		**1**		**1.5**		**2**		**3**	
Sa (g)	**Haz**	**Sa (g)**	**Haz**	**Sa (g)**	**Haz**	**Sa (g)**	**Haz**	**Sa (g)**	**Haz**	**Sa (g)**	**Haz**
0.1349	0.019995	0.1239	0.016665	0.1064	0.015504	0.0803	0.01532	0.0637	0.0142593	0.0419	0.013698
0.1682	0.01347	0.1543	0.011196	0.1326	0.0105423	0.1001	0.0106835	0.0795	0.0100673	0.0524	0.0098385
0.2097	0.0085795	0.1923	0.007082	0.1652	0.0067898	0.1248	0.0071108	0.0993	0.0067635	0.0655	0.0067741
0.2613	0.0051575	0.2396	0.0041963	0.2058	0.0041133	0.1556	0.0044761	0.1240	0.0043402	0.0819	0.0044571
0.3258	0.0028875	0.2985	0.0023065	0.2564	0.0023268	0.1940	0.0026562	0.1548	0.0026133	0.1024	0.0027788
0.4061	0.0014985	0.3720	0.0011634	0.3195	0.0012159	0.2418	0.0014692	0.1933	0.0014874	0.1281	0.0016297
0.5062	0.000715	0.4634	0.0005332	0.3981	0.0005816	0.3015	0.0007543	0.2414	0.0007869	0.1602	0.0008977
0.6310	0.0003076	0.5774	0.0002172	0.4960	0.0002506	0.3759	0.0003541	0.3015	0.0003816	0.2004	0.0004564
0.7866	0.0001171	0.7195	7.564E-05	0.6180	9.468E-05	0.4686	0.0001503	0.3764	0.0001695	0.2506	0.0002148
0.9805	3.902E-05	0.8964	2.129E-05	0.7699	3.009E-05	0.5842	5.548E-05	0.4701	6.568E-05	0.3134	8.975E-05
1.2222	1.073E-05	1.1169	4.711E-06	0.9593	7.652E-06	0.7283	1.734E-05	0.5870	2.227E-05	0.3920	3.323E-05
1.5235	2.203E-06	1.3917	8.273E-07	1.1952	1.498E-06	0.9080	4.347E-06	0.7330	5.957E-06	0.4902	1.01E-05

Table G2-3. Site Class E Hazard Curves continued

NOTE: In the tables below the column labeled 'Haz' is the annual frequency of exceeding the corresponding Sa value at the project site

Period (s) =	4		5		6		7		8		9	
Sa (g)	Haz	Sa (g)	Haz	Sa (g)	Haz	Sa (g)	Haz	Sa (g)	Haz	Sa (g)	Haz
0.0297	0.0136505	0.0231	0.013509	0.0188	0.0127893	0.0157	0.0121163	0.0133	0.0114163	0.0114	0.0107358
0.0372	0.0098543	0.0290	0.0097855	0.0236	0.0093348	0.0198	0.0088385	0.0169	0.0082595	0.0146	0.007686
0.0466	0.0068335	0.0363	0.0068348	0.0297	0.006536	0.0250	0.0062159	0.0214	0.0058128	0.0185	0.0054267
0.0583	0.004528	0.0455	0.0045646	0.0373	0.0044146	0.0315	0.0042291	0.0271	0.0039628	0.0236	0.0036883
0.0730	0.0028484	0.0571	0.0029036	0.0469	0.0028499	0.0398	0.0027546	0.0343	0.0026129	0.0300	0.0024541
0.0913	0.0016944	0.0716	0.0017575	0.0590	0.0017556	0.0502	0.0017263	0.0434	0.0016656	0.0381	0.0015927
0.1143	0.0009446	0.0897	0.0009996	0.0742	0.0010283	0.0633	0.0010371	0.0549	0.0010236	0.0485	0.0010011
0.1431	0.0004884	0.1125	0.0005321	0.0933	0.00057	0.0799	0.0005927	0.0695	0.0006052	0.0616	0.0006129
0.1791	0.0002337	0.1410	0.0002665	0.1174	0.0002965	0.1008	0.0003215	0.0880	0.0003433	0.0784	0.0003614
0.2242	0.0001006	0.1768	0.0001224	0.1476	0.0001445	0.1271	0.0001649	0.1115	0.0001854	0.0997	0.0002052
0.2807	3.78E-05	0.2217	5.065E-05	0.1856	6.433E-05	0.1603	7.967E-05	0.1411	9.5E-05	0.1268	0.000112
0.3513	1.215E-05	0.2780	1.813E-05	0.2334	2.645E-05	0.2022	3.562E-05	0.1786	4.631E-05	0.1613	5.772E-05

Period (s) =	10
Sa (g)	Haz
0.0100	0.010034
0.0128	0.0072018
0.0164	0.0050385
0.0210	0.0034458
0.0268	0.0023253
0.0342	0.001538
0.0437	0.0009925
0.0558	0.0006252
0.0713	0.0003815
0.0912	0.0002245
0.1165	0.0001266
0.1488	6.768E-05

APPENDIX G3
RESPONSE TO COMMENTS ON DRAFT REPORT

G3.1 - RESPONSE TO COMMENTS BY CLIENT

PRE FEED-LEVEL SEISMIC HAZARD STUDY
LNG TANK, ISBL, & OSBL AREAS
PACIFIC NORTHWEST LNG PROJECT
PETRONAS
LELU ISLAND , BRITISH COLUMBIA, CANADA

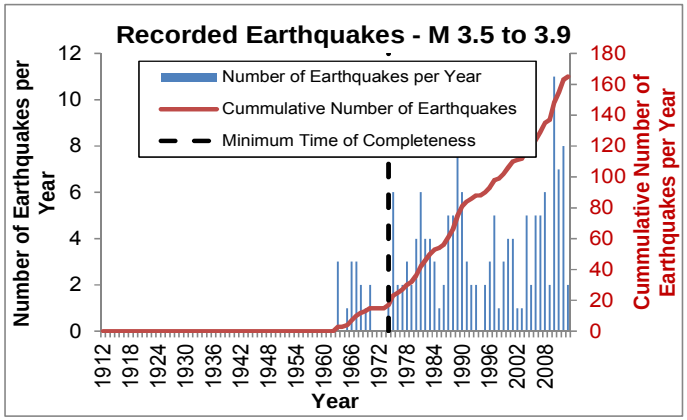
SUBMITTAL No: 04.10130058
SUBMITTAL DATE: 10/16/2013
COMMENTS DATE: 10/23/2013
RESPONSE DATE: 11/01/2013

RESPONDER: **Fugro**

Comment No.	Page No.	Reference	Comment	Response
1	1-3	Table 1-1	Horizontal Peak Ground Acceleration Estimates per site class. What is the basis of the estimate for the PGA values?	Table 1-1 provides an executive summary of the detailed results presented in Section 4. The PGA values(i.e., based on Sa(@0.01s) are based on site-specific probabilistic seismic hazard analyses (PSHA) conducted for this project and discussed in detail in Section 4. The word "estimates" will be deleted from Table 1-1 title in the Final report.
2			Knowing that based on the NCBC 2010 the values for the PGA (g) for Site Class C are 0.095 for the return period 475-year and 0.179 for return period 2475-year. The site specific is indicating an increase of 24% for 475-year return period and 21% for the 2475-year return period. The explanation in section 4.6 for this increases that is not due only to the inclusion of the deterministic 84th percentile spectral response for the Cascadia subduction zone earthquake scenario which is requirement from Z276-11, but also to other factors. The results of this study (Table 4-3) and Fig4-8a do not reflect the statement that “The spectral accelerations from this PSHA study are similar to the NBC values at PGA”. Some horizontal spectral acceleration almost double comparing values from Table 4-3(p4-9)	Section 4.6 reads "The spectral acceleration from this PSHA study are similar to the NBC values at PGA, but generally larger at longer structural periods." We will revise the text to read "The spectral acceleration from this PSHA study are overall larger than NBC. For short periods site-specific spectral values are about 25% larger than NBC values. For intermediate and long structural periods (e.g., Ts > 0.2s) site-specific spectral acceleration are 50% to 100% larger than respective code values. The differences between Fugro's site-specific study and 2010 NBC are associated with the PSHA results and not with the deterministic Cascadia spectrum. In general, the 2010 NBC ground motions are based on source model parameters and attenuation relationships that have been superseded in most recent years. The design spectra presented in Table 4-3 were developed for site - specific Probabilstic Seismic Hazard Analyses (PSHA) conducted for three different site class conditions, A, C, and E. These spectra were not developed by using code-based amplification factors.

Comment No.	Page No.	Reference	Comment	Response
3			If the deterministic 84th percentile response for the Cascadia subduction zone earthquake has impacted the results of the site specific and the PGA values are correct than these values will be used only for the LNG tanks and its impounding systems and components including the fire protecting system. So what is the site specific results would be based on NCBC-2010 criteria? These results must be added to this report as they are needed for the rest of the plant.	The 84th percentile deterministic response spectrum for Cascadia is lower than the Uniform Hazard Spectrum from PSHA across the entire range of structural periods. Therefore the SSE spectrum provided is not effected by the Cascadia deterministic spectrum. We can provide the design spectra per the NCBC 2010 in the final report. However it should be noted that the NCBC maps are based on a old seismic source model and attenuation relationships which have been superseded by more recent studies. As such using these maps may results in unconservative estimates of seismic demands. We recommend that the results from the site specific study presented in this report (i.e., site-specific SSE) be used for design.
4	3-2	Table 3-1	Empirical Relationships correlation Maximum Magnitudes with the Source Dimensions Correct most of the empirical formula; the general form is Mw=a*log(A)+b (Replace the (*) with(+))	These equations will be corrected in the final report.
5			P4-9 Section 4.6 (Open File report 6761 is listed “in preparation”) Are the results of this study valid without including this data in this study?	Fugro's study is based on a project-specific and site-specific source model, developed using the latest knowledge and understanding in the fields of source characterization and strong ground motion. The input parameters used to develop the 2010 NBC ground motion recommendations are not available at this time (report in preparation). However, based on information from other sources (e.g., http://earthquake.usgs.gov/hazards/about/workshops/CEUS-WORKSHP/2.22.2012/AdamsHalchuk2012Canada4posting.pdf), we infer that the 2010 NBC maps are based on seismic hazard models created in early-mid 1990s. Overall, due to the absence of documentation we are not able to directly compare the Fugro's site-specific study and the input parameters used in the development of the 2010 Canadian National Hazard maps and 2010 NBC maps.
6			Include a key map for the site showing the areas for different Site class location.	Such a map cannot be developed at this phase of the study due to the limited number of explorations available in the onshore areas which don't allow the interpolation and detailed delineation of zones with different site class attributes. A preliminary interpretation of the extent of soft soils is presented on Plate 20 of the "Pre FEED-Level geotechnical study report". Additionally, a preliminary figure with the thickness of soft sediments (which correlates to site class) is shown on Figure 4-1. Additional explorations, on a denser grid, are proposed as part of the FEED level study. These will allow the development of more detailed maps illustrating the extent of different soil profile types in the onshore areas.
7			This is a Pre-FEED level report. For our understanding what more will be added to this report to make it FEED Level or EPC Level report for PSHA, Onshore?	The following revisions/updates may be included in FEED level: 1) detailed characterization of Vs,30 and site class across onshore areas, 2) update of PSHA taking into consideration the possible presence of active faults onshore, 3) update of PSHA using the latest Ground Motion Prediction Equations (currently under development by PEER) if available at the time of the FEED level study.

Comment No.	Page No.	Reference	Comment	Response
8	1-2		Page 1-2 states that PSHA were conducted to develop earthquake ground motion estimates at one representative location. Can you identify that location and how was the location selected?	The representative location was taken at the center of the Island and the coordinates are provided in (Table 4-1). Overall, because the seismic sources contributing to the ground motion are at large distances from the site, the estimated *rock* spectral accelerations is similar across the site. For the nearshore area PSHA was conducted for a second location selected at the intersection of the trestle with the dock. The estimated *rock* ground motions (site class A) are within about 5% across all structural periods. Hence, selecting one single location for the purpose of developing rock ground motions for the onshore area was considered appropriate.
9	1-4		Page 1-4, last bullet implies that soil liquefaction is not an issue for the Onshore part of the site, especially after the site is brought to the proposed final grade elevation. Fugro to confirm KBR's interpretation.	This interpretation is based on a limited number of explorations. Based on the available explorations it appears that liquefaction hazard may be negligible in the onshore areas. However, this conclusion should be confirmed during the FEED level study based on liquefaction hazard analyses conducted for the additional planned explorations. The geotechnical report recommends removal of the soft soils (peat, clay, silt) and replace with crushed phyllite or imported aggregate. If left in place, soft soils (clay, silt, peat) may undergo significant cyclic softening and reduction in strength (as noted in Section 5.3). Although the strength loss in these soils may not be classified as 'liquefaction' as it is the result of change in soil structure and not excess pore pressures, the consequences of cyclic softening can be similar to liquefaction (excessive deformations, settlement, loss of soil resistance to bearing, etc.). The extent of these soils (below final grade) will also be delineated during FEED level study based on the a larger amount of explorations.
10	1-4		Page 1-4, Section 1.5, second sentence of second paragraph as the letter "l" missing in the word "lt".	This will be corrected in the final report.
11	2-5		Page 2-5, third sentence needs space between the words "to occur".	This will be corrected in the final report.
12	3-2		6. Page 3-2, Section 3.1.1.1 makes reference to Fig. 3-1. Where is Fig. 3-1, or did you mean Table 3-1?	Figure 3-1 is at the end of section 3. All figures are shown at the end of each section.
13	3-3		Page 3-3, first paragraph-What is the difference between the second and third rupture scenario considered? These two scenarios are identical.	The text will be reworded to clarify that 80% weight is given to the segmented model and the multi-segment rupture model (weighted 20%) is further broken down into 3 possible scenarios (with different slip rate estimates). This will be clarified in the final report.

Comment No.	Page No.	Reference	Comment	Response
14	3-12	Table 3-4	Table 3-4 on page 3-12 shows Completeness Interval of Seismicity Catalog. Please help us explain how this table was developed.	The completeness interval is the number of years before present time for which the catalog can be considered to have recorded all earthquakes in the magnitude ranges tabulated. For example, before 1975 (38 years before present time) it is estimated that the number of earthquakes with Mw 3.5-3.9 is not accurate. This is because seismograph stations were fewer or older equipment would not be triggered by such small events. This has been evaluated using the 'slope method' where the cumulative number of earthquakes with time is plotted and the year the rate of recorded earthquakes reduces, is taken to be the last year the catalog is complete for the magnitude range of interest. An example of how the completeness interval is established is shown in the figure below. 
15	4-6		Can you include in this report the profile of the shear wave velocity measured in the field along with the sub-soil conditions revealed by that borehole?	Figure 4-2 does present shear wave velocity measurements for boring BH-14 onshore. We will supplement this figure with boring log BH-14 in the final report.
16			Generally the national codes, such as the Canadian Building Code, will have quite conservative ground accelerations for a given area because the accelerations are not developed site specific. This study is site specific but the ground accelerations appear to be higher than those selected from the code.	In general, code maps are based on regional studies which may not characterize in detail the seismic sources around any given site. Additionally, seismic codes are updated more infrequently than the advancements in the fields of seismic source characterization and strong ground motion. Conducting a site-specific study allows one to design for smaller than code levels provided that such design is warranted. However, conducting a site-specific study allows for the owner to incorporate the most recent knowledge available and obtain a better assessment of the level of risk. The site specific study developed for this project incorporated the latest developments in ground motion prediction equations (GMPEs), was based on a current seismic catalog, and a detailed characterization of all seismic sources within approximately 300 km from the project site. Based on our review of the limited available information related to the 2005 and 2010 NBC hazard maps, it appears that these maps are based on source models dating back to the 1990s, which may be outdated.

G3.2 - RESPONSE TO COMMENTS BY OWNER

- **Modeling of fault sources vs. areal sources**. We suspect that a problem exists with the overall Logic Tree (LT) adopted in the analysis: a clear representation of such Logic Tree (LT) should be provided in the first place, because the description of the general branch dealing with the fault sources (FS) looks incomplete. In our understanding there should be two general LT branches, each with its own weight, providing alternative representations of the earthquake sources, one dealing with shallow crustal Areal Sources (ASs) and one dealing with Fault Sources which should also include the lower level seismicity. Both these representations should be complete, in the sense that both should independently account for all the seismic activity in the considered region. We think that the first, AS branch is described with sufficient clarity and is OK, with the source parameters summarized in Table 3.2c, while the second. FS branch looks incomplete to us. As a matter of fact, Tables 3-2a and 3-2b only provide parameters for the characteristic earthquakes and ruptures associated to Fault Sources, but nothing is said for the smaller events, having M, say, < 7.3 or so. We find only mentioned in the lower half of p. 3-12 , in connection with the truncated normal model, that "*Events of smaller magnitudes were accommodated within the surrounding areal source zones*", but no explanation is provided in the sequel as to how these smaller magnitude events are actually dealt with in the analysis. A correct description of the second branch actually requires including also the events with M < Mchar, with a treatment similar to that of the AS, but smaller values of Mmax (e. g. 7.5), perhaps adopting larger ASs than in the first branch. Such area sources, in which the FSs are embedded, are sometimes called BG ("background") sources. Since the largest magnitude (characteristic) events are taken out of the BG sources, the G-R and associated parameters of the truncated exponential model need in general to be re-calculated. Typically, if we expect characteristic earthquakes in the M 8+ range on the fault sources, the values of Mmax in the BG sources would not be expected to exceed 7.5-to-7.7.
We strongly recommend that this aspect be properly clarified in connection with the LT and, updated calculations be performed to account for the BG activity in the FS branch, if necessary.

- **Please see responses to repeat comments below.**

- **GMPEs.** Notwithstanding the statements to the contrary of both the report and the GMPE authors, the NGA GMPEs adopted should not be used for M > 8 without proper support because they are not constrained by data for Mw > 7.9 (see Figure 2 of the Chiou at al. article "NGA Project Strong-Motion Database" on Earthquake Spectra, Vol. 24(1), pp. 23–44, February 2008). Only the Boore and Atkinson (2008) GMPE has a stated upper bound of applicability (Mw 8.0) consistent with the limitations imposed by the data. Hence, to blindly use the GMPEs of Table 4-2 up to Mw 8.4, as required by the Mmax values adopted in the analyses, looks unwarranted, and needs to be adequately justified, possibly through numerical simulations.

Although GMPEs are being extrapolated (and therefore have greater uncertainty in the large magnitude range) these models are constrained with magnitude saturation. Note they also have limited distance applicability (R<200km, see discussion on page 4-3 of report). For these reasons we have proposed the newly released (or to be released) final NGA-West2 models which have larger distance and magnitude applicability for the FEED level study. The use of numerical simulations is well beyond the scope of our pre-FEED level study.

Comment number	**Reference Section**	**Comment/Question** **Pre Feed-Level Seismic Hazard Study LNG Tank, ISBL & OSBL Areas Pacific NorthWest LNG**	**Response/approach**
1	General	This review was performed recognizing that the report is marked draft, limited site-specific seismologic information is available, and available regional seismic information is limited and/or incomplete. As such, the review was performed at a high level and an in-depth review of technical elements (e.g., detailed review of the fault parameters, detailed review of the processing of the seismological database, etc.) was not performed. The final report would benefit from thorough technical editing and more descriptive figure captions.	Noted. This will be addressed in the final report.
2	General	The report does not specify the design code or standard that is the basis of the work. The report references CSA 7276-11 in a few locations and no other code or standard is found in the references, and so it is assumed in this review that this is the only design code considered for the work. The report would benefit from an explicit statement of the design codes or standards that the work is intended to meet.	The description of the design code used can be found in the report: -Summary , Page 1-3, second bullet -Definition of Deign Levels, Section 4.4 The design code used is also consistent with what was specified in Fugro's proposal.

Comment number	**Reference Section**	**Comment/Question** **Pre Feed-Level Seismic Hazard Study LNG Tank, ISBL & OSBL Areas Pacific NorthWest LNG**	**Response/approach**
3	Section 2 and Section 3	A fundamental shortcoming of the PSHA model is the lack of consideration of the Cascadia Subduction Zone. The Cascadia is a major seismic source that daylights beyond the 350 km radius considered in the study, but is capable of producing maximum magnitudes significantly higher than those of the faults considered in the study. Subduction zones of this type have been responsible for major recent seismic events such as the 2011 Tohoku earthquake (and tsunami) and the 2004 Indonesian earthquake (and Indian Ocean tsunami). PSHA models, particularly those for important, critical, or hazardous facilities, should include all sources that could have impact on the ground motion at the site of interest over the time periods of interest. It is likely that this source would have a significant contribution to hazard at the site, particularly in the long period range that is of interest to an LNG facility. Further, it is inconsistent to have the Cascadia omitted from the PSHA when it is the only source considered (or at least discussed) for the deterministic seismic hazard analysis (DSHA). The Cascadia Subduction Zone should be included in the PSHA model.	The primary reason for not considering Cascadia in the PSHA is the design code (CSAZ276-11, Section 7.1.5.4, item c.) specifically says that it should not be considered. The code specifies that Cascadia should only be considered as a deterministic lower limit on the SSE design spectrum. (See section 4.7 of the report). Additionally, the Cascadia subduction zone is approximately 500 km from the project site and is not expected to contribute to the hazard. Please note that the ~ 500 km distance to Cascadia lies well beyond the 300 km valid range of the GMPEs used for the deterministic results. (Atkinson and Boore (2003), and Zhao et al (2006)).

Comment number	Reference Section	Comment/Question Pre Feed-Level Seismic Hazard Study LNG Tank, ISBL & OSBL Areas Pacific NorthWest LNG	Response/approach
4	Section 2 and Section 3	A second set of seismic sources that seems to be excluded without sufficient justification are the sources that lie between the Coastal depression and the Coast Mountains, as show on Figure 1-2. Of particular interest is the Grenville Channel fault because the fault, if active, could have an impact on the seismic hazard of the site due to its proximity. The report states that the fault is inactive based on a lack of observed geomorphic expression indicating quaternary activity (see pages 2-2 and 2-3). No reference is provided to support this statement and there is no additional discussion or evidence provided. A further discussion of this point is warranted given that this is negative evidence and strike-slip faults are not always well expressed topographically (geomorphologically) Other information provided in the report may indicate activity of the fault. However, this information is not discussed. The conservation of slip rate and plate velocity (shown in Figure 2-2 (a) and Figure 2-2 (b)) may indicate activity but are not discussed in the report. Figure 2-2 (a) appears to show that the relative motion of the Pacific and North American plates is not fully accounted for in the seismic sources used in the PSHA model at the latitude of the site (as annotated on the figure at the end of the discussion of comment 4).	As there is no basis for declaring the fault active and no information available on slip rates, the GCF has not been explicitly modeled in the PSHA. That is not to say that earthquakes along the GCF and other identified parallel faulting features are not accounted for in the PSHA. The purpose of the Areal Sources (which surround the GCF, Principe Laredo Fault, and others) is to account for earthquakes along faults which are not clearly defined in terms of a) activity, b) slip rate, or c) geometry. The currently available information provides us the following basis for assuming the Grenville Fault is inactive: 1) All faults around the Grenville Channel Fault have been identified in the literature as inactive 2) There are no seismicity clusters along the Grenville Channel Fault to suggest that it is currently active. Also, there is no geologic or geodetic information available from which a slip rate can be inferred. The GCF is offshore and will be further evaluated as part of offshore investigations during FEED level studies. But, with the currently available data, there is no basis for including the GCF as fault source in the PSHA and therefore the seismicity in the area has been accounted through areal sources. An enhanced review of geomorphic and published evidence of “old” fault activity will be added in the final report including: 1)Geomorphic evidence 2)Fault activity rating criteria’s 3)Fault is part of a class of faults associated with accretion and no post dating activity.

Comment number	**Reference Section**	**Comment/Question** **Pre Feed-Level Seismic Hazard Study LNG Tank, ISBL & OSBL Areas Pacific NorthWest LNG**	**Response/approach**
5	Section 2 and Section 3	Figure 2-2 (b) seems to show a discontinuity of plate motions on either side of the Grenville Channel fault. The figure at the end of the discussion of comment 4 (below) has been annotated to show the approximate location of the fault as noted in Figure 1-2 and 2-1 and a significant change in the trajectory of the two areas on either side is apparent. Lastly, Figure 2-3 (also annotated below) appears to shows two seismic events with magnitudes of interest on or near the mapped fault trace. The lack of inclusion of this fault in the logic tree implies that there is no uncertainty about the inactivity of the fault. Because the fault is in the immediate proximity to the site, a stronger case for inactivity should be made. The discussion provided is not compelling enough to exclude a potentially important seismic source from the logic tree.	We will discuss fault activity criteria in the final report including the criteria to be considered a line source in the seismotectonic model. Shallow marine seismic pre-feed indicates no active faults and FEED level work is further addressing the documentation of these features.
6	Sections 2 and 3	It is hard to understand by reading the report how the source slip rates (and their uncertainties) are used in the development of the magnitude-recurrence relationship of the individual sources, including in the development of the maximum magnitude distribution of the sources. The report would benefit from a clearer discussion of how the slip rates (and their uncertainties) were used in development of the source parameters.	Uncertainties in slip rates and magnitude potential is considered by using 3 different slip rates and 3 maximum magnitudes (i.e. 9 scenarios with weights summing to 1.0). The magnitude-recurrence for fault sources is developed using the equation on page 3-15 for each of the weighted scenarios (based on the slip rate, fault area, Mmax, and magnitude pdf). We will include the logic tree and individual recurrence for each fault source in the final report.

Comment number	**Reference Section**	**Comment/Question** **Pre Feed-Level Seismic Hazard Study LNG Tank, ISBL & OSBL Areas Pacific NorthWest LNG**	**Response/approach**
7	Sections 2 though Section 4	Section 2 provides a discussion of the seismotectonic setting, Section 3 provides a discussion of how the model parameters are developed, and section 4 provides a discussion of the PSHA model itself. However, missing from these sections is a discussion of how information such as the overall slip rate or regional moment balance is used to enhance or constrain the PSHA model in terms of the seismicity assigned to the various seismic sources. It does not appear that there was an effort to assure that there are not gaps or overlaps in the logic tree as it relates to the regional slip rate and seismic moment budgets. In an area where limited data is available, this type of assessment can build assurance that the model is accurately addressing and capturing the regional seismicity. This type of assessment can also help to constrain appropriate maximum magnitude ranges. The model and the report would benefit from a more robust (or perhaps more transparent) treatment of regional slip and moment budgets as it relates to source parameter and model development.	The slip rate was used in development of on-fault earthquake recurrence. -The slip rate, fault dimensions, and Mmax were used to derive magnitude recurrence for faults. Comparisons of the seismicity and recurrence model are shown in Figures 3-5a through 3-5e. The compatibility of the slip rates and implied magnitude recurrence for QC sources (areal and embedded faults) is show on Figure 3-5a and it will be decomposed into the different sources (areal sources and faults) to illustrate the logic tree. With regard to moment-balancing of multi-segment ruptures, this is discussed in section 3.2.4.2.

Comment number	Reference Section	Comment/Question Pre Feed-Level Seismic Hazard Study LNG Tank, ISBL & OSBL Areas Pacific NorthWest LNG	Response/approach
8	Section 2.2 and 3.2	The magnitude conversion is not well explained in the report. The relationships used are provided without references, are not explained; and the approach to addressing uncertainty in the conversion factors is not discussed. A significant amount of work on this topic has recently been performed in the nuclear industry (see US Nuclear Regulatory Commission Report NUREG 2115). A review of this recent work may benefit this project. The Fugro report would benefit if the approach to conversion was better explained and the approach to capturing uncertainties related to conversion within in the PSHA model was made more transparent.	The magnitude conversions are based on regression specific to the source catalogs utilized and will be documented in the final report. We are familiar with the CEUS NRC study. This study was performed over a period of 3 years and was part of a Senior Seismic Hazard Analysis Committee (SSHAC) Level 3 assessment process sponsored by EPRI, DOE and NRC and completed in 2011. At the time of the study the Technical Integration Team for the seismic source modeling task comprised primarily Fugro geologists. Although a SSHAC Level 3 assessment is beyond the scope of this project, we are familiar with the framework and apply key components to our projects as needed. The analyses conducted for this study is compatible with FERC's requirements for similar projects. Please note that deaggregation plots (Figs. 4-6) indicate that the Queen Charlotte Fault Zone dominates the hazard. Because the recurrence of controlling magnitudes does not depend on historical seismicity further refinement of the catalog is unlikely to produce significant differences in the hazard results. Also note the Canadian hazard map approach does not use a magnitude conversion. As such, the reported conversion represent an improvement on existing studies.
9	Section 3	The development of maximum magnitudes for fault sources using the wells and coppersmith and Hanks and Bakun methods considers uncertainties due to the geometry of the faults but ignores the uncertainties inherent in the relationships. This uncertainty, which comes, in part, from the aleatory variability, should also be assessed and carried through the model.	The aleatory variability in Mmax is accounted for by means of a truncated normal magnitude probability density function. Please see bottom of page 3-12 and Figures 3-3a and 3-3b to see how aleatory variability is included in the magnitude modelling.

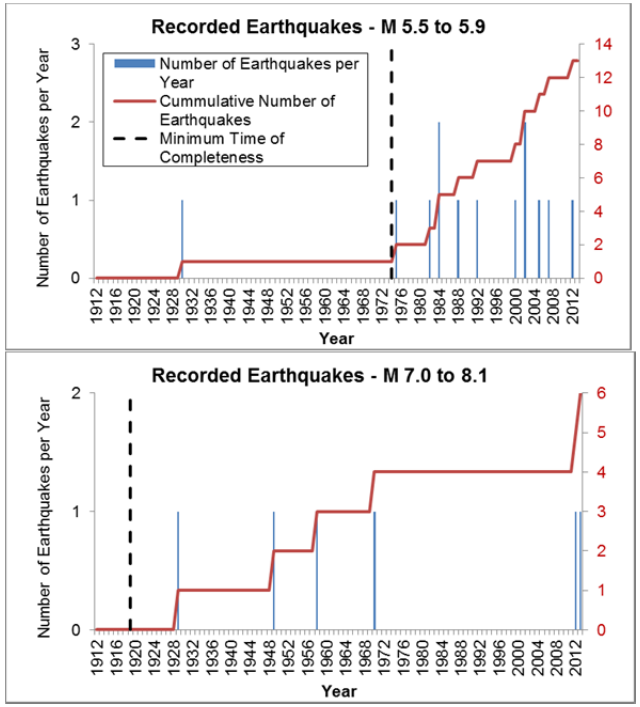
Comment number	**Reference Section**	**Comment/Question** **Pre Feed-Level Seismic Hazard Study LNG Tank, ISBL & OSBL Areas Pacific NorthWest LNG**	**Response/approach**
10	Section 3	The basis for the combined ruptures scenarios used and the weights of the combined rupture scenarios in the model is not discussed. The report would benefit from a discussion of the basis for this element of the model.	We will provide clarification in the final report.
11	Section 3.1.1.3	There are two sections (3.1.1.3 and 3.1.2.2) both entitled maximum magnitude, which makes the report somewhat confusing to read. Section 3.1.1.3 starts by specifying that that maximum magnitude for area sources will be called “maximum magnitude” and the maximum magnitude for fault sources will be called “mean characteristic magnitude”, but then immediately provides contradictory language by discussing the maximum magnitude of fault sources (leaving the discussion of area sources for 3.1.2.2).	This text will be clarified in the final report. The term characteristic magnitude for fault sources is used because we model aleatory variability about the characteristic magnitude and therefore it is not a true maximum (as described in response to comment 9 and Figure 3-3a). For areal sources the Mmax is a true maximum magnitude.
12	Section 3 and table 3-2	In the discussion of the magnitude of area sources, both the discussion in the text and Table 3-2 imply or state that the fault sources are treated by use of only a characteristic earthquake magnitude. The smaller magnitude earthquakes are treated as part of a background source This unconventional approach is not fully explained or justified. This approach makes an assessment of the consistency of the slip rate, maximum magnitude distribution, and magnitude recurrence distribution for the various fault sources challenging at best. It also doesn’t explain how the interface of the magnitude ranges is dealt with. If the above approach is what was done, it needs to be better explained and justified. Treatment of the slip rate and treatment of uncertainties should be part of any explanation. If the approach was not used, the report needs to be clarified.	This approach is consistent with the Working Group on California Earthquake Probabilities (UCERF2) modeling of Type A faults. This modeling decision does not imply that only characteristic earthquakes occur over the fault as areal sources overlap the faults sources. The attached figure, which will be included in the final report, illustrates how the modeling assumptions are implanted to develop magnitude recurrence for the case of the QC sources. Note that small and intermediate magnitude events at 200-300 km distance have negligible contribution to the hazard.

Comment number	**Reference Section**	**Comment/Question** **Pre Feed-Level Seismic Hazard Study LNG Tank, ISBL & OSBL Areas Pacific NorthWest LNG**	**Response/approach**
13	Section 3.2	By discussing the processing of the earthquake catalog within section 3.2, the report implies that the earthquake catalog was used only for development of the magnitude-recurrence of the area sources chosen. It is unclear why the earthquake catalog would not have been considered when the area sources were being developed given that the consistency of the activity rate is generally a consideration when defining area source boundaries. The report would benefit from moving the seismicity catalog forward and more clearly explaining all the elements it was used for.	Clarification will be provided in the final report. The seismicity patterns were one of the criteria considered in delineating the areal zone boundaries.
14	Section 3.2	The report provides the raw seismicity catalog, but does not provide the final catalog used in the development of the activity rates of the seismic sources. It is unclear why the raw catalog was provided and the final catalog was not. While, the report would definitely benefit from both catalogs being provided, the final catalog is the more important of the two and should be provided.	We will provide the final catalog as an appendix in the final report.
15	Figure 3-4 (c) and (d)	Figures 3-4 (c) and 3-4 (d) seem to indicate that the magnitude recurrence relationships used do not fully account for the recorded seismicity. The report would benefit from a more complete explanation and discussion of the figures (and in fact most of the figures in that section).	Figures 3-4a through 3-4f show the maximum likelihood fit of Guttenberg-Richter model (used to establish b-value for areal sources). Please see Figures 3-5a to 3-5e to compare modeled recurrence to historic seismicity. Areal sources E and F (Figures 3-4c and 3-4d) are not intended to capture fully the large magnitude events. For this reason faults are modeled within the areal sources E and F. As faults are modeled across zone boundaries, the comparison is made between seismicity and model for Zones E and F together with the faults within these zones (Figure 3-5a).

Comment number	**Reference Section**	**Comment/Question** **Pre Feed-Level Seismic Hazard Study LNG Tank, ISBL & OSBL Areas Pacific NorthWest LNG**	**Response/approach**
16	Sections 3 and 4	The report is hard to follow in terms of capturing all the pieces of overall model and the reader would be significantly challenged to reproduce the PSHA model used based on the report. It would be very helpful if the logic tree that represents the PSHA model was succinctly and transparently provided in the report. In addition to improving the clarity of the report, it would allow the reader to assess the overall consistency of the branches of the model with regional tectonics, and to allow the reader to peer review the numerical results.	A master logic tree will be provided in the final report.
17	Page 4-3	Page 4-3 states that sources in a radius of 300 km are considered when a radius of 350km is specified in the rest of the report.	A larger radius (350 km) is used in identifying and idealizing potential seismic sources in the region (Section 2 and 3). A 300 km radius is used for sources considered in the PSHA (Section 4). It's typical to identify sources over a larger radius than considered for the PSHA.
18	Section 4	It is unclear why only the Cascadia Subduction zone is considered for the deterministic analysis. The Cascadia would be expected to impact the long period range of ground motions, another source (particularly the Grenville Channel fault discussed in comment 4) may have more of an impact in the short period frequency range.	The Cascadia Subduction zone is required as a deterministic lower limit on the SSE by the code. See response to Comment 3 for further discussion on treatment of Cascadia. With the exception of Cascadia, design spectra are based solely on probabilistic methods in the CSA code. See response to Comment 4 on the Greenville fault..
19	Section 4	Some additional sources of uncertainty are not discussed in Section 4. These include the uncertainty in the development of maximum magnitude, in magnitude conversion, in the magnitude-recurrence distribution, and the activity of the additional faults.	Uncertainties will be more clearly illustrated in the master logic tree to be provided.
20	Section 4	The simple treatment of site amplification is appropriate for a preliminary FEED design study of this type. However, further work on the site would benefit from more site-specific treatment of the site response.	The nonlinear site response analyses were conducted for the nearshore facilities due to the presence of very thick soft soils (Hsoft>40 meters) which were generally not encountered in the onshore area (see Figure 4-1 of Draft Onshore Seismic Report). We understand that in the limited areas where soft soils are encountered onshore they will be treated before construction. If this is not the case we will conduct site response analyses in these areas during FEED.

Comment number	**Reference Section**	**Comment/Question** **Pre Feed-Level Seismic Hazard Study LNG Tank, ISBL & OSBL Areas Pacific NorthWest LNG**	**Response/approach**
21	Appendix A	Earthquake Catalog, 1880/10/26 MI 6.3 event (ID 1): There is a published paper entitled "Significant Canadian Earthquakes of the Period 1600-2006", Lamontagne, M; Halchuk, S; Cassidy, J F; Rogers, G C Geological Survey of Canada, Open File 5539, 2007; 32 pages available for free download from the GeoPub web site (see attached). In this paper, the authors selected historically and instrumentally recorded earthquakes larger than magnitude 6 in Canada, as well as some smaller ones felt by many Canadians. As mentioned in this report, there are a few instances of false events that should be removed from the catalog. The 1880 MI 6.3 event in the Fugro report (Appendix A) has not been tabulated in the list of significant earthquakes (see Table 1 of the paper attached). Please explain if this event is true or false. If this is a true event, how is the MI scale converted to Mw scale? Please add the appropriate reference(s) and conversion equation, if any, to the report. Please explain why this event has been ignored for the period of completeness?	This earthquake was in the United States (Alaska), not Canada and therefore likely not part of the Canadian catalog. It was most probably MMI VIII, converted to magnitude by the standard formula MI = 2/3(I) + 1. Magnitude conversions will be documented in an appendix. Note that this earthquake is 500km north of the project location and outside any of the 350-km radius from the project site. Seismic sources beyond this distance limited are not expected to contribute to the hazard at the project site because of the presence of sources with similar or greater magnitude potential and similar or greater activity significantly closer to the site (e.g., Queen Charlotte fault system and surrounding sources). Please see response to Comment 28 for additional explanation on completeness periods. Completeness period should not coincide with the earliest recorded event in a specified magnitude range.
22	Section 3.2.2.1 and Appendix A	What is the basis for the magnitude conversion formulas? These conversion equations show that the different magnitude scales are equivalent or close to moment magnitude scale over a wide range of magnitudes. If we consider the magnitude uncertainty, we can state that there are no magnitude conversions have been used in this catalog. All magnitude scales have been considered to be equivalent to moment magnitude, why? Please see columns "recorded M scale" and " Mw". Please explain this issue and related references in the report.	More information on the magnitude conversion will be presented in Appendices of the final report.

Comment number	**Reference Section**	**Comment/Question** **Pre Feed-Level Seismic Hazard Study LNG Tank, ISBL & OSBL Areas Pacific NorthWest LNG**	**Response/approach**
23	Appendix A	The range of equivalences for each magnitude scale should be defined in the report. For example, local magnitude scale (ML) is saturated at about 7.0. It means that the ML scale stops increasing with increasing moment at about 7.0. Thus, please explain why, for example, ML 8.1 has been reported for the 1949/08/22 event (ID 20) or ML 7.7 for the 1958/07/10 event (ID 30) in the catalog. At least a reference(s) should be given for the formulas or assumed equivalences.	There will be a more detail on magnitude conversion in the final report. The 1949 earthquake is also classified as Mw 8.1 by Lamontagne et al (2007).
24	Section 3.2.2.1	The body-wave magnitude scales is usually expressed by “mb” not MB, and is saturated at about magnitude 6.5. Please explain why body-wave magnitude scale is equivalent or close to moment magnitude over wide range of magnitude (see page 3-10). A justification for magnitude conversions should be made in the report.	See above
25	General	All magnitude scales and source of events (Agency) in the catalog should be defined in the report and Appendix A.	This information will be provided in the final report.
26	Appendix A and Section 3.2.2.1b	The “raw” earthquake catalog contains 4,478 events (see Appendix A). On page 3-10, the final declustered catalog contains 1,109 mainshocks. The dependent events (aftershock and foreshocks) should be identified in the catalog. Please add a new column to the “raw” catalog (Appendix A) to identify the dependent events and mainshocks, which have been used in the seismicity analysis.	The declustered catalog will be provided in the final report.
27	Section 3.2.2.1b Table 3-3	The first column in Table 3-3 shows that the 0.5 magnitude bin is used for declustering. Please explain how to estimate time and distance values for magnitudes between the defined magnitude events.	As described in Section 3.2.2.1b of the report, the Gardner and Knopoff (1974) method is used. Linear interpolation is performed for time and space windows for magnitudes between values shown in Table 3-3.

Comment number	Reference Section	Comment/Question **Pre Feed-Level Seismic Hazard Study LNG Tank, ISBL & OSBL Areas Pacific NorthWest LNG**	Response/approach
28	Section 3.2.2.2 Table 3-4	In Table 3-4 how can the last four magnitude intervals have periods of completeness of “93” years, when the catalog [Appendix A] started from 1880 to 2013 years of data? If you look at the paper cited in comment 20, this period of completeness might be even longer. The methodology of completeness needs to be explained in more detail in this report. The “93” years” should be justified because it could impact on the a- and b-values.	The completeness interval is the number of years before present time for which the catalog can be considered to have recorded all earthquakes in the magnitude ranges tabulated. This is very different than the date of the earliest recorded earthquake. The completeness has been evaluated using the 'slope method' where the cumulative number of earthquakes with time is plotted and the year the rate of recorded earthquakes reduces, is taken to be the year the catalog is complete for the magnitude range of interest. An example of how the completeness interval is established is shown in the figures below. These figures will be provided in the final report. Please note that the large magnitude events which primarily contribute to the hazard at the site are modeled using a pure characteristic magnitude recurrence model which does not depend on the b-value obtained from regressions on historical seismicity. 

Comment number	**Reference Section**	**Comment/Question** **Pre Feed-Level Seismic Hazard Study LNG Tank, ISBL & OSBL Areas Pacific NorthWest LNG**	**Response/approach**
29	General	The period of completeness and number of complete events in each source zones should be tabulated in the report.	This will be provided in the final report.
30	Figure 3.1	Based on the seismic source model, location of site is near the boundary between area sources B and D. This boundary should be justified because of the boundary location error. A sensitivity run could be warranted where this boundary should be plotted.to include the site either in Zone B or Zone D.	This sensitivity was performed and it makes little difference as the rate of earthquakes per square km in zones B and D are within 5% of each other.
31	Figure 3-1 and 3-2	The three fault sources QCN, QCS, and QCU are within the area sources E and F. Table 3-2a and Table 3-2c show the summary of seismic source parameters for these sources. The maximum magnitude of about 8.0 with uncertainty is used for both area sources and fault sources. It should be noted that the use of large magnitudes greater than 7.6 for these sources (faults and background sources) could lead to "double counting of large events" and then it could increase the ground motions in the project site. Please clearly explain the "logic tree approach" that you have used to incorporate seismicity of these sources (weighting and moment balance) into PSHA. Please explain clearly in the report that there is no double counting issue for these significant sources.	There is no double counting issue. The logic tree will be provided in the final report. Figure 3-5a illustrates that the combined Zone+Fault modeling of the Queen Charlotte Transform boundary area compares well with historical seismicity while compatible with geologic/geodetic slip rate and Mmax constraints.
32	Section 3.1.2.2 Table 3-2c	The b-values in the last column of Table 3.2c are mainly depend on the "magnitude bins", "period of completeness", and "number of mainshocks" (see comments 25, 26 and 27). The values for these parameters should be tabulated for each source in the report.	We will tabulate number of events (mainshocks) per magnitude bin per source. Period of completeness is already tabulated per magnitude bin.
33	General	The plots of the hazard curves as well as the tabulated values of the hazard curves should be added into the report, At least in an Appendix, all hazard curves should be tabulated.	This will be provided in the final report.
34	General	Please add plots of source-by-source hazard curves to identify and understand the sensitivity of parameters and sources that control the hazard results.	Hazard curves for individual sources will be added in the final report.
35	Section 4.7 and Figure 4-8	The report does not clearly discuss why the PSHA results for site class C (5%-damping horizontal acceleration response spectra for the 475-year and 2475-year return periods) are "significantly" higher than the "2005" and "2010" National Building Code (NBC) of Canada. This discussion should be added into the report at least for the 2005 NBC, which is available. Please also explain why the "2005" NBC seismic source models have not been used in this report for a sensitivity run and comparison.	Please see attached presentation. We will include comparisons in the final report.

Reference Section	Comment/Question Near shore PSHA	Response
General	This review was performed recognizing that the report is marked draft and limited site-specific information is available. As such, the review was performed at a high level and an in-depth review of technical elements was not performed. The final report would benefit from thorough technical editing.	Noted. Review comments and responses will be included in the Final Report.
General	The report does not specify the design code or standard that is the basis of the work and no code or standard is provided in the reference list. The report would benefit from an explicit statement of the design codes or standards that the work is intended to meet.	The design levels for the nearshore facilities are consistent with the onshore analyses per the requirements of the Canadian Standards Association document for LNG production, storage and handling, CSA Z276-11 Detailed description of the design code used can be found in the Onshore PSHA Report: - Page 1-3, Summary, second bullet, Section 1.4 - Page 4-7, Definition of Design Levels, Section 4.4
Section 2	It is unclear to the reader why the ground motions are reported at a depth of 10 meters. It is not stated whether or not the motions provided are “within” motions or are hypothetical free field motions. The report would benefit from clarity on the assumptions made in the report as it relates to the reported ground motions such that there is not a miscommunication with engineers using the report subsequently for design.	The ground motions in Section 2 were developed as free-field "outcrop" motions for Site Class A which were later used as input motions, at depth, for the nonlinear site response analyses as described in Section 3. PGA and spectral accelerations at the depth of 10 meters are within motions and reported as the results from nonlinear site response analyses. These results were used to develop the recommended spectra for pile design (Table 3-3). Clarification on Table 1-1 will be provided in the Final Report. A detailed discussion on the selection of the 10-meters as an appropriate depth to extract motions for design purposes is presented in Section 3.4.4 "Acceleration Response Spectra for Pile Design" of the draft report.
Section 2	Updates to the PSHA model, as described in the comments to the onshore report, may result in higher ground motions, particularly in the long period range (as a result of inclusion of the Cascadia Subduction Zone). If that is the case, the seed ground motions used may need to be revisited. The general approach to matching the time histories, however, is generally an appropriate approach and the use of the PEER database to obtain seed motions assures that appropriate processing was applied prior to use.	Noted. Review comments and responses from the Onshore Report will be included in the Final Report.

Reference Section	Comment/Question Near shore PSHA	Response
Section 2	Figures 2.2-1 through 2.2-5 would benefit from having the target response spectrum also plotted. There is nowhere in the report where it is easy to get a sense for the level of scaling that it applies to the time histories prior to spectral matching.	The figures will be provided in the final report. In the interim the scaling factors can be estimated from the unscaled seed motions shown on Figures 2.2-1 to 2.2-5 and the target spectra shown on Figure 2-1 and tabulated in Table 2-2.
Section 3	It is unclear why a different approach was used for development of site amplification functions for the FEED level work for the offshore and onshore facilities. The project would benefit from a consistent approach using site-specific amplification assessments being used for the entire site in order to gain the most insights from the assessments performed.	The nonlinear site response analyses were conducted for the nearshore facilities due to the presence of very thick soft soils (Hsoft>40 meters) which were generally not encountered in the onshore area (see Figure 4-1 of Draft Onshore Seismic Report). For very thick soft soils, modeling of the nonlinear dynamic behavior such as modulus reduction with increasing shear strain and hysteretic damping is critical. In addition, nonlinear site response analyses were conducted such that accelerations at the depths of piles' point of fixity can be derived to develop the spectra for pile design. We understand that in the limited areas where soft soils are encountered onshore they will be treated before construction. If this is not the case we can conduct site response analyses in these areas during FEED.
Section 3	Figure 3-1 seems to show that the ideal site profiles used do not capture well the range of the shear wave data. The figure indicates that the site was modeled as being generally stiffer than indicated by the data. The basis for the choice of profiles in consideration of the site data should be more robustly discussed such that the reader can understand the apparent skew.	The best-estimate and lower-bound Vs profiles were developed primarily based on the in-situ PS Logging data which are direct measurement of the shear wave velocity and are the most reliable data for Vs. The Vs values interpreted from the UU shear strengths are not direct measurements and although fit reasonably well with the PS Logging data, are generally smaller probably due to sample disturbance. Hence the Vs values estimated from the UU data using empirical correlations were only considered with a small weight in defining the idealized shear wave velocity profiles. The upper-bound Vs profile was developed to address the potential for strain-rate effects, which typically results in larger effective soil stiffness during dynamic loading. We selected a ratio (UB/BE) equal to 1.25 based on our experienced with soft soils and laboratory data for other projects, available literature, and code requirements. This ratio can be refined if laboratory tests are performed to look into strain rate effects during FEED.

Reference Section	Comment/Question Near shore PSHA	Response
Section 3	Similar to comment 8 above, the upper top plot seems to indicate that a sheer modulus curve was used that doesn't address the epistemic uncertainty in the available relationships. This leads to the site being modeled as stiffer than if the average of the relationships was used. The report would benefit from an explanation as to the basis for this choice.	Due to the lack of site-specific laboratory data (i.e. cyclic simple shear tests), the modulus degradation curves for pre-FEED were selected from the available literature (Darendeli, Vucetic and Dorby) based on the plasticity index and effective overburden stress. Figure 3-2 compares the modulus reduction curve used as input in FLAC to a range of relevant curves from the literature, showing agreeable comparisons. During FEED we have proposed that soil-specific resonant column and cyclic simple shear tests be performed on high quality undisturbed samples to allow for the development of soil-specific modulus reduction curves for this project.
Section 5	The liquefaction analysis performed provides data only in the framework of CSR/CRR, which is often used to develop a simple Factor of Safety (FS) assessment. The project may benefit from also using an approach that provides probability of triggering (e.g., that developed by Cetin) in addition to the approach used.	Additional evaluation with probability can be conducted and presented in the Final Report.

APPENDIX H

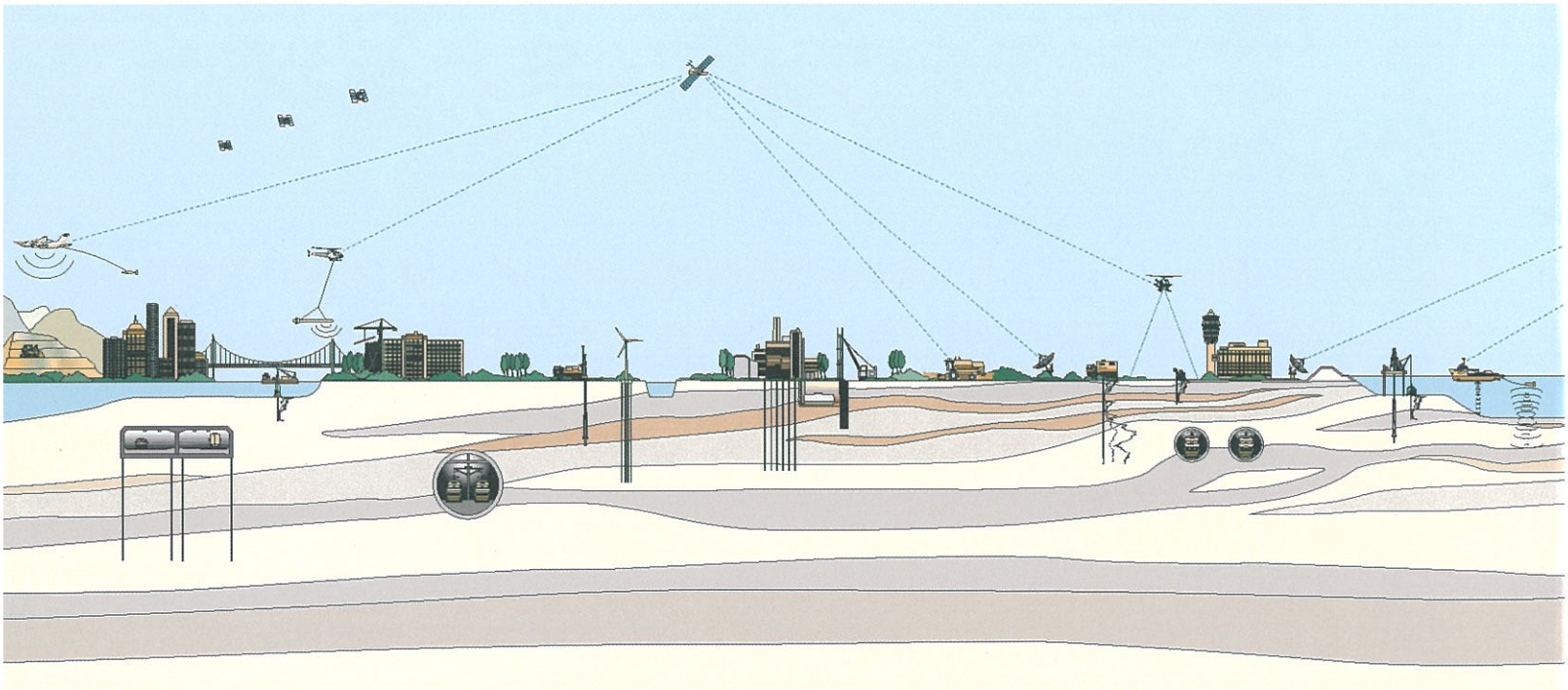
Seismic Hazard Analyses – Nearshore

FUGRO CONSULTANTS, INC.

PRE FEED-LEVEL SEISMIC HAZARD STUDY FOR BERTHING AND TRESTLE FACILITIES PNW LNG PROJECT NEARSHORE LELU ISLAND, BRITISH COLUMBIA CANADA

Prepared for:
KBR
HOUSTON, TEXAS

DECEMBER 2013
Report No. 04.10130058



REVISION TABLE

Rev. #	Date	Approved By:	Description of Change:
0	10/31/2013	TT	Draft Issued for Review
1	12/20/2013	TT	Final version addressing comments from Client and Owner.

FUGRO CONSULTANTS, INC.

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December 20, 2013
Project No. 04.10130058

KBR
601 Jefferson Avenue
Houston, Texas 77002

Attention: Mr. Nathan Chesley (nate.chesley@kbr.com)
Project Manager

Subject: Pre FEED-Level Seismic Hazard Study for Berthing and Trestle Facilities Nearshore Lelu Island, British Columbia, Canada

Fugro Consultants, Inc. (Fugro) is pleased to present this report of our pre FEED-Level seismic analyses for the planned Berthing and Trestle facilities of the Pacific NorthWest LNG (PNW LNG) project located in Lelu Island, British Columbia, Canada. Fugro has been contracted by KBR under a Master Services Contract No. 4600002309 to perform geotechnical investigation for the proposed PNW LNG project. Our services were performed in general accordance with our proposal No. 05.2012G031, and request for change order 7 dated August 13, 2013.

The PNW LNG project consists of construction of both onshore and nearshore facilities. The onshore facilities are anticipated to include LNG storage tanks, LNG trains, flare stacks, processing facilities, workshops, administration buildings, pipe racks and pipelines, a construction camp, future fractionation/common facilities, and a bridged site access across the northern channel from/to the mainland. The nearshore facilities are anticipated to include a turning basin, berthing facility, materials off-loading facilities (MOF), a trestle, and a mooring facility. This report presents our findings and recommendations from the seismic analyses conducted for the Berthing and Trestle areas.

We appreciate the opportunity to be of service to KBR and PNW LNG. Please call us at (713) 369-5400 if you have any questions or comments concerning this report, or when we may be of further assistance.

Sincerely,

FUGRO CONSULTANTS, INC.
TBPE Firm Registration No. 299

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Copies Submitted: PDF

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1.0 INTRODUCTION

1.1 PROJECT DESCRIPTION

KBR is assisting the design and construction of Pacific Northwest LNG (PNW LNG) Project on Lelu Island, British Columbia (BC), Canada. PNW LNG is a proposed liquefied natural gas (LNG) liquefaction and export facility on Lelu Island within the District of Port Edward on land administered by the Port of Prince Rupert, in British Columbia, Canada. The project comprises both onshore and nearshore facilities. This report presents the analyses and recommendations from the seismic studies conducted for the nearshore facilities in the Trestle and Berthing areas.

The Lelu Island Site is located within western British Columbia, south of Alaska, along the Coastal Mountain physiographic province near Prince Rupert (Figure 1.1-1). The region is characterized by moderate to high levels of seismic activity. Site-specific seismic hazard studies for the onshore area were performed by Fugro and presented in the seismic hazard report (Fugro, 2013a).

The LNG export terminal will consist of multiple berths with a connecting Trestle. The berths for the LNG Jetty are proposed to be located nearshore, past both Agnew Bank and Flora Bank with water depths mostly greater than 15 meters. The conceptual layout showing the LNG Jetty and the Trestle is presented on Figure 1.1-2. According to the conceptual drawings (MA-ATA-G20B-008 and -0010), the Trestle and Jetty will be supported by steel pipe piles with a diameter of 914 mm. The mudline slope is generally less than 2.5 degrees along the Trestle; however, the slope becomes steeper near the Berthing area at about 12 degrees towards the southwest direction.

Fugro's seismic analyses for the nearshore area includes 1) seismic hazard analyses and development of input ground motions at the bedrock level, 2) performing nonlinear 1-D site response analyses to develop near-surface design spectra, 3) evaluating nearshore slope stability and estimating deformation during seismic events, and 4) evaluating liquefaction triggering hazard.

The site response analyses were conducted for representative nearshore profiles along the proposed Trestle and Jetty. The depth to bedrock for these profiles ranges between approximately 40 to 120 meters. Hence the recommendations in this report are applicable in the nearshore areas only for subsurface conditions compatible with the above bedrock depths. If structures are planned in areas with estimated depth to rock beyond this range, the proposed design spectra may need modification.

1.2 WORK AUTHORIZATION

Fugro is providing engineering services to KBR for conducting seismic analyses for the Lelu Island Development Project located in Lelu Island, British Columbia. The work was performed in general accordance with the scope of work outlined in our Proposal, dated August 13, 2013.

1.3 SCOPE AND ORGANIZATION

The approved seismic scope of services is as follows:

- Task 1 – Review of Geotechnical Data and Development of Idealized Soil Profiles;
- Task 2 – Seismic Hazard Assessment and Input Ground Motions Development;

- Task 3 – Nonlinear Site Response Analyses;
- Task 4 – Simplified Seismic Slope Stability Analyses; and
- Task 5 – Liquefaction Triggering Hazard Assessment.

Following this introductory section, Section 2.0 presents the development of the horizontal acceleration spectra at the rock level in the nearshore area. The development of input ground motions for the subsequent site response analysis is also presented in Section 2.0. Section 3.0 presents the nonlinear 1-D site response analyses and development of the design response spectra for pile foundation. Section 4.0 presents the results of slope stability assessment using limit equilibrium analyses and simplified empirical relationships (e.g., Makdisi and Seed, 1978, Bray and Travasarou, 2007, Rathje and Antonakos, 2011). Finally, Section 5.0 presents the assessment for the soil liquefaction triggering hazard in the nearshore Trestle and Berthing areas.

1.4 LIMITATIONS OF THIS STUDY

This report has been prepared solely to assist KBR with seismic design of the nearshore facilities in the Berthing and Trestle areas for the PNW LNG Project. The results herein apply to the specific location mentioned and are not applicable to other locations.

Seismic hazard analysis is a dynamic, rapidly evolving field of earthquake engineering. It is likely that the standard of practice in the project region for these services will evolve over the next few years. Additionally, the analyses were conducted using the geological and geotechnical information available to the date of issue of this report. Consequently, the results presented in this study should be reviewed if new standard of practice or data are available during the design of the project.

This report has been prepared for the exclusive use of KBR and their agents for the specific application to the Lelu Island Development Project located in Lelu Island, British Columbia. In our opinion, the findings, conclusions, professional opinions, and recommendations presented herein were prepared in accordance with generally accepted geotechnical earthquake engineering practice of the project region.

Although information contained in this report may be of some use for other purposes, it may not contain sufficient information for other parties or uses. If any changes are made to the project as described in this report, the conclusions and recommendations in this report shall not be considered valid unless the changes are reviewed and the conclusions and recommendations of this report are modified or validated in writing by Fugro.

1.5 SUMMARY AND FINDINGS

The seismic studies presented in the current report included the following:

- Developing idealized best-estimate, as well as upper- and lower-bound soil properties for use in subsequent site response analyses. The idealized profiles and properties were developed based on the geotechnical data presented in Fugro (2013b).
- Developing horizontal acceleration response spectra for the SSE and OBE design levels for Site Class A (i.e. bedrock), representative of the input depth for site response analyses. The design ground motions are selected based on hazard deaggregation such as magnitude and distance from the site and then spectrally matched to the design spectra. The procedure and results are presented in Section 2.0.

- Conducting site response analyses using a nonlinear approach to propagate the ground motion from the bedrock (i.e. site class A) to the seafloor. Near-surface horizontal response spectra at the depths of 10 and 20 meters below mudline were used to develop the acceleration response spectra for pile design.
- Performing simplified slope stability evaluations using empirical relationships including Makdisi and Seed (1978), Bray and Travasarou (2007) and Rathje and Antonakos (2011) to estimate the potential for dynamic slope instability and associated permanent deformations at the Berthing area.
- Evaluating the liquefaction triggering hazard with the Idriss and Boulanger (2008) and Cetin et. al. (2004) relationships for the nearshore borings. The liquefaction potential for fine-grained soils was evaluated with the Bray and Sancio (2006) relationship.

The primary results from this study are summarized as follows:

- Table 1-1 presents the near-surface peak ground acceleration (PGA) and spectral acceleration at the period of 1 second recommended for pile design in the nearshore Berthing and Trestle areas. These values are based on interpretation of the results from nonlinear site response analyses (presented in detail in Section 3.0). The entire recommended design acceleration response spectra (encompassing structural periods from zero to 10 seconds) are presented in Table 3-3.

Table 1-1: PGA and Spectral Acceleration of 1 sec Recommended for Pile Foundation Design

Design Level	Nearshore Area	
	Horizontal PGA (g)	SA at 1 sec (g)
OBE	0.08	0.25
SSE	0.13	0.36

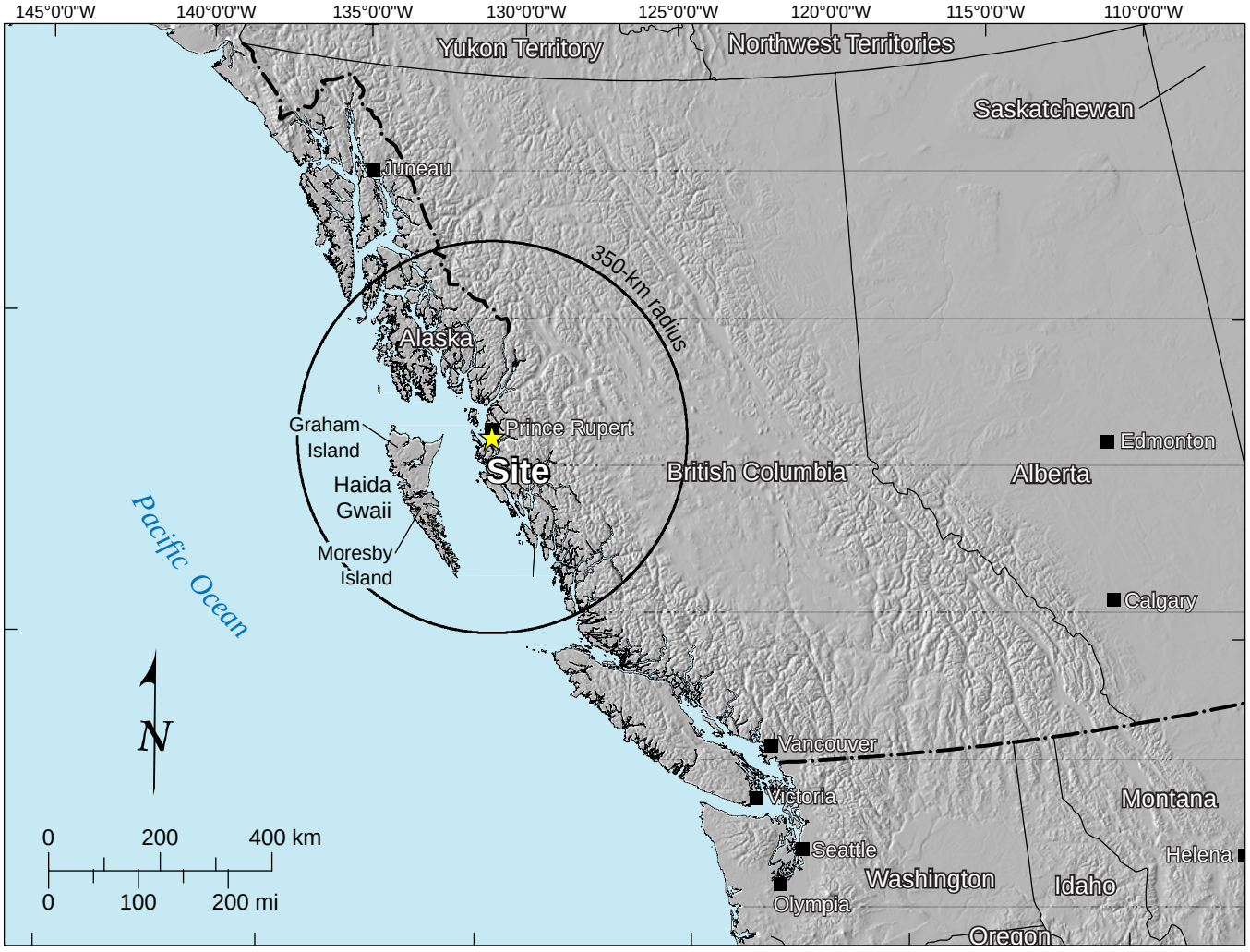
- Table 1-2 presents the range of permanent seismic slope displacements estimated using simplified empirical approaches near the Berthing area for the two design levels.

Table 1-2: Estimated Permanent Seismic Slope Displacements near Berthing Area

Design Level	Slope Displacement (cm)
OBE	2 – 30
SSE	10 - 80

- Shallow coarse grained soils (within approximately 6 meters below mudline) at Borings BH-32 and BH-33 were found to be liquefiable during both SSE and OBE events. Similarly, for Boring BH-34, soils from the mudline to the depth of 16

meters are found to be liquefiable for both SSE and OBE events. For the fine-grained soils encountered at the depth of 9 meters in Boring BH-35, the materials are identified as moderately susceptible to liquefaction. Soils encountered in BH-36 and BH-37 were primarily clays, therefore, are not susceptible to liquefaction.



SITE LOCATION MAP
PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

FIGURE 1.1-1

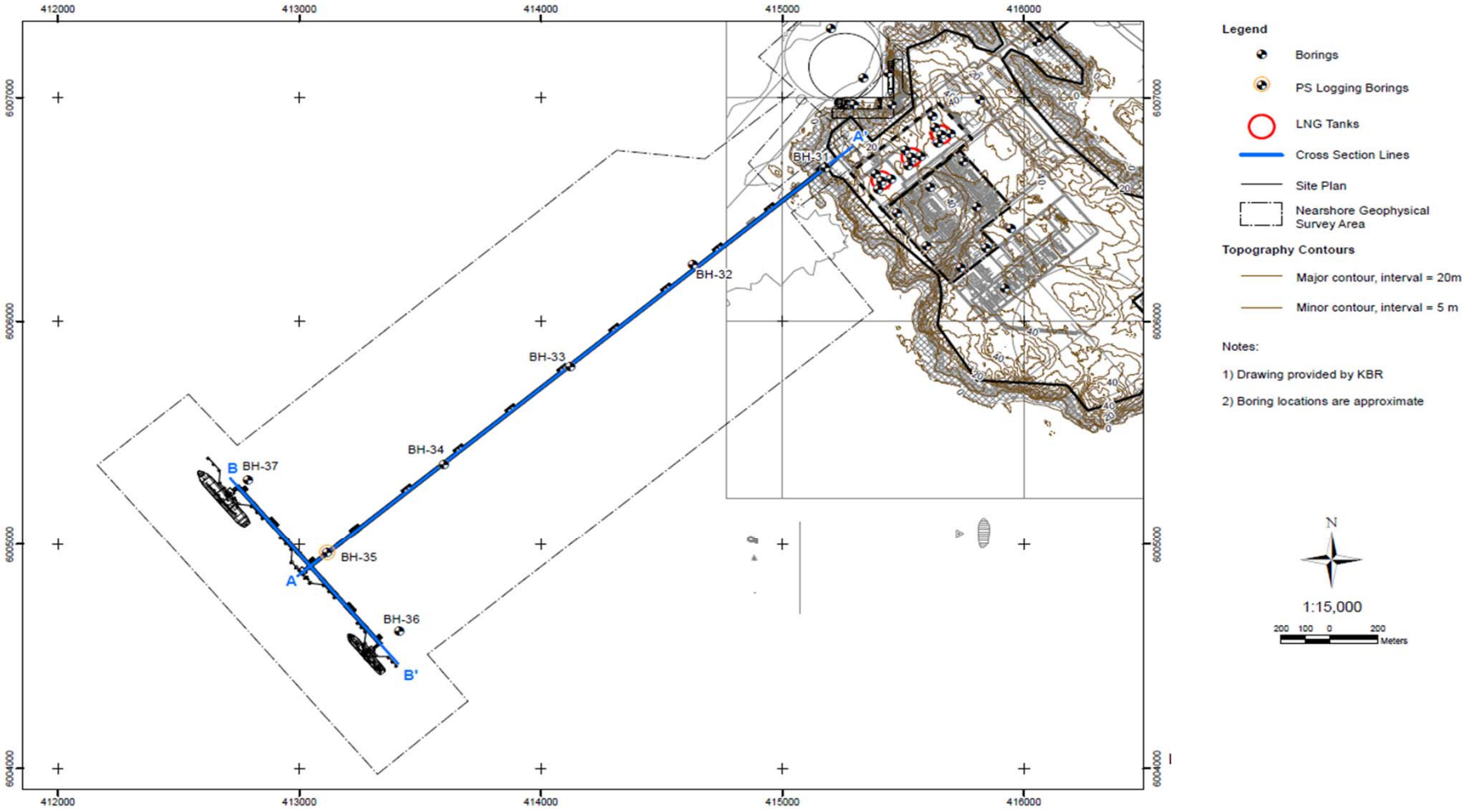


FIGURE 1.1-2

LNG JETTY AND TRESTLE LAYOUT

PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

2.0 DEVELOPMENT OF DESIGN GROUND MOTIONS

2.1 INTRODUCTION

Probabilistic seismic hazard analyses (PSHA) were conducted at a representative nearshore location of Lelu Island in order to develop target spectra at the bedrock level corresponding to Site Class A. The PSHA were conducted for both OBE and SSE design levels corresponding to the 475- and 2475-year return periods, respectively. The design levels for the nearshore facilities are consistent with the onshore analyses per the requirements of the Canadian Standards Association document for LNG production, storage and handling, CSA Z276-11. Ground motions for the site response analyses were selected and spectrally matched to be compatible with the target spectra at the bedrock.

2.2 DEVELOPMENT OF TARGET SPECTRA AT THE BEDROCK

Probabilistic seismic hazard analyses were conducted using the computer program HAZ38 (Abrahamson, 2007) at a representative nearshore location (i.e., intersection between trestle and jetty). The geographical coordinates of the location used for the seismic hazard analyses are shown in Table 2-1. The regional seismotectonic model developed for the project, presented in the Seismic Hazard report for the onshore area (Fugro, 2013a), was used as input to the seismic hazard analyses for the nearshore location.

Table 2-1: Coordinates of the Representative Nearshore Location

Latitude (degrees)	Longitude (degrees)
54.185	-130.331

Geographical coordinates are referenced to datum WGS 84 - World Geodetic System

PSHA were conducted for an average shear-wave velocity in the top 30 meters (V_{s30}) of 1500 m/s, corresponding to site class A, and considered representative of bedrock conditions at depth. In the absence of in-situ shear wave velocity measurements for the bedrock in the nearshore area, the value of V_{s30} used in analyses was selected based on the shear wave velocity data from P-S suspension logging tests conducted in rock in the onshore area. The acceleration response spectra at the 475- and 2475-year return periods were developed using the same methodology presented in the onshore seismic hazard report (Fugro, 2013a). For the nearshore location, the acceleration response spectra developed at the bedrock level (i.e. Site Class A) are shown on Figure 2.2-1 and tabulated in Table 2-2. The acceleration spectra were then used as the target for the development of input motions at depth as subsequent input in site response analyses.

Table 2-2: 5%-Damped Horizontal Acceleration Response Spectra at the Bedrock (Site Class A)

Period (s)	Horizontal Spectral Accelerations (g)	
	475yrs	2475yrs
0.01	0.082	0.151
0.05	0.096	0.181
0.1	0.130	0.252
0.15	0.159	0.305
0.2	0.175	0.331
0.3	0.178	0.341
0.5	0.146	0.277
0.75	0.128	0.247
1	0.110	0.214
1.5	0.073	0.142
2	0.052	0.099
3	0.031	0.059
4	0.021	0.040
5	0.016	0.031
6	0.014	0.026
7	0.012	0.022
8	0.010	0.019
9	0.009	0.017
10	0.008	0.015

2.3 DEVELOPMENT OF INPUT GROUND MOTIONS AT THE BEDROCK

2.3.1 Ground Motion Selection

Input acceleration time histories were developed as free-field “outcrop” motions at the bedrock and later used as input in the 1-D nonlinear site response analyses. Five recorded ground motion time histories were selected and modified to be compatible with the 475- and 2475-year return period design spectra for Site Class A presented in Section 2.2.

The selection process of recorded ground motions was based on project-specific parameters such as magnitude and site-to-source distance as determined from the hazard deaggregation, peak intensity measures, duration of shaking, and frequency content (i.e., spectral shape). Fault rupture mechanism and site conditions were also taken into consideration in the selection process.

The hazards associated with the structural period of PGA and 1 second for return periods of 475 and 2475 years are considered in determining contributing scenarios (magnitude, distance, epsilon, and style of faulting) for ground motion selection. Based on the deaggregation results presented in the onshore Seismic Hazard Report (Fugro, 2013a), for short structural periods, the seismic hazard at the project site is controlled by two types of scenarios: large magnitudes between 7.5 to 8.5 at distances larger than 150 km associated with the Queen Charlotte fault and surrounding areal source; and intermediate magnitude

events (i.e., magnitudes of 6 to 7) at distances about 50 km to 100 km associated primarily with the Graham Island areal source (i.e., Zone C). For longer structural periods (i.e., period of 1 second), the relative contribution from large magnitude (i.e., 7.5 to 8.5) events increases. These scenarios are associated with the Queen Charlotte fault and surrounding areal source. Accordingly, three ground motions were selected with large magnitudes (in the range of 7.5 to 8.5) and distances between 100 to 200 km and two ground motions were selected with intermediate magnitudes of 6.5 to 7.5 and distances from 40 to 100 km. Attention was paid such that all ground motion recordings have usable periods higher than 7.5 seconds and correspond to shallow crustal seismotectonic environment.

Table 2-3 summarizes the parameters of the selected seed time histories. The shallow crustal ground motions were downloaded from the Pacific Earthquake Engineering Research (PEER) Center strong motion database website (http://peer.berkeley.edu/smcat/). The selected original recorded motions and target spectra developed in Section 2.2 are shown on Figures 2.3-1 to 2.3-5.

Table 2-3: Summary of Seed Ground Motions Characteristics

No.	Earthquake	Magnitude / Style of Faulting[1]	Recording Station	Horizontal Component	Distance (km)	PGA (g)	$V_{S,30}$ (m/s)	Lowest Usable Freq. (Hz)
1	2002 Denali Alaska	7.9/ Strike Slip	PS08	319	105	0.04	425	0.13
2	1999 Kocaeli Turkey	7.51 / Strike Slip	TKR	090	165	0.03	659	0.125
3	1999 Chi-Chi Taiwan	7.62 / Reverse-Oblique	TAP046	N	118	0.05	474	0.025
4	1989 Loma Prieta	6.93 / Subduction (Interface)	A07	090	42	0.09	415	0.125
5	1999 Hector Mine	7.13 / Strike Slip	0534	180	62	0.06	345	0.06

2.3.2 Ground Motion Modification

A time-domain spectral matching procedure was used to better preserve the characteristics of the seed time histories. The procedure usually involves the following steps:

- Spectral matching of the motions to the target spectra in the time-domain; and
- Baseline correction of the spectrally matched motions.

Time-domain spectral matching procedure adds finite wavelets in the time domain to decrease the spectral deficiencies between the seed motion and the target spectra. The result is a realistic looking time history that preserves the seed motion characteristics while generally achieving a close match with the target response spectra at all spectral ordinates.

The time-domain spectral matching was accomplished using the computer code RSPMATCH written by Abrahamson (2003). The code calculates the spectral differences

between a response spectrum and a target spectrum, and then adds wavelets in the time domain to alter the frequency content to reduce the differences.

The quality of the result is measured by the tolerance to which the matched motions converge toward the target spectrum, and how well the matched motions compare to the original motions in the time domain. In particular, the matched displacement and velocity time histories should look reasonable and overall reflect the key non-stationary characteristics of the original motions.

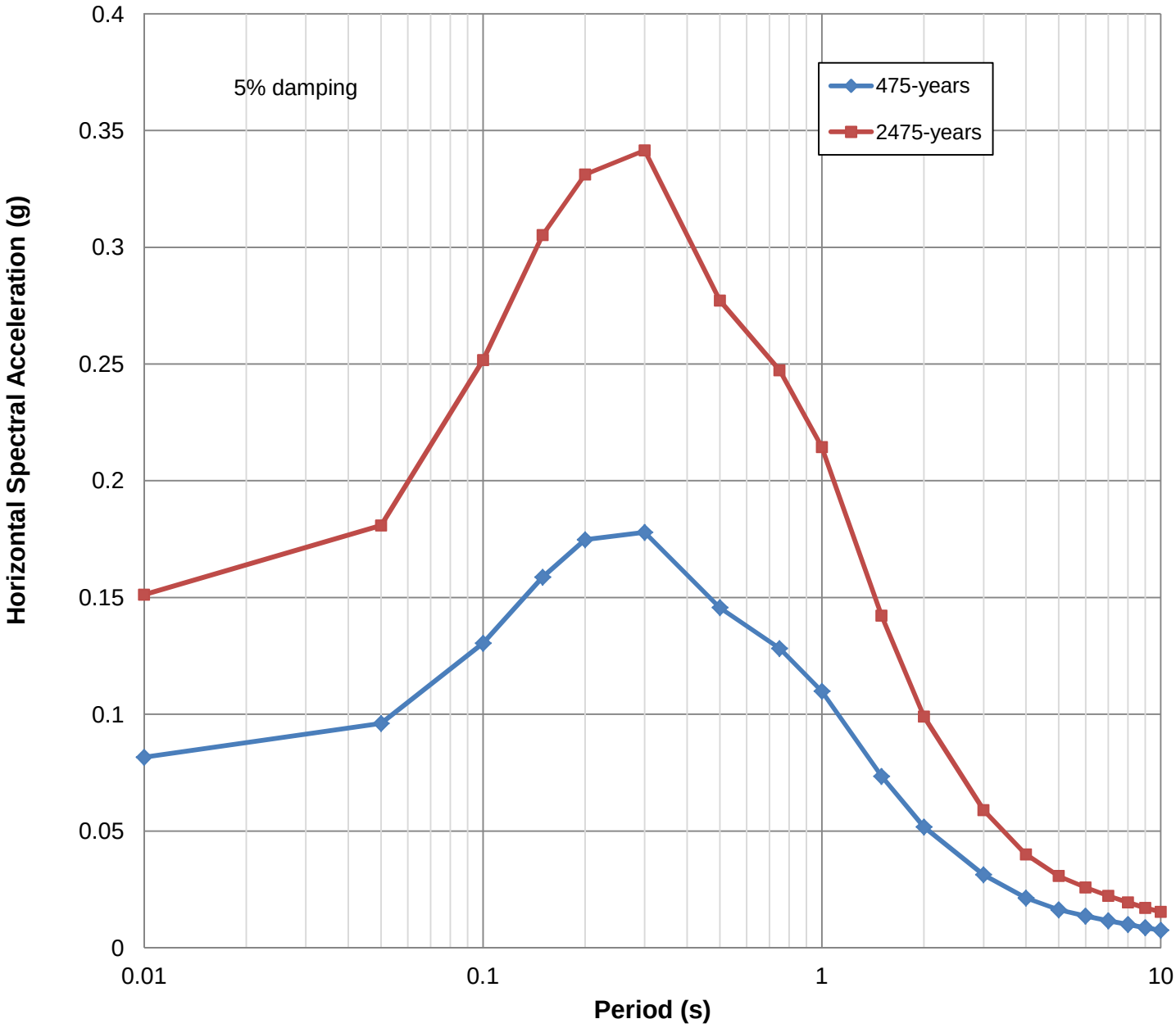
A final baseline correction was performed to remove any permanent offset imposed on the time history through the spectral matching procedure. The baseline correction was carried out by fitting an n^{th} order polynomial (where n = 4 to 7) to the displacement time history. The second derivative of this polynomial was then subtracted from the acceleration time history.

2.3.3 Spectrally Matched Motions

The acceleration response spectra for the return periods of 475 and 2475 years were normalized to the respective PGA values. The normalized spectral values are within approximately 3 percent for all structural periods of interest. Hence, an idealized normalized spectrum based on the average of these spectra was selected for matching purposes.

The spectrally matched motions (after baseline correction) are presented on Figures 2.3-6 through 2.3-10. The Figures show the spectrally matched time histories of acceleration, the integrated velocity-, and displacement as well as the 5%-damped target acceleration PGA-normalized response spectrum and the matched PGA-normalized response spectrum. In the frequency domain a target maximum spectral mismatch of 5% was used, however at long periods (> 7 seconds) the tolerance was allowed to be larger in order to avoid significantly altering the characteristic waveform of the seed motions. The spectrally matched acceleration time histories were used for the site response analyses in Section 3.0 for the nearshore area.

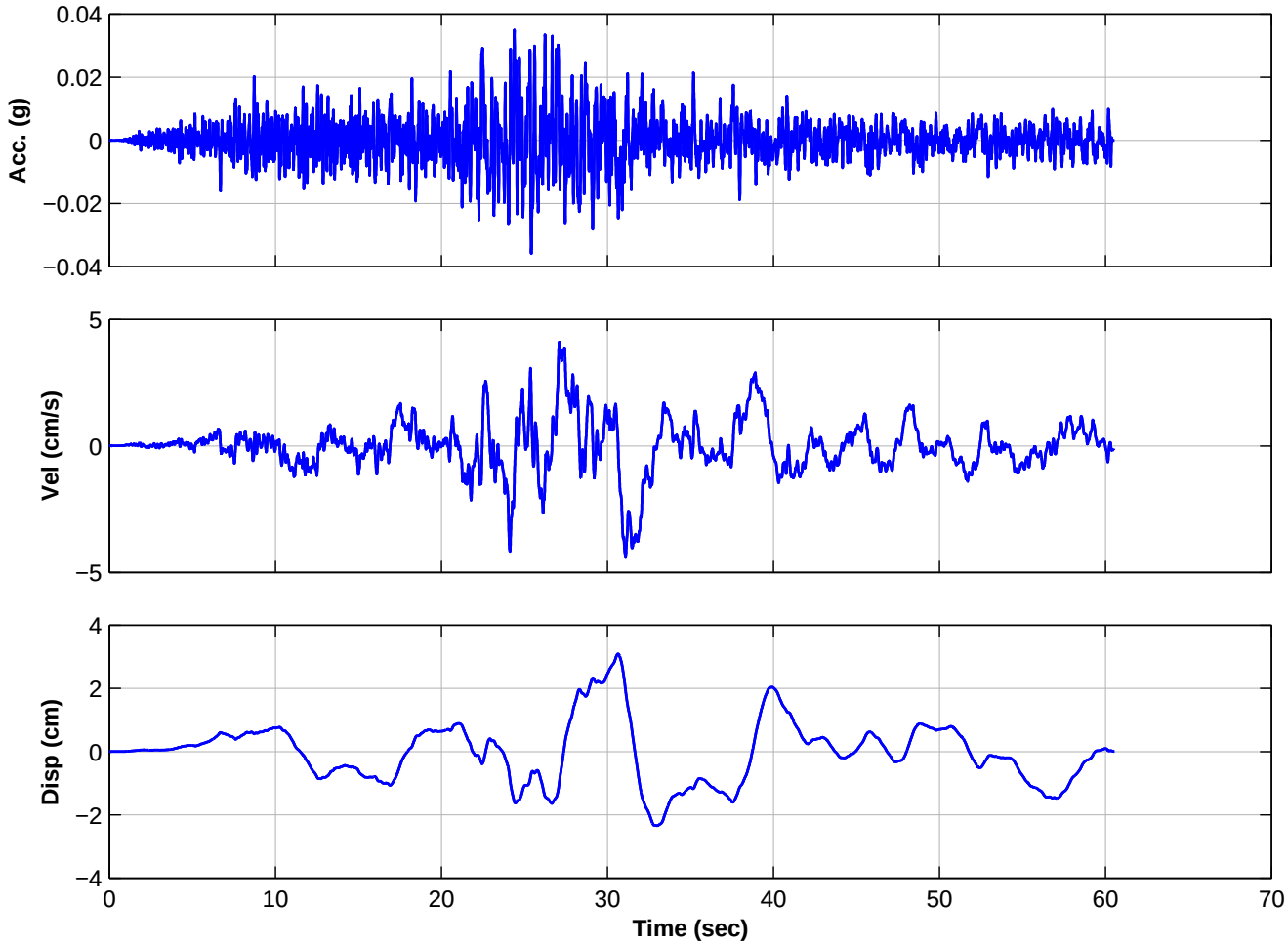
Spectral matching of ground motions (as opposed to amplitude scaling) is intended to remove variability in spectral ordinates between design ground motions and is therefore, a very efficient and reliable way to estimate the average response of a structure. However, as the intention of these motions is to give an estimate of average structural response for design, it should be noted that the variability in structural response is under-represented with the given motions. Should variability or fragility curve development by needed for formal risk calculations, amplitude scaling of a large number of ground motions is required.

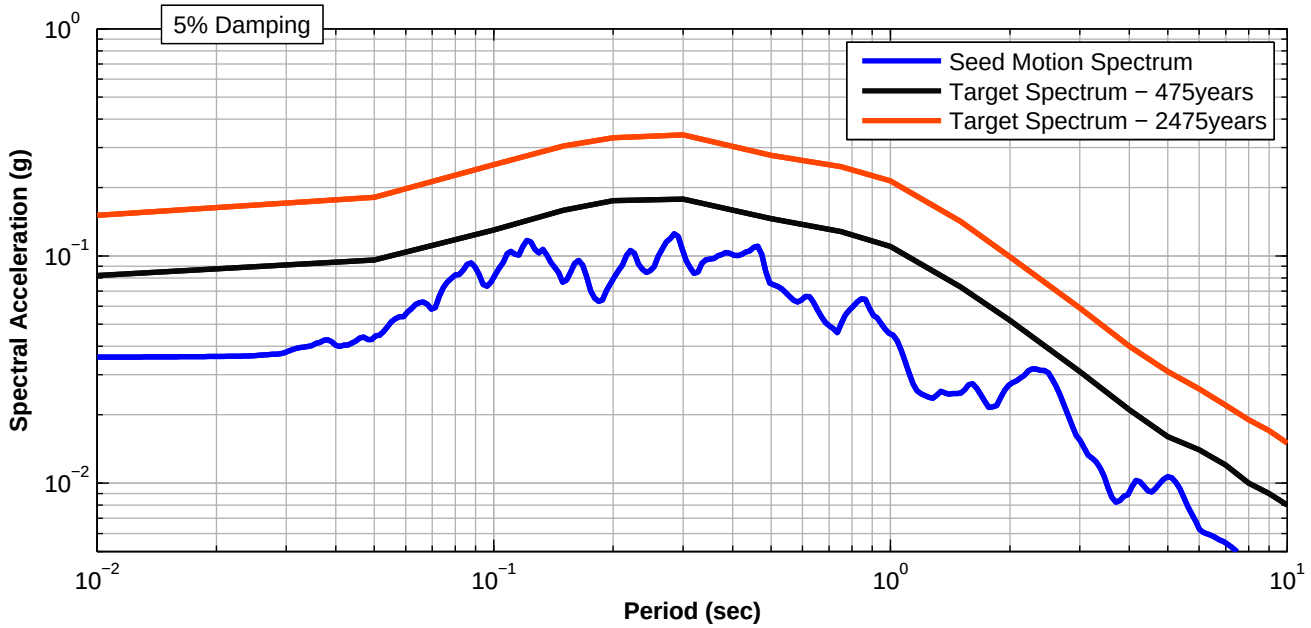


TARGET HORIZONTAL ACCELERATION RESPONSE SPECTRA FOR SITE CLASS A FOR 475 AND 2475-YEAR RETURN PERIOD

PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

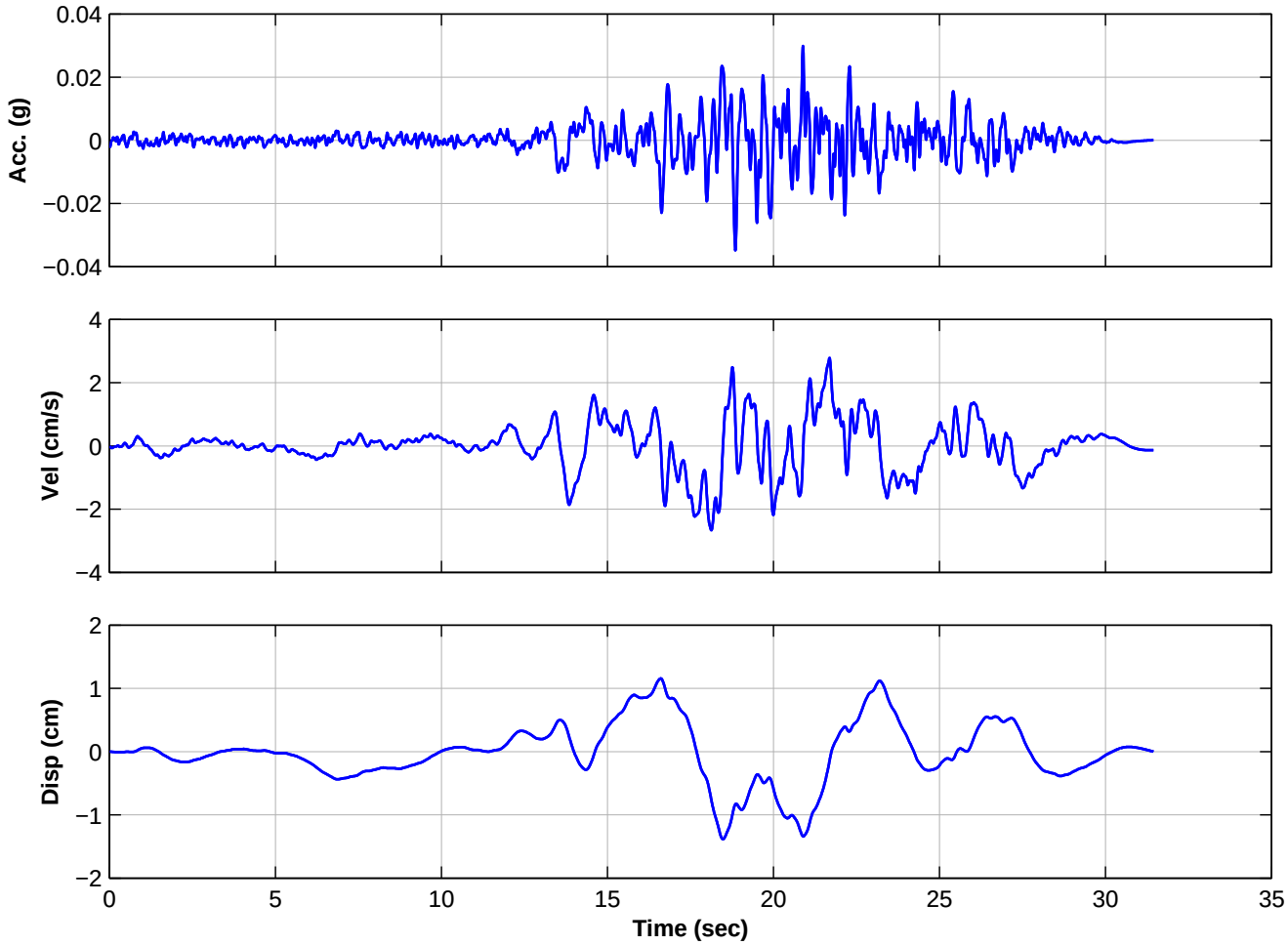
FIGURE 2.2-1

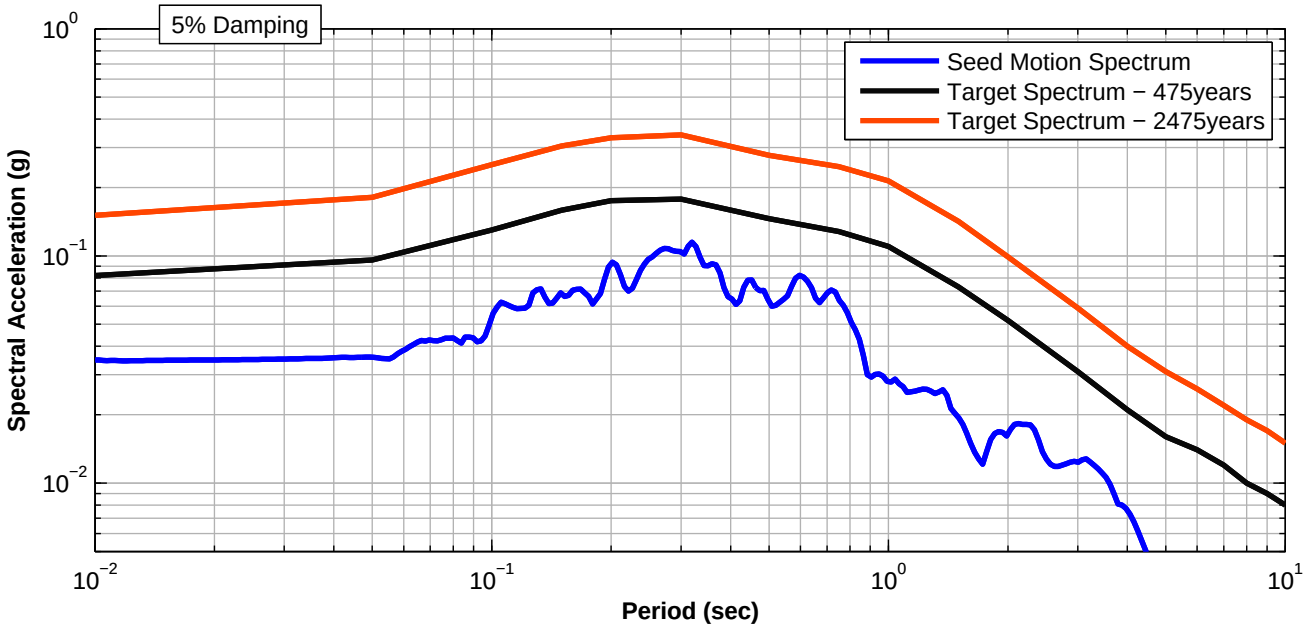




DENALI ALASKA, 2002 EARTHQUAKE
PS08 STATION, 319 COMPONENT
PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

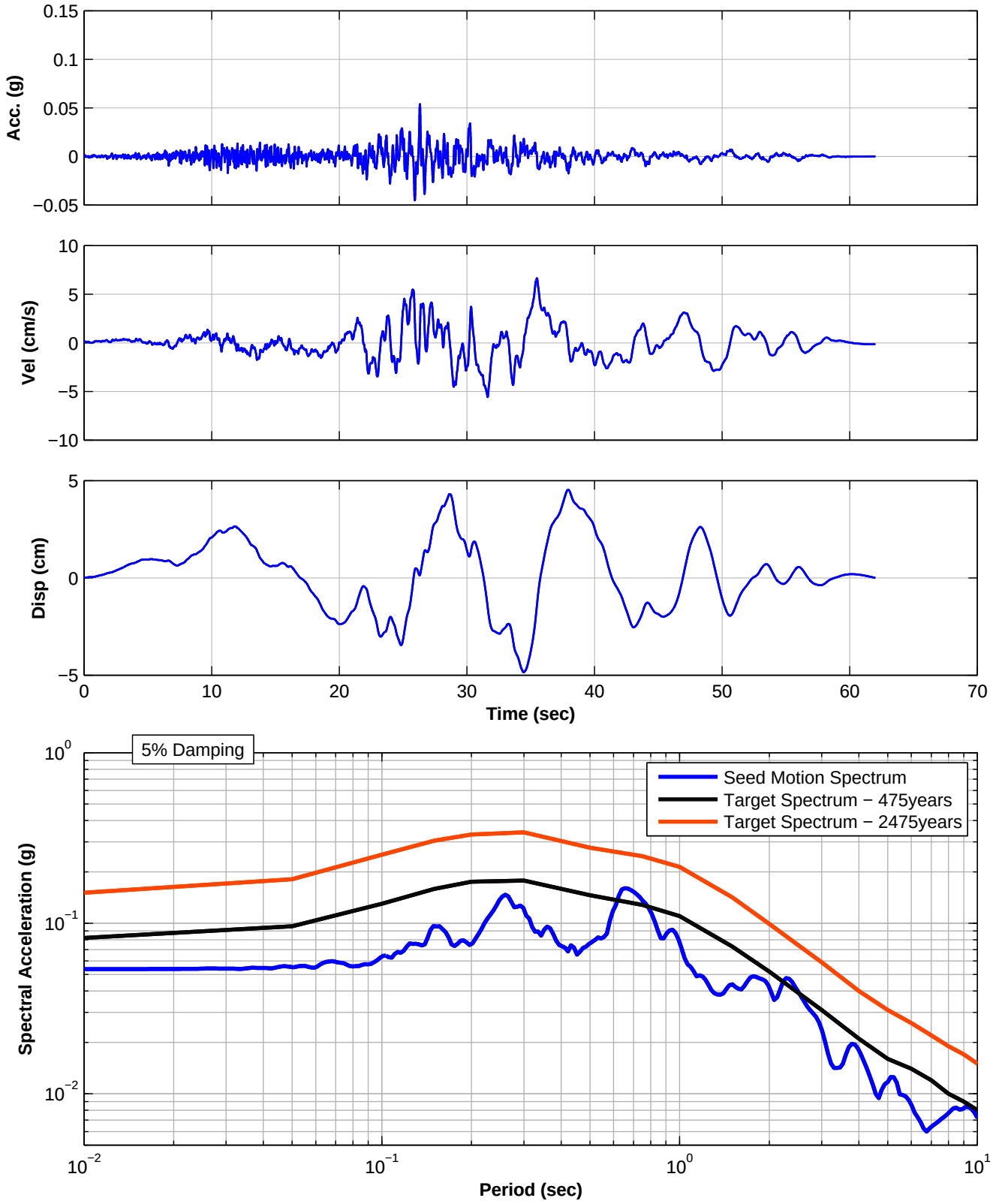
FIGURE 2.3-1





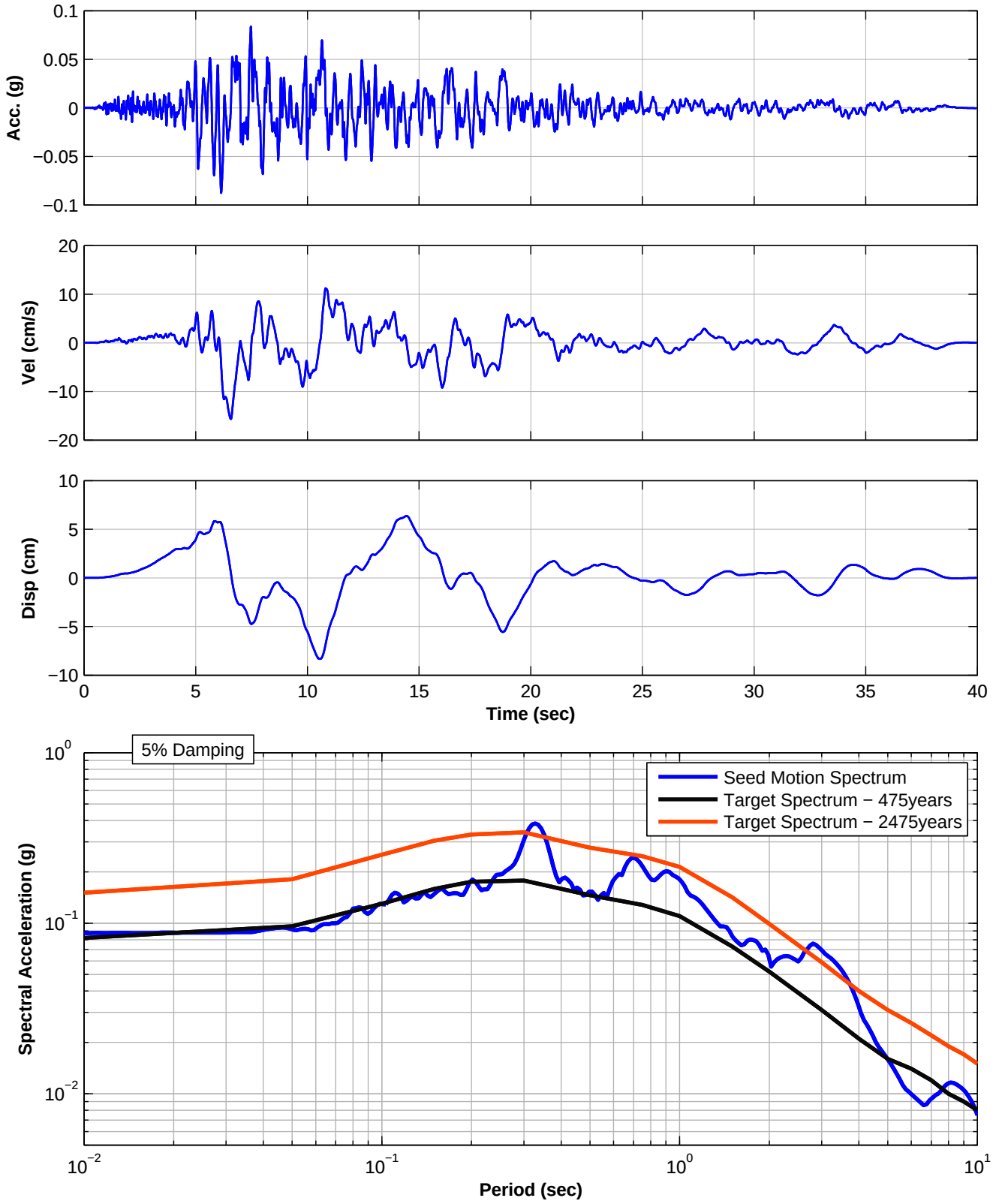
KOCAELI, TURKEY, 1999 EARTHQUAKE
TKR STATION, 090 COMPONENT
PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

FIGURE 2.3-2



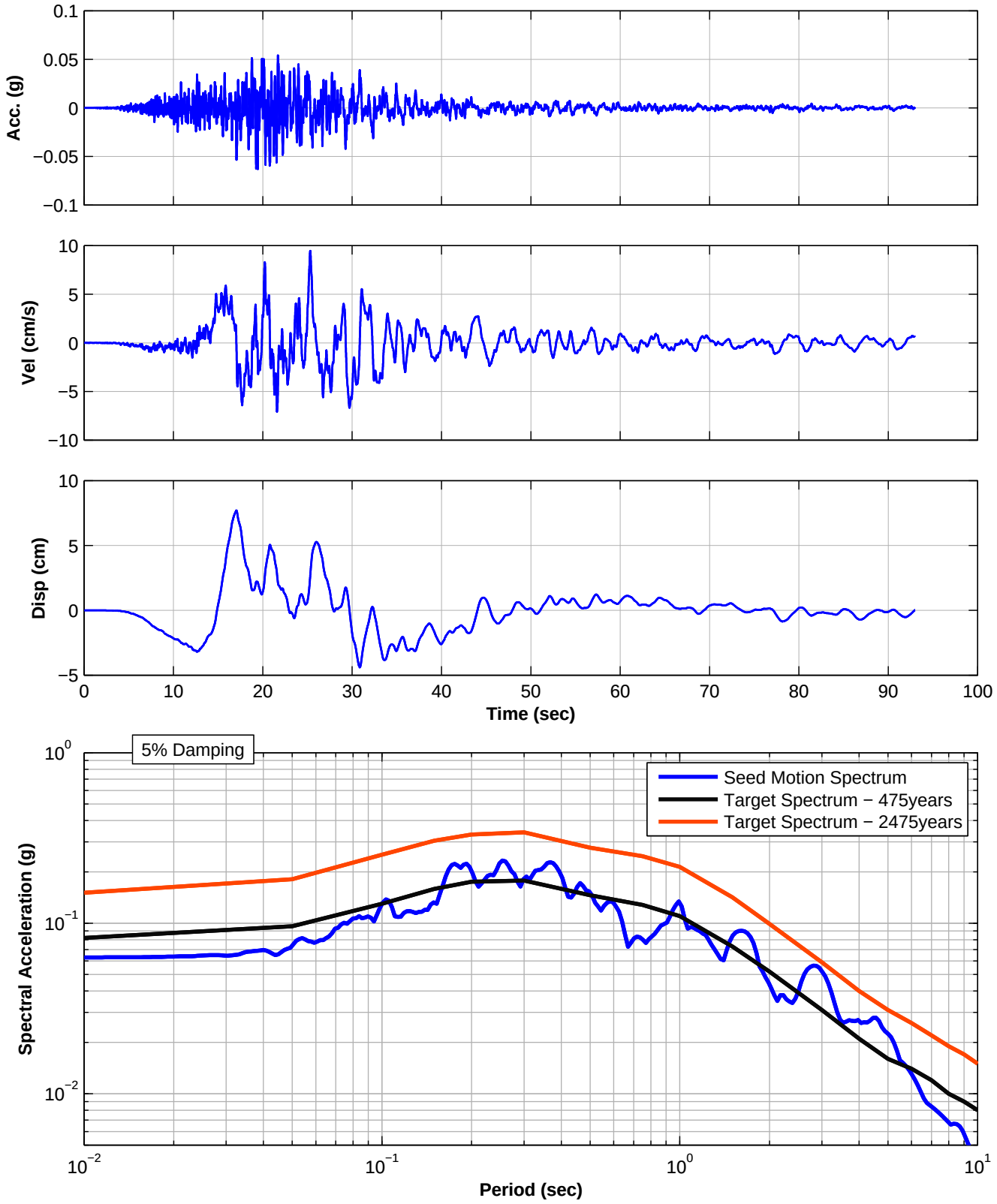
CHI−CHI, TAIWAN, 1999 EARTHQUAKE
TAP046 STATION, N COMPONENT
PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

FIGURE 2.3-3



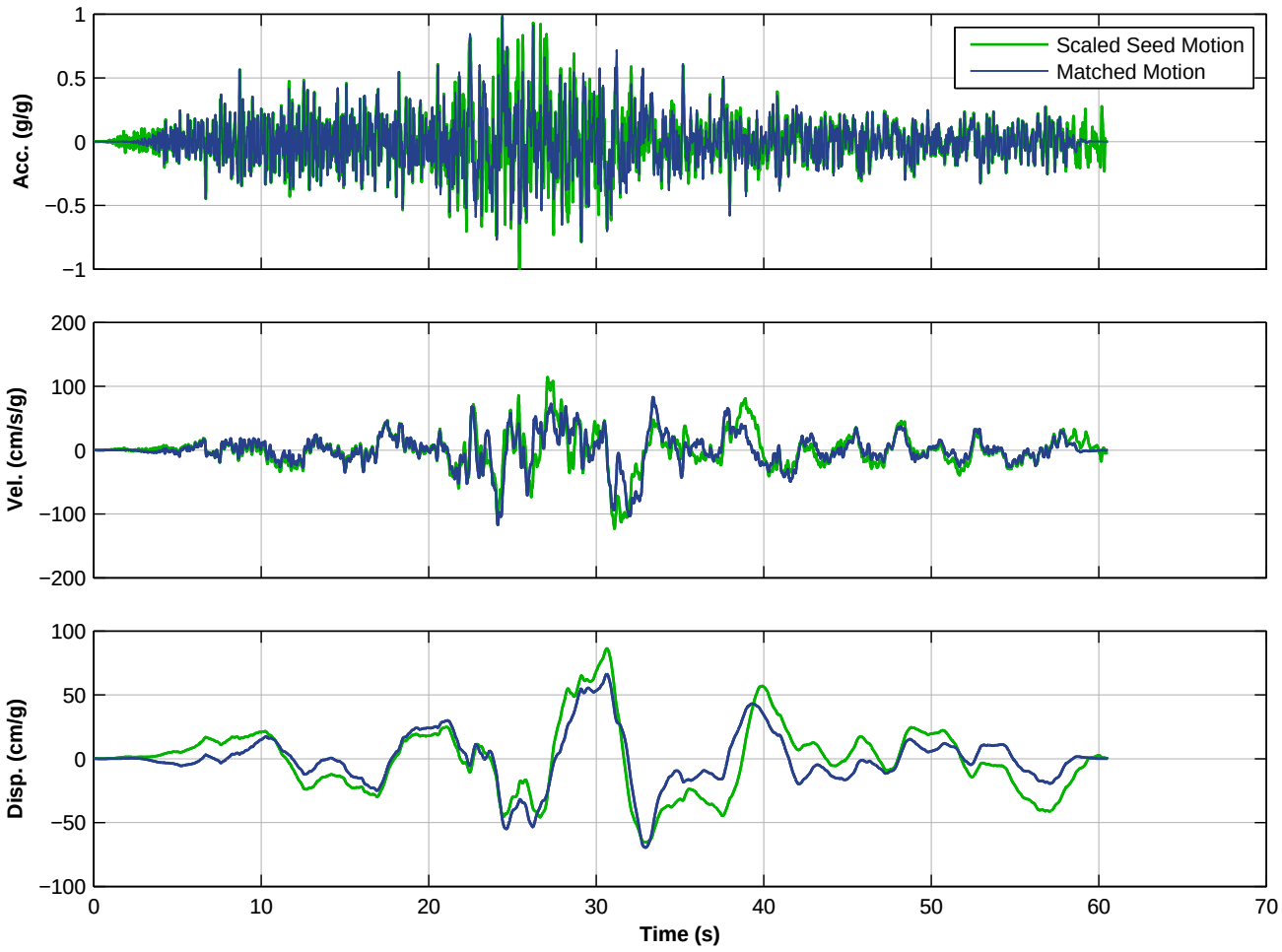
LOMA PRIETA, 1989 EARTHQUAKE
A07 STATION, 090 COMPONENT
PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

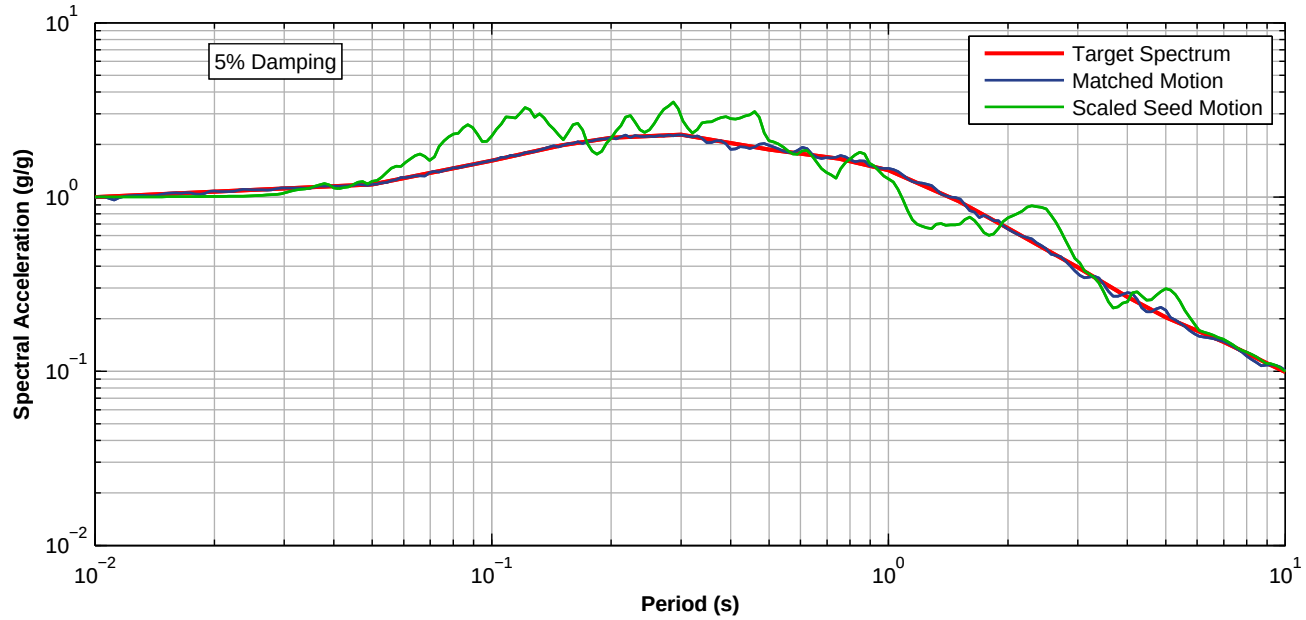
FIGURE 2.3-4



HECTOR MINE, 1999 EARTHQUAKE
STATION, 180 COMPONENT
PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

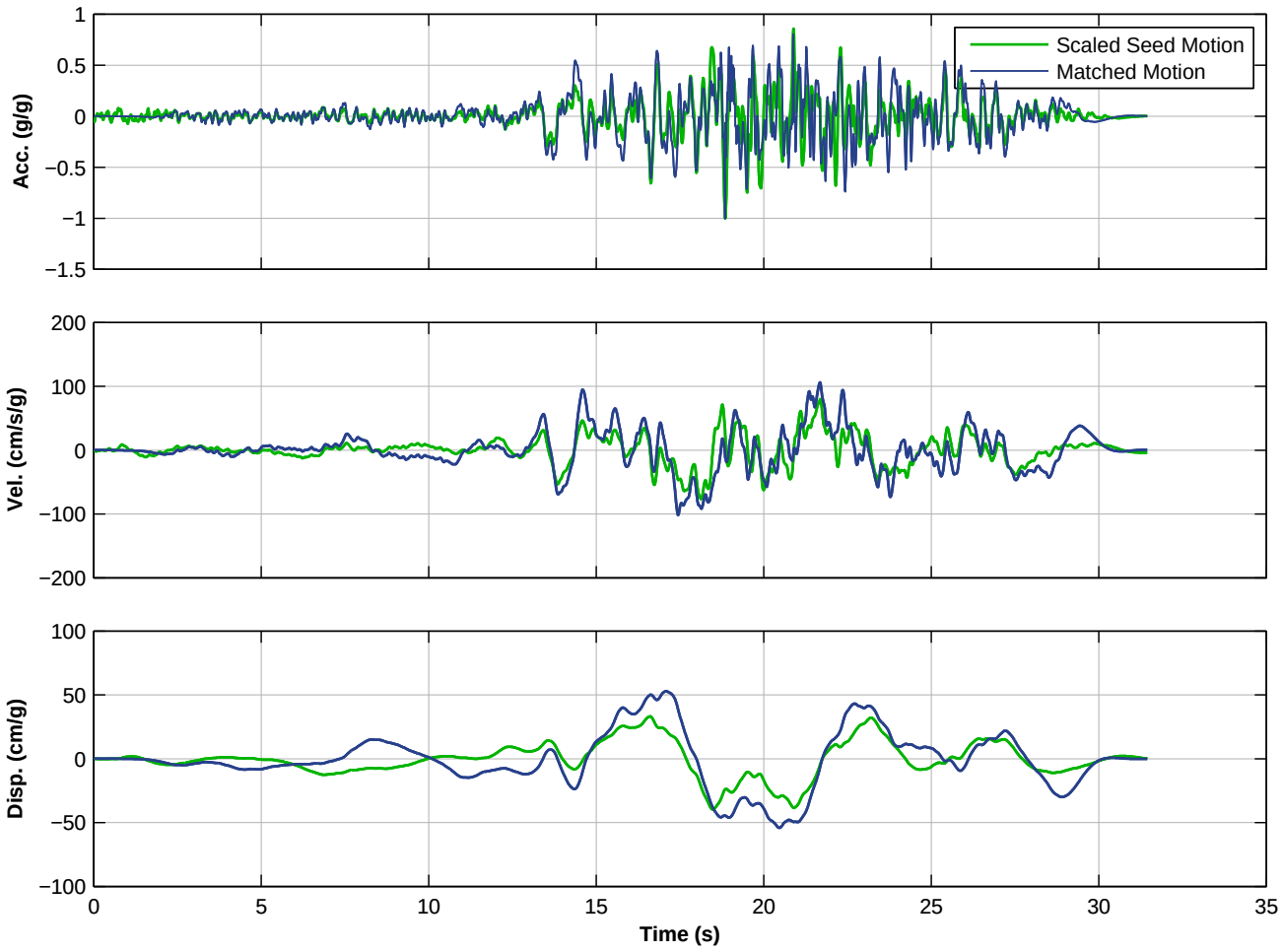
FIGURE 2.3-5

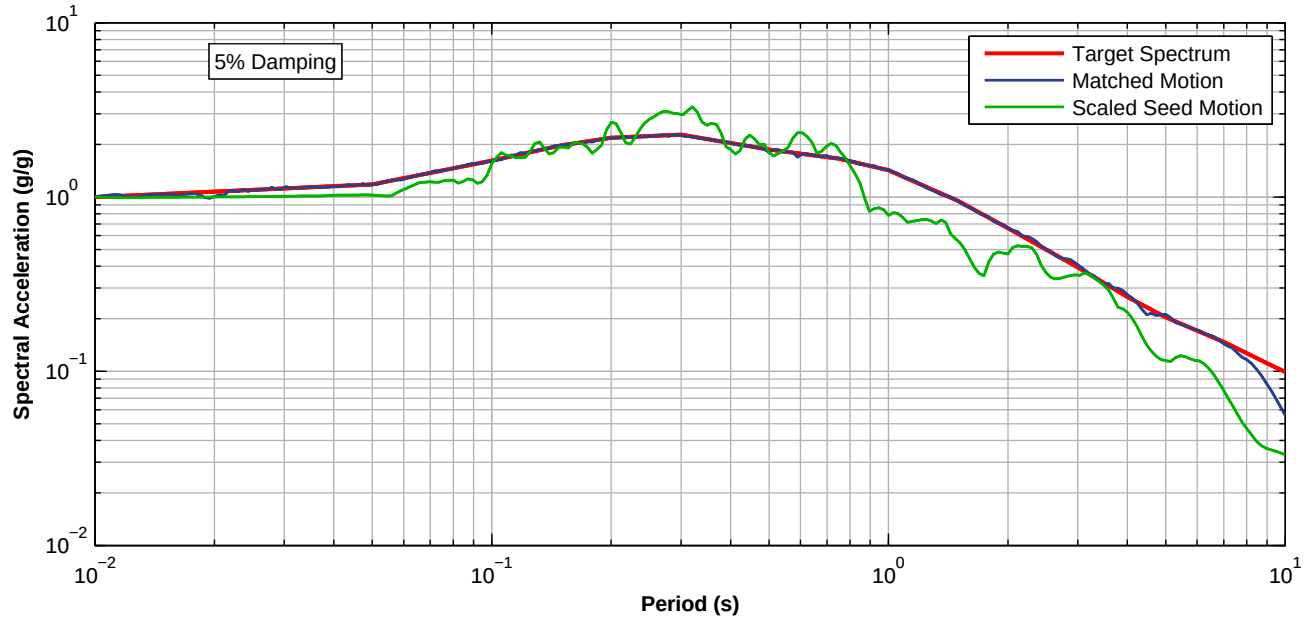




SPECTRALY MATCHED RECORD
DENALI ALASKA, 2002 EARTHQUAKE
PS08 STATION, HORIZONTAL 319 COMPONENT
PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

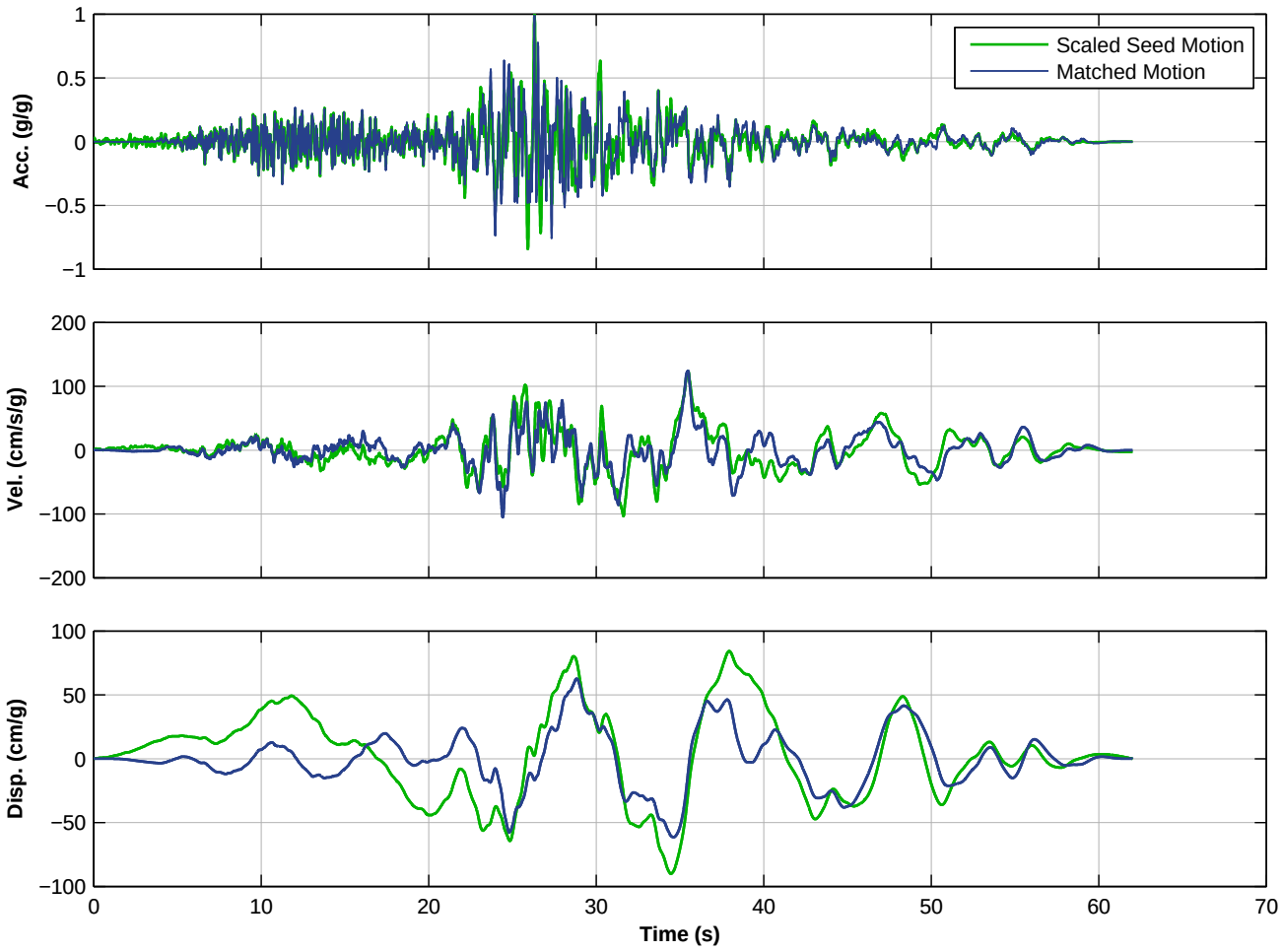
FIGURE 2.3-6

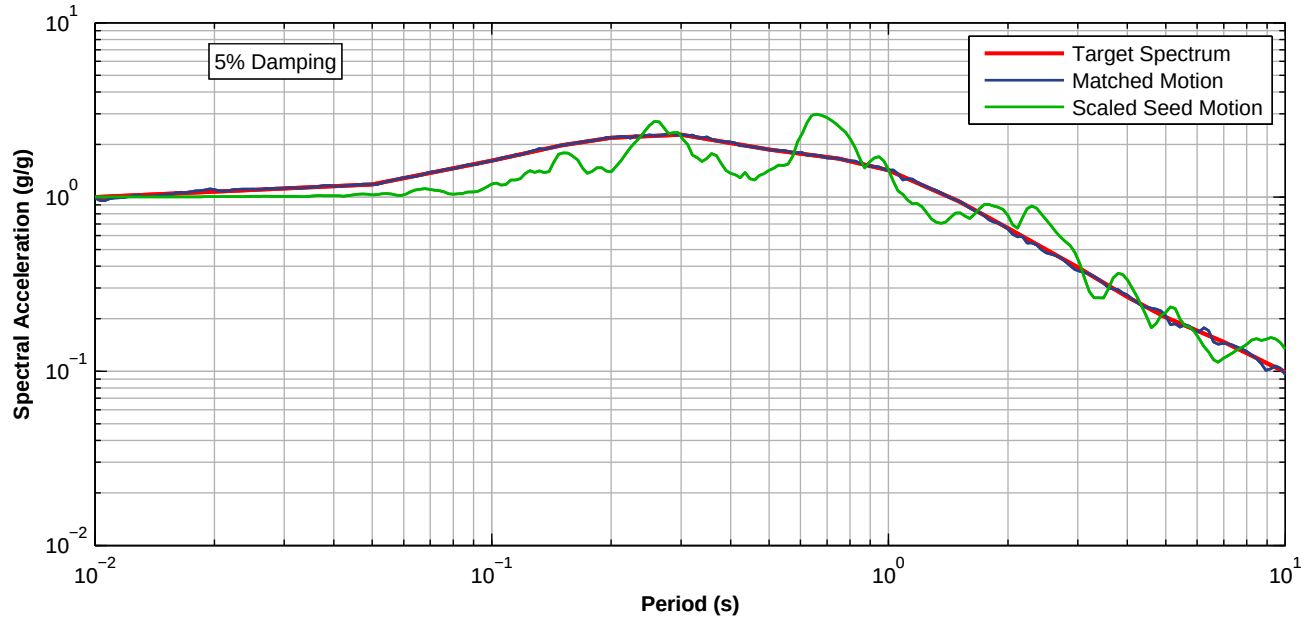




SPECTRALY MATCHED RECORD
KOCAELI, TURKEY, 1999 EARTHQUAKE
TKR STATION, HORIZONTAL 090 COMPONENT
PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

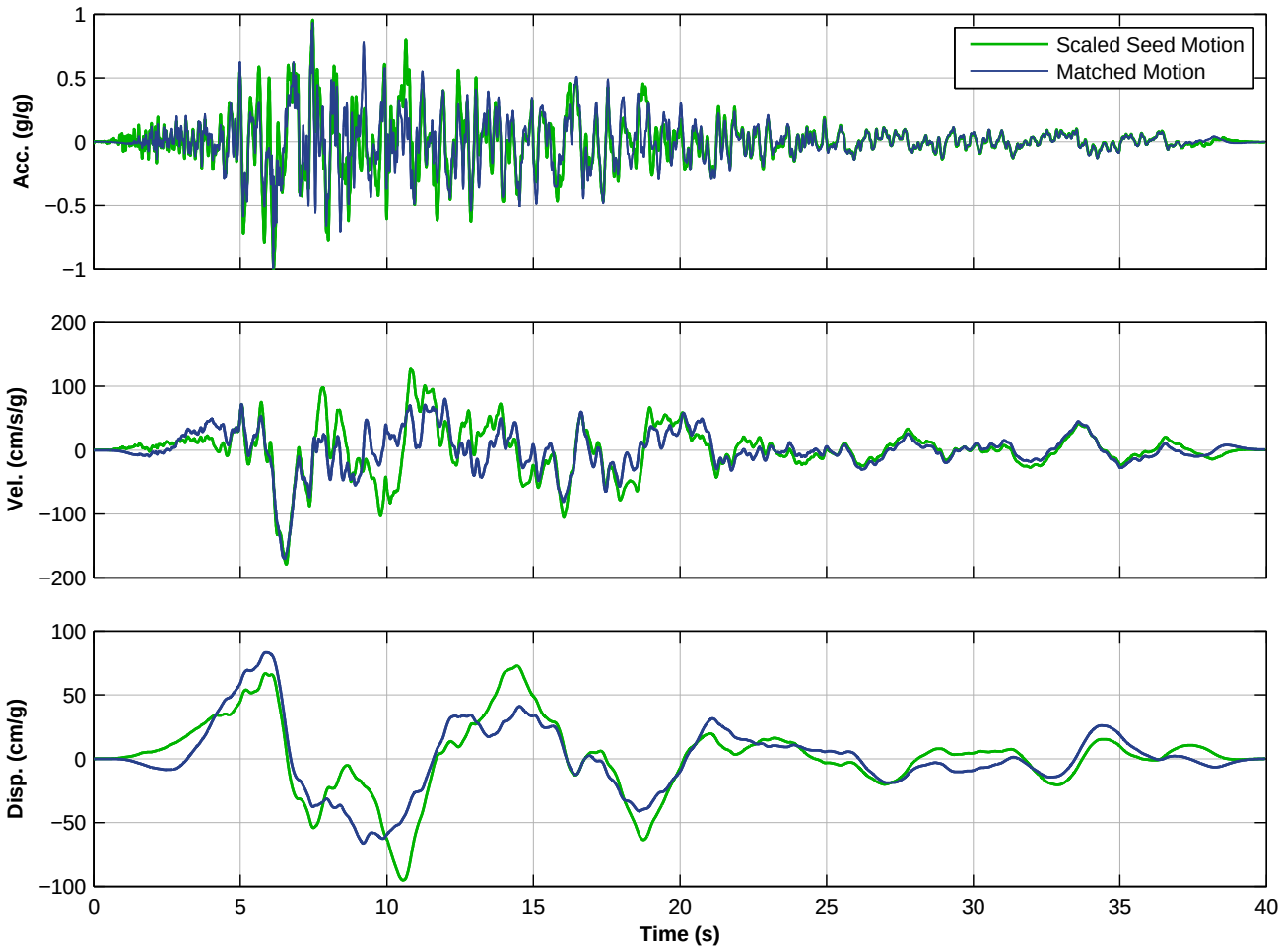
FIGURE 2.3-7

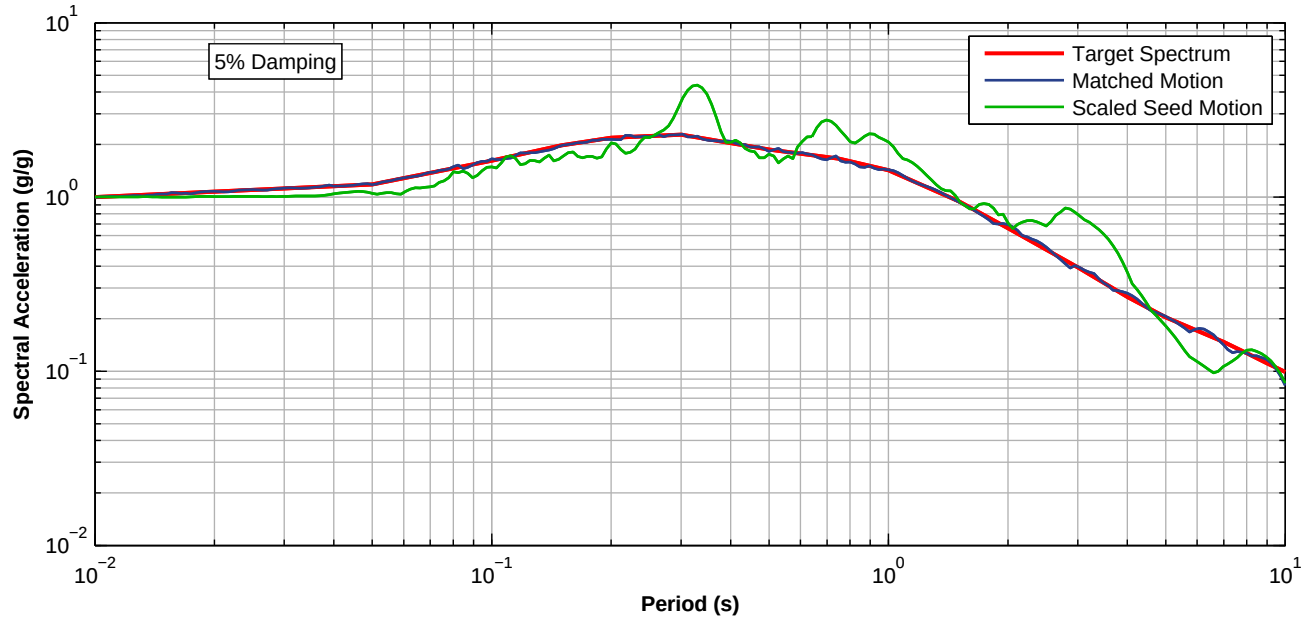




SPECTRALY MATCHED RECORD
CHI−CHI, TAIWAN, 1999 EARTHQUAKE
TAP046 STATION, HORIZONTAL N COMPONENT
PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

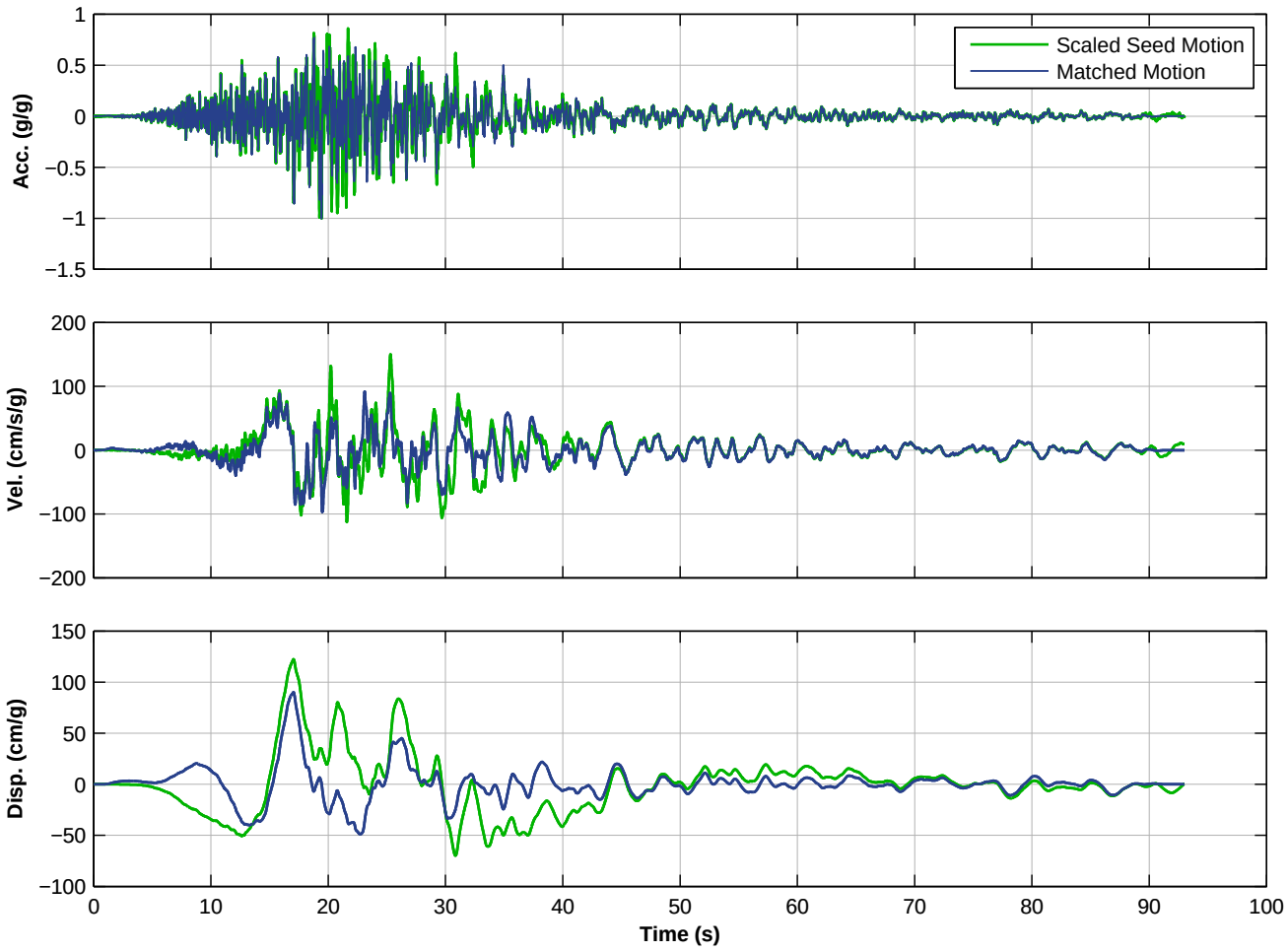
FIGURE 2.3-8

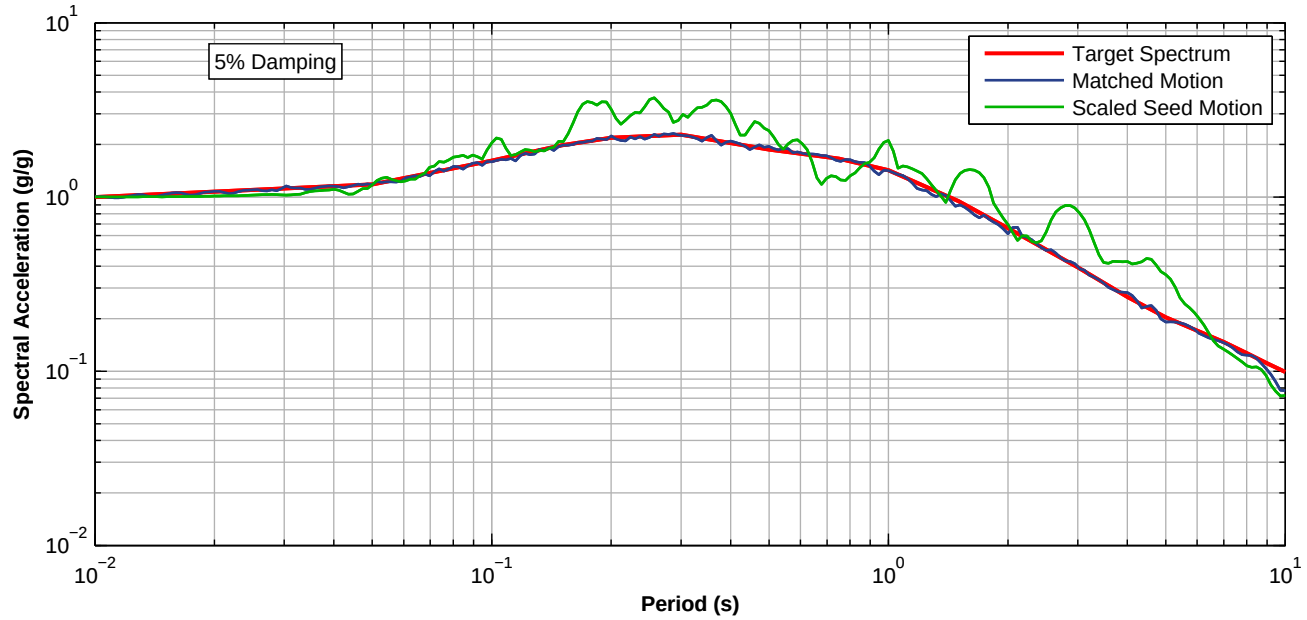




SPECTRALY MATCHED RECORD
LOMA PRIETA, 1989 EARTHQUAKE
A07 STATION, HORIZONTAL 090 COMPONENT
PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

FIGURE 2.3-9





SPECTRALY MATCHED RECORD
HECTOR MINE, 1999 EARTHQUAKE
0534 STATION, HORIZONTAL 180 COMPONENT
PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

FIGURE 2.3-10

3.0 NONLINEAR SITE RESPONSE ANALYSES

3.1 INTRODUCTION

Site response analyses were conducted for the soil conditions representative of the nearshore Berthing and Trestle areas to develop the horizontal response spectra for pile design. Due to the presence of very thick soft soils (H_{soft} > 40 meters) which were generally not encountered in the onshore area, modeling of the nonlinear soil behavior including modulus reduction with increasing shear strain and hysteretic damping is important. Free-field site response analyses were performed using FLAC (Itasca, 2008) which is capable of capturing the nonlinear hysteretic soil behavior during dynamic loading. The soil profile was modeled as horizontally layered strata overlying a uniform half-space. In addition, nonlinear site response analyses were conducted such that accelerations at the depths of piles' point of fixity can be derived to develop the spectra for pile design.

Nonlinear site response analyses were performed using the five design ground motions spectrally matched to the acceleration response spectra for both return periods of 475 and 2,475 years presented in Section 2.0. The procedure of spectral matching and the design ground motions are presented in Section 2.0.

For site response analyses, soil parameters are developed based on the geotechnical information provided in Fugro (2013b), which presented boring data acquired during an nearshore site investigation (Figure 1.1-2). Borings BH-31 through BH-35 were located along the Trestle while borings BH-36 and BH-37 were located at the ends of the Berthing structure.

3.2 IDEALIZED STRATIGRAPHY AND SOIL PARAMETERS

3.2.1 Stratigraphy

The idealized stratigraphy for the nearshore area was developed based on the geotechnical data presented in Fugro (2013b). In the nearshore area, seven locations were investigated referred to as BH-31 to BH-37. Most of the explorations extended to depths from 40 to 70 m where bedrock was encountered. Borings BH-35 and BH-36 extended to the depth of approximately 110 meters below mudline; however, bedrock was not encountered in these two borings. Depths to the bedrock at each nearshore borings are summarized in Table 3-1.

Table 3-1: Depths to the Bedrock Encountered in Nearshore Borings

Boring	Depths to Bedrock (m)	Area
BH-31	2	Trestle
BH-32	52	Trestle
BH-33	70	Trestle
BH-34	43	Trestle
BH-35	> 110 (Bedrock was not encountered up to 110m)	Trestle/Berthing
BH-36	> 110 (Bedrock was not encountered up to 110m)	Berthing
BH-37	72	Berthing

To capture the variance in the depth to bedrock and its impact to the near-surface soil responses, three bedrock depths were considered: 40, 70, and 120 meters below mudline in the following site response analyses. We understand that during the FEED phase additional borings and explorations will be conducted. Information with respect to the depth to rock will be revised if necessary and site response evaluations will be updated accordingly.

3.2.2 Idealized Soil Properties

3.2.2.1 Shear Wave Velocity

The dynamic input parameters necessary for site response studies include the small-strain shear modulus and strain-dependent shear modulus reduction curves. The small-strain shear modulus, G_{max}, can be calculated as a function of total mass density, ρ_{tot}, and shear wave velocity, V_s, as:

$$G_{max} = \rho_{tot} \cdot V_s^2$$

The idealized V_s profiles for the site response analyses in the nearshore area were estimated primarily based on the measured V_s data presented in Fugro (2013b) for boring BH-35 where PS suspension logging was performed. In addition, V_s values were calculated using the empirical relationship between undrained shear strength and V_s proposed by Dickenson (1994) ($V_s = 18 * Su^{0.475}$, where Su is the undrained shear strength). Figure 3.2-1 presents the best estimate, upper- and lower-bound V_s profiles used in the site response analyses for the nearshore area. The best estimate and lower-bound profiles were developed primarily based on the data from the PS suspension logging which are direct measurements of the shear wave velocity and are the most reliable data for V_s. The V_s values interpreted from the unconsolidated undrained (UU) shear strengths are not direct measurements and although fit reasonably well with the PS logging data, are generally smaller probably due to sample disturbance. Hence the V_s values estimated from the UU data were considered only with a small weight in defining the idealized shear wave velocity profiles. The upper bound profile was selected to address the potential for strain-rate effects, which typically results in larger effective soil stiffness during dynamic loading. In the absence of laboratory tests to evaluate strain-rate effects, the upper bound shear wave velocity profile was developed using a multiplication factor of 1.25 on the best estimate shear

wave velocity. The factor was estimated based on our experience with laboratory data from other projects with soft soils, available literature and code requirements. This ratio can be refined if laboratory tests are performed to look into strain rate effects during FEED.

3.2.2.2 Shear Strength

The soil profiles show predominantly clay layers with cohesionless materials mainly in the shallow depths. Oedometer test results suggested that the clays encountered in all nearshore borings are under to normally consolidated. Based on the laboratory test data, undrained shear strengths in clays vary between different borings but generally increase with depth. The laboratory UU data and empirical correlation between V_s and Su were used as a guideline to develop the best-estimate shear strength profile. The Su/p' ratio for the best-estimated profile is about 0.2, where p' is the effective vertical soil stress. An upper-bound strength profile was developed to consider the strength increase due to dynamic loading. The Su/p' considered in the upper bound case was equal to 0.3. Finally, a lower-bound strength profile was developed to capture the lower shear strengths measured within under-consolidated clays. The idealized Su/p' used for the lower bound profile is equal to 0.1. These strength profiles are later used in the nonlinear site response analyses to capture the variance in shear strength and its impact to the site response.

3.2.2.3 Index Properties

Static soil properties required for site response analyses include unit weight and Atterberg limits (e.g. plastic index), which were also derived from the laboratory test results. The saturated unit weight is generally uniform throughout the full investigated depth from all borings. For site response analyses, a uniform saturated unit weight of 17.3 (kN/m^3) was used. Based on laboratory tests, the plastic index (PI) values vary from 8 in the cohesionless materials to 55 within the clay layers. For the purpose of site response, an average value of 25 is adopted as a guideline to select the modulus reduction curves. The selection of modulus reduction curves is described in Section 3.2.2.4.

3.2.2.4 Modulus Reduction Curves

Due to the lack of site-specific laboratory data, the modulus reduction (G/Gmax) behavior was characterized based on the in-situ soil data (e.g. effective stress, plastic index) presented in Fugro (2013b) and shear modulus reduction curves available in the literature for similar soil types, plasticity characteristics and depth (e.g., Darendeli, 2001 & Vucetic and Dobry, 1991). Additionally, the shear wave velocity and unit weight profiles for the soil column and the undrained shear strength for each soil layer were also used as a guide to develop the modulus reduction curves. Figure 3.2-2 presents the modulus reduction curves used for the three soil strata in the site response analyses. We have proposed that soil resonant column and cyclic simple shear tests be performed on high quality undisturbed samples during FEED to allow for the development of soil-specific modulus reduction curves.

3.2.2.5 Idealized Stratigraphy

The idealized stratigraphy and properties used in the nonlinear site response analyses are presented in Table 3-2.

Table 3-2: Idealized Stratigraphy and Soil Properties

Stratum Number	Depth (m)	Total Unit Weight (KN/m^3)	Undrained Shear Strength, Su/p'	Shear Wave Velocity, (m/s)			G/Gmax and Damping Curves[1]
				Best Estimate	Lower Bound	Upper Bound	
I	0 – 40	17.3	0.1 (Lower-bound) 0.2 (Best-estimate) 0.3 (Upper-bound)	100 - 180	75 - 135	125 - 225	Darendelli (2001) PI=25, 0.5~2atm
II	40 – 70			180 – 240	135 – 180	225 – 300	Darendelli (2001) PI=25, 2~3atm
III	70 – 120			240 - 340	180 - 255	300 - 425	Darendelli (2001) PI=25, 3~5atm

NOTE: 1) G/GMAX CURVES FROM DARENDELLI (2001) WERE USED AS GUIDELINES. ACTUAL REDUCTION CURVES USED IN ANALYSES ARE SHOWN ON FIGURE 3.2-2

3.3 METHODOLOGY

Due to the significant thickness of soft soils at the nearshore site, a non-linear site response formulation was selected over conventional equivalent linear techniques. The analyses were performed using the numerical analysis software FLAC (Itasca, 2008). FLAC is an explicit finite difference program for engineering mechanics computations, which operates in the time domain. It simulates the behavior of soils that may undergo plastic flow when their yield limits are reached. The soil behaves according to a nonlinear stress-strain relationship implemented through a "hysteretic" model that allows for the modeling of the reduction of the shear modulus with increasing shear strain and corresponding increase in hysteretic damping. The soil constitutive model selected for this set of analyses was ITASCA Hysteresis Sigmoidal (S3) model, which is one of the built-in models in FLAC (Itasca, 2008).

3.3.1 Itasca Hysteresis Sigmoidal (S3) Model

The default ITASCA Hysteresis model computes the nonlinear behavior of the soil by means of a nonlinear stress-strain back bone curve and the associated stress-strain loops that represent the energy dissipated in the soil during seismic loading. The main input parameters to the Itasca Hysteresis model are the small-strain shear modulus, bulk modulus, friction angle, and cohesion. In addition, the model uses an analytical formulation (i.e., sigmoidal curve) to capture strain-dependent reduction of secant shear modulus. The curve is defined by means of three parameters as given in the Equation below:

$$\frac{G}{G_{\max}} = \frac{a}{1+\exp(-(L-x_0)/b)}$$

where a, x_o, and b are the model parameters, and L is the 10-base logarithm of the shear strain in percentage.

3.3.2 Input Ground Motions and Boundary Conditions in FLAC

As described in Section 3.2.1, the site response analyses were conducted with 3 bedrock depths – 40m, 70m, and 120m below mudline. Finite Difference (FD) grids used in the FLAC analyses for the bedrock at 120 meters is illustrated on Figures 3.3-1. In the FLAC soil column, nodes along the lateral edges were modeled as “free-field” to allow for energy dissipation in the horizontal direction. The ground motions developed in Section 2.0

were input at the base of the model and propagate upwards in the form of seismic shear waves.

Since the input ground motions were developed to be compatible with a target response spectra for “Site Class A” with an average shear wave velocity of 1500 m/s, these motions were defined as “outcrop” rock motions and should be applied at a depth below which the shear wave velocity is estimated to be about 1500 m/s or where bedrock is expected. Accordingly, a compliant-base was used at the bottom of the model to simulate the half space.

3.4 RESULTS

Nonlinear site response analyses were performed using the five spectrally matched time histories for return periods of 475 and 2,475 years, for the best estimate, upper-, and lower-bound shear wave velocity and shear strength profiles. In addition, 3 bedrock depths for each case were modeled to capture the variance in the bedrock elevation. Analyses for a total of nine idealized profile cases (i.e., three assumed rock depths coupled with best estimate, upper bound and lower bound properties) were conducted. The results from these analyses are presented in the following sections.

3.4.1 Peak Shear Strain Profiles

The peak shear strain profiles estimated from nonlinear site response analyses are shown on Figures 3.4-1 to 3.4-3 for the 40m, 70m, and 120m rock depth, respectively, for both return periods of 475 and 2,475 years (i.e., figures i and ii, respectively). These figures show the results for all ground motions and three idealized soil profiles. In all cases, peak shear strains of about 0.3 to 0.5 percent were estimated at 10 to 30 meters below mudline. The lower-bound soil profile generally estimates higher strains compared to the other two profiles. The results also show that soils at the nearshore area will experience moderate nonlinear behavior while excited by both OBE (475-year) and SSE (2475-year) events.

3.4.2 Peak Acceleration Profiles

The peak acceleration profiles estimated from nonlinear site response analyses are shown on Figures 3.4-4 to 3.4-6 for the 40m, 70m, and 120m bedrock depth, respectively, for both return periods of 475 and 2,475 years. Higher accelerations were estimated by the upper-bound soil profile for all the bedrock depth cases. Overall, de-amplification of PGA near the mudline was estimated due to the presence of very soft soils.

3.4.3 Shear Stress- Shear Strain Loops

Figure 3.4-7 illustrates the dynamic shear stress-shear strain loops calculated in FLAC. The stress-strain loops are calculated for soil element at the depth of 10.5 meters from the 70-meter rock depth model excited by the spectrally matched time history - TAP046. As shown, due to higher level of shaking from the 2,475-year level event, the stress-strain loop is larger and soil experienced more nonlinearity compared to the 475-year level. As a result, more energy was dissipated during the cyclic loading.

3.4.4 Acceleration Response Spectra

Figures 3.4-8 to 3.4-10 present the 5%-damped acceleration response spectra at the depth of 10 meters of all ground motions and each soil profile for the three bedrock depths, respectively, and for return periods of 475 and 2,475 years. These figures also present the average spectrum for each case. Also plotted for reference is the input (outcrop) response spectrum at the base of the model (i.e. bedrock). Overall, accelerations at short periods are

de-amplified with respect to the input outcrop motion. However, amplification at intermediate to longer periods, especially around the fundamental period of the soil column, is observed.

3.4.5 Acceleration Response Spectra for Pile Design

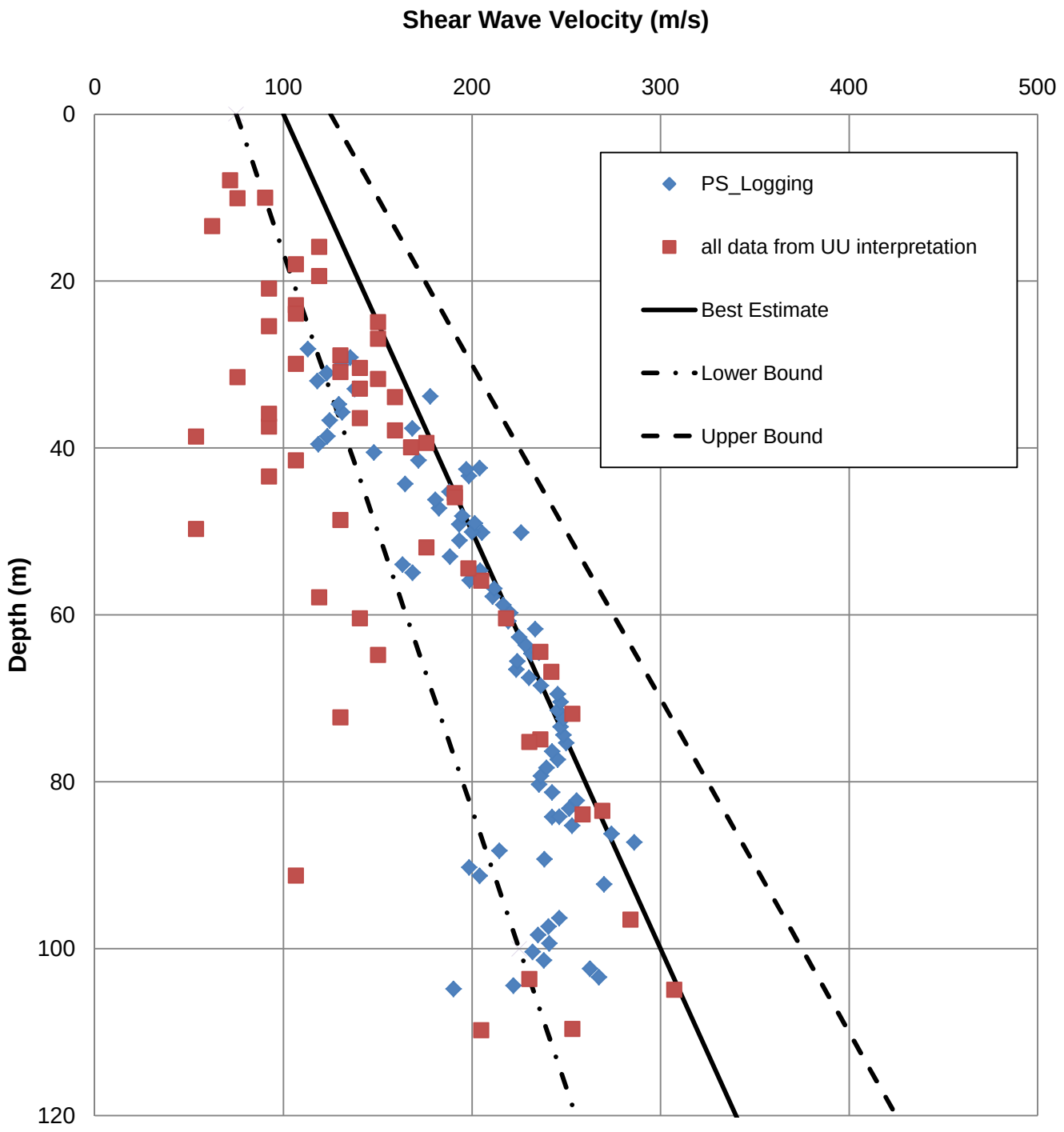
The recommended horizontal acceleration response spectra for use in pile design were developed based on the results from site response analyses. In general, the effective motion that the foundation will experience will be associated with soil acceleration over the pile length, hence, the mudline (surface) motion is not representative for design. For pile design, the ground motions are typically developed at the estimated piles' point of fixity, the shallowest depth where the relative motion between the pile and adjacent soil is negligible. The point of fixity was estimated based on the proposed pile dimensions from the structural drawings and results from preliminary push over analyses presented in Fugro (2013b). For the nearshore structure in the Trestle and Berthing areas, the structure will be supported by steel pipe piles with the diameter of 916 mm. Based on the preliminary LPILE analyses (Fugro 2013b), the piles' point of fixity is at about 10 to 20 meters below mudline (equal to about 10 to 20 times of pile diameter) depending on the loading cases and soil condition. As shown on Figure 3.4-11, the idealized horizontal design response spectra are developed based on spectra at the depths of 10 and 20 meters from all nine analytical cases. The idealized design spectra generally envelop the individual spectrum and are generally based on the average plus one standard deviation spectra. The recommended design horizontal response spectra for return periods of 475 and 2,475 years are presented on Figure 3.4-12, respectively, and tabulated in Table 3-3. The site class associated with the design response spectra presented in Table 3-3 is site class E, where liquefiable soils are not encountered. The site class is F if liquefiable soils are present.

Table 3-3: 5%-Damped Near-Surface Horizontal Response Spectra for Pile Design for Return Periods of 475 and 2,475 Years

Period (seconds)	Horizontal Spectral Acceleration (g)	
	475-year Return Period	2,475-year Return Period
0.01	0.084	0.130
0.05	0.092	0.151
0.1	0.140	0.250
0.15	0.200	0.310
0.2	0.250	0.360
0.3	0.250	0.360
0.5	0.250	0.360
0.75	0.250	0.360
1	0.250	0.360
1.2	0.250	0.360
1.5	0.220	0.360
2	0.170	0.290
3	0.093	0.173
4	0.052	0.095
5	0.034	0.068
6	0.023	0.048
7	0.020	0.040
8	0.015	0.031
9	0.011	0.025
10	0.009	0.018

3.5 SUMMARY

A series of nonlinear site response analyses were conducted for the nearshore Trestle and Berthing areas in Lelu Island. The variances in soil properties (i.e. undrained shear strength and shear wave velocity) as well as the depth to bedrock were considered by using best-estimate, lower- and upper-bound properties and three bedrock elevations in the analyses. Horizontal response spectra at the depth of 10 and 20 meters below mudline (i.e. 10 and 20 times the proposed pile diameter) were applied to develop the idealized design spectra for preliminary pile design consideration. It is noted that design spectra provided in this section are free-field soil response without considering the soil structure interaction effect. The proposed spectra will be updated in the FEED phase of the project incorporating information from additional borings and CPT soundings, including depth to rock in the Berthing area and additional in-situ shear wave velocity measurements and soil-specific modulus reduction curves.

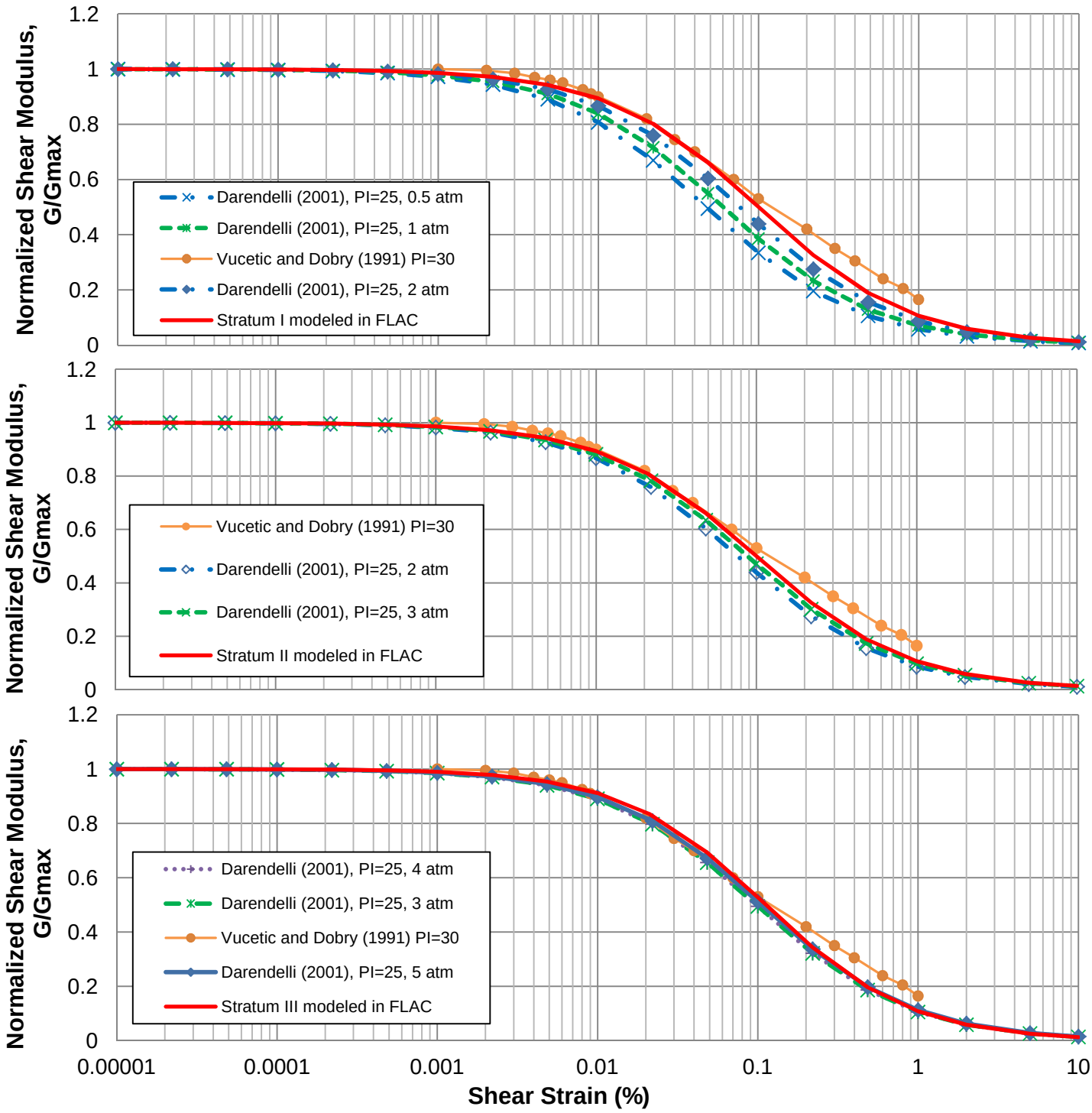


IDEALIZED SHEAR WAVE VELOCITY PROFILES - OFFSHORE AREA

PNW LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

FIGURE 3.2-1

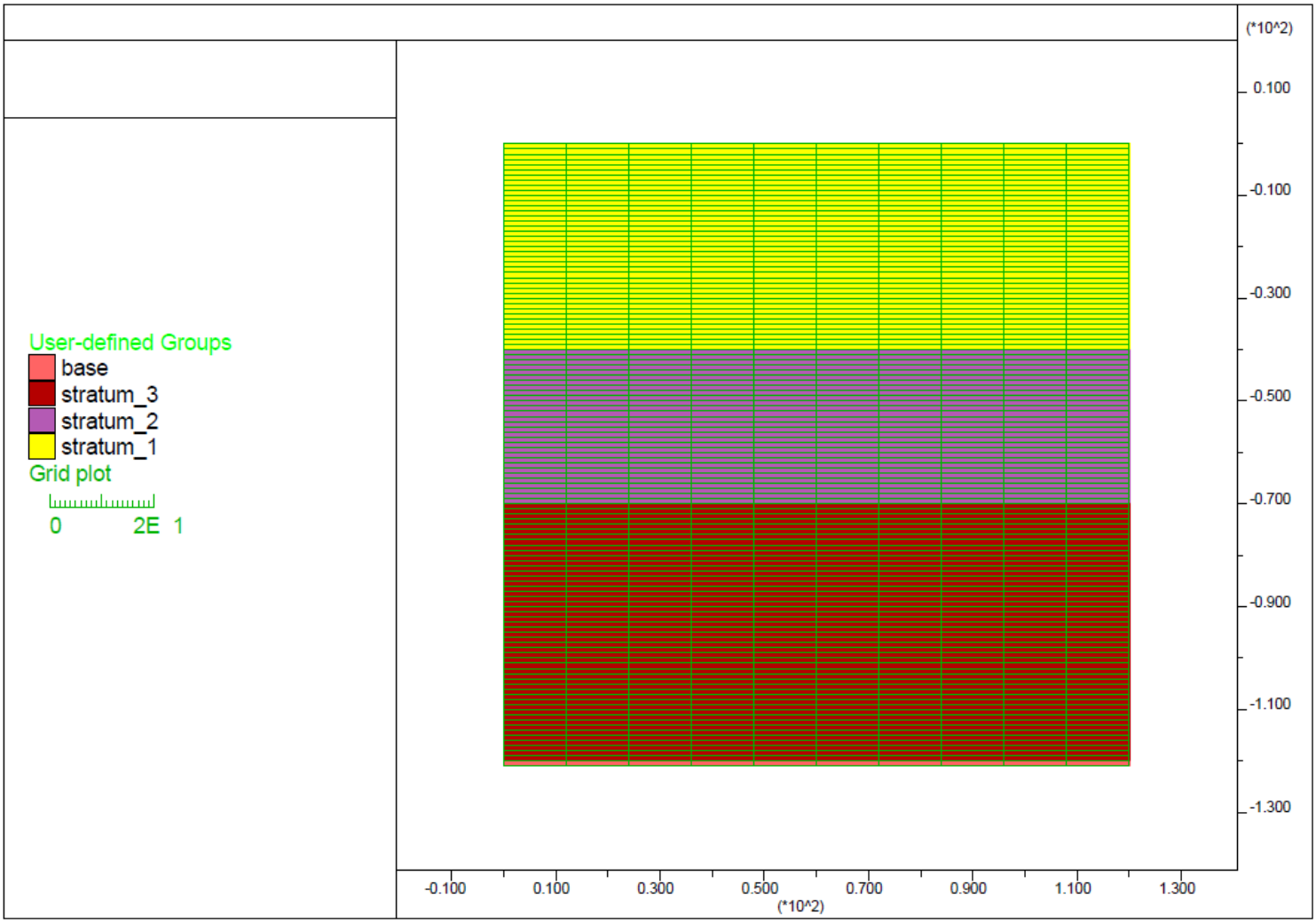


MODULUS REDUCTION CURVES

PNW LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

FIGURE 3.2-2

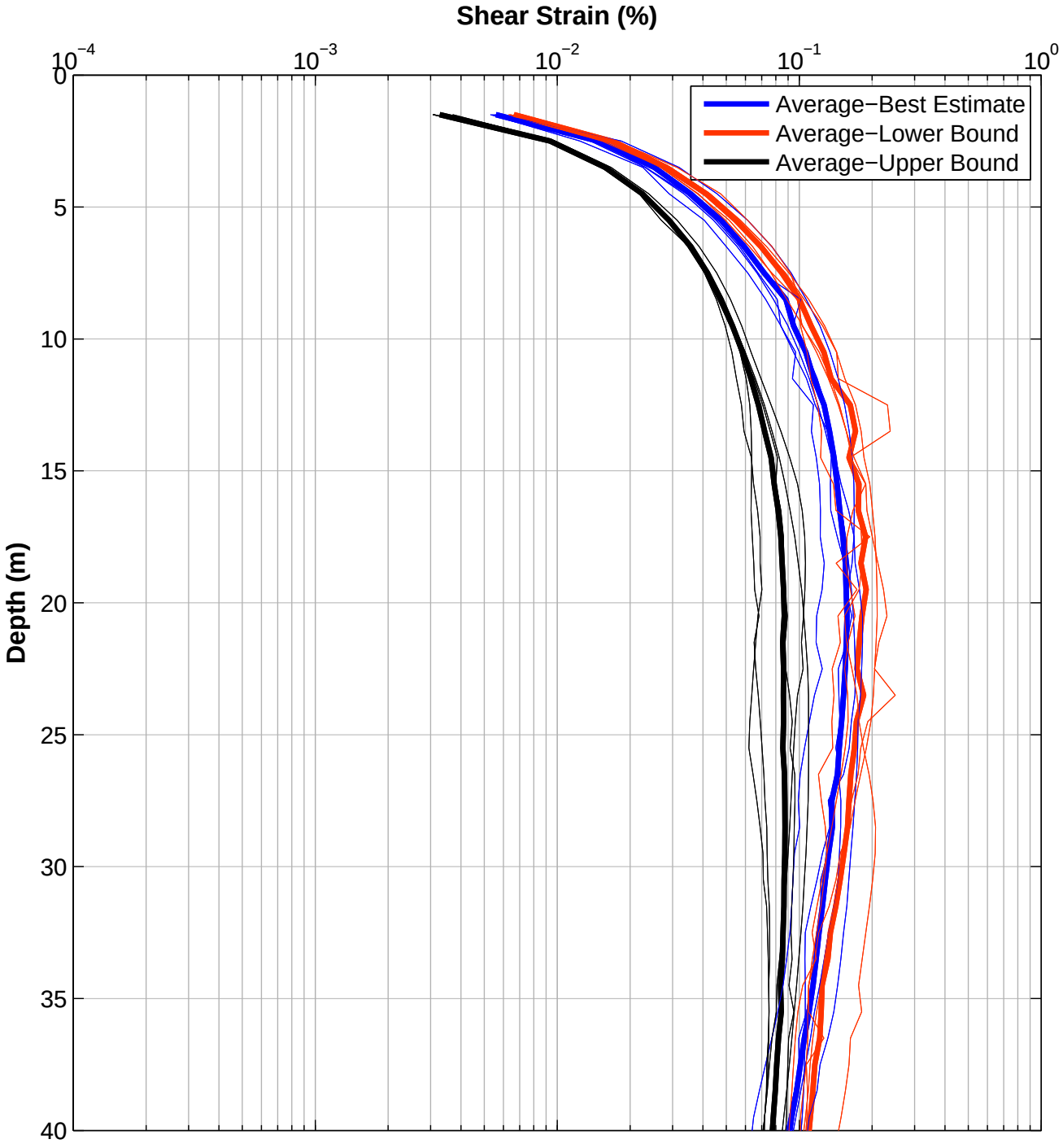


NONLINEAR SITE RESPONSE MODEL IN FLAC (EXAMPLE FOR ROCK DEPTH AT 120 METERS)

PNW LNG PROJECT

LELU ISLAND, BRITISH COLUMBIA, CANADA

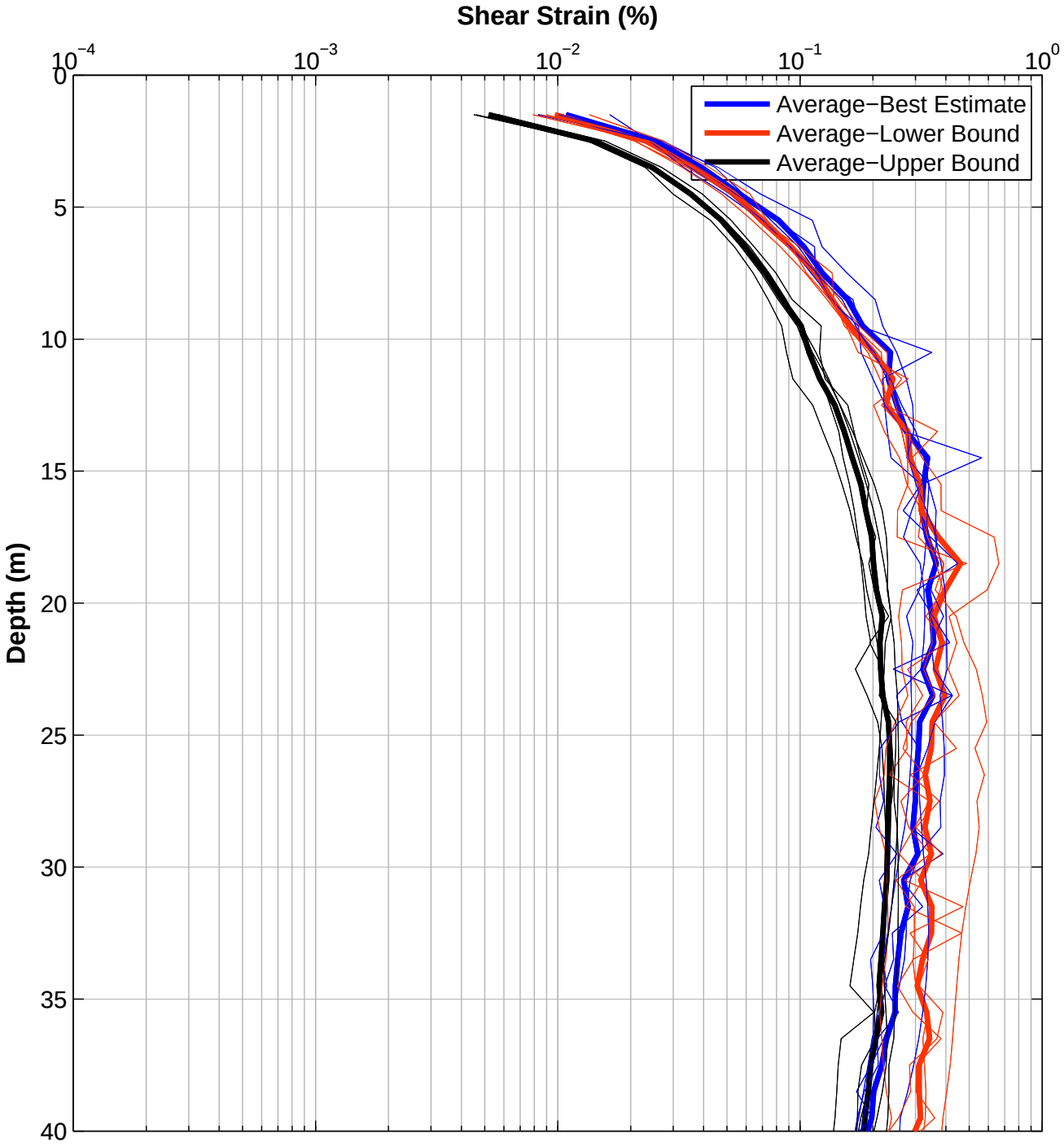
FIGURE 3.3-1



SHEAR STRAIN PROFILE VS DEPTH,40 METER PROFILE
RETURN PERIOD 475 YEARS

PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

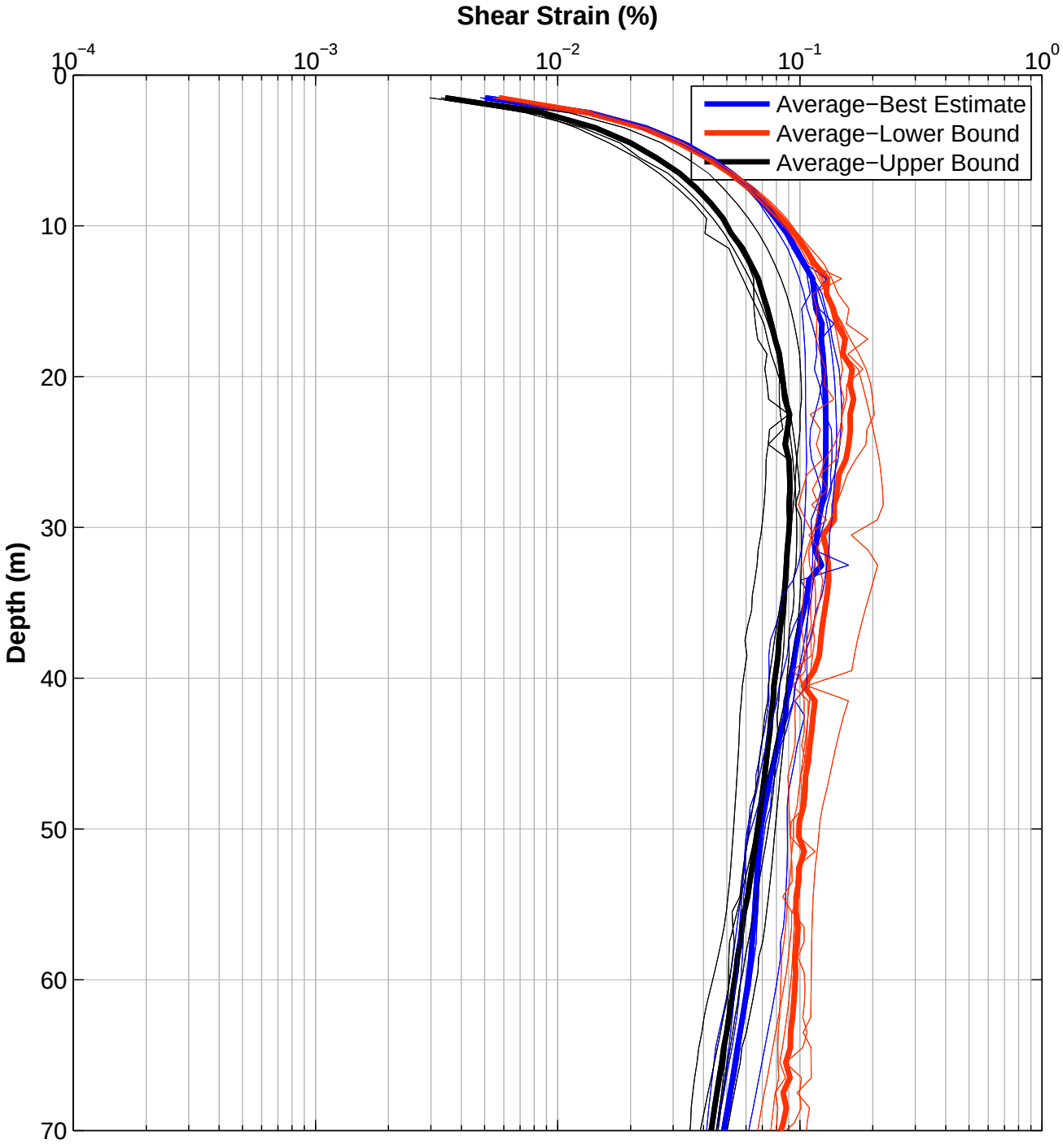
FIGURE 3.4-1i



SHEAR STRAIN PROFILE VS DEPTH,40 METER PROFILE
RETURN PERIOD 2475 YEARS

PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

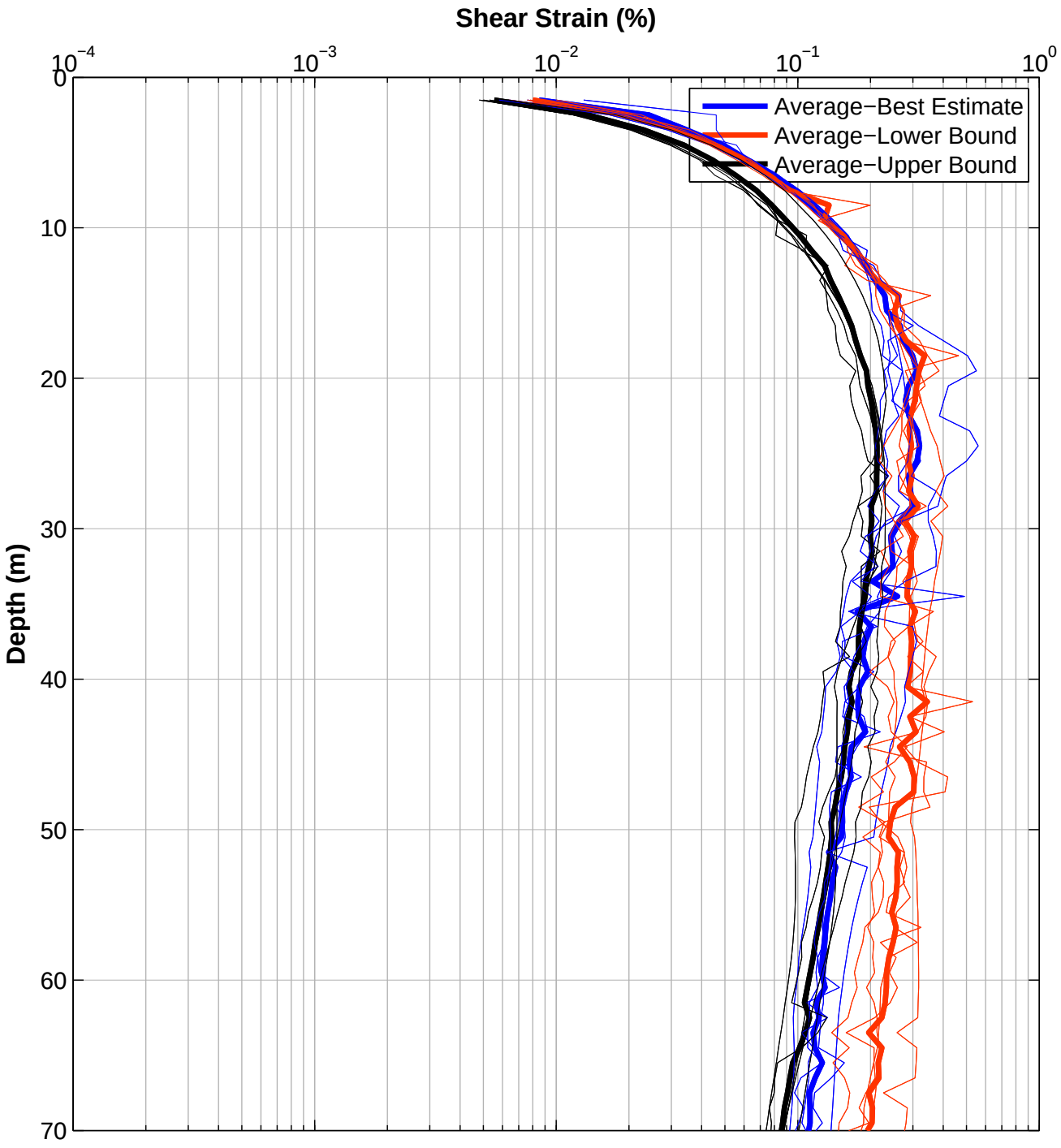
FIGURE 3.4-1ii



SHEAR STRAIN PROFILE VS DEPTH,70 METER PROFILE
RETURN PERIOD 475 YEARS

PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

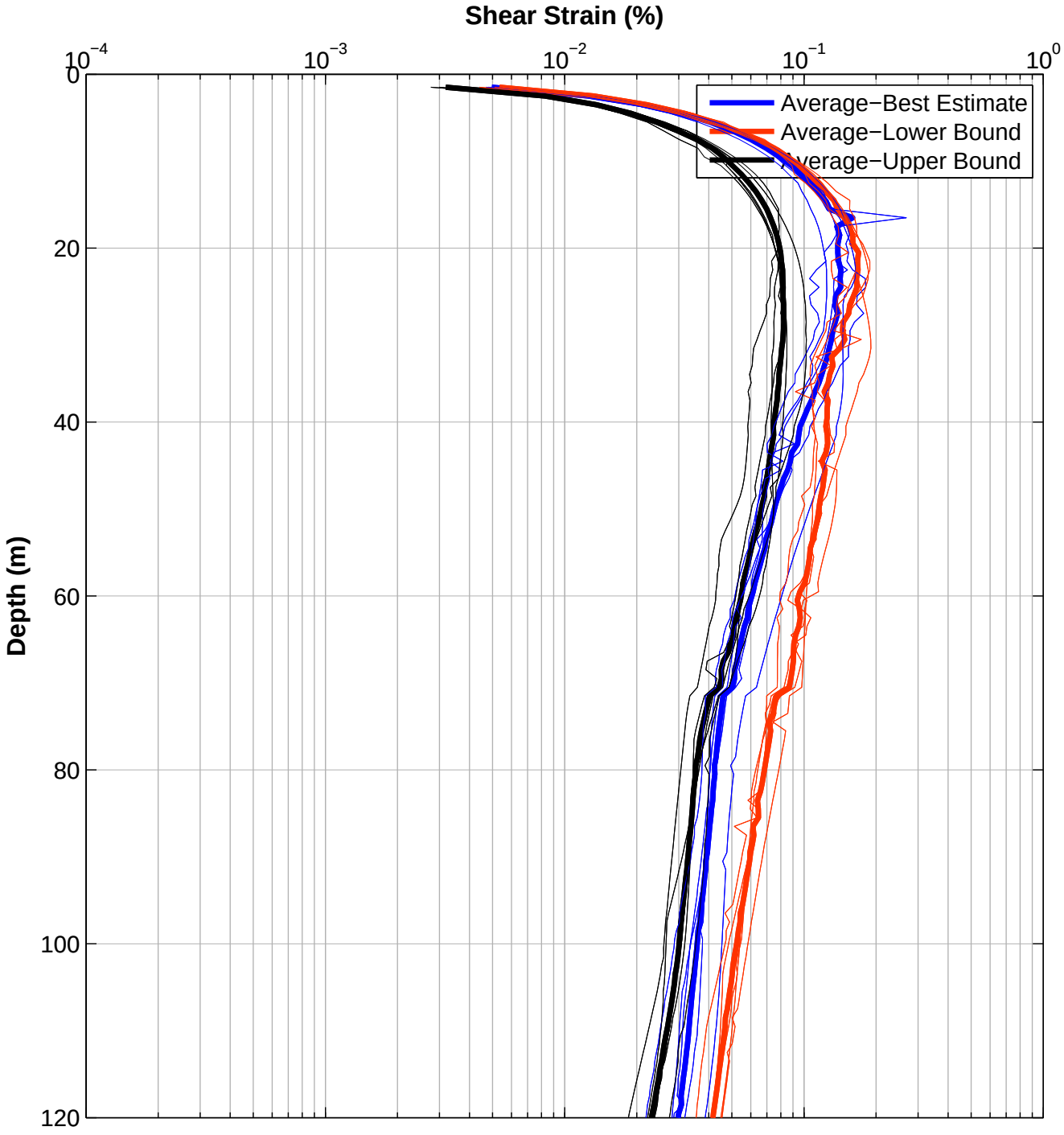
FIGURE 3.4-2i



SHEAR STRAIN PROFILE VS DEPTH,70 METER PROFILE
RETURN PERIOD 2475 YEARS

PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

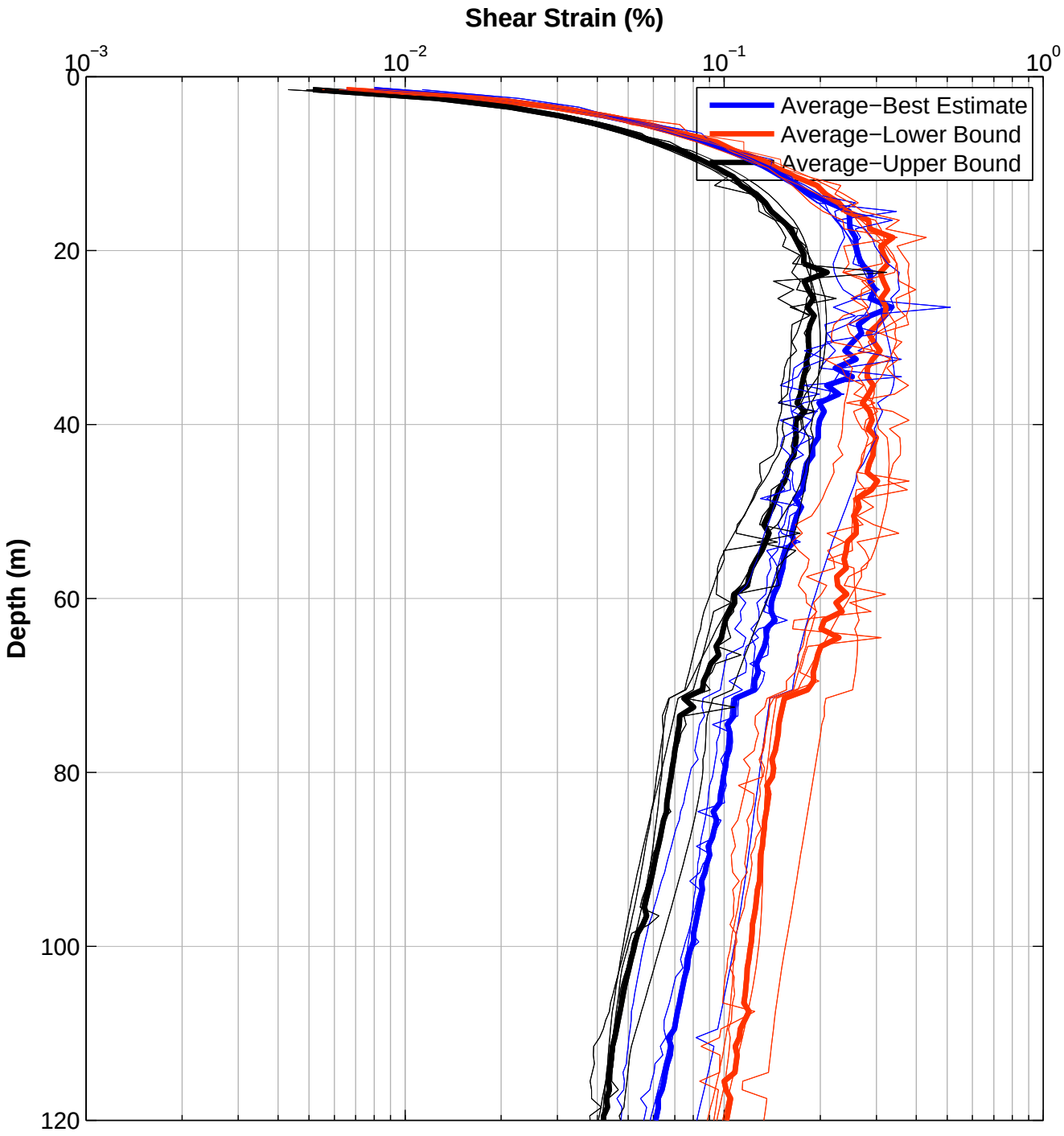
FIGURE 3.4-2ii



SHEAR STRAIN PROFILE VS DEPTH,120 METER PROFILE
RETURN PERIOD 475 YEARS

PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

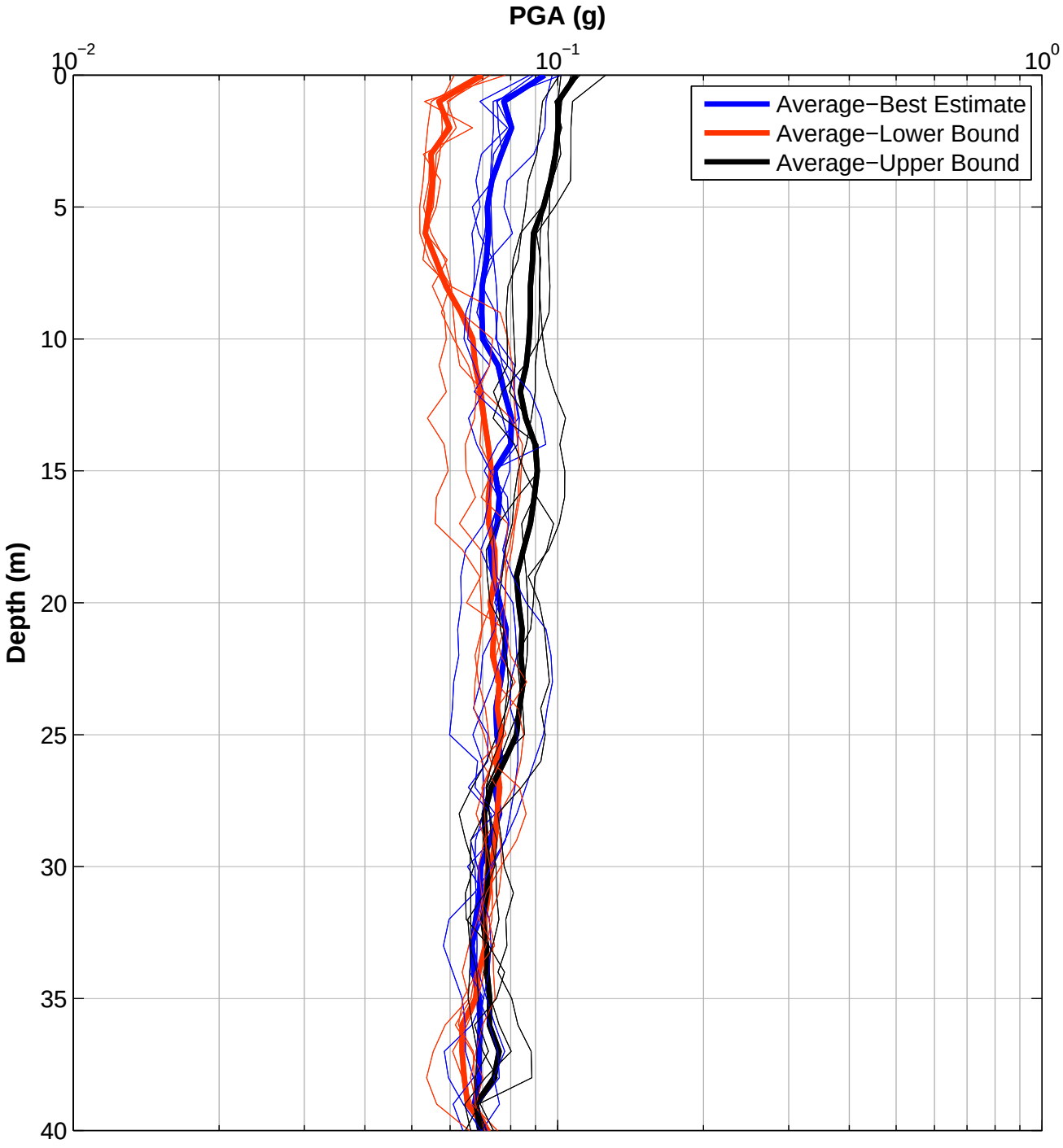
FIGURE 3.4-3i



SHEAR STRAIN PROFILE VS DEPTH,120 METER PROFILE
RETURN PERIOD 2475 YEARS

PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

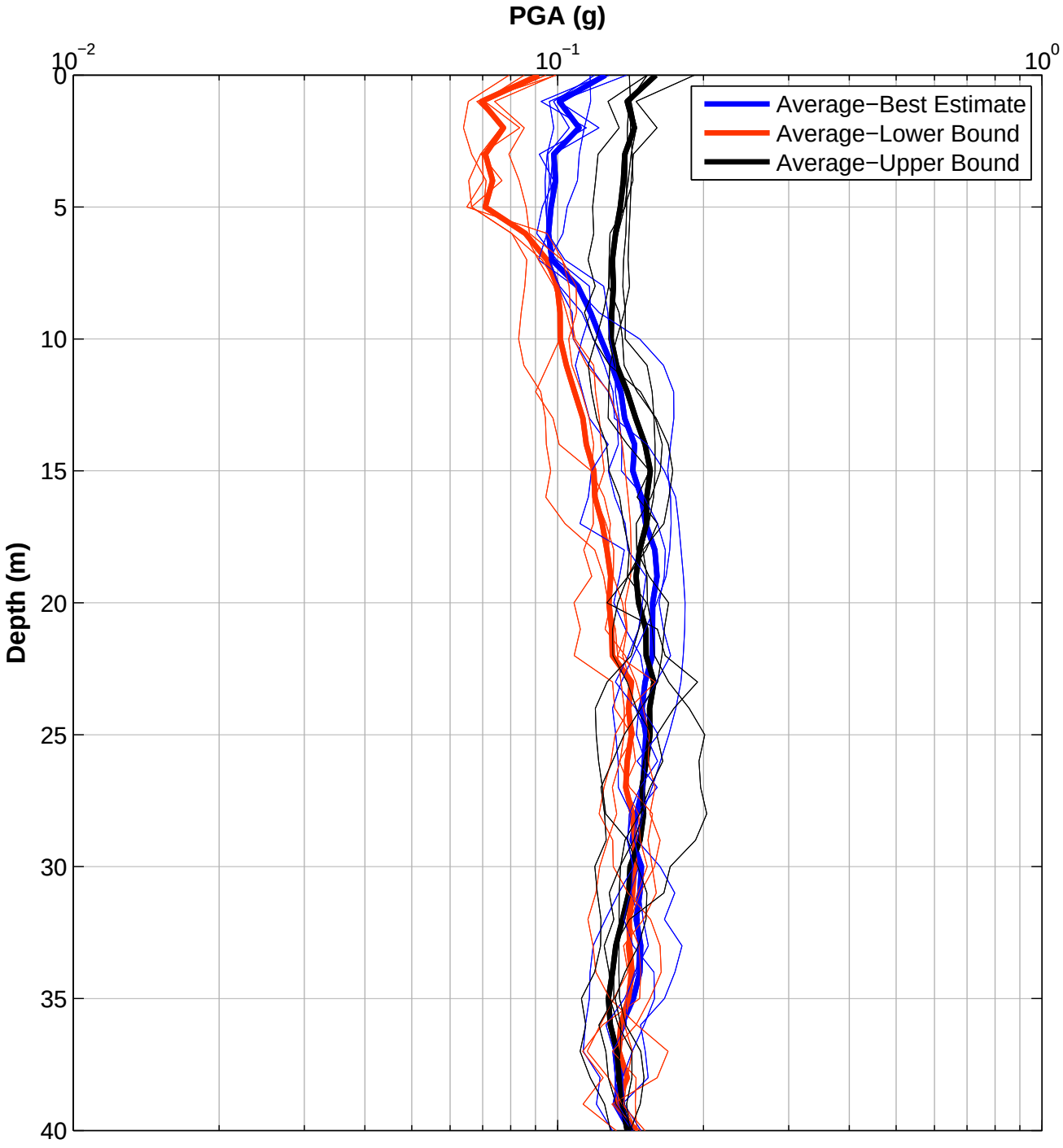
FIGURE 3.4-3ii



PEAK GROUND ACCELERATION VS DEPTH,40 METER PROFILE
RETURN PERIOD 475 YEARS

PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

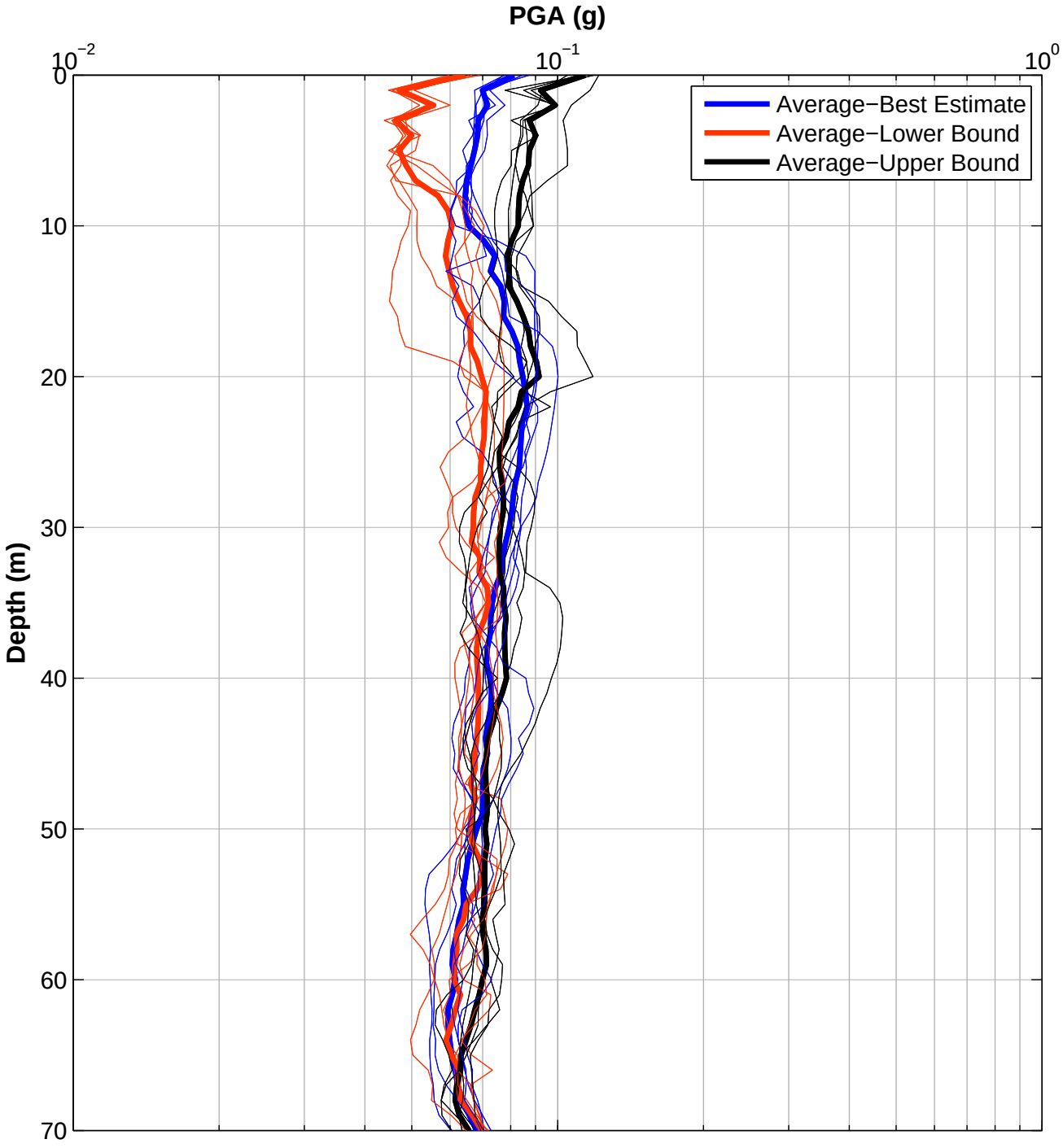
FIGURE 3.4-4i



PEAK GROUND ACCELERATION VS DEPTH,40 METER PROFILE
RETURN PERIOD 2475 YEARS

PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

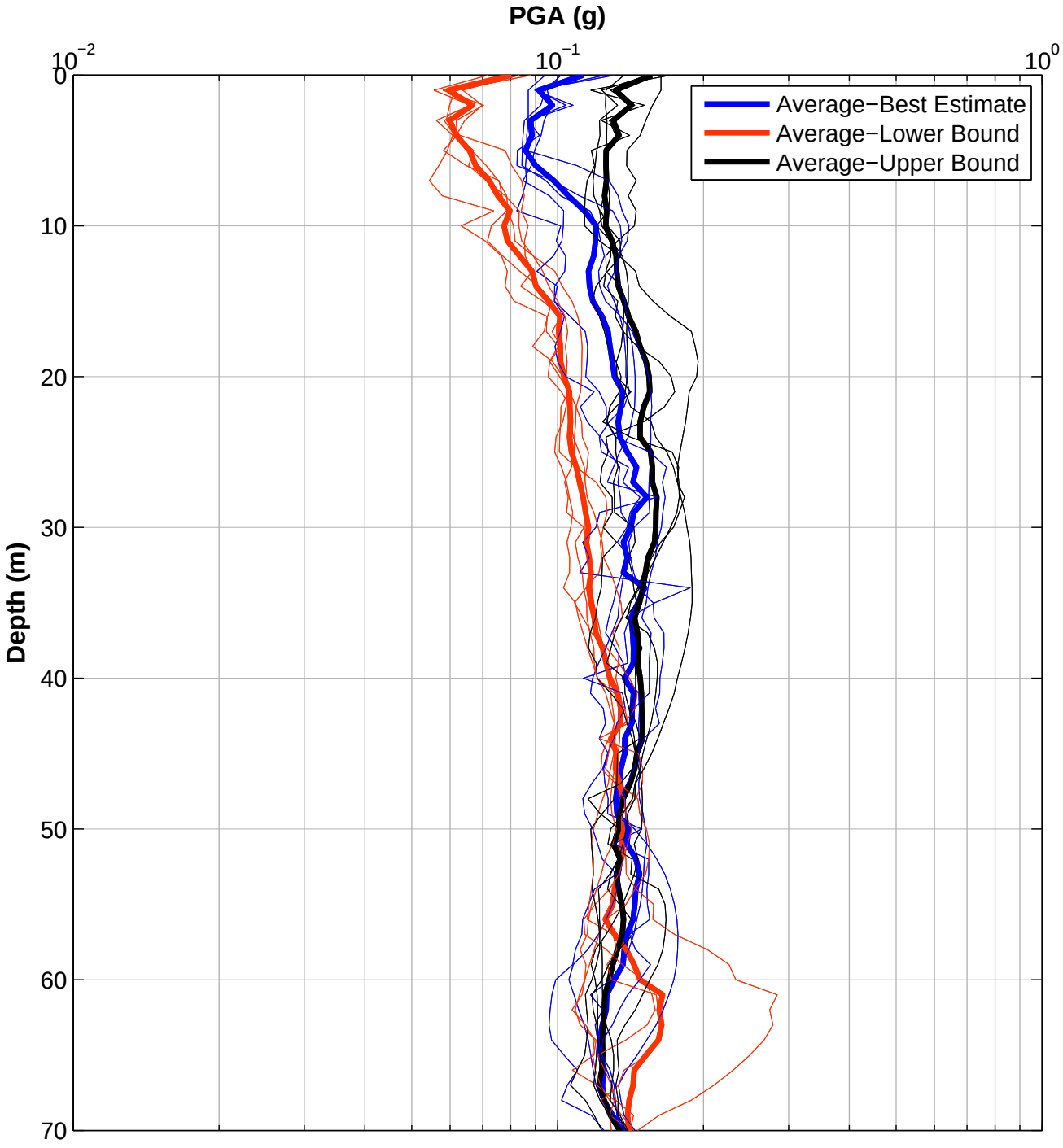
FIGURE 3.4-4ii



PEAK GROUND ACCELERATION VS DEPTH,70 METER PROFILE
RETURN PERIOD 475 YEARS

PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

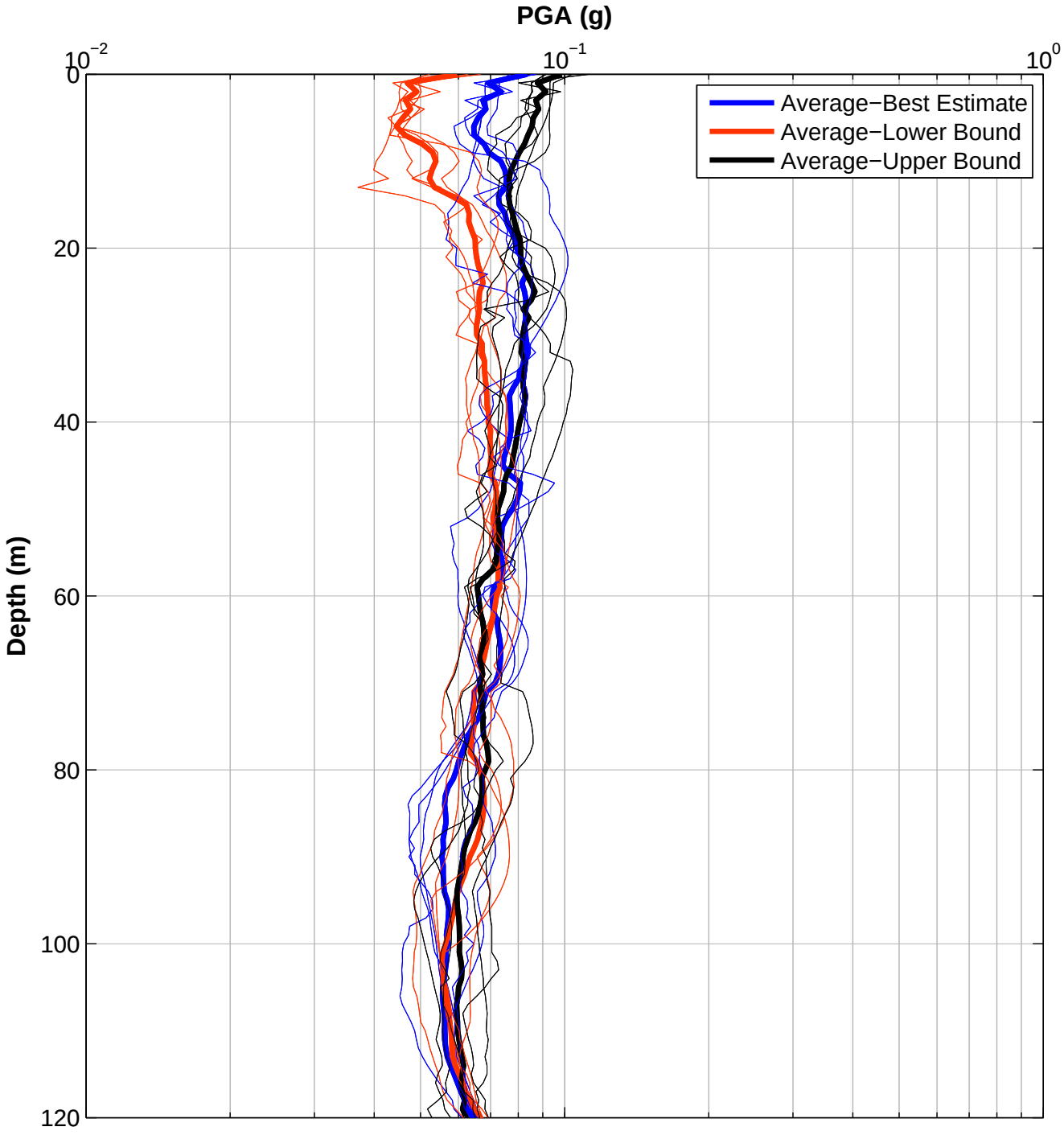
FIGURE 3.4-5i



PEAK GROUND ACCELERATION VS DEPTH,70 METER PROFILE
RETURN PERIOD 2475 YEARS

PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

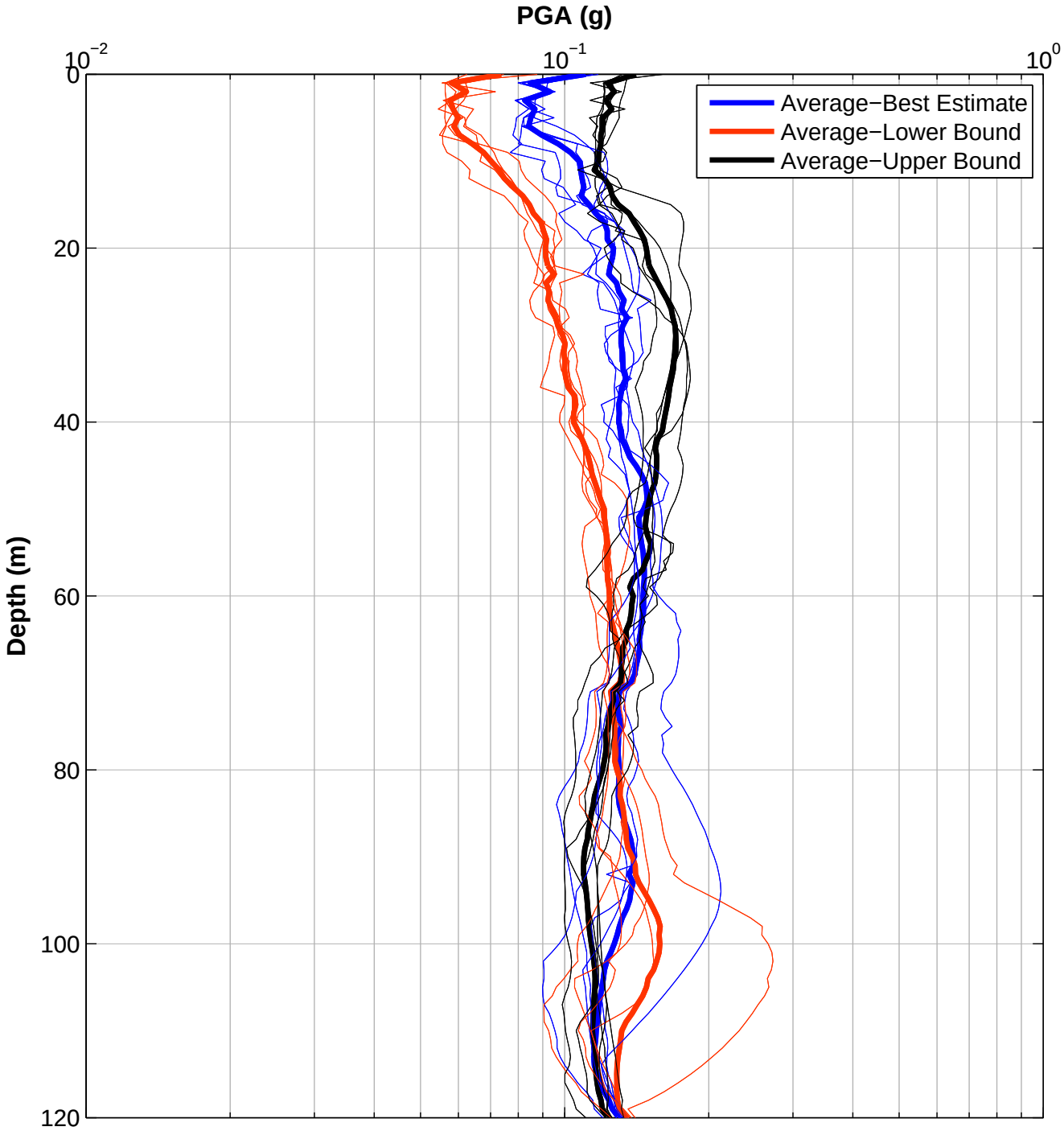
FIGURE 3.4-5ii



PEAK GROUND ACCELERATION VS DEPTH,120 METER PROFILE
RETURN PERIOD 475 YEARS

PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

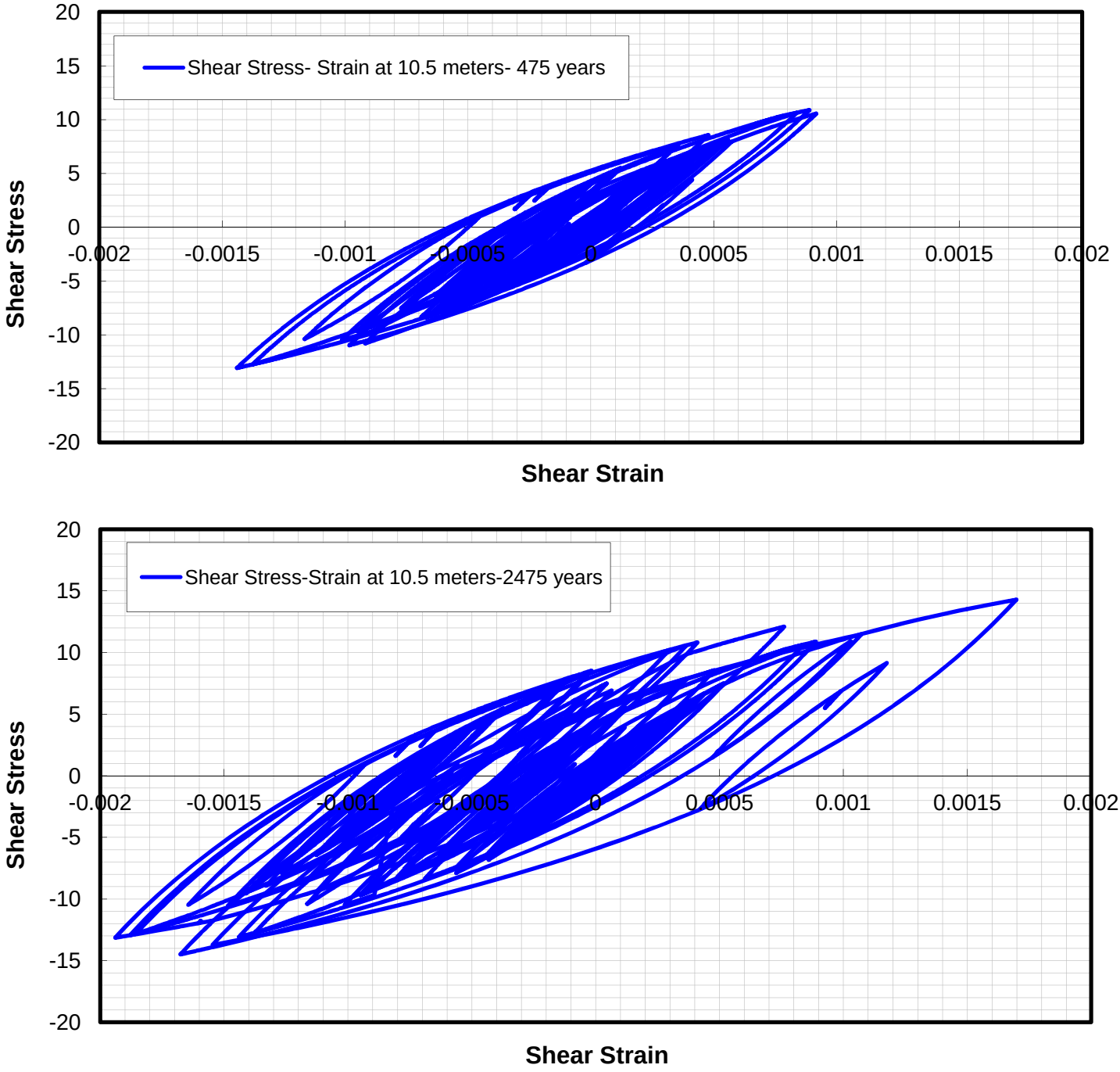
FIGURE 3.4-6i



PEAK GROUND ACCELERATION VS DEPTH,120 METER PROFILE
RETURN PERIOD 2475 YEARS

PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

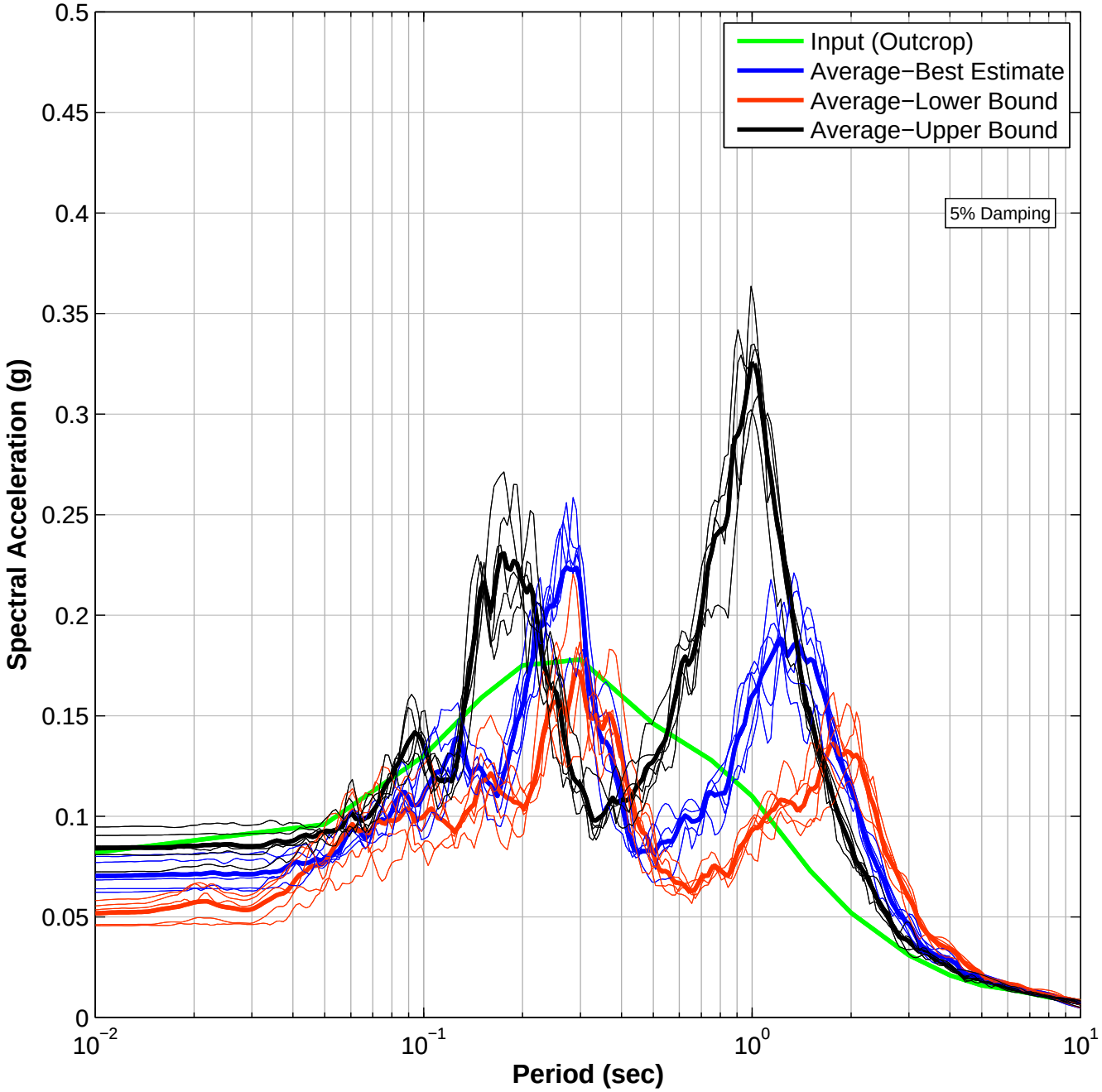
FIGURE 3.4−6ii



DYNAMIC SHEAR STRESS - SHEAR STRAIN LOOPS AT THE DEPTH OF 10 METERS PREDICTED BY FLAC FOR 475 AND 2475 YEAR RETURN PERIOD (TAP046)

PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

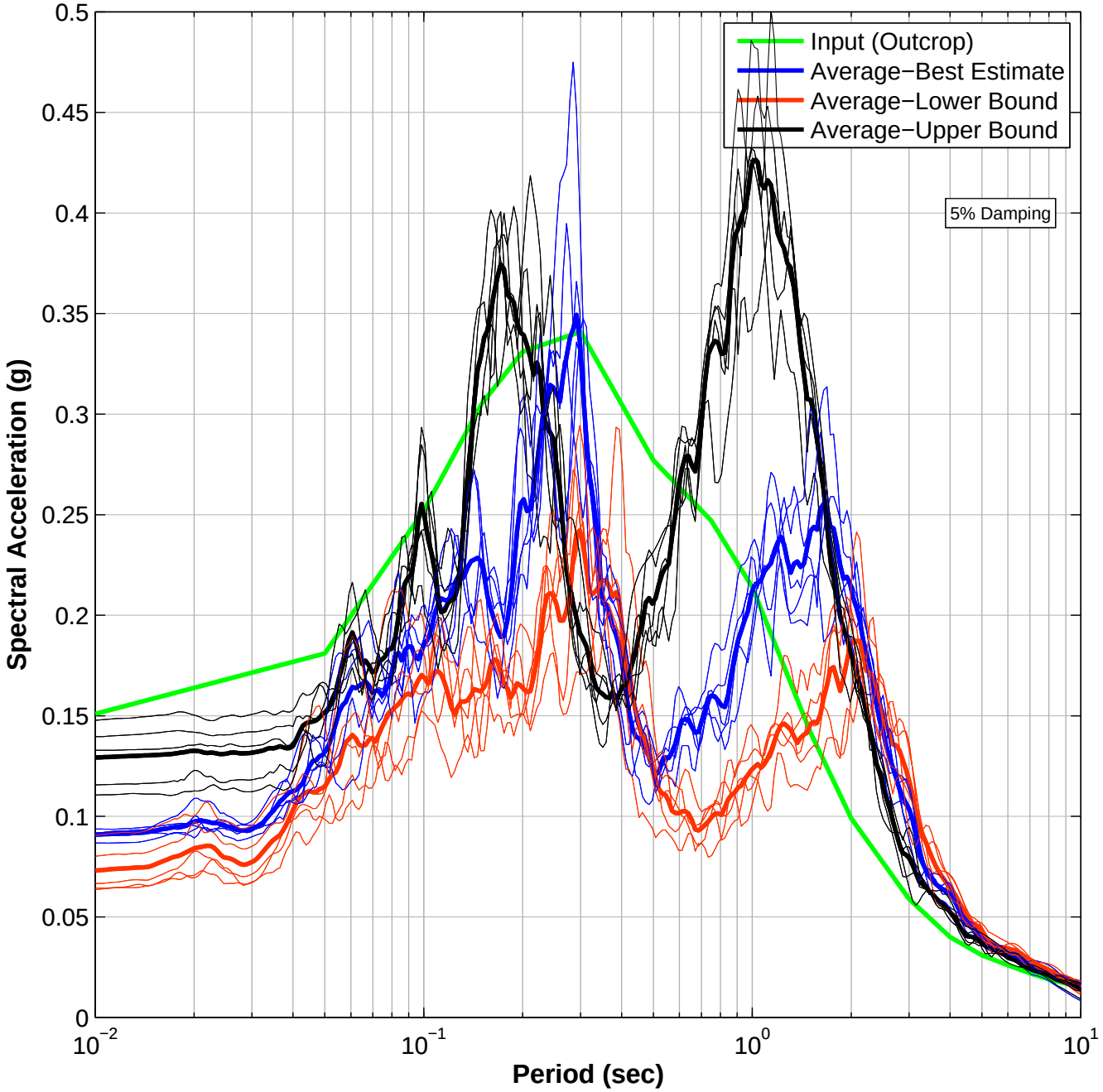
FIGURE 3.4-7



HORIZONTAL ACCELERATION RESPONSE SPECTRA FOR ROCK DEPTH AT 40 METERS FOR 475−YEAR RETURN PERIOD

PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

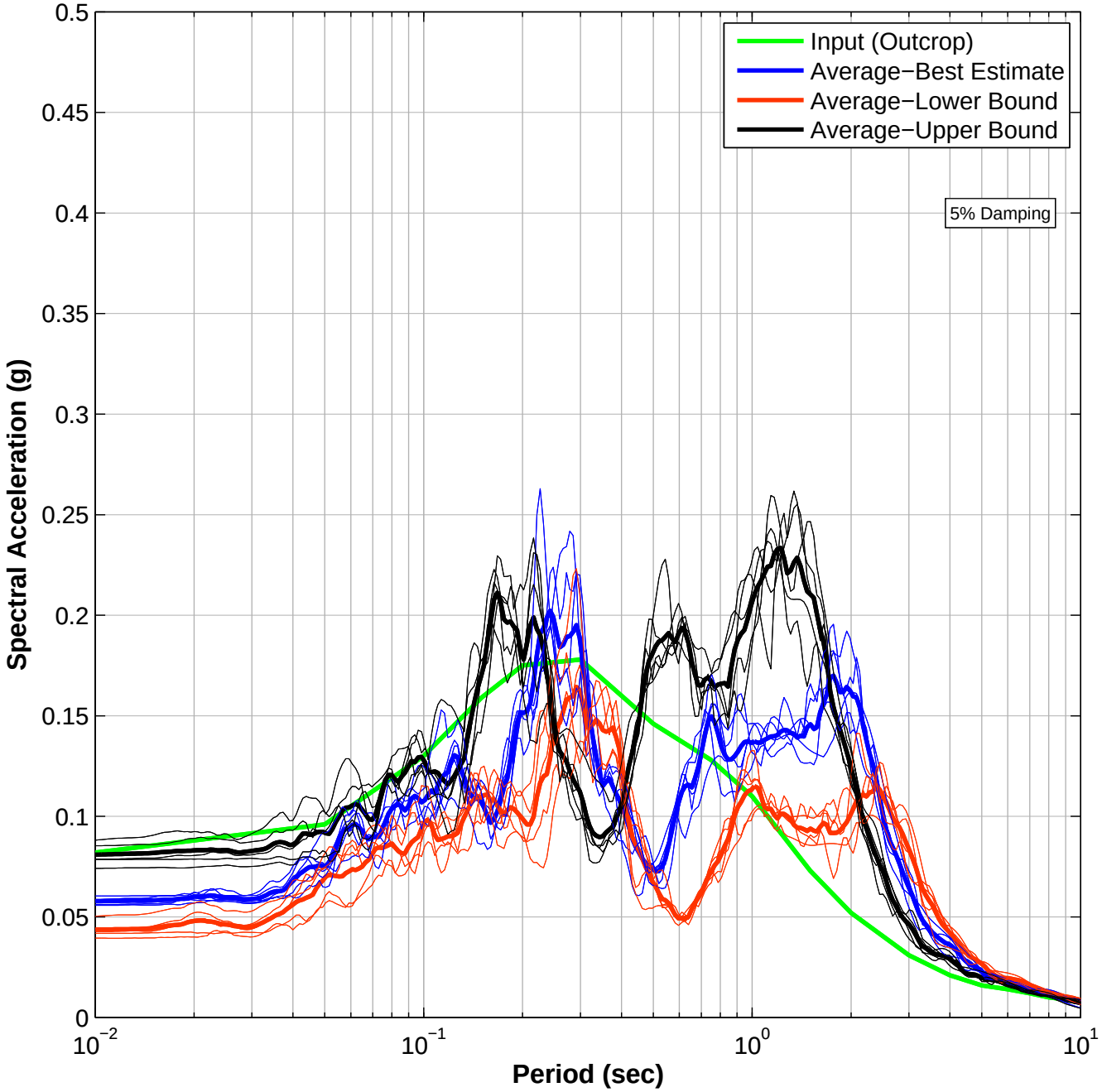
FIGURE 3.4-8i



HORIZONTAL ACCELERATION RESPONSE SPECTRA FOR ROCK DEPTH AT 40 METERS FOR 2475−YEAR RETURN PERIOD

PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

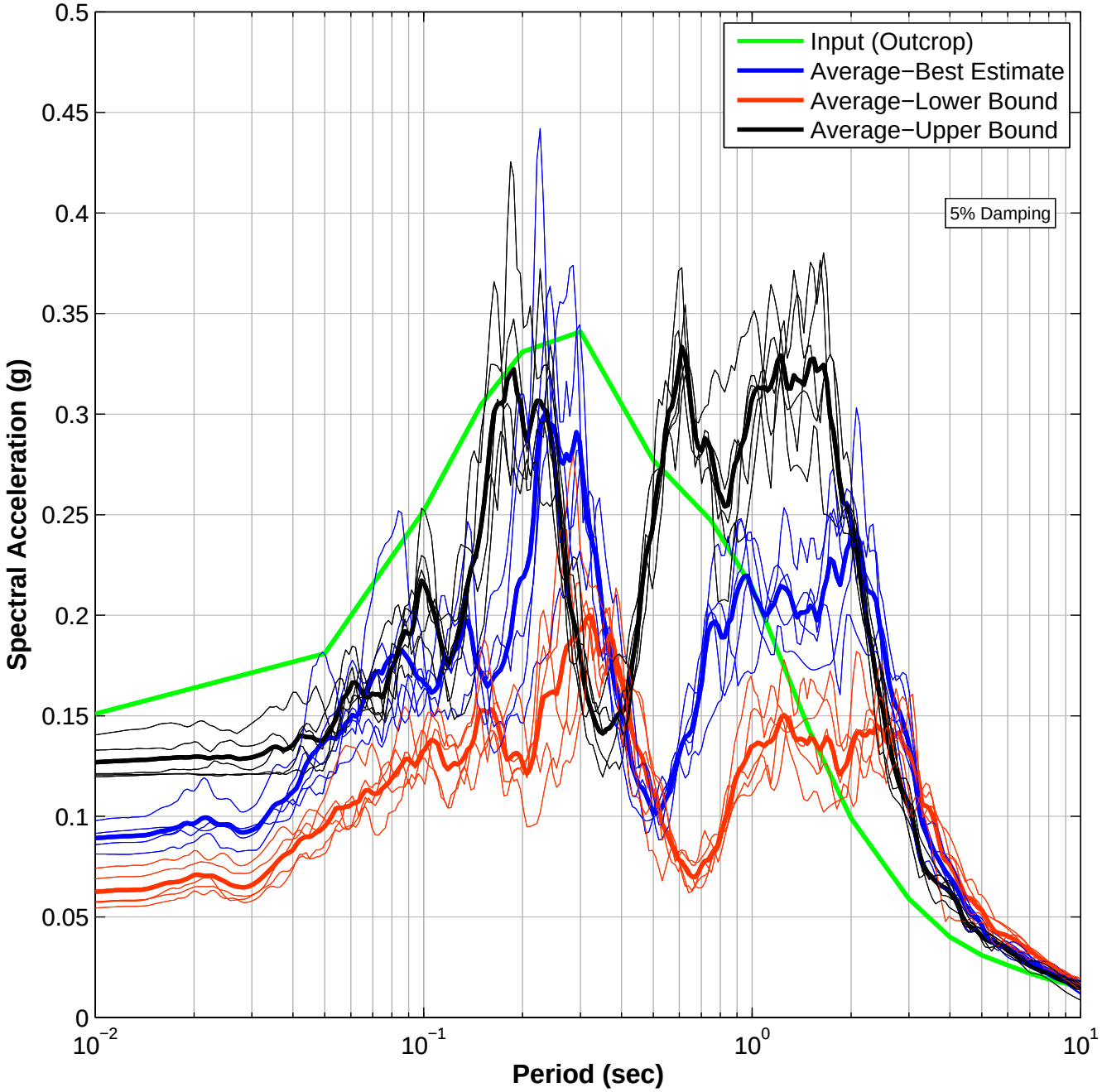
FIGURE 3.4-8ii



HORIZONTAL ACCELERATION RESPONSE SPECTRA FOR ROCK DEPTH AT 70 METERS FOR 475−YEAR RETURN PERIOD

PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

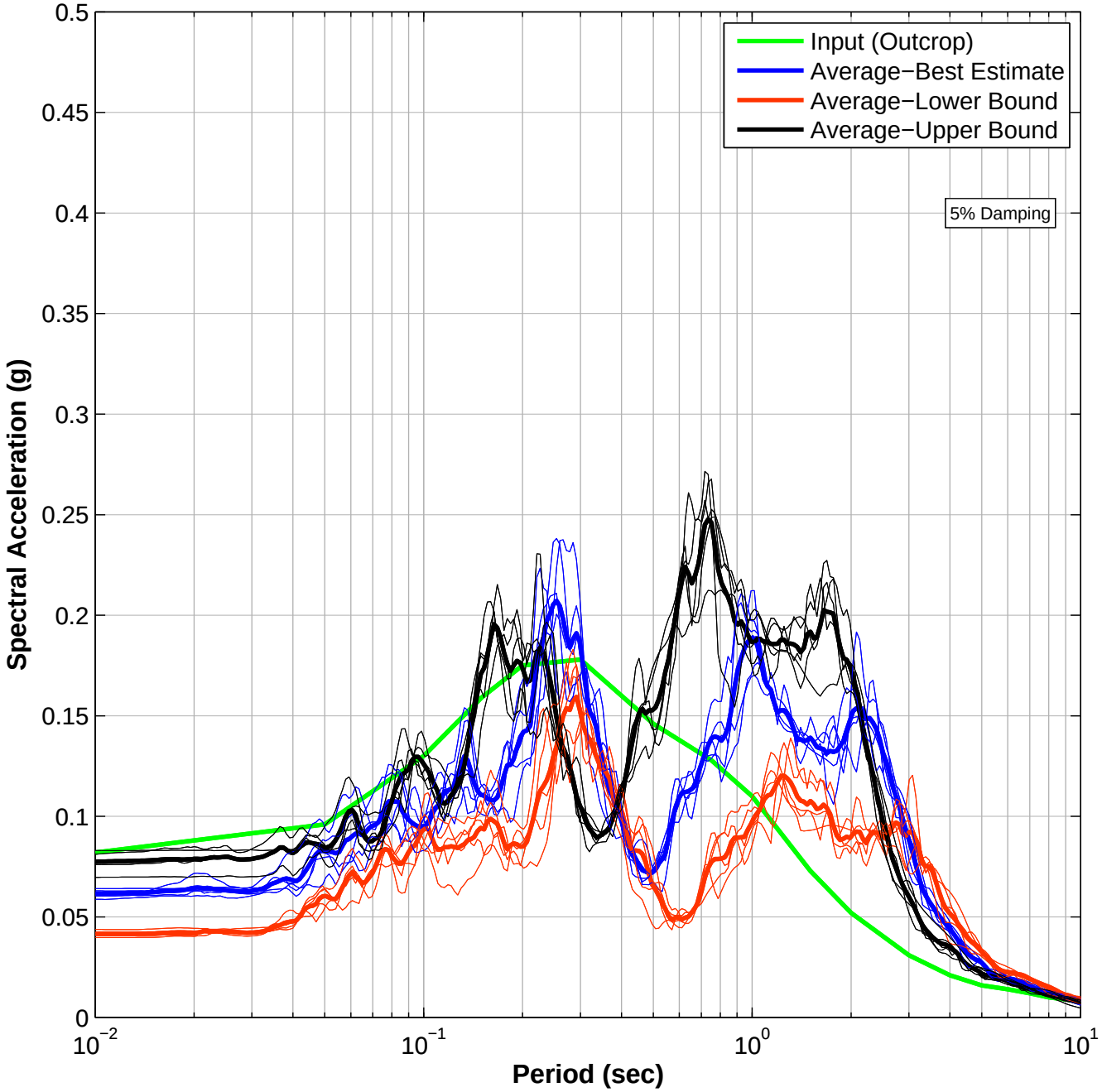
FIGURE 3.4-9i



HORIZONTAL ACCELERATION RESPONSE SPECTRA FOR ROCK DEPTH AT 70 METERS FOR 2475−YEAR RETURN PERIOD

PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

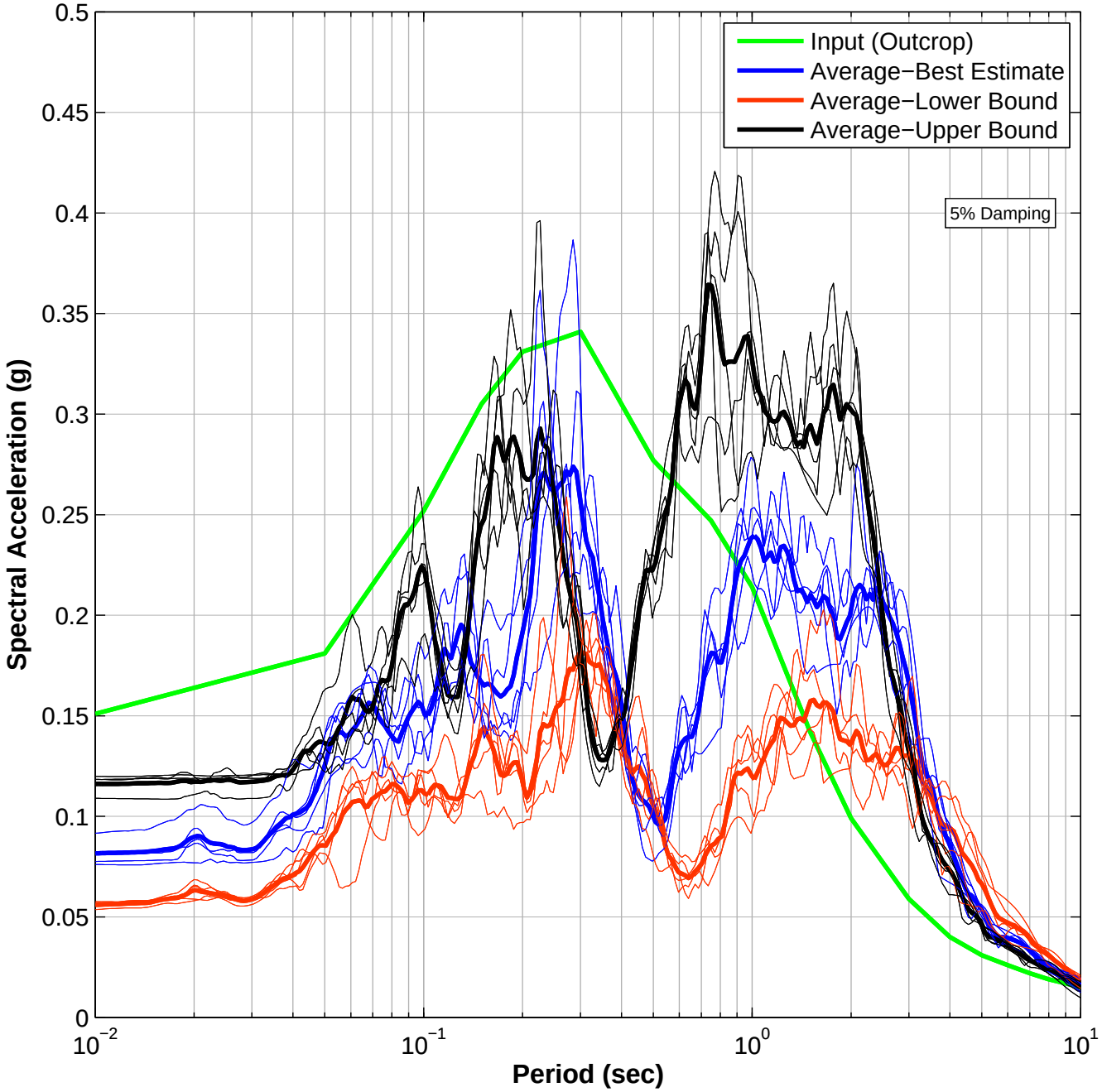
FIGURE 3.4-9ii



HORIZONTAL ACCELERATION RESPONSE SPECTRA FOR ROCK DEPTH AT 120 METERS FOR 475−YEAR RETURN PERIOD

PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

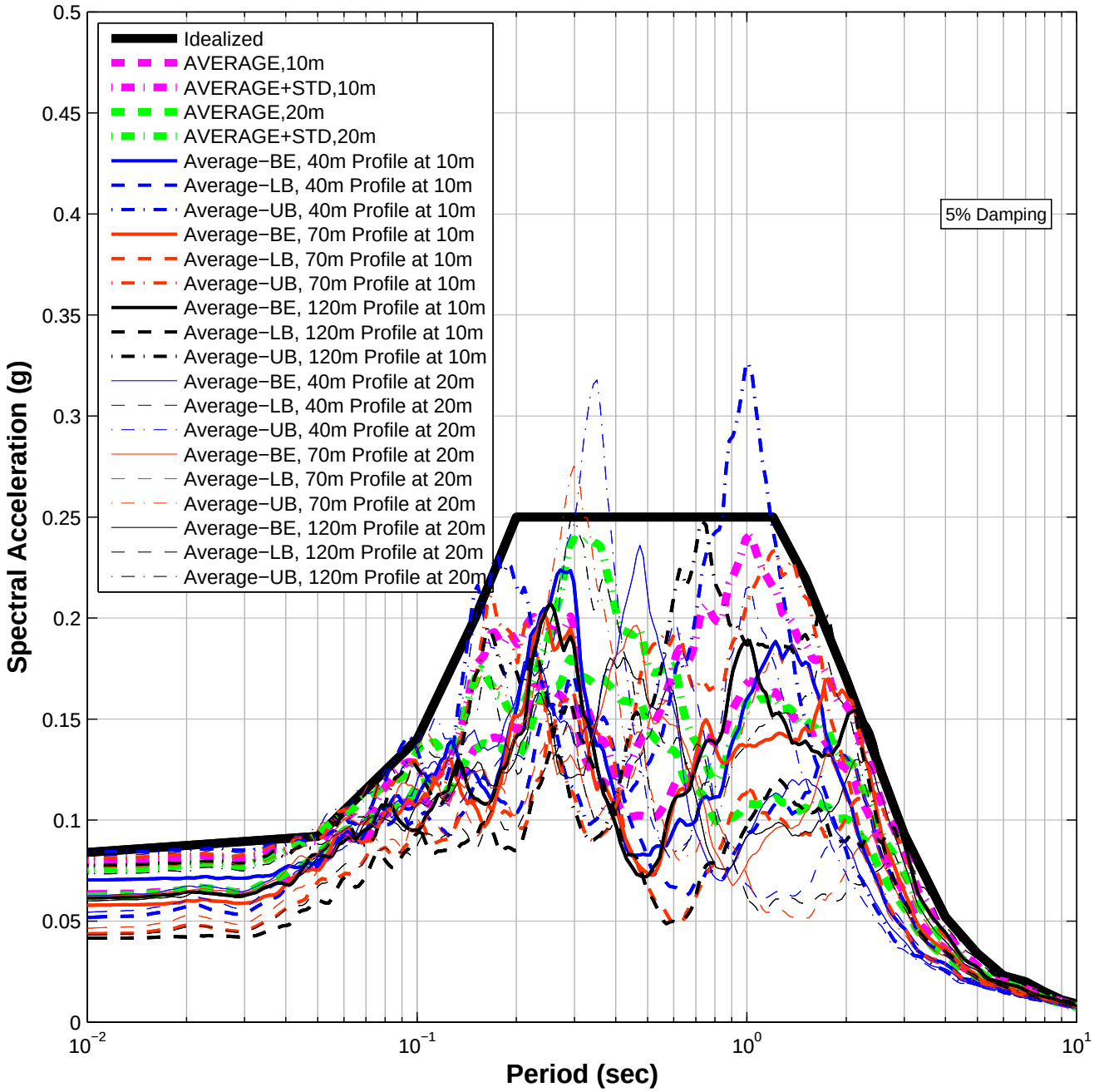
FIGURE 3.4-10i



HORIZONTAL ACCELERATION RESPONSE SPECTRA FOR ROCK DEPTH AT 120 METERS FOR 2475−YEAR RETURN PERIOD

PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

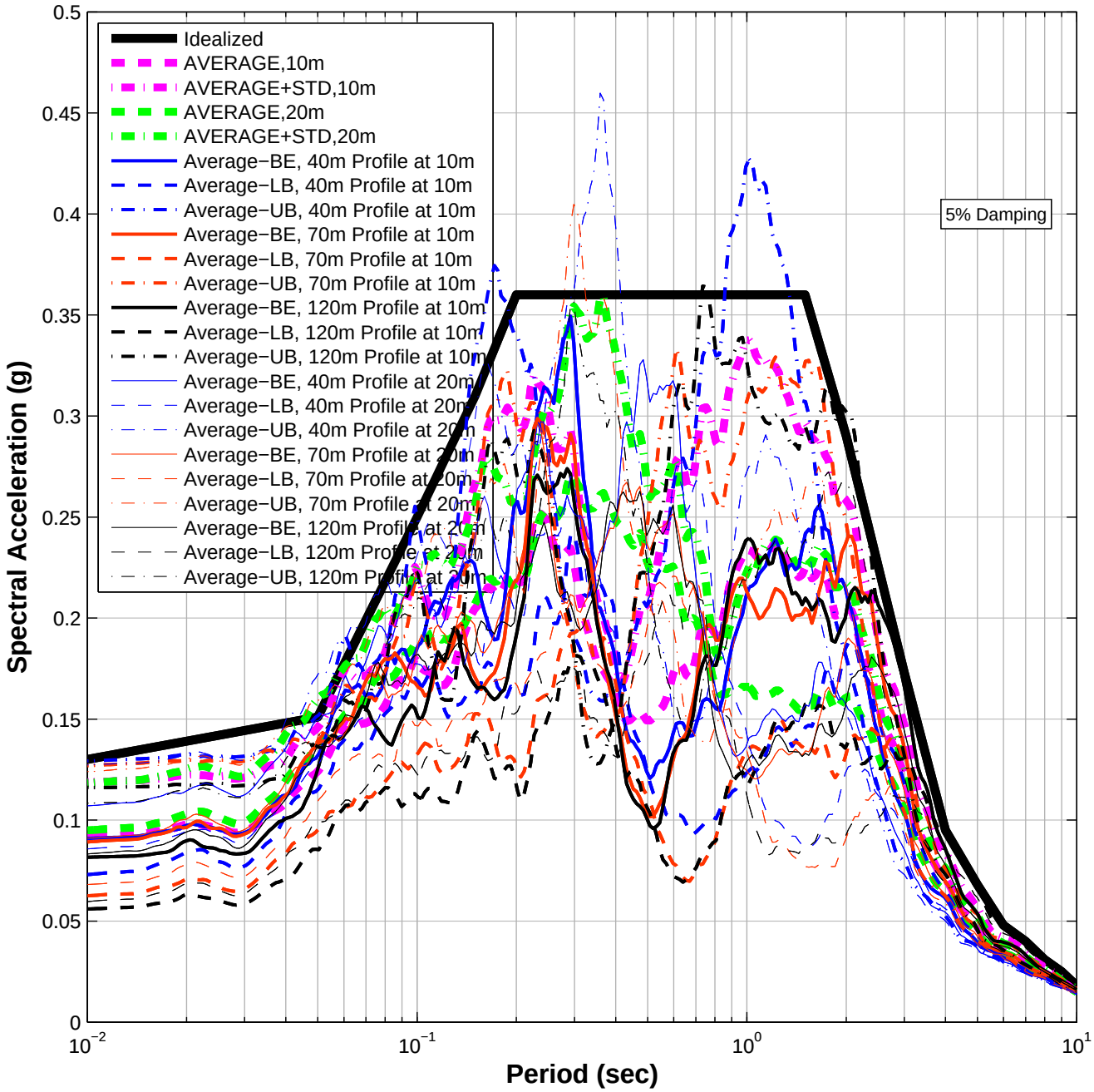
FIGURE 3.4-10ii



DEVELOPMENT OF DESIGN SPECTRA
FOR 475−YEAR RETURN PERIOD

PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

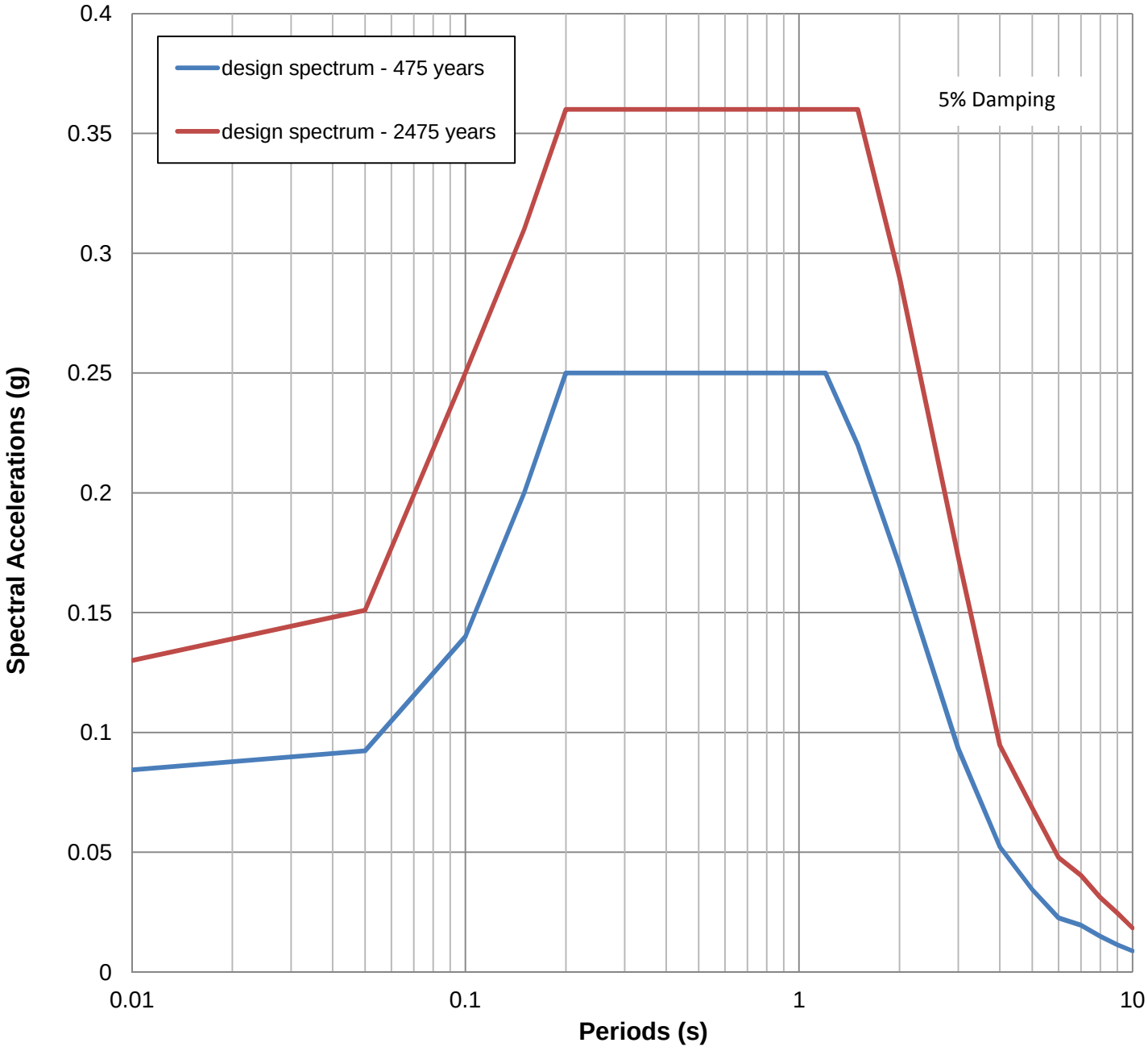
FIGURE 3.4-11i



DEVELOPMENT OF DESIGN SPECTRA
FOR 2475−YEAR RETURN PERIOD

PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

FIGURE 3.4-11ii



DESIGN SPECTRA FOR 475 AND 2475 YEAR RETURN PERIOD

PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

FIGURE 3.4-12

4.0 SIMPLIFIED SEISMIC SLOPE STABILITY ANALYSES

The seafloor along the Trestle is sloping mildly, at approximately 2.5 degrees towards southwest. In the Berthing area the seafloor slope increases to approximately 12 degrees. Simplified slope stability analyses were conducted to assess the potential for slope instability near the Berthing area and the need for more detailed analyses during the FEED phase. The simplified analyses consisted of: a) limit equilibrium, static and pseudostatic slope stability analyses performed for a representative cross section crossing the Berthing area (Figure 4.0-1); and b) permanent, seismically-induced, slope deformation evaluations using simplified empirical relationships. Three simplified methods were considered to address uncertainty in the methodology of evaluating slope displacements. These are the methods proposed by: a) Makdisi and Seed (1978), b) Bray and Travasarou (2007), and c) Rathje and Antonakos (2011).

4.1 LIMIT EQUILIBRIUM SLOPE STABILITY ANALYSES

The slope stability evaluation is performed in a 2-D manner using Slope/W (GeoStudio, 2007). Slope/W is a 2-D slope stability program capable of analyzing slope stability using multiple limit equilibrium equations (e.g. Bishop, Janbu, Spencer, etc.) for different slip surface shapes (e.g. circular, block, planer, etc.) The sliding mass is divided into multiple slices between which interslice forces and moment/force equilibrium are balanced. The factor of safety is generally calculated as the ratio between shear strength and shear stress along the bottom of the sliding mass. The yield acceleration (ky), which is the horizontal acceleration applied at the center of the sliding mass in a pseudostatic manner and resulting in a factor of safety equal to unity, is also estimated in Slope/W.

The subsurface cross-section A-A' presented on Figure 4.0-1 was used as the representative baseline for slope stability analyses. The idealized undrained shear strength and the shear wave velocity profiles considered in the slope stability analyses are shown on Figure 4.1-1. The bedrock was assumed at the depth of 120 meters below mudline. Both circular and block slip surface shapes were considered for the factor of safety (FOS) and yield acceleration estimation.

Figures 4.1-2 and 4.1-3 present the critical failure surfaces and FOS for both circular and block shapes examined. For both failure shapes, the estimated FOS is on the order of 1.7. Figures 4.1-4 and 4.1-5 present the results from the pseudostatic slope stability analyses for both cases considered. The estimated yield acceleration (ky) is 0.035 and 0.037 for the circular and block surface failure shape, respectively.

For the purpose of estimating permanent slope displacements due to seismic shaking, the design earthquake magnitude for the SSE event is 8.2. For OBE event, the design magnitude is 7.8.

4.2 MAKDISI AND SEED (1978) PROCEDURE

Makdisi and Seed (1978) used average accelerations over the depth of the sliding mass ($a_{max,ave}$) along with earthquake magnitude and yield acceleration (ky) of the failure slope to estimate the seismic slope deformation. The analytical procedure is illustrated on Figure 4.2-1, details regarding development of this procedure can be found in Makdisi and Seed (1978).

For the analyzed cross section the yield acceleration (ky) from the pseudostatic slope stability analysis is 0.035 and the z/H ratio for the analytical cross section was equal to 0.27.

The average acceleration ratio ($a_{max,ave}/a_{max,z=0}$) was estimated based on the z/H ratio and the chart on Figure 4.2-1. The $a_{max,z=0}$, which is the peak acceleration at the ground surface, is derived from the site response analyses presented in Section 3.0. As presented in Table 4-1, the $a_{max,ave}$ was calculated based on the z/H ratio and the resulted ky/ $a_{max,ave}$ ratio is 0.5 and 0.61 for the SSE and the OBE seismic event, respectively. The estimated permanent slope displacement (per the chart on Figure 4.2-1) is about 30 to 80 cm for the SSE event and 2 to 12 cm for the OBE event.

Table 4-1: Permanent Seismic Slope Displacement per Makdisi and Seed (1978)

EQ Event	Ky (g)	z/H	amax,ave/amax,z=0	$a_{MAX,AVE}$	Ky/ $a_{MAX,AVE}$	Slope Displacement (cm)
SSE	0.035	0.27	0.83	0.070	0.50	30 - 80
OBE	0.035	0.27	0.83	0.057	0.61	2 - 12

4.3 BRAY AND TRAVASAROU (2007) PROCEDURE

Estimates of co-seismic slope displacements were computed using the empirical simplified procedure proposed by Bray and Travasarou (2007). This method was based on a fully coupled stick-slip model. In a stick-slip model, displacement occurs during distinct episodes of slip, when the input acceleration exceeds the slope's yield acceleration. During non-slip conditions the "sliding" mass and underlying halfspace "stick" together with no relative movement. The Bray and Travasarou (2007) procedure considers both the dynamic response of the sliding mass and the slip episodes in a one-step analysis. This model is more realistic and representative of actual behavior compared to the de-coupled model used by Makdisi and Seed (1978). The procedure considers the fundamental period of the sliding mass ($T_s = 4H/V_s$), the degraded spectral acceleration at a degraded period equal to 1.5 times the fundamental period of the sliding mass (Figure 4.3-1 from the site response analyses) and the ky values estimated from the pseudo-static limit equilibrium analyses to estimate the co-seismic deviatoric slope displacements associated with the critical sliding surfaces. Slope deformation associated with volumetric failure, however, is not included. The input parameters used in the slope displacement assessment are presented in Table 4-2. The results of the slope displacement estimates are also provided in Table 4-2.

Table 4-2: Permanent Seismic Slope Displacement per Bray and Travasarou (2007)

EQ Event	Ky (g)	Sliding Mass Depth, H (m)	Vs_ave (m/sec)	Ts (sec)	EQ. Magnitude	Slope Displacement (cm)
SSE	0.035	32	90	1.3	8.2	18 - 65
OBE	0.035	32	90	1.3	7.8	9 - 33

4.4 RATHJE AND ANTONAKOS (2011) PROCEDURE

Estimates of seismic slope displacements were also computed using the empirical simplified procedure proposed recently by Rathje and Antonakos (2011). The predictive model is a function of the peak ground acceleration (PGA), the earthquake magnitude (M), the natural period of the sliding mass ($T_s = 4H/V_s$), the mean period of the earthquake motion

(Tm) and the ky values estimated from the pseudo-static limit equilibrium analyses. The input parameters used in the slope displacement assessment and the results of the slope displacement estimates are presented in Table 4-3.

Table 4-3: Permanent Seismic Slope Displacement per Rathje and Antonakos (2011)

EQ Event	ky (g)	Ts/Tm	PGA (g)	EQ. Magnitude	Kmax (g)	Slope Displacement (cm)
SSE	0.035	1.1	0.084	8.2	0.061	10 - 60
OBE	0.035	1.3	0.069	7.8	0.045	1 - 5

4.5 SUMMARY

Slope Stability evaluation was conducted using limit equilibrium (Slope/W) and simplified empirical methods to estimate the slope deformation along cross section A-A' (Figure 4.0-1) in the Berthing area..

The Factor of Safety from the limit equilibrium analyses is estimated to be approximately 1.7 with both circular and block failure slopes. The yield acceleration (ky) is small and estimated to be about 0.035 for the critical failure slope.

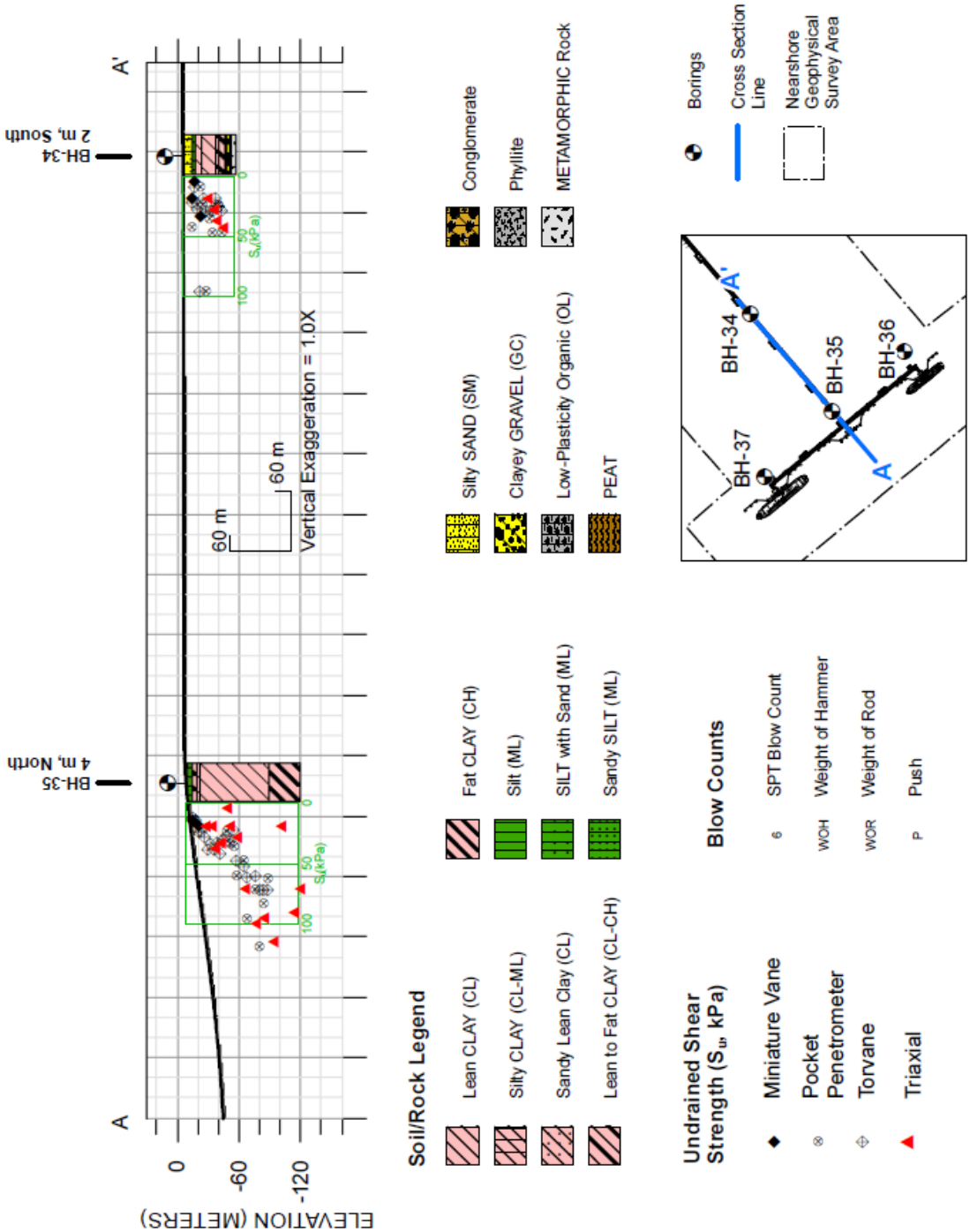
The estimated seismic slope displacements were computed using the empirical simplified procedures proposed by Makdisi and Seed (1978), Bray and Travasarou (2007) and Rathje and Antonakos (2011). The results from these empirical simplified procedures indicate that the expected seismic slope displacements range between about 1 to 33 cm for the OBE event and about 10 to 80 cm for the SSE event.

The estimated ranges of displacement suggest that there is a potential with slope instability associated with medium to large displacements for the design events. These results are based on ky values computed using the best estimate peak shear strength from unconsolidated undrained (UU) tests. However based on the available soil data, fine-grained soils at the project site are moderately sensitive with sensitivities range from 1 to 5. Alternatively, a reduced soil strength profile was used to estimate the seismic slope displacements. The results indicated that estimated slope movements increase significantly with the reduced shear strength considering soil sensitivity effects. The results using the reduced strength are however preliminary and more detailed analyses considering the full peak-to-residual stress curves are recommended.

For the FEED phase of the project we recommend that additional in-situ and laboratory tests be conducted to better characterize the sensitivity of the fine-grained soils near the Berthing area and potential for strain-softening and post-peak response. Recommended in-situ and/or laboratory tests include field vane, miniature vane (including peak and residual values), and direct shear tests.

The estimated displacement range can be refined during the FEED phase based on more advanced numerical analyses incorporating the data from additional explorations, and laboratory testing which is being proposed for the FEED phase, including the potential strain-softening behavior. The analyses will include: a) entire peak-to-residual shear strength curve, b) modeling of progressive failure, and c) dynamic time history modeling. These features are not captured by the simplified methods used in the screening assessment

presented in this report. Additionally, the advanced numerical analyses can include structural pile elements and evaluate the dynamic performance of the foundation piles.



CROSS SECTION A-A'

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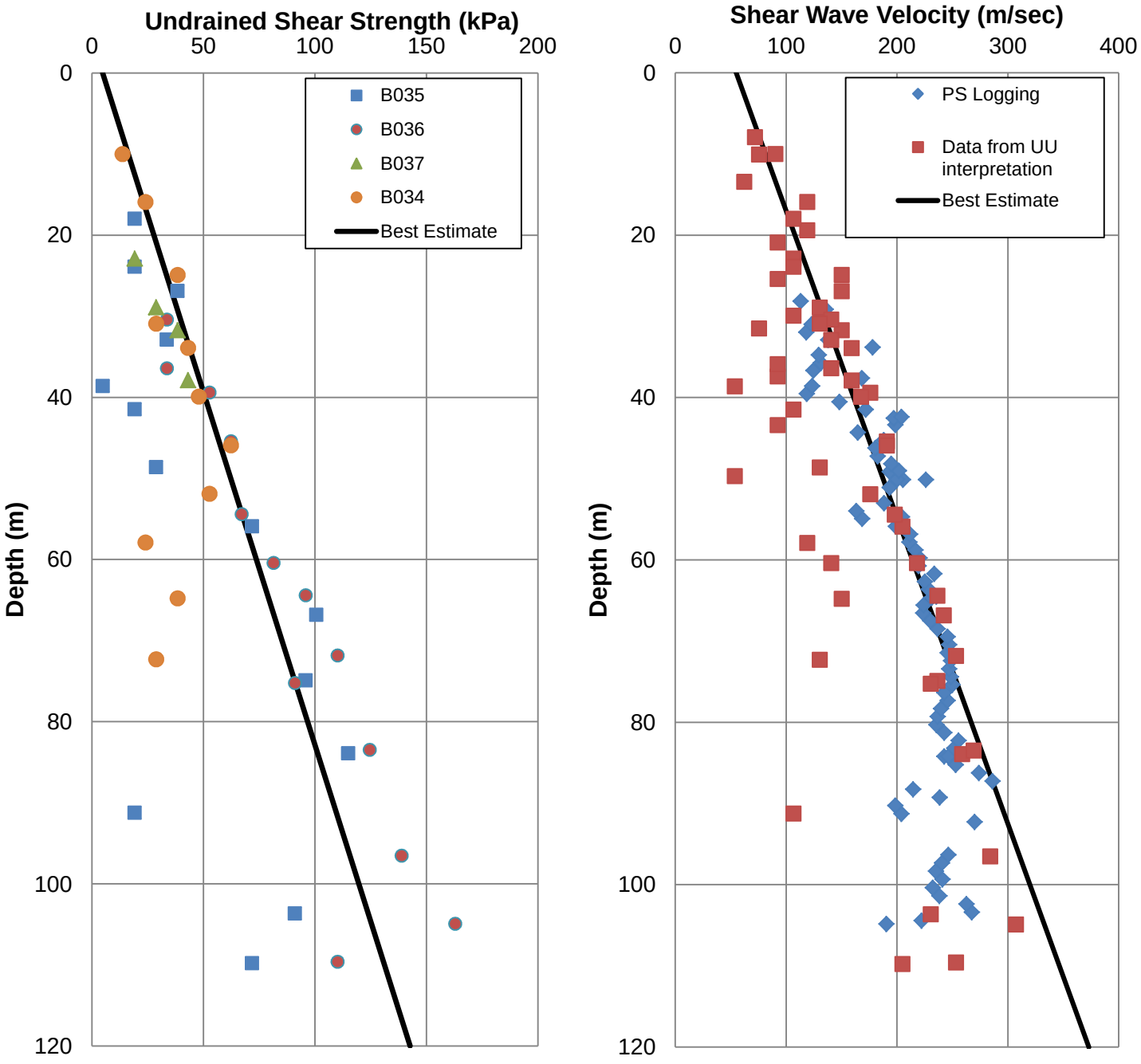
LELU ISLAND, BRITISH COLUMBIA, CANADA

FIGURE 4.0-1



IDEALIZED UNDRAINED SHEAR STRENGTH AND SHEAR WAVE VELOCITY PROFILES FOR THE SLOPE STABILITY ANALYSIS

PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

FIGURE 4.1-1

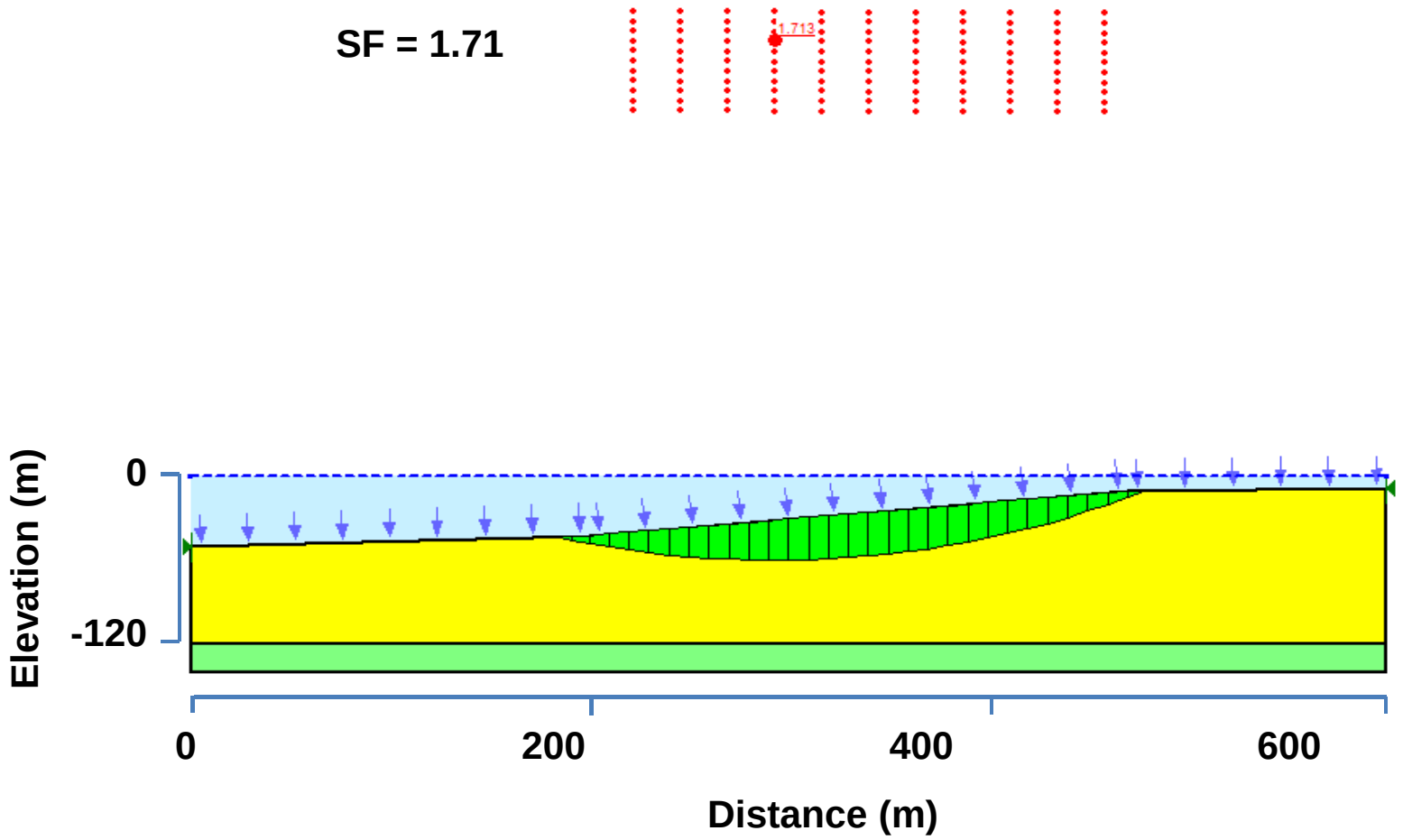


FIGURE 4.1-2

STATIC SAFETY FACTOR FOR CIRCULAR SLIP SURFACE FAILURE SHAPE

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LELU ISLAND, BRITISH COLUMBIA, CANADA

SF = 1.75

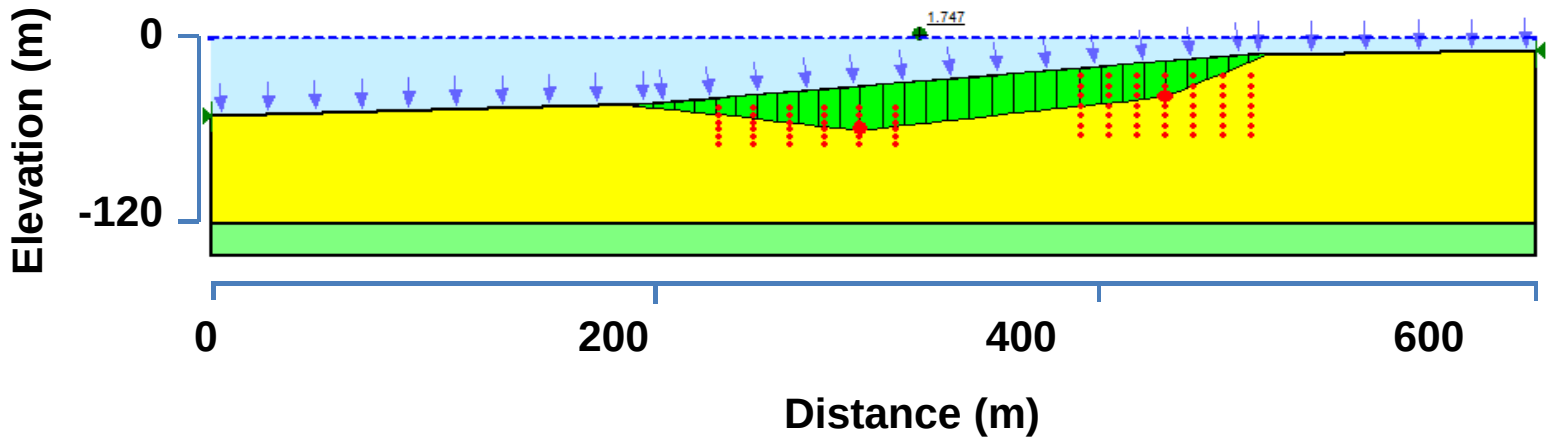

FIGURE 4.1-3

STATIC SAFETY FACTOR FOR BLOCK SLIP SURFACE FAILURE SHAPE

PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

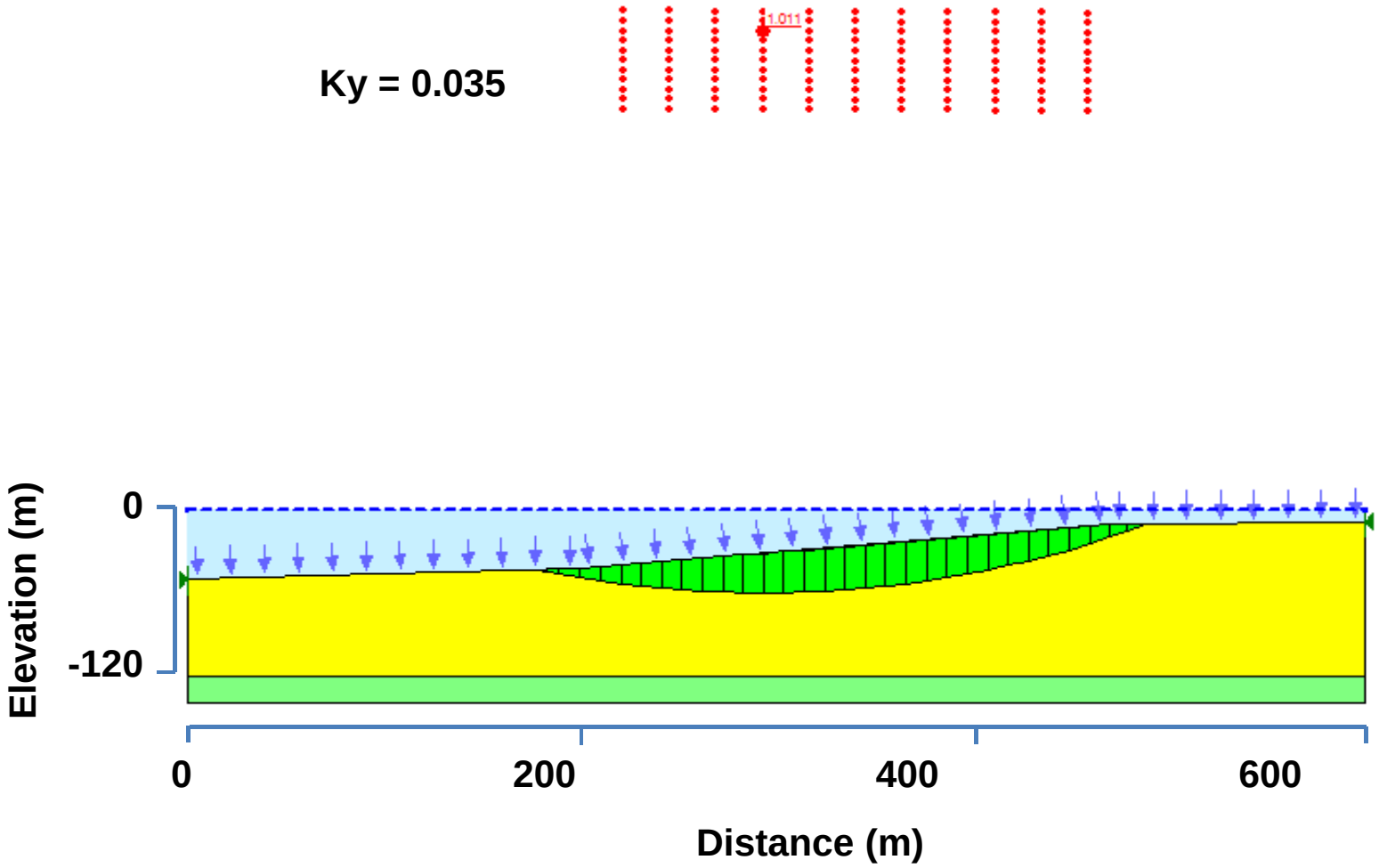

FIGURE 4.1-4

PSEUDOSTATIC SLOPE STABILITY ANALYSIS FOR CIRCULAR SLIP SURFACE FAILURE SHAPE

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LELU ISLAND, BRITISH COLUMBIA, CANADA

Ky = 0.037

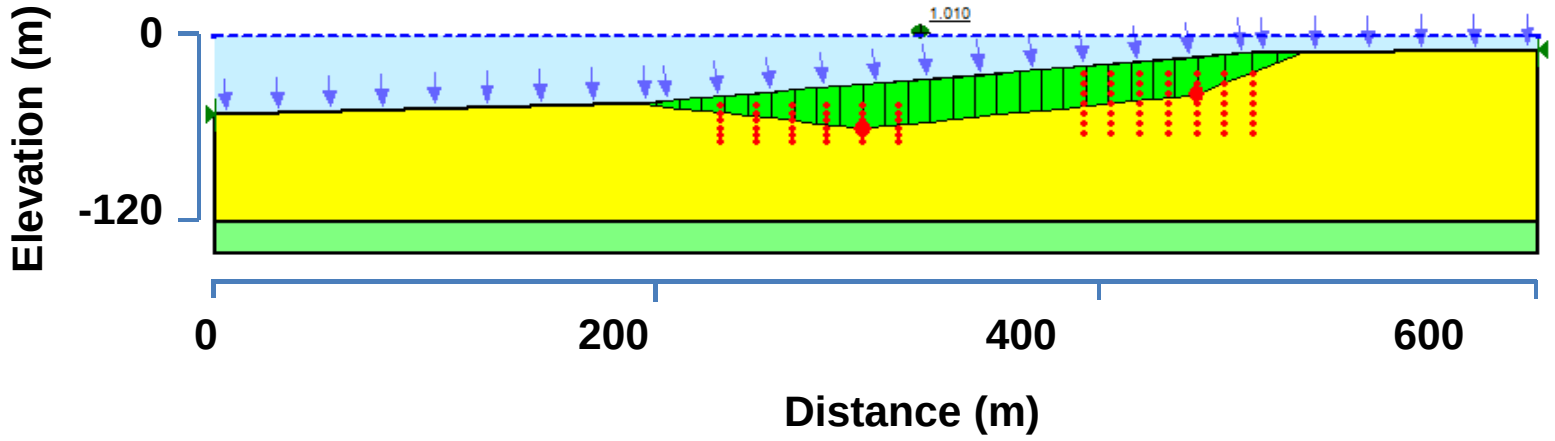
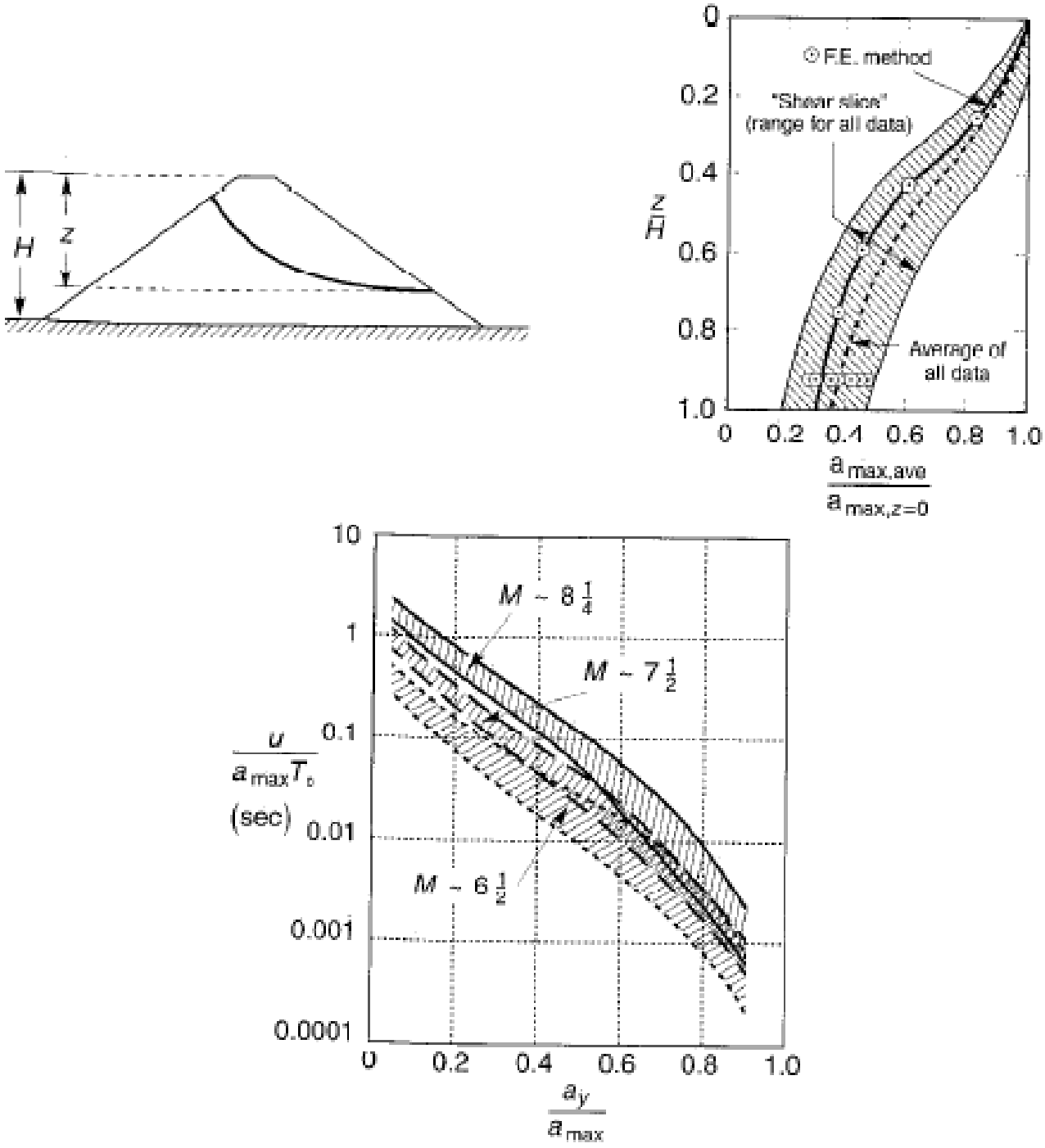


FIGURE 4.1-5

PSEUDOSTATIC SLOPE STABILITY ANALYSIS FOR BLOCK SLIP SURFACE FAILURE SHAPE

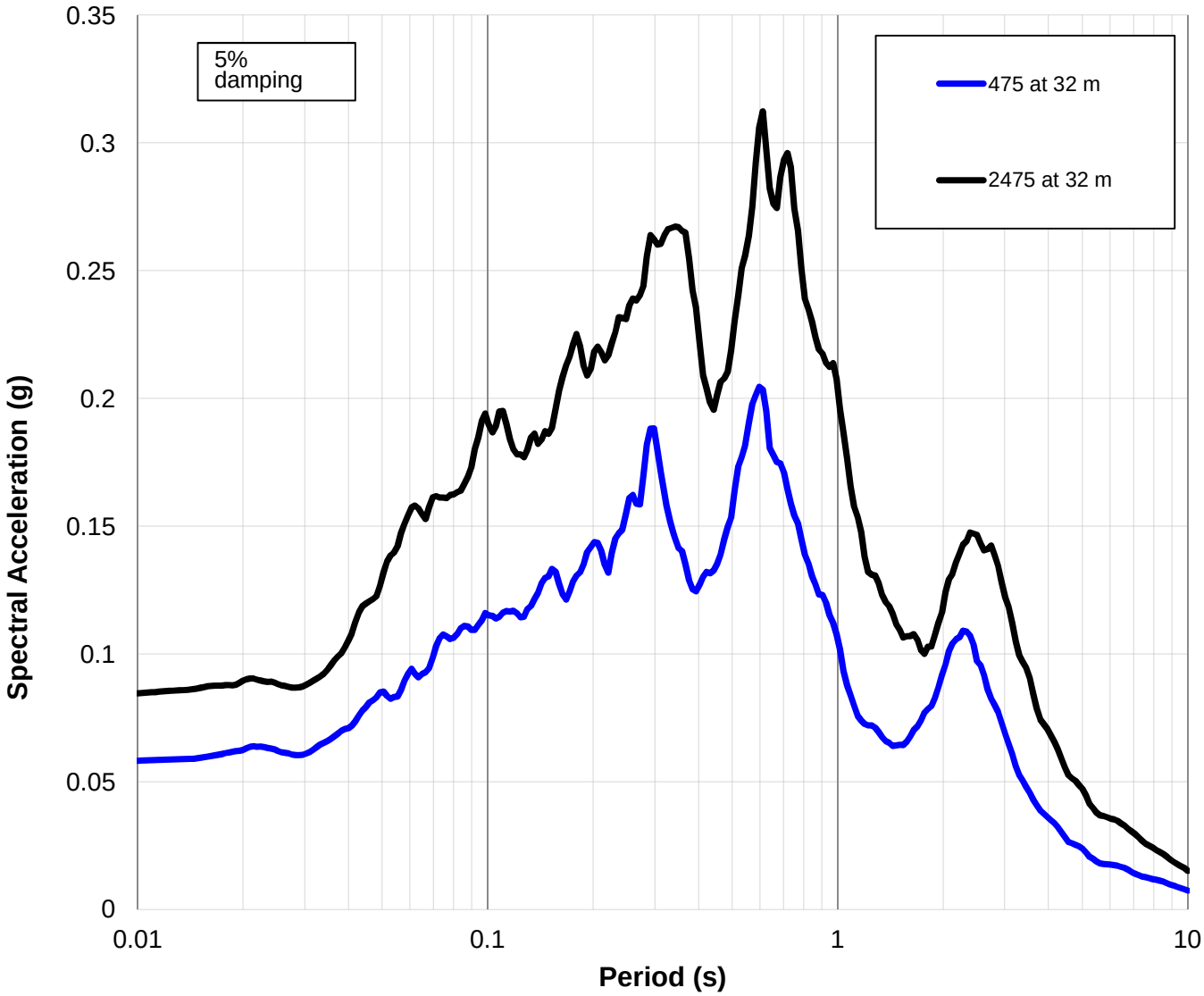
PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA



SIMPLIFIED PROCEDURE FOR ESTIMATING EMBANKMENT EARTHQUAKE-INDUCED DEFORMATIONS (MAKDISI AND SEED, 1978)

PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

FIGURE 4.2-1



HORIZONTAL ACCELERATION RESPONSE SPECTRA FOR THE EXAMINED LOCATION AT 32 M DEPTH FOR 475 AND 2475-YEAR RETURN PERIOD

PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

FIGURE 4.3-1

5.0 ASSESSEMENT OF LIQUEFACTION HAZARD

5.1 INTRODUCTION

Liquefaction is a dramatic loss of strength that can occur in saturated coarse-grained soils during seismic shaking and results from increased pore-water pressure and reduced effective stress. The primary susceptible soil type is clean sands, although recent studies (e.g., Bray and Sancio, 2006) have also shown liquefaction can occur in fine grained soils such as low-plasticity silts. The consequences of soil liquefaction can be severe and may result in significant damage to structures. Liquefaction-induced effects include ground settlement and differential settlement of structures, slope failure and lateral spreading, loss of foundation bearing capacity, loss of lateral support on deep foundations, drag loads and downdrag on deep foundations, kinematically-induced demands and uplift of light initially buried structures.

5.2 LIQUEFACTION HAZARD ASSESSMENT

A screening level liquefaction hazard evaluation was conducted for the nearshore area based on the evaluation of available geotechnical data from 7 nearshore borings (i.e., BH-31 through BH-37). The goal of the study was to explore the presence of liquefaction susceptible soils and delineate their extent.

5.3 LIQUEFACTION TRIGGERING HAZARD ASSESSMENT

Of the 7 nearshore borings evaluated, 3 borings (BH-32 through BH-34) have been identified with soils classified as primarily coarse-grained materials (e.g. silty sands (SM)) and are vulnerable to liquefaction. However, these strata are relatively shallow and within 16 meters below mudline. In BH-32, the SPT-N values within the silty sand layer in the upper 6 meters are relatively low, with the N value ranging between 4 and 9. In BH-33, the SPT-N value is 3 at about 1 meter below mudline. In BH-34, the SPT-N values are 2 between depths of 3.5 to 6 meters below mudline. A liquefaction triggering assessment for selected samples was conducted based on the SPT-based procedures proposed by Idriss and Boulanger (2008) and Cetin et. al. (2004). For both procedures, the Cyclic Stress Ratios (CSR), which is the ratio of the average horizontal cyclic shear stress (τ_{cyc}) induced by shaking to the vertical effective stress ($\sigma_{v'}$), were estimated based on the peak shear stress derived directly from the site response analyses as described in Section 3.0 rather than using CSR estimates based on simplified approaches. This approach allows for a more reliable estimate of the CSR based on site-specific dynamic evaluations. The input parameters and the results according to Idriss and Boulanger (2008) are summarized in Tables 5-1 to 5-3 for the three rock depth cases, respectively. Tables 5-4 to 5-6 present the probability of liquefaction (P_L) according to Cetin et. al. (2004) procedure. The results show that shallow silty sand layers encountered in Borings BH-32 through BH-34 are vulnerable to liquefaction under both SSE and OBE shaking levels with Factor of Safety with respect to liquefaction to be less than 1.0. Figures 5.3-1 and 5.3-2 present the results from the liquefaction analyses of borings BH-32 through BH-34 with bedrock at 70 m depth according to Idriss and Boulanger (2008) for the SSE and the OBE event, respectively.

Table 5-1: Liquefaction Triggering Hazard Assessment According to Idriss and Boulanger (2008) based on Site Response Results for Selected Nearshore Borings (Bedrock at 120 m Depth)

EQ Event	Boring	Depth (m)	EQ Magnitude	SPT-N	CSR	CRR	FOS
SSE	BH-32	3.5	8.2	4	0.164	0.106	0.64
	BH-33	0.5		3	0.381	0.112	0.29
	BH-34	4		2	0.186	0.103	0.56
		14		5	0.164	0.109	0.66
OBE	BH-32	2.5	7.8	4	0.112	0.118	1.05
	BH-33	0.5		3	0.241	0.124	0.52
	BH-34	4		2	0.127	0.115	0.90
		14		5	0.113	0.121	1.07

Table 5-2: Liquefaction Triggering Hazard Assessment According to Idriss and Boulanger (2008) based on Site Response Results for Selected Nearshore Borings (Bedrock at 70 m Depth)

EQ Event	Boring	Depth (m)	EQ Magnitude	SPT-N	CSR	CRR	FOS
SSE	BH-32	3.5	8.2	4	0.177	0.106	0.60
	BH-33	0.5		3	0.375	0.112	0.30
	BH-34	4		2	0.199	0.103	0.52
		14		5	0.173	0.109	0.63
OBE	BH-32	2.5	7.8	4	0.118	0.118	1.00
	BH-33	0.5		3	0.259	0.124	0.48
	BH-34	4		2	0.134	0.115	0.86
		14		5	0.116	0.121	1.04

Table 5-3: Liquefaction Triggering Hazard Assessment According to Idriss and Boulanger (2008) based on Site Response Results for Selected Nearshore Borings (Bedrock at 40 m Depth)

EQ Event	Boring	Depth (m)	EQ Magnitude	SPT-N	CSR	CRR	FOS
SSE	BH-32	3.5	8.2	4	0.186	0.106	0.57
	BH-33	0.5		3	0.386	0.112	0.29
	BH-34	4		2	0.216	0.103	0.48
		14		5	0.184	0.109	0.59
OBE	BH-32	2.5	7.8	4	0.130	0.118	0.91
	BH-33	0.5		3	0.247	0.124	0.50
	BH-34	4		2	0.145	0.115	0.79
		14		5	0.121	0.121	1.00

Table 5-4: Liquefaction Triggering Hazard Assessment according to Cetin et al. (2004) based on Site Response Results for Selected Nearshore Borings (Bedrock at 120 m Depth)

EQ Event	Boring	Depth (m)	EQ Magnitude	SPT-N	CSR	P_L (%)
SSE	BH-32	3.5	8.2	4	0.164	100
	BH-33	0.5		3	0.381	100
	BH-34	4		2	0.186	100
		14		5	0.164	100
OBE	BH-32	3.5	7.8	4	0.112	76
	BH-33	0.5		3	0.241	78
	BH-34	4		2	0.127	99
		14		5	0.113	81

Table 5-5: Liquefaction Triggering Hazard Assessment according to Cetin et al. (2004) based on Site Response Results for Selected Nearshore Borings (Bedrock at 70 m Depth)

EQ Event	Boring	Depth (m)	EQ Magnitude	SPT-N	CSR	P_L (%)
SSE	BH-32	3.5	8.2	4	0.177	100
	BH-33	0.5		3	0.375	100
	BH-34	4		2	0.199	100
		14		5	0.173	100
OBE	BH-32	3.5	7.8	4	0.118	83
	BH-33	0.5		3	0.259	87
	BH-34	4		2	0.134	100
		14		5	0.116	85

Table 5-6: Liquefaction Triggering Hazard Assessment according to Cetin et al. (2004) based on Site Response Results for Selected Nearshore Borings (Bedrock at 40 m Depth)

EQ Event	Boring	Depth (m)	EQ Magnitude	SPT-N	CSR	P_L (%)
SSE	BH-32	3.5	8.2	4	0.186	100
	BH-33	0.5		3	0.386	100
	BH-34	4		2	0.216	100
		14		5	0.184	100
OBE	BH-32	3.5	7.8	4	0.130	92
	BH-33	0.5		3	0.247	82
	BH-34	4		2	0.145	100
		14		5	0.121	89

In addition to the coarse-grained materials, fine-grained soils (e.g. silt and clay) were encountered in all nearshore borings. A screening assessment of the liquefaction potential of fine-grained soils was performed based on the procedures of Bray and Sancio (2006). Figure 5.3-3 shows a chart of Plasticity Index (PI) versus water content normalized by Liquid Limit (w_c/LL) with data from soils within the depth of 10 meters in nearshore borings. Also shown are zones where soils are classified based on liquefaction susceptibility per Bray and Sancio (2006).

- Susceptible to liquefaction (PI<12, wc>0.85LL), and
- Moderately susceptible to liquefaction (12<PI<18, wc>0.8LL)

One sample in BH-35 is estimated to be moderately susceptible to liquefaction. This sample was retrieved at the depth of 8.9 meters below mudline and was classified as silt (ML) to lean clay (CL). Two samples in BH-34 are estimated to be susceptible to liquefaction, both samples are in the upper 11 meters and classified as sandy silt (ML) to silt with relatively low plasticity.

5.4 CONCLUSIONS

Liquefaction triggering evaluation was performed for nearshore borings for the Lelu Island project. In general, shallow coarse-grained soils (within 6 meters below mudline) were found to be liquefiable for both SSE and OBE events for borings BH-32 and BH-33, while the shallow coarse-grained soils in boring BH-34 are susceptible to liquefaction up to 16 meters. The nearshore boring BH-35 also indicates the presence of fine-grained soils which are moderately susceptible to liquefaction at the depth of 9 meters. Soils encountered in Borings BH-36 and BH-37 were primarily clays, therefore are not susceptible to liquefaction.

In general, the thickness and extent of liquefiable soils can be refined based on information from CPT soundings which provide a continuous recording of soil tip resistance. These data, which are proposed as part of the FEED phase, should be complemented by laboratory index tests, including fines content and Atterberg limits.

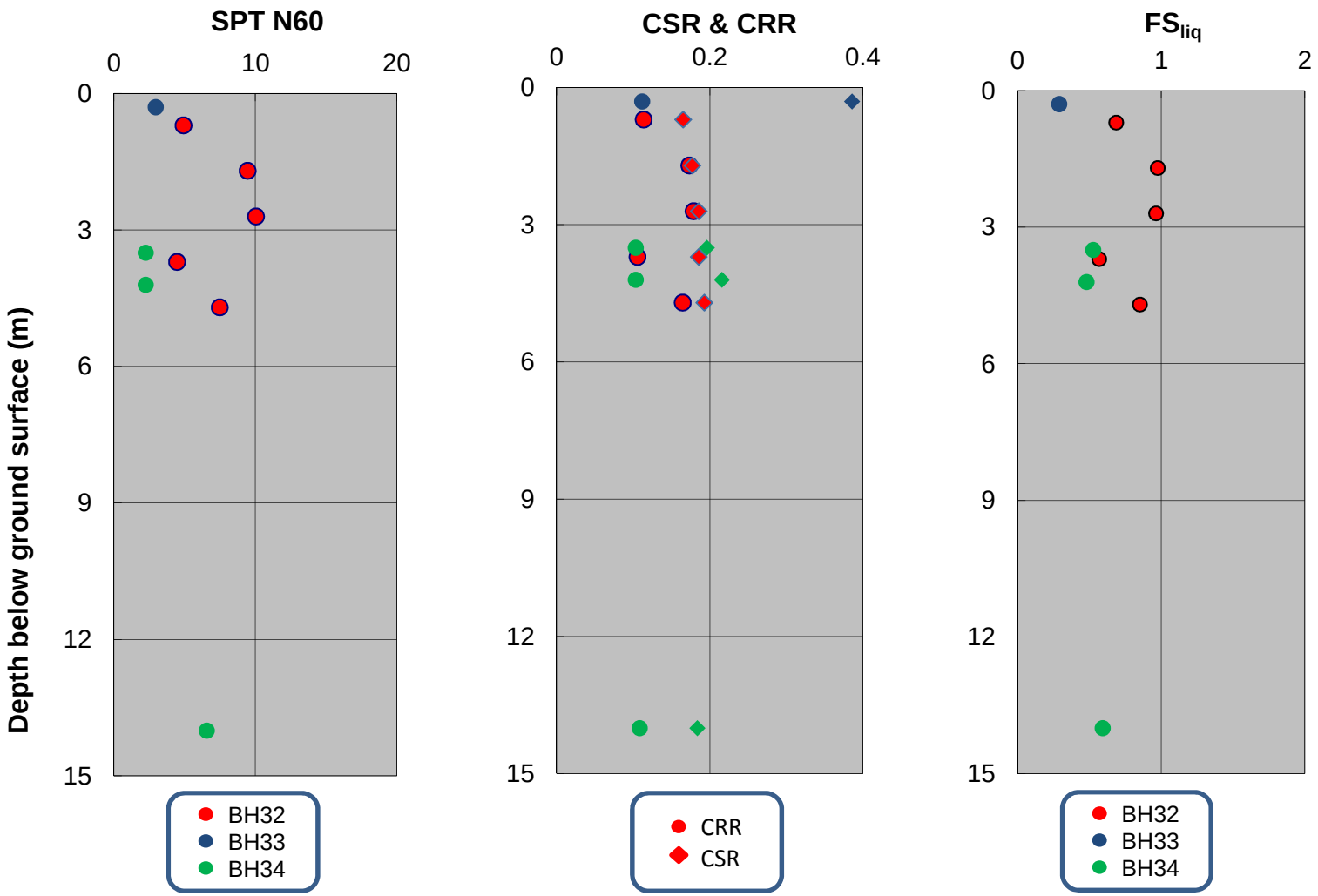
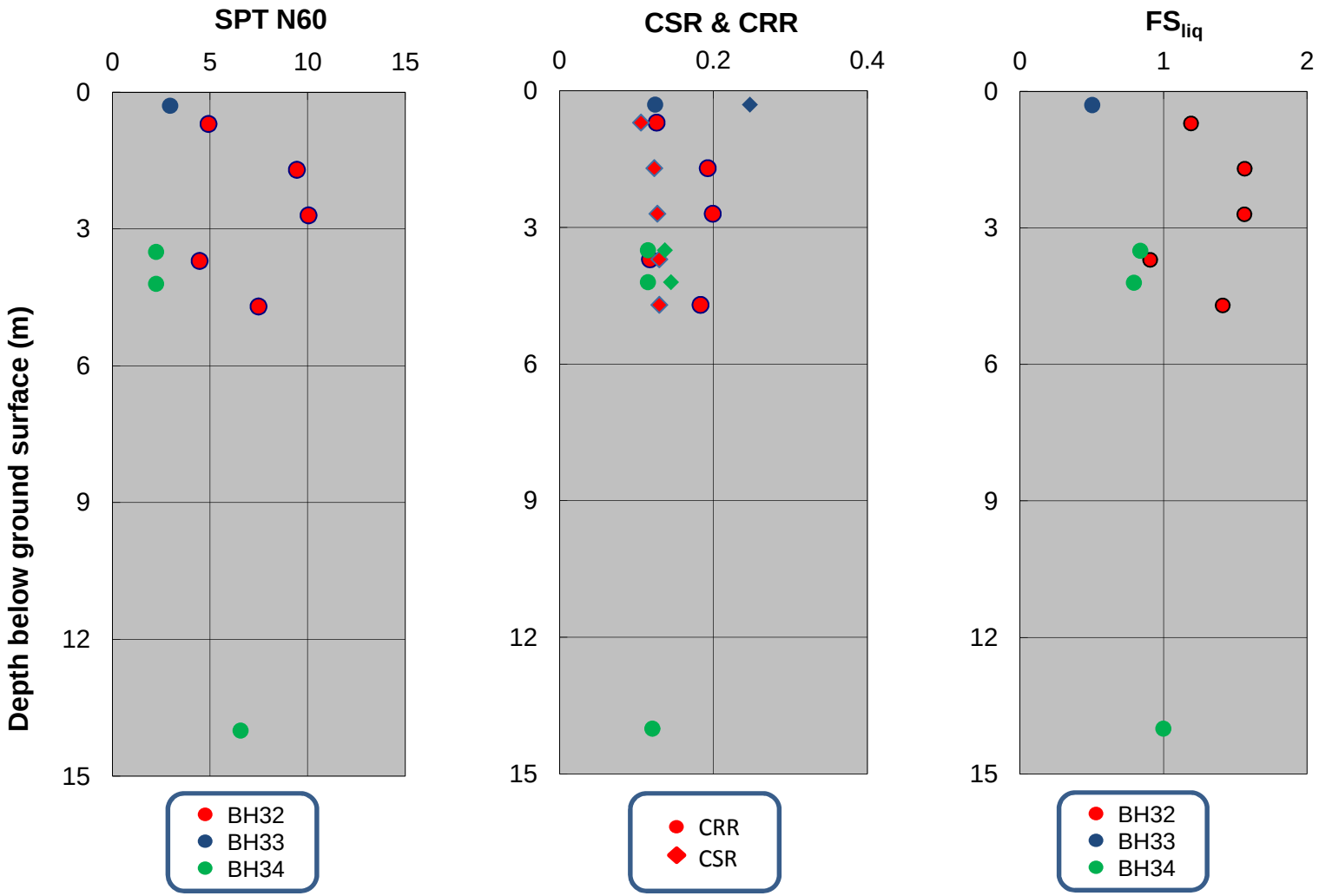


FIGURE 5.3-1

LIQUEFACTION TRIGGERING ASSESSMENT WITH BEDROCK AT 40M FOR THE SSE EVENT

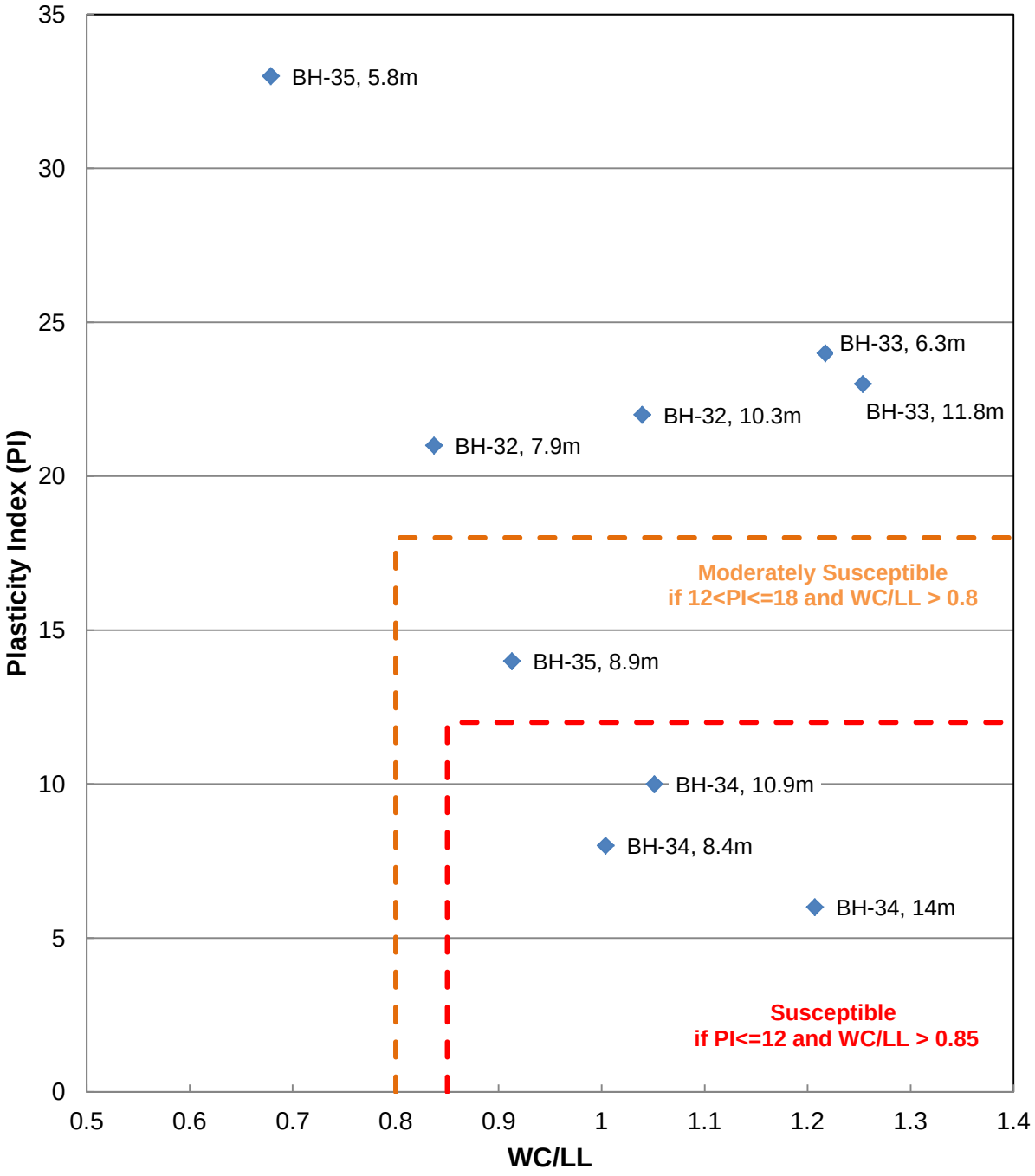
PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA



LIQUEFACTION TRIGGERING ASSESSMENT WITH BEDROCK AT 40M FOR THE OBE EVENT

PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

FIGURE 5.3-2



LIQUAFACTION TRIGGERING ASSESSMENT - BRAY AND SANCIO (2006)

PNW LNG PROJECT
LELU ISLAND, BRITISH COLUMBIA, CANADA

FIGURE 5.3-3

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APPENDIX I

Lineament Analysis and Report

Lineament Analysis & Report
Petronas/Progress PNW LNG Project
Lelu Island, British Columbia, Canada

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September 6th 2013

EXECUTIVE SUMMARY

This report presents the results from the Fugro Consultants, Inc. (FCL) reconnaissance geologic assessment of lineaments and the potential for fault surface rupture or deformation at the PNW LNG Lelu Island site for KBR. Although previous regional studies did not recognize evidence for Quaternary surface rupture or deformation at the site or vicinity, LiDAR-derived elevation data acquired for this project indicates the presence of strongly expressed linear topographic features.

Lineaments such as these can be produced by a variety of different processes, including differential erosion along prominent bedrock discontinuities (i.e., foliation and jointing; accentuated by glacial processes), faulting, or ground movements (tectonic or non-tectonic). In order to rule out faulting and potentially hazardous surface deformation, FCL reviewed previous field and desktop studies including, analysis of available LiDAR data, bedrock and geomorphic reconnaissance mapping. In addition, a limited field investigation consisting of excavation and logging of shallow test pits across mapped linear features was performed to provide direct evaluation of targeted lineaments.

The results of this study indicate that the fault rupture and surface deformation hazard for the Lelu Island PNW LNG is very low. This is supported by the following observations:

1. Available publications and reports describing the seismotectonic setting of northwestern coastal British Columbia consider the nearest active fault zone to be 200 km to the west of Lelu Island, and no Quaternary/active faults or tectonic features have been identified at or near the site. Available seismicity catalog data support this conclusion as no seismicity has been recorded within 50km of Lelu Island.
2. Geologic mapping of bedrock along the long southern shoreline of Lelu Island indicates that no major bedrock shears or faults have experienced any significant displacement or deformation of bedrock beds or contacts, or pervasive and consistent foliation patterns, since their emplacement. Interpolation of prominent bedrock contacts between the east and west shorelines provide a good match that further precludes more than a few tens of meters of possible cumulative displacement since approximately 90 million years ago.

Although the fault rupture hazard for Lelu Island is considered very low, FCL recommends that future FEED level boring logs be reviewed for consistency with the mapped bedrock trends, and that observation of excavations be performed during construction by an experienced geologist to determine potential excavation stability and confirm the bedrock lineaments features.

It should be noted that the regulatory documents covering the construction and licensing of LNG facilities does require the characterization of seismic hazards, to the standards outlined in CSA

Z276-11. This standard does not specifically state how seismic activity is to be determined for fault features. The FCL analysis and report were carried out in compliance with State of California standards for fault investigation, exceeding CSA standards.

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1.0 PURPOSE AND SCOPE

This report describes results of a desktop and field-based evaluation of fault or surface deformation hazard (based on evidence for Quaternary surface deformation) on Lelu Island, British Columbia (BC). Lelu Island is an area of low relief within the Skeena River tidal channel near Port Edward, BC. Bedrock underlying Lelu Island consists of Paleozoic-Mesozoic sheared and moderately to highly metamorphosed sedimentary and volcanic rocks (phyllitic to schistosic gneiss) with dominant foliation oriented roughly N30°W (214°/12°) (coast-parallel). These orientations are sub-parallel to the modern plate boundary (e.g. Queen Charlotte fault) (Figure 1), however the lithologic contacts mapped at Lelu Island in previous phases of Fugro's work (FCL, 2012A, 2012B; and FCL, 2013) and presented in academic articles (Clor, 2001; Gehrels, 2001; GCS, 2000; Massey, et al., 2005; etc.) have not been recognized to have Quaternary deformation or recognized -active fault or deformation zones. The goal of this study was to: (1) perform a reconnaissance geologic assessment of the presence or absence of evidence for fault surface rupture or deformation at an appropriate (site-specific) scale, and (2) determine whether further geologic investigations should be recommended to support pre-FEED- and FEED-level project licensing, planning, and design.

Although previous regional studies did not recognize evidence for Quaternary surface rupture or deformation, LiDAR-derived elevation data acquired for this project indicates the presence of strongly expressed linear topographic features (Figure 2). Lineaments such as these are produced by a variety of different processes, including differential erosion along prominent bedrock discontinuities (i.e., foliation and jointing) and, though unlikely, faulting and surface rupture. In order to rule out faulting and surface rupture, FCL performed a desktop- and limited field-based study including (1) analysis of available LiDAR data, (2) bedrock and geomorphic reconnaissance mapping, and, (3) excavation and logging of shallow test pits across or in direct vicinity of select lineaments (Figure 3).

2.0 BACKGROUND

2.1 Tectonic Setting

Lelu Island is located on a structural bedrock block of Paleozoic to Mesozoic rock along the western coast of British Columbia near the southern border of Alaska, approximately 18 km south of Prince Rupert (Figure 1). The region is bounded by the active right lateral transform Queen Charlotte Fault and coast parallel tectonic assemblages of rock divided by coast parallel "inactive" faults (Gehrels, 2001). Foliation within these tectonic assemblages parallels the coast and terrane fault boundaries.

2.2 Bedrock and Structure

Lelu Island lies within the Coast Mountains within the Alexander Terrane, a tectono-metamorphic unit consisting of accreted and locally metamorphosed Ordovician to Triassic age bedrock (Figure 4; GCS, 2000). The bedrock consists of eastward dipping beds of metasedimentary well-foliated greenschist facies and upper amphibolite facies gneiss and schist with quartzite (Crawford et al., 1999).

Previous FCL field mapping and desktop study identified numerous linear features within the bedrock (FCL, 2012A). Mapped foliation lineaments suggested structures parallel to the present day active tectonic regime (Figure 2 and Figure 5).

2.3 Geomorphology and Surficial Geology

The surficial geology of the site is the result of glacial scour into layered bedrock, followed by stream erosion leading to inundation by rising sea level at the beginning of the Holocene. Pleistocene glaciation reached its peak on the British Columbia coast 16,000 to 17,000 years ago followed by a rapid retreat due to climate change and calving leaving the Prince Rupert Area ice free after about 13,000 years ago (Clague and Ward, 2011). Scouring by glacial ice, left extensive bedrock exposures, Lelu Island being one of them, of relatively fresh bedrock exposed at the surface. The Lelu Island site was once located in the bottom of a glaciated valley where ice flows generally flattened the terrain. Differential weathering by glacial scour acting on interlayered weak and hard rock resulted in undulating bedrock surface and linear ridges and valleys of the strength differentiated layers. The depth of the scoured depressions has been observed to be up to 12.5m (B-16) in some places (Pending Fugro Onshore Investigation report; FCL, 2012B; and FCL, 2013).

Melt water eroded deep channels (e.g. Porpoise Inlet) along the northwest shore of the island (Figure 1 & 4). Pervasive fractures and jointing also influence the geometry of coastal erosion and the resulting shape of the shoreline. The northwest and southeast shoreline lie at a high

angle to foliation in the rock and differential weathering is strongly expressed in the headlands and embayment common along beaches (Figures 4; Figure 5; Table 2).

Erratic rounded boulders of granite and local materials are common along the shoreline of the island, suggesting storm wash up of glacial materials, or deposits from old (relict) shoreline deposition (Figure 4). Based on initial borehole logs (FCL Onshore geotechnical Report, In Preparation) It is likely that deeper scour marks do not contain older glacial deposits left behind by melting ice, but instead are filled with post-glacially derived organic and soil deposits.

Bogs and deposits of peat have formed where organic materials have accumulated in depressions in the glaciated bedrock surface (Figure 4). In some cases, the mass of accumulated organic matter may slow the drainage on some slopes resulting in terrace-like bogs. A layer of interlocking roots and mass forms a continuous cover in over fallen logs, soil and outcrops of rock (FCL, 2012B). Much of this island is covered by blanket bog of saturated organic debris and intergrown moss (Stantec, 2012). Raised bog with fill topography occurs inland in low relief terrain with poor drainage (Figure 4).

2.4 Sea-level Changes and Relict Shorelines

The shore of the island suggest at least three moderately developed wave cut terraces or platforms formed on the bedrock where a shelf was identified at common elevations around the island (Figure 2 and Figure 4). A bedrock terrace, cut by wave action, was observed in aerial photographs and some portions during low-tide site reconnaissance, which extends at least 100 meters offshore from the west end of the island. The oldest relict shoreline is interpreted at as the highest elevation with subsequently lower terraces identified as younger. The general age of these platforms post-dates glacial scrapping as the platforms/terraces cut glacially carved lineaments (e.g. Figure 4- NW island corner). Studies to the south of Lelu Island (James, et al., 2005) suggest sea level dropped from roughly 14,000 years before present (Last Glacial Maximum) to present day, for a total drop of approximately 150 meters to the levels of present day.

3.0 METHODS

3.1 Analysis of LiDAR Dataset

Analysis of the LiDAR data set was performed using equal elevation contour, hillshade, and slope renderings of a digital terrain model produced from an airborne LiDAR survey of Lelu Island as provided by KBR to FCL. These elevation (and derivative) visualizations provide the ability to examine and characterize terrain morphology on Lelu Island at a higher resolution, than was previously available, with a vertical resolution of 1.0 meters.

Analyses of terrain models for geohazard screening studies is a useful techniques to identify diagnostic specific geomorphic features typically produced by various active geologic processes that could represent a hazard (e.g., fault ruptures, landslides, debris flows). Depending on the capacity of a landscape to preserve evidence of fault surface rupture, repeated surface ruptures along a fault zone can produce distinctive features including closed depressions, deflected drainages, sag ponds, linear (along-fault) drainages, linear troughs/fault-line valleys, side-hill benches, side hill troughs, and vertical scarps. Any fault-related geomorphology identified in LiDAR data is typically verified during a field-based review of initial desktop results, at which time specific features or representative features can be observed and characterized as either likely or unlikely evidence for past surface deformation.

In addition to analysis of possible tectonic features, this study included analysis of landscape features that could serve as strain markers including: (1) shoreline angles (back edges of wave-cut platforms eroded by wave abrasion of bedrock during past incidences of higher relative sea level), (2) of erosion-resistant bedrock horizons that underlie prominent topographic highs, and (3) continuity and consistency of bedding planes/contacts and foliation.

3.2 Reconnaissance and Mapping

Reconnaissance and mapping was performed as part of this study with the objective of: (1) evaluating and validating any geomorphic features prospectively identified during LiDAR, and (2) collecting additional observations of bedrock type and discontinuities to analyze distribution with respect to prospective features.

Field reconnaissance of possible fault-related features commonly includes evaluation of geologic and geomorphic context often unavailable from elevation data alone, including: (1) the type of material (bedrock or soil) that a scarp or slope is developed in, (2) evidence for continuity of scarps or other linear features, (3) evidence for disruption of small-scale drainage patterns beyond the resolution of LiDAR data, and (4) evidence for small-scale deposits of alluvium or colluvium related to surface rupture or deformation beyond the resolution of LiDAR data. Field reconnaissance performed for this study was intended to quickly evaluate a subset

of representative features identified during LiDAR analysis and evaluate whether any of these features should be considered as definitive evidence for recent fault surface rupture—this task was performed in conjunction with the exploratory test pits described in Section 3.3.

Bedrock mapping was performed along the coastline of Lelu Island and included reconnaissance-level observations of rock type (including mineralogy and relative descriptions of metamorphic grade) and attitudes of discontinuity planes (including foliation and prominent joints). Photographs were collected and geo-tagged with a GPS device for later reference.

3.3 Test Pit Excavation and Logging

A limited suite of shallow test pit investigations was planned in support of the geologic mapping and field reconnaissance tasks with the goal of evaluating the nature of surficial deposits along several of the prospective scarps identified in LiDAR analysis. The test pit effort had a secondary purpose of evaluating the feasibility of completing a more comprehensive fault study in the case that one or more scarps identified during LiDAR analysis were determined to have been likely produced by past fault surface rupture. Test pit locations were selected to investigate scarps of different orientations in the general vicinity of the proposed LNG facilities and were refined in the field to avoid water-logged or saturated areas and to select representative locations along each given feature.

Test pits were excavated to depths of 1 meter or less until encountering bedrock or groundwater. Geologic units exposed in test pits were described following standard soil description methodology (e.g., United Soil Classification System) and one representative wall of each test pit was logged at a scale of approximately 1:20 (1 inch equals 0.5 m). All exposures were observed systematically for detrital charcoal fragments for analysis (Organics required for carbon age dating), but none were identified. Two test pit locations were abandoned during siting and reconnaissance efforts due to an abundance of surface water that would fill the excavations if attempted.

4.0 RESULTS

4.1 Analysis of LiDAR Dataset

Analysis of the Lelu Island LiDAR dataset identified features warranting further evaluation as possible evidence for past fault surface rupture and features appropriate for use as strain markers to place constraints on the location and orientation of cumulative displacements. The features identified for further evaluation include two sets of prominent lineaments defined most commonly by steep slope breaks and less commonly by linear drainages (Figure 2). The first set of prominent lineaments is characterized by orientations ranging from WNW to NW with dominantly NNE- and NE-facing scarps between 1 and 8 m in height and lateral continuity on the order of hundreds of meters up to 0.5 km. The second set of prominent lineaments is characterized by N-S orientations with dominantly W-facing scarps between 1 and 6 m in height and lateral continuity on the order of hundreds of meters up to 1.3 km. Neither of these two lineament sets are associated with systematic beheading, or deflection of drainage patterns or other topographic disruptions.

Possible strain markers identified in LiDAR include a series of three likely shoreline angles (the preserved back-edges of abandoned wave-cut platforms) located along the margins of Lelu Island. The lowest elevation (and youngest) shoreline angle (SA-0; Figure 2) is preserved along roughly three-fourths of the island and is located at elevations of approximately 3 to 4 m. The next youngest shoreline angle (SA-1; Figure 2) is preserved mostly along the southern and northern margins of Lelu Island and is located at elevations of 8 to 9 m. The highest elevation and oldest identified shoreline angle (SA-2; Figure 2) is preserved along the south and east margins of Lelu Island at elevations of 13 to 14 m. The consistent elevation of the youngest two sets of shoreline angles (SA-0 and SA-1) is evidence for absence of significant relative displacement since the erosion of the wave-cut platforms, though the amount of time represented by this constraint is probably only a few thousand years (see Section 2.4 for discussion of the amount and timing of late Pleistocene changes in relative sea level).

4.2 Reconnaissance and Mapping

Ground reconnaissance of lineaments was performed in conjunction with the test pit program in mid-July 2013. Reconnaissance was focused on the western half of the island in order to evaluate LiDAR lineaments or other possible scarps or small-scale geomorphologic features potentially indicative of active faulting or ground deformation. In every case the prominent scarps identified in LiDAR topography were developed in bedrock and did not continue with any topographic expression into adjacent swales and drainages filled with geologically young unconsolidated deposits. Larger valleys incised into bedrock scarps generally have gentle gradients where they enter the adjacent bog marshes and do not exhibit knick-points or other gradient changes produced by localized vertical displacements.

Geologic mapping along the margins of Lelu Island confirmed that the underlying bedrock is strongly foliated metamorphic rock, gradually increasing in metamorphic grade from northeast to southwest from phyllite to phyllitic schist to gneissic schist to schistosic gneiss. Foliation orientations vary systematically by about 25° from about 315° (N45°W) at the western end of the island to 290° (N20°W) at the eastern end—foliation dips are relatively consistent from 45°NE to 60°NE. These bedding attitude measurements in combination with topographic trends observed in the LiDAR dataset allow confident interpolation of the gneissic schist to schistosic gneiss contact between the east and west sides of the active faulting or deformation that would be expressed as cumulative displacement along any structure or zone with a strike of N-S or similar. No bedrock fault zones were identified in the nearly continuous exposure along the south side of Lelu Island.

Persistent jointing patterns are developed in the bedrock due to compressional stresses. The Lelu Island region underwent considerable compression and shear both during the emplacement of the different terranes and through the present day (Monger, 2008).

In order to better understand the role of bedrock discontinuities in controlling erosional processes on Lelu Island, a total of 72 joint set measurements were collected on bedrock exposures along the margins of Lelu Island (Table 2). These joints are typically planar cracks, sometimes more than 10 meters long, forming sets spaced 1 to 2 meters apart (Figure 2). These measurements were compiled and analyzed using DIPS Rocscience© stereonet plotting program and resulting calculation shows that the population clusters around three dominant orientations: N14°W/47°E (J1), N48°E/89°SW (J2), and N53°E/63°NW (J3) (Figure 5). Observations of bedrock exposures at sea level around Lelu Island indicate that these joint orientations are influencing the pattern of wave erosion and it is reasonable to expect that these discontinuities are also contributing to the processes on the interior of the island that have produced some of the north- to northeast-trending escarpments shown on Figure 2.

Table 2 Joint, Fracture, and Foliation Data

Type	Set	Strike	Dip	Rock type (if noted)
Foliation	F1	317	57	
Foliation		315	67	Highly weathered
Foliation	F1	303	48	
Foliation	F1	313	47	Gneissic schist
Foliation	F1	310	46	
Foliation	F1	321	44	
Foliation	F1	323	50	

Type	Set	Strike	Dip	Rock type (if noted)
Foliation	F1	321	49	
Foliation	F1	315	61	
Foliation	F1	320	43	Gneissic schist
Foliation	F1	324	48	Schistosic phyllite
Foliation	F1	325	46	
Foliation	F1	313	54	
Foliation	F1	302	47	Phyllite

Type	Set	Strike	Dip	Rock type (if noted)
Foliation	F1	315	54	Phyllite
Foliation	F1	322	43	Phyllite
Foliation	F1	322	52	Phyllite
Foliation	F1	308	56	Phyllite
Foliation	F1	316	55	Phyllite
Foliation	F1	307	54	
Foliation	F1	304	48	Phyllite
Foliation	F1	296	61	Gneissic schist
Foliation	F1	282	48	Gneissic schist
Foliation	F1	285	48	Gneissic schist
Foliation	F1	307	50	Gneissic schist
Foliation	F1	288	47	Gneissic schist
Foliation	F1	286	52	Gneissic schist
Foliation	F1	293	44	Gneissic schist
Foliation	F1	284	62	Gneissic schist
Foliation	F1	292	59	Gneissic schist
Foliation	F1	296	45	Gneissic schist
Foliation	F1	296	50	Gneissic schist
Foliation	F1	293	52	Schistosic gneiss
Foliation	F1	295	45	Schistosic gneiss
Foliation	F1	299	48	Schistosic gneiss
Foliation	F1	300	51	
Foliation	F1	302	43	Schistosic gneiss
Foliation	F1	305	51	Schistosic gneiss
Foliation	F1	316	40	
Foliation	F1	292	45	Schistosic gneiss
Foliation	F1	299	55	Schistosic gneiss
Foliation	F1	318	45	Gneissic schist
Foliation	F1	319	45	Schistosic gneiss
Foliation	F1	308	46	Phyllitic schist
Joint	J3	30	75	
Joint		330	5	
Joint	J1	175	40	
Joint	J2	255	85	

Type	Set	Strike	Dip	Rock type (if noted)
Joint		355	30	
Joint		170	30	
Joint	J3	66	76	
Joint	J3	69	70	
Joint	J1	180	40	
Joint	J1	180	45	
Joint	J1	155	45	
Joint	J3	49	79	
Joint		150	70	
Joint		338	45	
Joint	J2	35	90	
Joint		200	75	
Joint		175	25	
Joint	J3	45	60	
Joint		225	75	
Joint	J3	65	55	
Joint	J1	165	50	
Joint		235	15	
Joint		175	30	
Joint	J2	75	90	
Joint	J3	32	45	
Joint	J3	75	70	
Joint		142	45	
Joint		265	20	
Joint	J2	209	90	
Joint	J3	54	61	
Joint	J3	35	55	
Joint	J2	25	90	
Joint	J3	60	70	
Joint		158	71	
Joint	J3	70	55	
Joint	J2	255	90	
Joint		188	90	
Joint	J3	40	50	

Type	Set	Strike	Dip	Rock type (if noted)
Joint	J1	150	50	
Joint	J3	30	48	
Joint	J1	155	55	
Joint	J3	40	75	
Joint	J3	64	58	
Joint	J1	170	50	
Joint	J3	47	65	
Joint	J1	170	45	
Joint	J2	20	90	
Joint	J1	165	50	
Joint	J1	165	40	
Joint		345	70	
Joint	J1	165	42	
Joint		287	25	
Joint	J2	230	90	
Joint	J1	175	45	
Joint	J3	65	73	
Joint		95	37	
Joint		340	47	
Joint		330	85	
Joint		165	90	
Joint		160	65	
Joint		140	57	
Joint	F1	333	53	
Joint	J1	157	48	
Joint		340	25	
Joint	J1	150	50	
Joint	J1	155	47	
Joint	J1	165	50	
Joint	J1	165	43	
Joint	J1	165	54	
Joint	J2	45	90	
Joint		120	60	
Joint		295	55	

4.3 Test Pit Excavation and Logging

A total of eight test pits were excavated by hand, shovel, and chainsaw in mid-July 2013 in an attempt to better characterize subsurface materials along the lineaments identified during analysis of the LiDAR data. Test pit locations are shown on Figure 3 and listed in Table 1. Stratigraphy of the units exposed in all eight test pits was generally similar to the following composite profile:

(1) Root mat with partially humus and silt, 25-50% partially humified organics (15 to 60 cm);
(2) Organic silt, 50-75% partially to fully humified organics and 25-50% mineral component (10 to 70 cm);
(3) Residual soil, gray micaceous silty sand (10 to 20 cm);
(4) Saprolite, tan to brownish gray silty sand with residual bedrock fabric (thickness varies); and,
(5) Bedrock, tan to dark gray and highly weathered, foliation commonly well expressed.

This composite profile demonstrates that organic material forms a large component of the total volume of unconsolidated material located in the low relief areas of Lelu Island. Relative percentages of organic material decrease with depth, and the relative component of weathered mineral material increases with depth. These relations imply that the majority of mineral transport is occurring in the shallow subsurface through mixing of residual soil with the heavily humified organic material via bioturbation and solifluction processes. Organic transport likely occurs by a similar mechanism, undergoing a humification process and downward mixing into the combined organic and mineral horizon. Bioturbation probably occurs at a gradual rate through root mixing and tree throw, though solifluction may occur seasonally as soils dry and contract slightly between rain storms and expend and flow incrementally when rewetted.

The implications for characterizing fault rupture hazard in shallow subsurface conditions such as these are:

(1) Unconsolidated materials are weakly stratified composites formed from mixing materials of various ages and are poorly suited for use as datum to determine the location or timing of past fault displacement; and,
(2) Unconsolidated materials have very little shear strength or cohesion and are unlikely to generate a localized scarp if faulted or preserve a scarp if generated.

Each of the eight test pits was excavated to rock and determined to have no fault displacement of the top of bedrock surface. No detrital charcoal was identified for radiocarbon analysis.

Table 1. Test Pit Locations

Test Pit	Easting (m)	Northing (m)	Elev. (m)	Remarks
TP-1	N/A	N/A	N/A	**Canceled**: Flowing water at or near ground surface at planned location prevented excavation.
TP-2	6006639	415397	30	No evidence for fault displacement.
TP-3	6006782	415356	19	No evidence for fault displacement.
TP-4	6006783	415393	20	No evidence for fault displacement.
TP-5	6006748	415508	28	No evidence for fault displacement.
TP-6	415530	6006859	23	No evidence for fault displacement.
TP-7	6006978	415544	14	No evidence for fault displacement.
TP-8	N/A	N/A	N/A	**Canceled**: Flowing water at or near ground surface at planned location prevented excavation.
TP-9	6006685	416214	29	No evidence for fault displacement.
TP-10	6007056	415993	11	No evidence for fault displacement.

5.0 DISCUSSION AND RECOMMENDATIONS

The results of desktop LiDAR dataset analysis, field-based reconnaissance and bedrock mapping, and test pit excavation and logging indicate that the fault rupture hazard for the Lelu Island PNW LNG is very low. Available publications and reports describing the seismotectonic setting of northwestern coastal British Columbia consider the nearest active fault zone to be 200km to the west of Lelu Island. Available seismicity catalog data are consistent with this conclusion with no seismicity within 50km of Lelu Island (Figure 1).

Desktop analysis of LiDAR data performed for this study recognizes presence of at least three shoreline angles (back edges of wave-cut platforms) that preclude more than a few meters of cumulative surface deformation across Lelu Island within the past several thousand years. Geologic mapping of bedrock along the long southern shoreline of Lelu Island indicates that no major bedrock shears that have accommodated any significant disruption of bedrock foliation patterns and interpolation of prominent bedrock contacts between the east and west shorelines further precludes more than a few tens of meters of cumulative displacement since approximately 90 million years ago (Greher, 2001 and Monger, 2008)

Although the fault rupture hazard for Lelu Island is considered very low, FCL recommends that future FEED level boring logs be reviewed for consistency with the mapped bedrock trends, and that observation of excavations be performed during construction by an experienced geologist, to determine potential excavation stability and confirm the bedrock lineaments features.

6.0 REFERENCES

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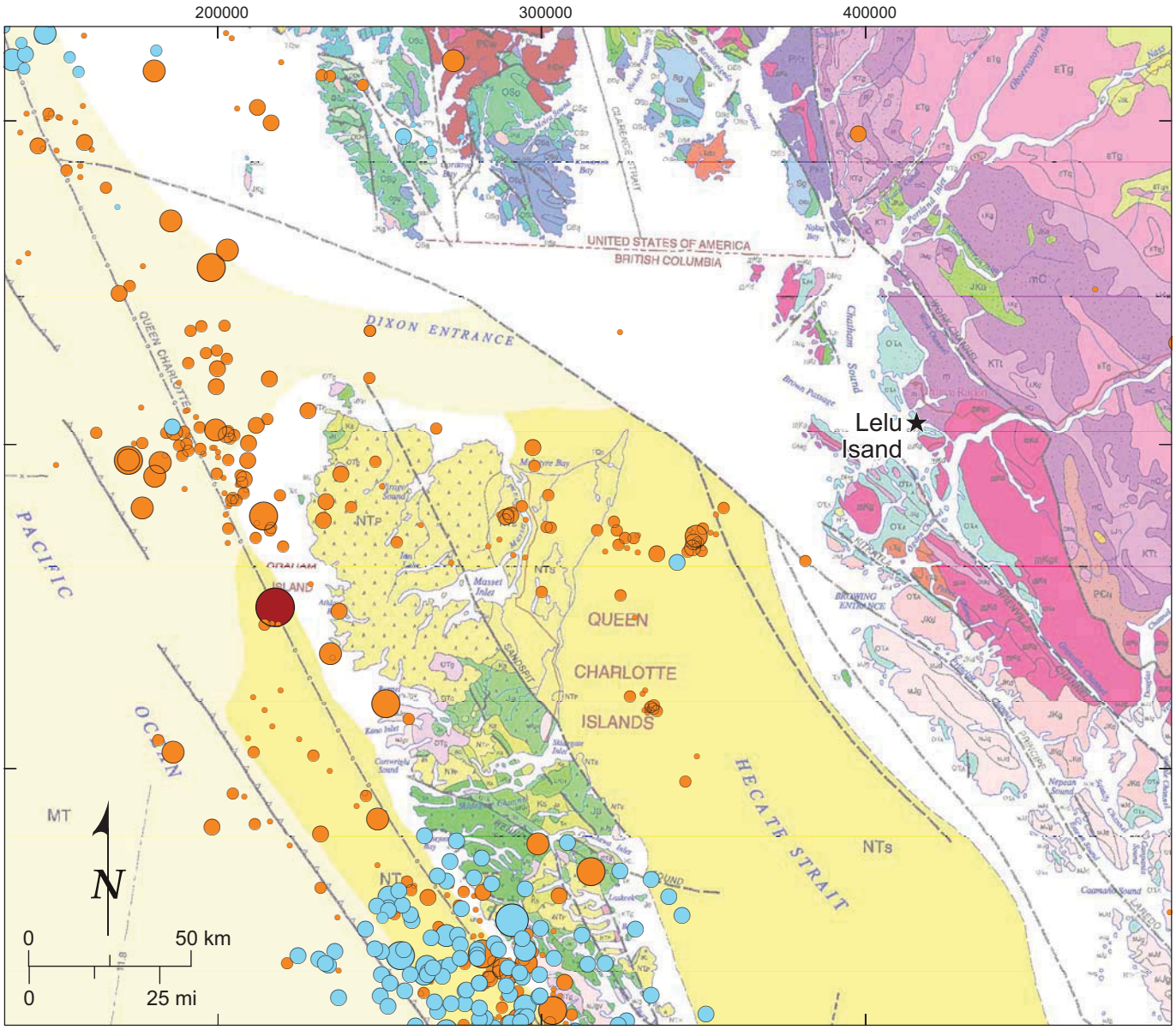
Figures



Coordinate System: WGS 1984 UTM Zone 9N

Map source: GCS, 2000 - OF2948d

Explanation

Seismicity Magnitude (dated 2009 to 2013)

- 2.5 - 2.9
- 3 - 3.9
- 4 - 4.9
- 5 - 5.9
- 6.0 - 6.9
- 7.0 - 7.9
- 8.0 - 8.9
- ≥ 9.0

Source: USGS

Seismicity Magnitude (dated 1700 to 2008)

- 2.5 - 2.9
- 3 - 3.9
- 4 - 4.9
- 5 - 5.9
- 6.0 - 6.9
- 7.0 - 7.9
- 8.0 - 8.9
- ≥ 9.0

Source: SHEEF

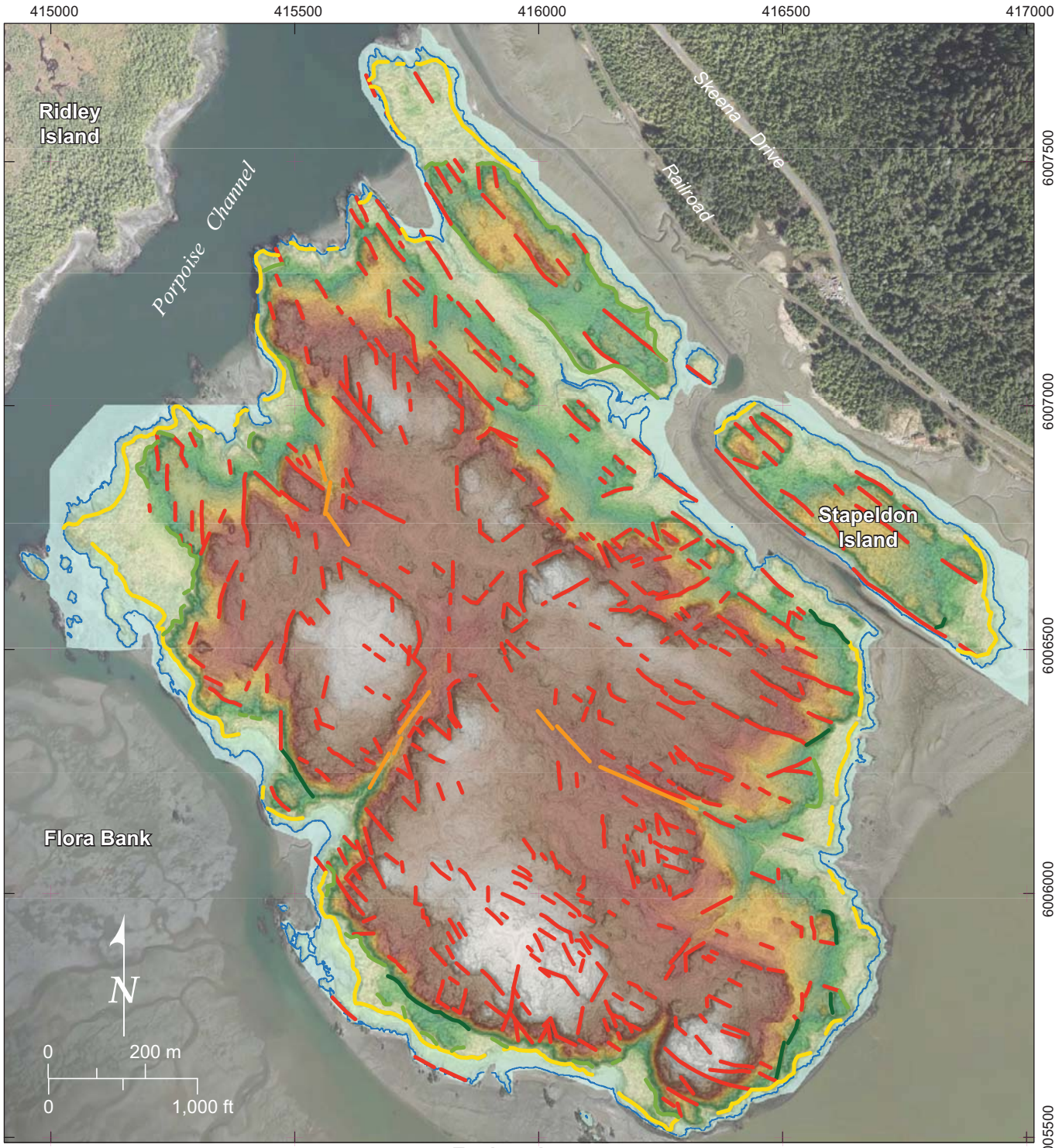
Geologic Units

m	Metamorphic rocks (undivided); includes Central Gneiss Complex (mC)
mK	Variably foliated hornblende quartz diorite, tonalite, and hornblende diorite intrusive into Gravina-Nutzotin rocks of South East Alaska and forming part of Western Coast Plutonic Complex (Mid-Cretaceous (87 - 130 Ma)
OTA	Undivided phyllite in Alexander Terrane, includes Devonian to Triassic rocks in Duncan Canal Shear Zone; undivided calcareous mudstone, siltstone, thin-bedded limestone, subordinate mafic to felsic volcanics, carbonate chert, minor ultramafics; locally metamorphosed to slate, phyllite, schist, gneiss, and marble; marine (Ordovician - Triassic)

PROJECT, 10130058 Pacific Northwest LNG, _05 Graphics, modified 08.07.13

Tectonic Setting and Location Map

FIGURE 1



Coordinate System: WGS 1984 UTM Zone 9N

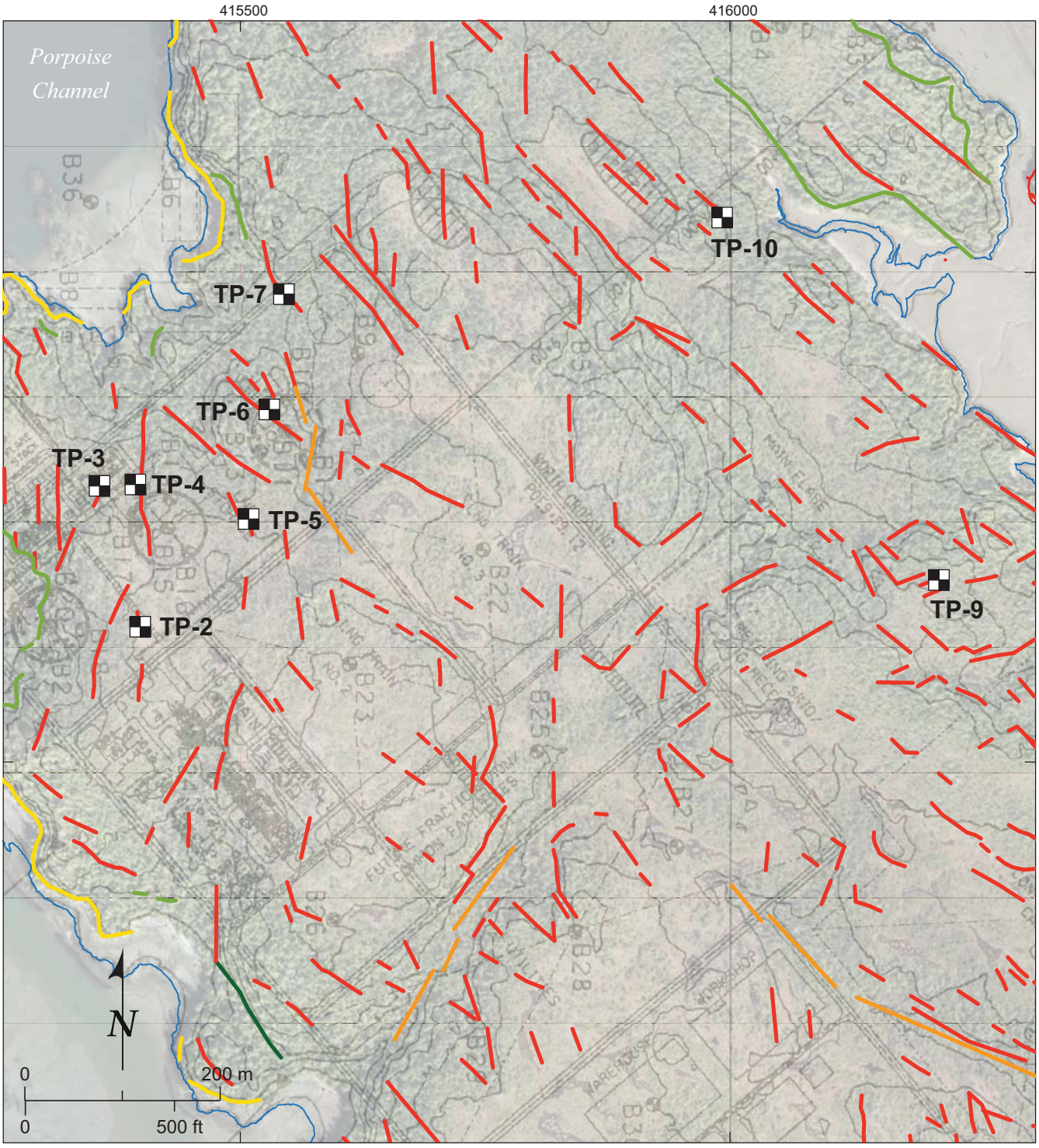
Explanation

- Present day coastline
- *Lineaments*
  - Topographic break
  - Linear stream
- Relict shorelines
  - Younger
  - ↓
  - Older

PROJECT, 10130058 Pacific Northwest LNG, _05 Graphics, modified 08.15.13

Lelu Island Topographic Lineament Map

FIGURE 2



Coordinate System: WGS 1984 UTM Zone 9N

Explanation

TP-2 PNW test pit, as built July 24, 2013

Present day coastline

Lineaments

Topographic break

Linear stream

Relict shorelines

Younger

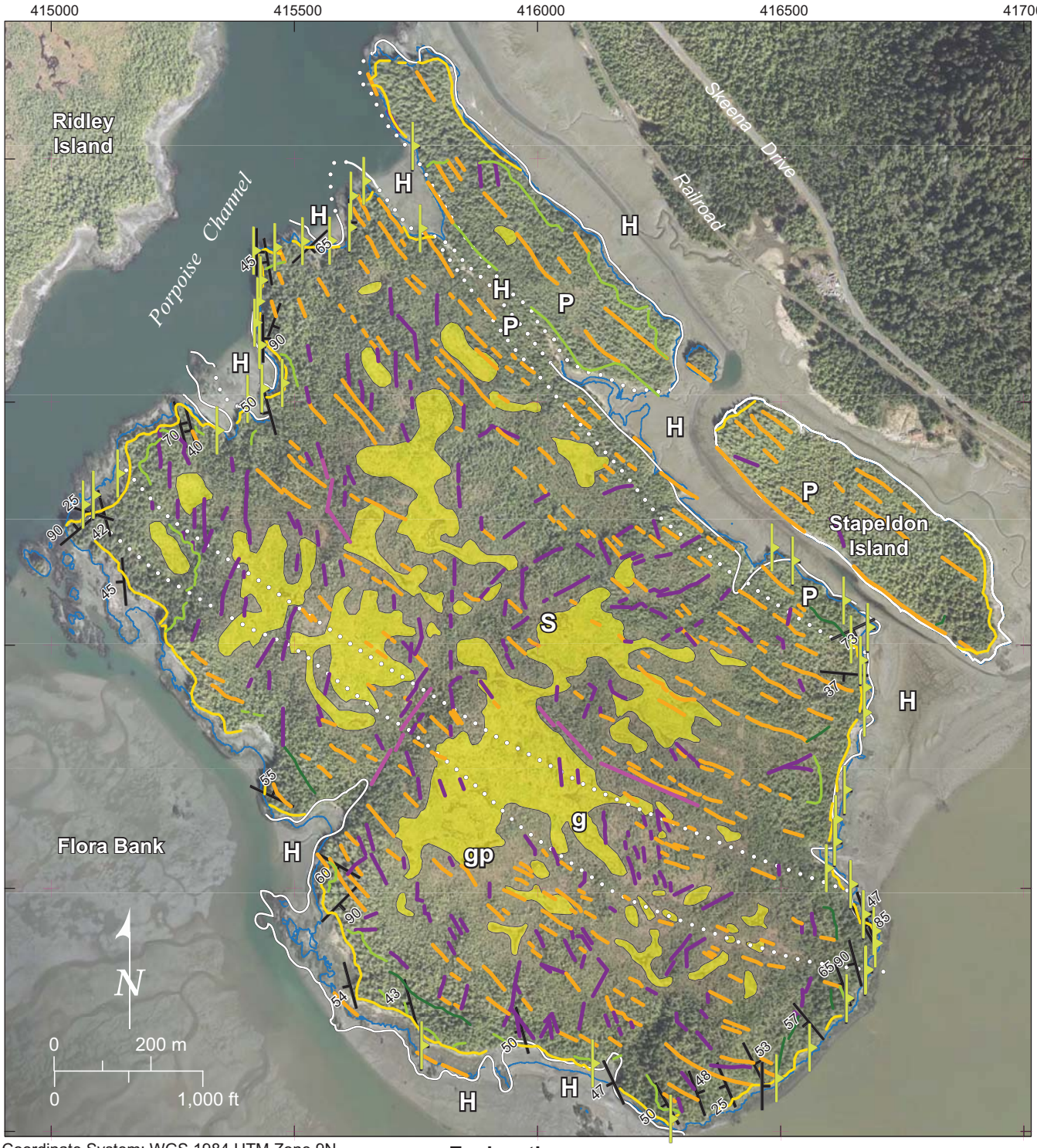
Older

Test Pit	Easting (m)	Northing (m)	Elevation
TP-2	6006638.71401	415397.433252	30
TP-3	6006781.93541	415355.694272	19
TP-4	6006783.47759	415392.914189	20
TP-5	6006747.97030	415508.405062	28
TP-6	6006859	415530	23
TP-7	6006977.69471	415543.935936	14
TP-9	6006685.00460	416213.902067	29
TP-10	6007056.29292	415992.952594	11

Lelu Island Test Pit Locations with Plant Layout and Lineaments

FIGURE 3

PROJECT, 10130058 Pacific Northwest LNG, _05 Graphics, modified 08.15.13



Coordinate System: WGS 1984 UTM Zone 9N

Explanation

Symbols

- Coastline
- Joint, dip in degrees
- Foliation
- Geologic contact, solid where certain, dotted where buried
- Bog

Lineaments

- Foliation
- Joint
- Linear stream
- Relict shorelines
  - Younger
  - Older

*Geologic Units**

- H — Young sediment (Holocene)
- (Devonian - Triassic)
  - P — Phyllite
  - S — Schist
  - g — Gneiss schistosic
  - gp — Porphroblastic gneiss

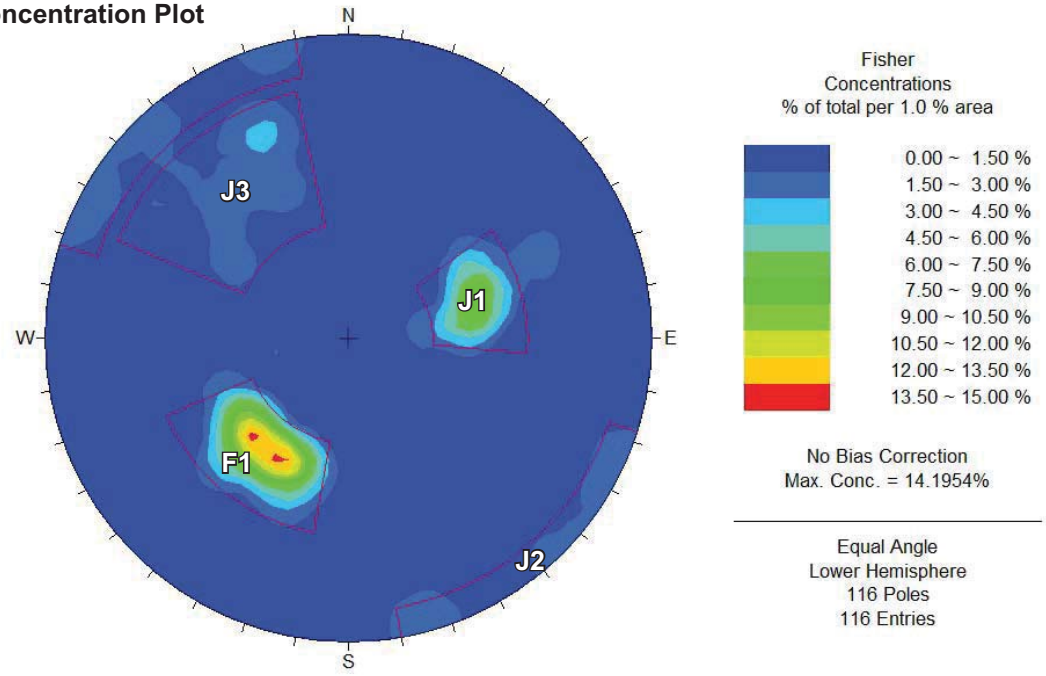
* Variable bog thickness across island interior.

Updated Geologic Map

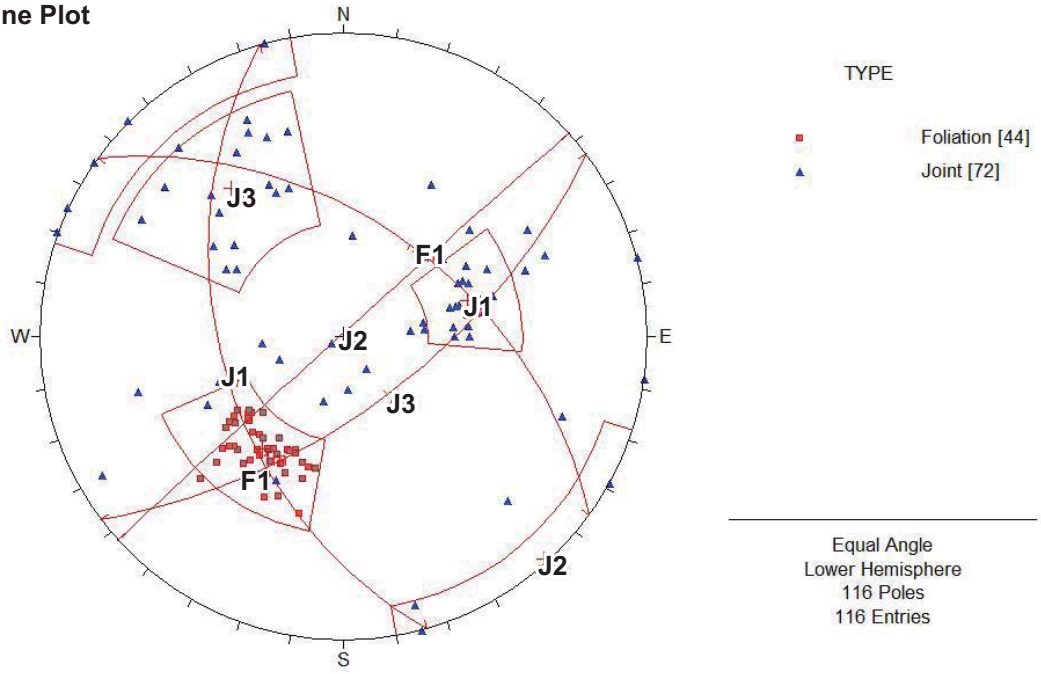
FIGURE 4

PROJECT, 10130058 Pacific Northwest LNG, _05 Graphics, modified 08.19.13

Pole to Concentration Plot



Pole to Plane Plot



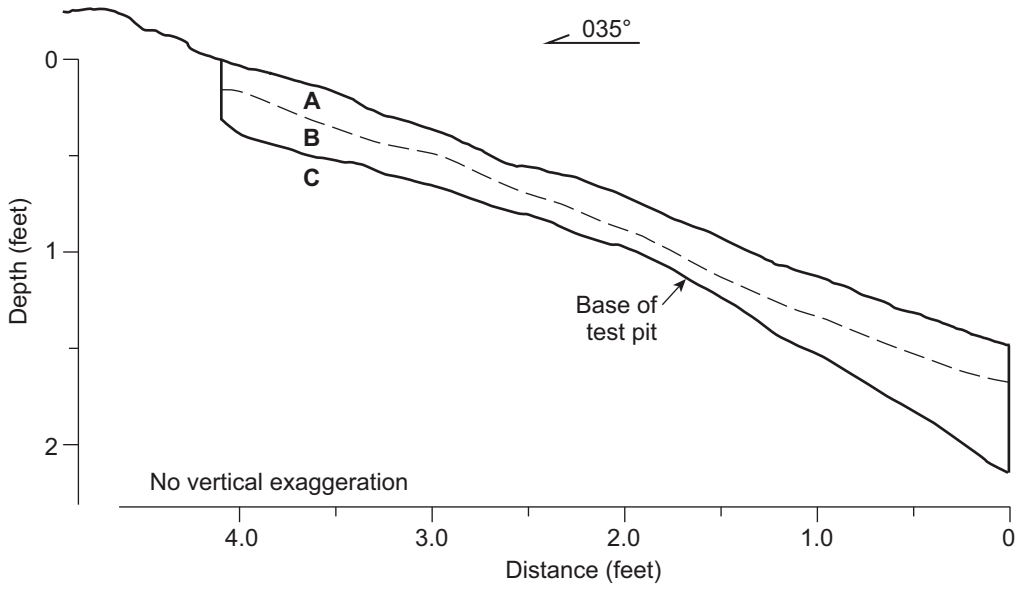
Explanation

Centroid of Foliation and Joint Sets

F1	214/42
J1	074/43
J2	138/01
J3	323/27

PROJECT, 10130058 Pacific Northwest LNG, _05 Graphics, modified 08.06.13

Stereonet Diagrams of Foliation and Joints FIGURE 5



Unit Descriptions

Unit A: Root mat with humus and silt (Pt-OH); dusky red (2.5YR 3/2); moist; very soft; estimated 25-50% partially humified organic material and organic silt; lower contact wavy and clear over 2 to 3 cm.

Unit B: Very fine sandy silt (ML) (residual soil); very dark grey (10YR 3/1); moist; very soft; common fine sand- to silt-sized detrital mica indicates local schistose/phyllitic bedrock as parent material; lower contact wavy and clear over 2 to 3 cm.

Unit C: Very fine sand and silt (saprolite with relict bedrock fabric); black (5YR 2.5/1) with tan mottling; damp; medium dense/soft; lower contact wavy and sharp over 1 cm. Grades to phyllite (bedrock), mottled tan to grayish brown, R0-R2, foliation orientation 307°/32°; prominent joint sets oriented 310°/90° and 295°/90°.

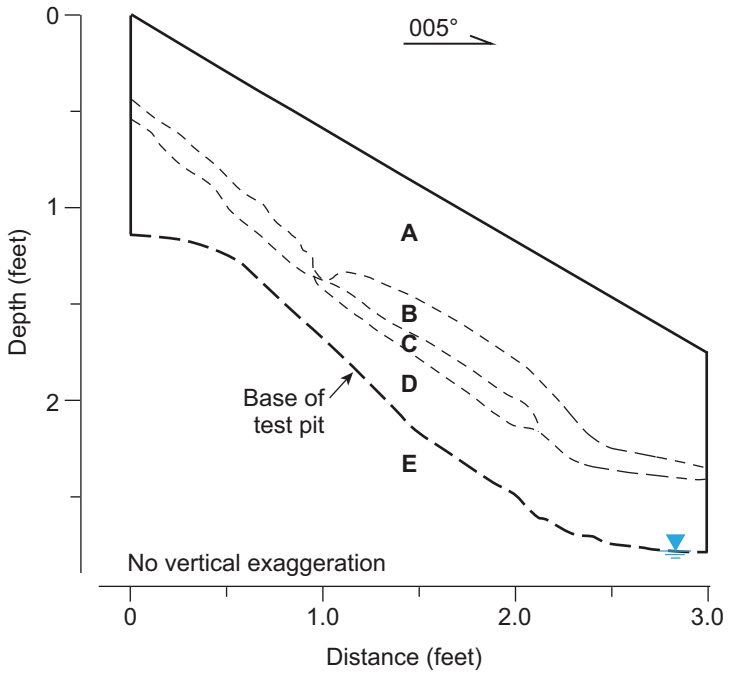
Notes: 1. Ground surfaces consists of low vegetation and moss.
2. Ground surface slopes 21°.
3. Excavated July 17, 2013, logged July 17, 2013.

Test pit TP-2, view southeast

Test pit TP-2, view northeast

Test Pit TP-2

FIGURE 6



Unit Descriptions

Unit A: Root mat with humus and silt (Pt-OH); dark reddish brown (5YR 2.5/2); moist; very soft; estimated 25-50% partially humified organic material and organic silt; lower contact wavy and clear over 2 to 3 cm.

Unit B: Silty very fine sand (SM) (residual soil); gray (5Y 5/1); moist; very loose; abundant fine sand- to silt-sized detrital mica indicates local schistose/phyllitic bedrock as parent material; lower contact wavy and clear over 2 to 3 cm.

Unit C: Organic silt (OH); very dark grey (10YR 3/1); moist to damp; very soft; estimated 50-75% partially to fully humified organic material; lower contact wavy and clear over 3 to 5 cm.

Unit D: Silty sand (saprolite with very weak relict bedrock fabric); mottled gray, tan, and brown; moist; loose; lower contact wavy and clear over 1 to 3 cm.

Unit E: Phyllitic schist/phyllite, tan to dark gray to orangish brown, R0-R1, moderately to highly weathered, micaceous, foliation oriented 310°/52°.

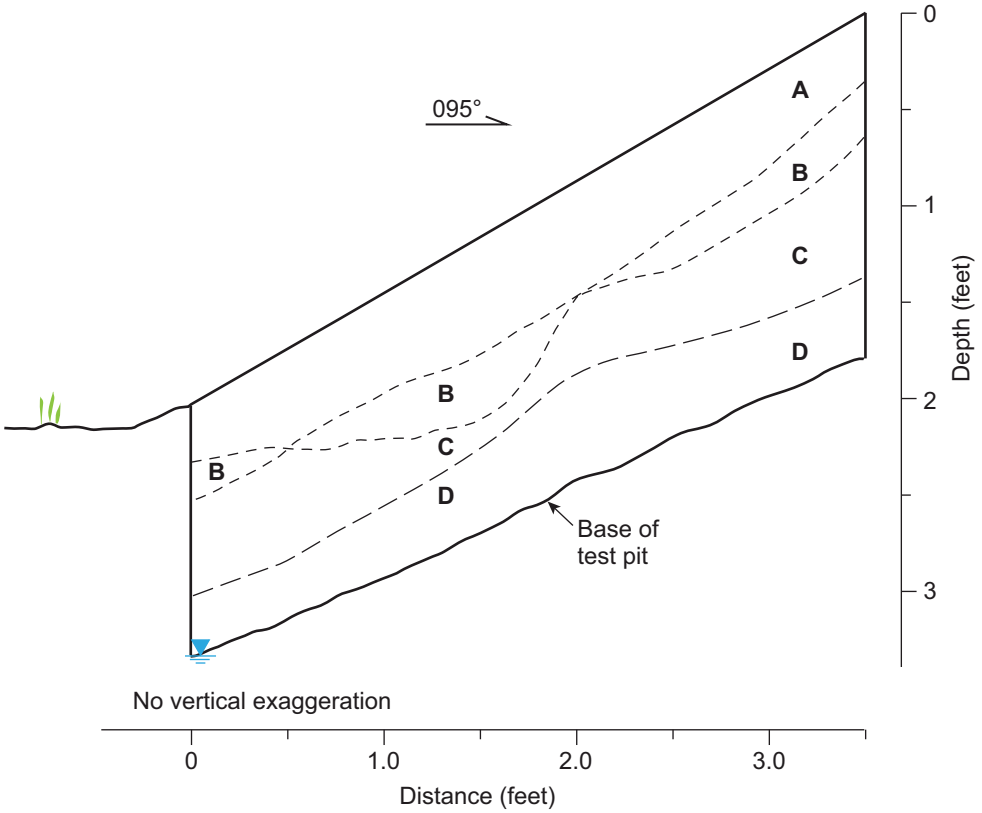
Notes: 1. Ground cover consists of moss.
2. Ground surface slopes 30°.
3. Excavated July 17, 2013, logged July 17, 3013.

Test pit TP-3, view south

Test pit TP-3, view west

Test Pit TP-3

FIGURE 7



Unit Descriptions

Unit A: Root mat with humus and silt (Pt-OH); very dark brown (7.5YR 2.5/2); moist; soft; estimated 25-50% partially humified organic material and organic silt; lower contact wavy and clear over 3 to 5 cm.

Unit B: Organic silt (OH); dark brown (10YR 3/3); moist; very soft; estimated 50-75% partially to fully humified organic material; lower contact wavy and clear over 3 to 5 cm.

Unit C: Very fine sandy silt (ML) (residual soil); black (2.5Y 2.5/1) with tan mottling; wet; soft; abundant fine sand- to silt-sized detrital mica indicates local schistose/phyllitic bedrock as parent material; lower contact wavy and clear over 2 to 3 cm.

Unit D: Phyllite/phyllitic shale, tan to dark gray to orangish brown, R0-R1, moderately to highly weathered, micaceous, foliation oriented 315°/55°.

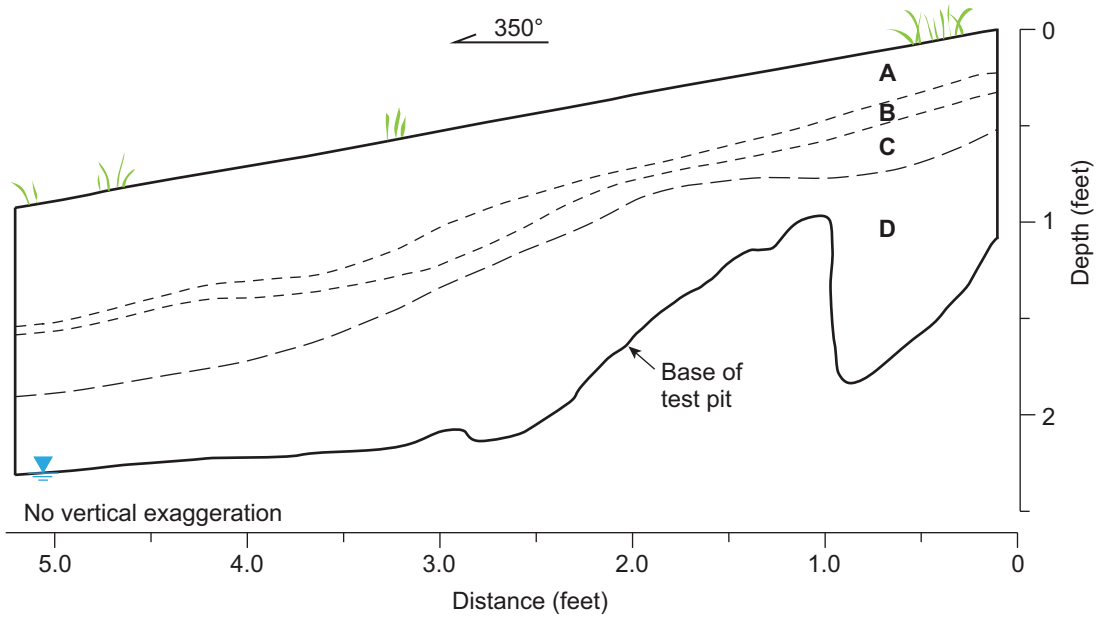
Notes: 1. Ground cover consists of low vegetation and moss.
2. Ground surface slopes 30°.
3. Excavated July 17, 2013, logged July 17, 3013.

Test pit TP-5, view west

Test pit TP-5, view south

Test Pit TP-4

FIGURE 8



Unit Descriptions

Unit A: Root mat with humus and silt (Pt-OH); dark brown (7.5YR 3/2); moist; soft; estimated 25-50% partially humified organic material and organic silt; lower contact wavy and clear over 3 to 5 cm.

Unit B: Organic silt (OH); brown (10YR 4/4); moist; very soft; estimated 50-75% partially to fully humified organic material; lower contact wavy and clear over 2 to 5 cm.

Unit C: Very fine sandy silt (ML) (residual soil); dark grey (2.5YR 4/1); moist; very soft; abundant fine sand- to silt-sized detrital mica indicates local schistose/phyllitic bedrock as parent material; lower contact wavy and clear over 2 to 3 cm.

Unit D: Phyllite/phyllitic schist, tan to dark gray, R0-R2, highly weathered, micaceous, foliation oriented 302°/61°, prominent joint set oriented 350°/68°.

Notes: 1. Ground cover consists of low vegetation and moss.
2. Ground surface slopes 10°.
3. Excavated July 16, 2013, logged July 16, 3013.

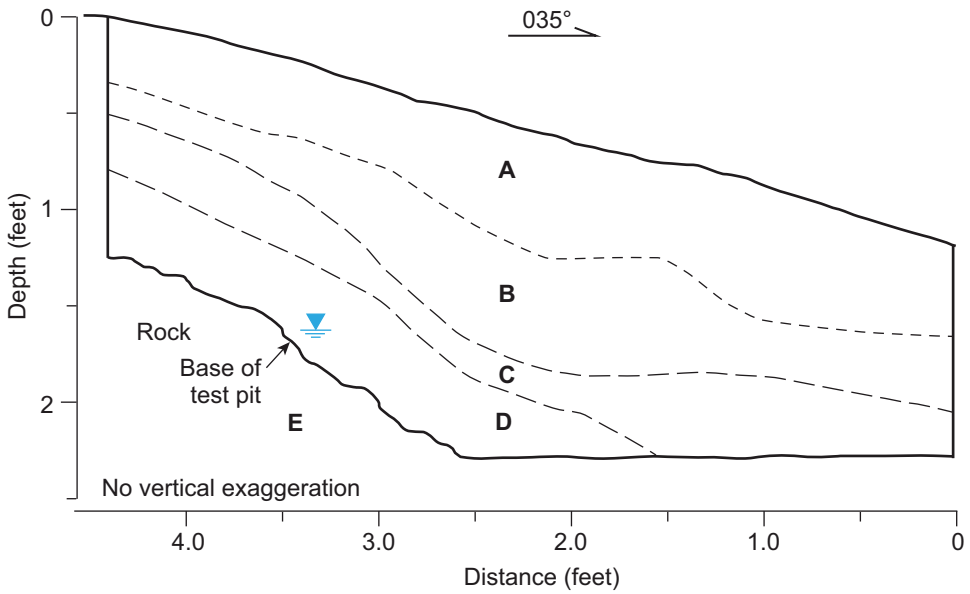
Test pit TP-5, view south

Test pit TP-5 location

Test pit TP-5, view east

FIGURE 9

Test Pit TP-5



Unit Descriptions

Unit A: Root mat with humus and silt (Pt-OH); dark reddish brown (5YR 2.5/2); moist; soft; estimated 25-50% partially humified organic material and organic silt; lower contact wavy and clear over 3 to 5 cm.

Unit B: Organic silt (OH); black (5YR 2.5/1); wet; very soft; estimated 50-75% partially to fully humified organic material; lower contact wavy and clear over 2 to 5 cm.

Unit C: Very fine sandy silt (ML) (residual soil); very dark grey (10YR 3/1); moist to wet; very soft; lower contact wavy and sharp to clear over 1 to 5 cm.

Unit D: Silty sand (saprolite with very weak relict bedrock fabric); grayish brown with tan mottles; wet; medium dense; lower contact wavy and clear over 1 to 3 cm.

Unit E: Phyllite/phyllitic shale, tan to dark grayish brown, R0-R2, highly weathered—foliation planes difficult to identify confidently; prominent joint sets oriented 266°/62° and 227°/77°.

Notes: 1. Ground cover consists of small trees and moss.
2. Ground surface slopes 15°.
3. Excavated July 17, 2013, logged July 18, 2013.

Test pit TP-6, view southwest

Test pit TP-6 location

Test pit TP-6, view northwest

Test Pit TP-6

FIGURE 10

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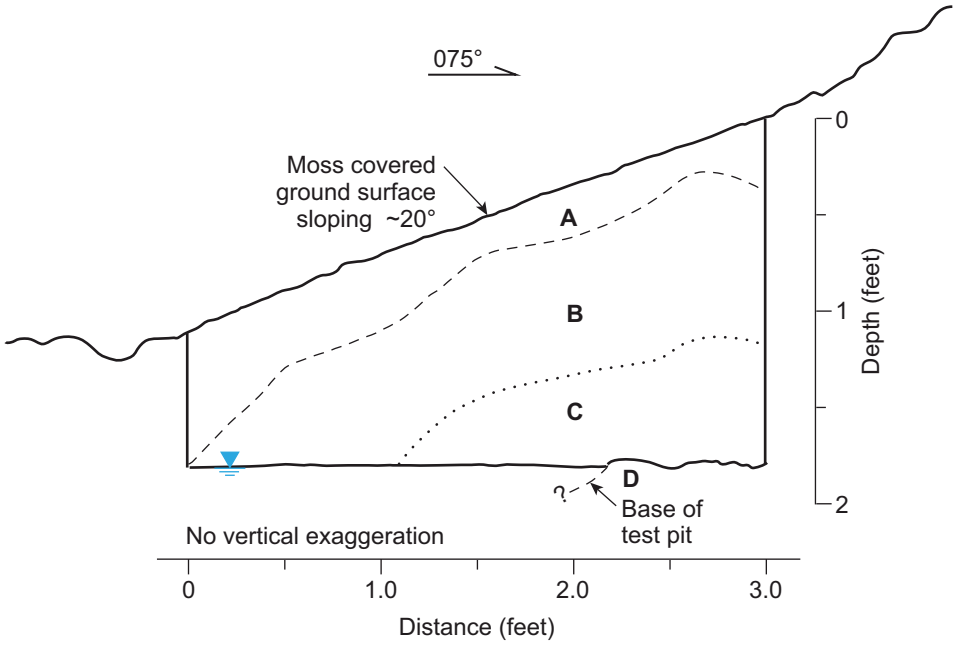
Project No. 04.10130058 Pacific Northwest LNG



Unit Descriptions

Unit A: Root mat with humus and silt (Pt-OH); very dark brown (10YR 2/2); wet; soft; estimated 25-50% partially humified organic material and organic silt; lower contact wavy and clear over 3 to 5 cm.

Unit B: Organic silt (OH); very dark grayish brown (10YR 3/2); wet; very soft; estimated 50-75% partially to fully humified organic material; lower contact wavy and clear over 2 to 5 cm.

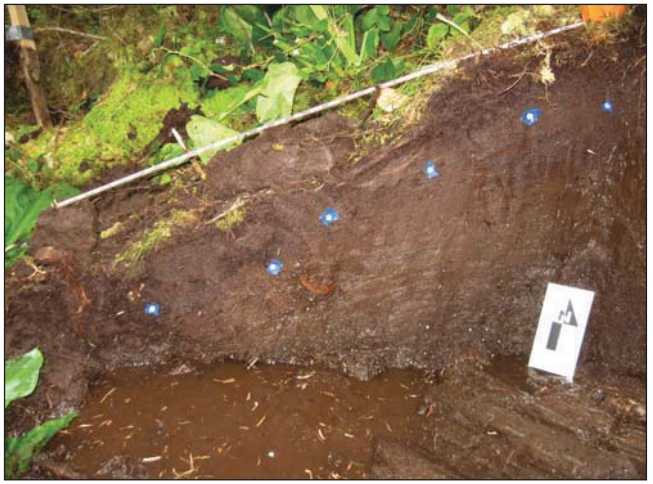
Unit C: Very fine sandy silt (ML) (residual soil); very dark greyish brown (10YR 3/2); moist to wet; very soft; lower contact wavy sharp over 1 cm.

Unit D: Phylittic schist/phyllite with thin quartz veins, tan to dark grayish brown, R0-R2, foliation strikes 290° to 330°, dips 40° northeast.

Notes: 1. Ground cover consists of small trees and moss.
2. Ground surface slopes 20°.
3. Excavated July 17, 2013, logged July 18, 2013.

Test pit TP-7, view southwest

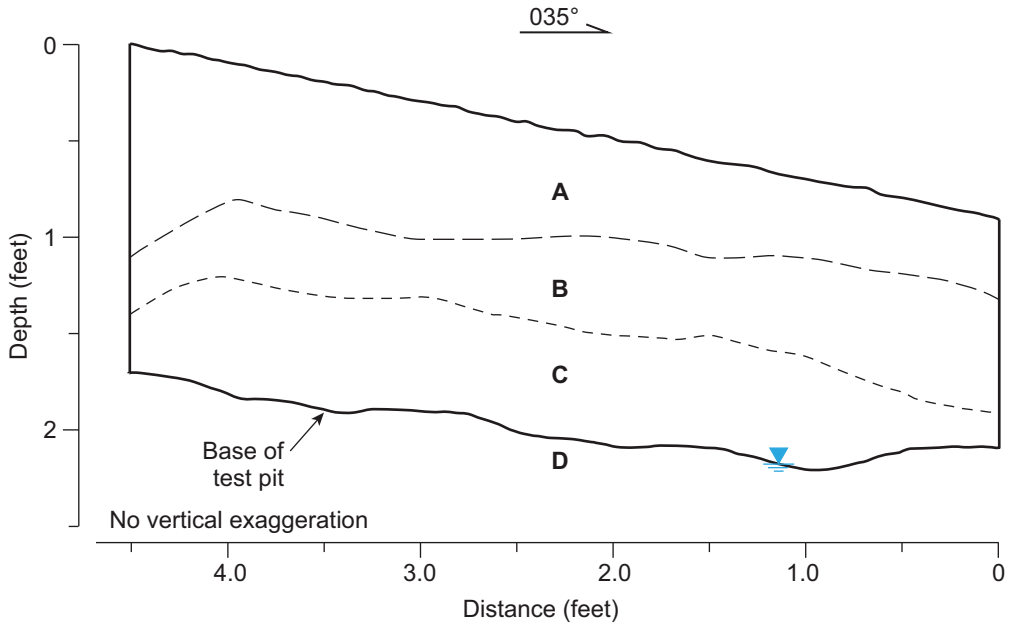
Test pit TP-7 location



Test pit TP-7, view northwest

Test Pit TP-7

FIGURE 11



Unit Descriptions

Unit A: Root mat with humus and silt (Pt-OH); reddish black (2.5YR 2.5/1); moist; very soft; estimated 25-50% partially humified organic material and organic silt; lower contact wavy and clear over 2 to 3 cm.

Unit B: Organic silt (OH); brownish yellow (10YR 6/6) with very dark brown (10YR 2/2) mottles; wet to moist; very soft; estimated 50-75% partially to fully humified organic material; lower contact wavy and clear over 2 to 3 cm.

Unit C: Very fine sand and silt (saprolite with relict bedrock fabric); very dark greyish brown (10YR 3/2) with tan mottling; moist; medium dense; lower contact wavy and sharp over 1 cm.

Unit D: Phyllite/phylittic schist (bedrock), tan to grayish brown, R0-R1, foliation orientation 304°/34°.

Notes: 1. Ground cover consists of low brush and moss.
2. Ground surface slopes 11°.
3. Excavated July 18, 2013, logged July 19, 2013.

Test pit TP-9, view southwest

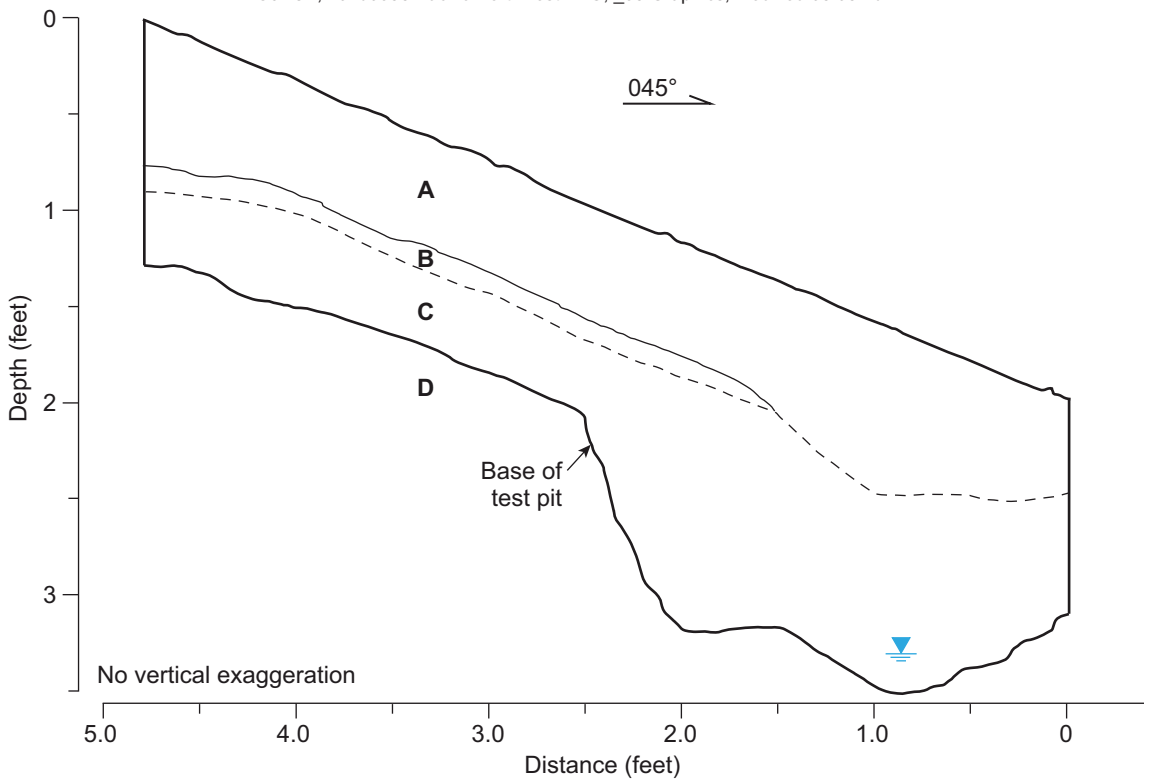
Test pit TP-9, location

Test pit TP-9, view northwest

Test Pit TP-9

FIGURE 12

Fugro Consultants, Inc.
Project No. 04.10130058 Pacific Northwest LNG



Unit Descriptions

Unit A: Root mat with humus and silt (Pt-OH); dark red (2.5YR 2.5/1); moist; soft; estimated 25-50% partially humified organic material and organic silt; lower contact wavy and sharp over 1 to 2 cm.

Unit B: Very fine sandy silt (ML) (residual soil); very dark grey (10YR 3/1); moist; very soft; common fine sand- to silt-sized detrital mica indicates local schistose/phyllitic bedrock as parent material; lower contact wavy and clear over 2 to 3 cm.

Unit C: Very fine sand and silt (saprolite with relict bedrock fabric); black (5YR 2.5/1) with tan mottling; damp; medium dense/soft; lower contact wavy and sharp over 1 cm.

Unit D: Phyllite (bedrock), mottled tan to grayish brown, R0-R2, foliation orientation 307°/32°; prominent joint sets oriented 310°/90° and 295°/90°.

Notes: 1. Ground cover consists of trees and thick brush.
2. Ground surface slopes 22°.
3. Excavated July 17, 2013, logged July 17, 2013.

Test pit TP-10, view southwest

Test pit TP-10 location

Test pit TP-10, view southeast

Test Pit TP-10

FIGURE 13

Appendix A

Field Photograph Index
From July 2013 Field Investigations

TP10_PreExcavation

TP10_ProfileLogged

TP10_ProfileLoggedb

TransitToLelu

Augering_TP9

EsideLelu

HelicopterOverLelu

Lutz_LoggingPoseLeluIsland

TP2_PlanView

TP2_ProfileLogged

TP3_PlanView

TP3_ProfileLogged

TP4_PlanView

TP4_ProfileLogged

TP4_ProfileLoggedb

TP6_PlanView

TP6_PreExcavation

TP6_ProfileLoggedA

TP6_ProfileLoggedB

TP7_PlanView

TP7_PreExcavation

TP7_ProfileLogged

TP7_ProfileLoggedUpdated

TP9_PlanView

TP9_PreExcavation

TP9_ProfileLogged

TP9_ProfileLoggedb

TP10_PlanView

DSC_5833

DSC_5834

DSC_5837

DSC_5838

DSC_5839

DSC_5840

DSC_5841

DSC_5842

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DSC_5898

DSC_5899

DSC_5900

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DSC_5903

DSC_5904

DSC_5905

DSC_5906

APPENDIX J

Marine Geophysical Survey Report

PACIFIC NORTHWEST LNG PROJECT
MARINE GEOPHYSICAL SURVEY
LELU ISLAND, BC

MARINE GEOPHYSICAL SURVEY REPORT

Survey Period: May 4 – 16, 2013
Report Number: 23.00007028 R2

Prepared for: Kellogg Brown and Root, LLC

Client Reference: 23.00007028

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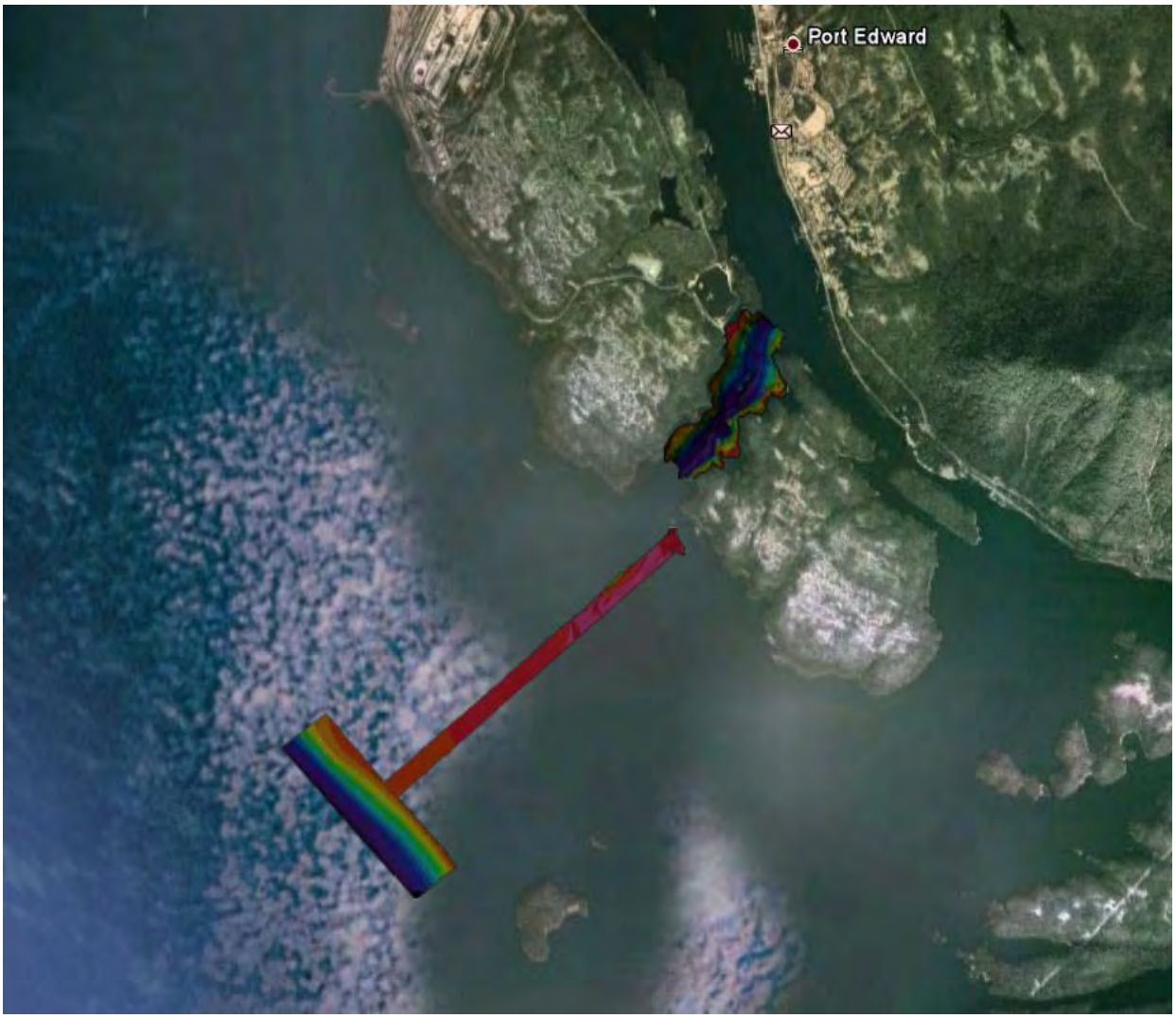
0	Issued as Draft	A. Tardif	C. Pratt	J. Carothers	14 May 2013
Rev	Description	Prepared	Checked	Approved	Date



SURVEY AREA

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EXECUTIVE SUMMARY

Kellogg Brown and Root, LLC (KBR) contracted Fugro, to conduct marine geophysical surveys offshore Lelu Island, future site of the Northwest LNG facility. This Marine Geophysical Survey Report summarizes the geologic conditions within two sites near Lelu Island: the trestle and mooring area, and the two turning basins area. Bathymetry, side scan sonar, magnetometer, 2D high-resolution multi-channel seismic, sub-bottom profiler, and seabed features data were acquired over both sites, except where water depths were too shallow for safe vessel operations, as identified on the Charts accompanying this report.

In the trestle and berthing area, seabed elevations range from -1.8 meters to -46.8 meters, and slopes are generally less than 2.5° except for the berthing area where slopes are as steep as 12.5°. Near the shoreline and adjacent to a channel immediately northwest of the trestle route, local slopes approach 32°. Seabed elevations in the turning basin area range from -3 meters to -31 meters and slopes sometimes approach 60° where bedrock protrudes up through the sediment.

Bedforms such as dunes, ripple marks, and sandwaves indicate bottom currents are present reworking the surficial sand. These currents are likely related to tidal flows.

Aside from numerous crab traps (pots), the survey did not reveal any major man-made objects along the trestle route and berthing areas, although there are a few magnetic anomalies and minor sonar contacts that should be considered before construction activities commence. A near shore structure was detected outside of the turning basin area, and appears to be located on a small shallow spot just off the shoreline. It is likely this structure will be visible to mariners and construction personnel entering the turning basin area at low tide.

Loose sand blankets the seabed along the trestle route, with a few bedrock outcrops along the shoreline and the sand likely grades to muddy or fine sand near the berthing area, where muddy fine sand/silt/clay likely predominates. In the turning basin, the sediment is either sand, silt, clay or outcropping bedrock.

A small slump along the shoreline for the trestle route was detected. This slump is not considered a fatal flaw, though consideration should be made for potential slumps along the shoreline (within 100 meters of the shore).

The top of bedrock was not seen in the geophysical data for the trestle and berthing areas; the top of bedrock likely lies well below the limit that the boomer and sub-bottom profiler systems were able to image below the seabed. The top of bedrock was found and is mapped for the turning basin area. In the southern turning basin, the only bedrock shallower than the -12.5 meter dredge elevation are the rock outcrops encountered adjacent to the shoreline, which does not appear to warrant another borehole.

The Geotechnical data reveals that the top of bedrock elevation is much deeper than expected from desktop studies and deeper than the detection capabilities of the geophysical survey. KBR may want to consider conducting additional geophysical surveys to possibly estimate the depth to top of bedrock elevations and spatial undulations in the top of the bedrock. Fugro can discuss with KBR conducting additional higher energy geophysical surveys using higher powered geophysical source equipment.. Higher power will in theory allow deeper penetration however the depth of penetration for any acoustic equipment is still dependant on the composition and gas content of the overburden material present. It must be realized that even with these additional surveys, we may or may not be able to map the depth to top of bedrock or undulations.

Based on the results of the offshore geophysical survey, it does not appear that there is a need to modify the ongoing Pre FEED level geotechnical study in the survey area.

Fugro used the results of the Geophysical Survey to interpret the presence of; (1) active faults, (2) locate potential landslides and (3) slump features, and provide an indication of (4) side slope stability based on slope steepness as per the requirements of KBR. With relation to the four interpreted specific features above there were no apparent “Fatal Flaws” discovered that would require abandoning the project.

1. INTRODUCTION AND SCOPE OF WORK

1.1 General

Kellogg Brown and Root, LLC (KBR) contracted Fugro, to conduct marine geophysical surveys offshore Lelu Island, future site of the Northwest LNG facility.

This Marine Geophysical Survey Report summarizes the geologic conditions within two sites near Lelu Island: the trestle and berthing area, and two turning basin areas. Bathymetry, side scan sonar, magnetometer, 2D high-resolution multi-channel seismic, sub-bottom profiler, and seabed features data were acquired over both sites, except where water depths were too shallow for safe vessel operations, as identified on the Charts accompanying this report.

The bathymetric survey, as well as the side scan sonar and magnetometer surveys, were conducted onboard the *M/V Rain Coast Explorer* from May 4 to 10, 2013. The sub-bottom and 2D seismic surveys were conducted onboard *M/V My Lady* from May 12 to 16, 2013. Bathymetry, side scan sonar, magnetometer, 2D high-resolution multi-channel seismic, sub-bottom profiler, and seabed features data were acquired over a 2,800 x 1,300 meter area for the trestle and mooring area, and a 1000 x 500 meter area for both turning basin options, except where water depths were too shallow for safe vessel operations, as identified on the Charts in Appendix G. For the mooring facility, twelve lines were run at 25-meter spacing parallel to the shore, with five tie lines at 300-meter spacing run perpendicular to shore. For the trestle, five lines were run at 25-meter spacing perpendicular to shore, with five tie lines at 500-meter spacing run parallel to shore. For each turning basin, sixteen lines were run at 25-meter to 50-meter spacing parallel to shore, with two tie lines at 200-meter spacing perpendicular to shore. Additional lines were run to complete the coverage of the bathymetric data. All tie lines mentioned above were run for the seismic system only.

All acquired data are referenced to the NAD-83 spheroid with a Universal Transverse Mercator (UTM) projection in Zone 9 North, meter grid.

On May 3, 2013, a control point (PE) was recovered in the vicinity of the survey area. Said control point was established by McElhanney Consulting Services Ltd. static GPS observations and processed using the Prince Rupert and Terrace active control points (BCPR and BCTE). Table 1-1 provides the coordinates of the control point utilized for all survey operations on the *M/V Rain Coast Explorer*.

Table 1-1. Results of Benchmark Survey.

	UTM 9 North (Meters)		Orthometric CVC28BC
	Easting	Northing	Elevation (m)
PE	415834.964	6008493.674	5.034

The vertical datum reference for this project is orthographic (CVC28BC – Canadian Vertical Datum 1928). Depths were corrected in real-time and referenced to control point PE during field activities.

1.2 Units and Conventions

Units used on the survey are as follows:

- Linear units are meters.
- Angular units are degrees (°).

Time was recorded as Coordinated Universal Time, and was noted in field logs.

1.3 Abbreviations

DGPS	Differential Global Positioning System
FS-SB	Full Spectrum - Sub-bottom
GPS	Global Positioning System
IMU	Inertial Measurement Unit
kHZ	Kilohertz
LNG	Liquefied Natural Gas
MSEC	Millisecond
M/V	Marine Vessel
NAD	North American Datum
RTK	Real-Time Kinematic
SVP	Sound Velocity Profile
UTM	Universal Transverse Mercator
WGS84	World Geodetic System of 1984

2. METHODS AND RESOLUTION LIMITATIONS

2.1 Positioning and Navigation System

Wide area Differential Global Positioning System (DGPS) was used to position the survey vessel onboard *M/V My Lady*. A "wide area" application operates with correction values applied to a stand-alone GPS receiver from base stations located over large distances. DGPS corrections were supplied to the system using the STARFIX II network. This differential network is a worldwide system operated by Fugro. STARFIX II broadcasts differential corrections via a communications satellite downlink to field receivers. The differentially-corrected position from the Trimble receiver was passed to an onboard navigation computer running Hypack navigational software.

All positioning during survey operations taking place onboard *M/V Rain Coast Explorer* was provided by RTK GPS positioning with reference to control point PE.

2.2 Survey Control

Prior to survey operations, survey control at the project site was recovered based on UTM coordinate system and orthometric elevations. As the primary vertical control for this survey was provided by RTK global positioning system (GPS) observations, it was vital to the project to have an accurate ellipsoid separation model for on-the-fly conversions from the WGS84 ellipsoid to CVC28BC. For this project, PE was used as the reference control point.

2.3 Multibeam Bathymetric Data

The R2 Sonic 2024 system was used to provide multibeam bathymetry coverage of the seafloor. The R2 Sonic 2024 transmits a shaped continuous wave pulse at a user-selected frequency (200 KHz to 400 KHz). The transmit pulse is narrow in the along-track direction, but very wide in the across-track direction. The reflected acoustic energy is received via the R2 Sonic 2024 receivers. Within the receiver head, the beams are formed and the bottom-detection process takes place. The resultant bottom detections (range and bearing) are sent via Ethernet deck lead to the Sonar Interface Module (SIM). The SIM then sends the data out to the sonic control software and the data acquisition software.

The R2 Sonic 2024 works on user-selectable frequency ranges so it is adaptable to a wide range of survey depths and conditions. The frequency can be selected on-the-fly without having to shut down the sonar system, change hardware, or halt data recording. This system produces a user-selectable swath width of 10° to 160° using all 256 beams; the desired angle can be selected on-the-fly.

Sound velocity profile (SVP) data were acquired using an AML sound velocimeter sensor. The AML measures at a rate of 10 velocity and pressure observations per second, and responds to temperature changes immediately, maximizing its ability to identify and map thermoclines, a necessity for multibeam bathymetric data acquisition.

The Applanix POS MV inertial navigation system was used to control motion and attitude for the R2 system. The POS MV delivers full 6-degree-of-freedom position and orientation solutions for marine survey vessels, and outputs all motion variables at a high rate: position, velocity, heave, roll, pitch,

true heading, acceleration vectors, and angular rate vectors. The system combines GPS/DGPS with rugged high-quality inertial sensors. The system measures true heading together will roll and pitch to 0.02 degree accuracy or better under dynamic conditions, including hard turns, and rapid acceleration and deceleration with heave accuracy of 5 centimeters or 5 percent, all in real time. The POS MV system consisted of two GPS antennas mounted atop the vessel (primary port), a processor, version four, and an Inertial Measurement Unit (IMU) mounted 151.4 centimeters above the transducer. Data were fed from the processor to Hypack via Ethernet at 25 hertz. Delayed heave and position data, used for the post-processing of data, were logged at 100 hertz.

Calibrations. A patch test was completed as part of the system calibration procedures. The patch test used seafloor topography to bring multibeam swaths (run at varying speeds, headings, and overlaps) into coincidence. They are employed so that data can be corrected for timing latency, pitch, azimuth, and roll offsets, which may exist between the multibeam transducer and the IMU. Following this calibration, the POS MV quickly and automatically initialized itself upon power-up, outputting accurate navigation data. In addition, the system continuously monitored its sensors to ensure optimum performance.

Processing. For the bathymetry, the HySweep software package by Hypack, Inc. was used to process and bin the raw data sets by first applying acquisition-specific variables - such as vessel offsets, seawater sound velocities, vessel draft, system calibration (patch test), and delayed heave values - and then editing the data to remove spurious soundings.

The field-recorded raw sounding files were imported to HySweep, and the acquisition variables were entered into the vessel configuration file. Once the sounding files were imported, the appropriate SVP file was loaded into each line, and the line corrected for sound refraction. Concurrent with SVP corrections, the bathymetry data were also corrected for dynamic vessel heave, pitch, and roll. The attitude, heading, navigation, and bathymetry data were then examined for noise and gaps. Nadir beam-filters were used to reject data from the outer reaches of the swaths.

After each individual line was examined and cleaned in the HySweep Swath editor, the lines were merged. Adjacent overlapping lines of corrected bathymetry data were examined to identify any vertical offsets, data gaps, sound velocity, and motion errors. Any residual noise in the data set was also rejected at this time.

After all data were filtered and processed, the final data set was binned to 1 meter x 1 meter cell size, using the average depth of all depths within the cell. The horizontal location of the representative average depth was the cell center. The data set was adjusted to the client requirement for elevation and presented as final in Orthometric Height of CVC28BC – Canadian Vertical Datum of 1928. Horizontal positioning was left in NAD83 UTM Zone 9 North, and all units vertical and horizontal are in meters. The gridded data were subsequently contoured at a half-meter interval, and these contours were exported for final charting in AutoCAD format. The contour interval on Chart 1A and 1B is a half meter, with index contours every 5 meters.

2.4 Seabed Features and Obstruction Mapping

Seabed features and obstructions have been interpreted from a side scan sonar system and marine magnetometer. The side scan sonar system consisted of a digital, dual-frequency, EdgeTech 4125

towfish and armored tow cable that was interfaced to the EdgeTech topside unit, which was networked to a data-logging computer and EdgeTech's Discover acquisition software.

During the survey, the towfish was deployed from the starboard stern of the *M/V Rain Coast Explorer* as the vessel traversed the survey grid. The side scan sonar was operated at frequencies of 400 kHz and 900 kHz at slant ranges of 50 meters and 75 meters.

A Marine Magnetic Corporation SeaSPY marine magnetometer was deployed from the port stern of the survey vessel, and run in order to confirm man-made objects versus natural objects. Magnetic anomalies occur when the towed magnetometer sensor passes near an object containing iron. The size of the magnetic anomaly depends mostly on how close to the iron object the sensor is and the amount (mass) of iron. The size (intensity) of magnetic anomalies is expressed in gammas (or nanoteslas). Total field readings were logged to the navigation computer through the SeaSPY's communications transceiver.

Processing. Chesapeake Technology, Inc.'s SonarWiz 5 software was utilized for complete post-processing capabilities. During data processing, the individual sonar data files - each composed of one sonar survey trackline - were first reviewed and corrected for towfish altitude. Navigation data for each file were edited for errant position fixes and velocity errors. Each line was analyzed individually for rocks, vegetation, ripple marks, and man-made objects. Crab pots (traps) were detected on all sonar records as sonar contacts. Crab pots (traps) were not charted, as they are too numerous and the likelihood of crab pots (traps) remaining in place is negligible. A number of sonar contacts not related to crab pots (traps) were also detected and tabulated. The sonar contact report in Appendix C lists all sonar contacts with showing thumbnail images of each contact. The sonar contact table was imported to Global Mapper and converted to shapefiles with attributes. These shapefiles were subsequently imported to AutoCAD for mapping. Sonar Contacts are shown on Charts 1A & 1B and Charts 2A & 2B.

A sonar mosaic was generated in SonarWiz for each area (trestle/berthing, and turning basin). These mosaics were output as GeoTiff format graphic files, which were imported to AutoCAD for seabed classification. Polygons were drawn for areas of Sand (sediment), Rock, and Vegetation. This seabed classification is shown on Chart 1A & 1B. The sonar mosaic is depicted on Charts 2A & 2B.

The magnetometer data were imported to SonarWiz 5 along with the side scan sonar data. The locations of observed magnetic anomalies were determined from the magnetometer data utilizing anomaly-modeling techniques that incorporated the anomaly duration, signature, and peak-to-peak amplitudes. Potential magnetic anomalies were detected and compared side by side with the side scan sonar data to detect possible sources for the magnetic anomalies. In most instances, magnetic anomalies were correlated to crab pots (traps); other times anomalies were picked without correlated sonar contacts. The anomalies that lack sonar contacts (or crab pots (traps)) likely emanate from buried objects.

Once picked, anomalies were exported to a text file for tabulation. A magnetic anomaly table is included in Appendix D. Magnetic anomalies were converted into attributed shapefiles in Global Mapper, and were then imported to AutoCAD. Charts 1A & 1B and Charts 2A & 2B show the locations of all magnetic anomalies not identified as crab pots (traps) for the survey area.

2.5 Shallow Geology Mapping

An EdgeTech full-spectrum profiler (Chirp) system was deployed to obtain shallow sub-bottom data for characterization of the sediment layers immediately beneath the seabed. These shallow data provided information on the areal distribution and thickness of the unconsolidated surficial sediments. The EdgeTech FS-SB system included the SB-216S towfish, the Model 3200 topside processor, and EdgeTech's Discover acquisition software.

The towfish was deployed and towed from the rear starboard cleat of the *M/V My Lady*. The system was triggered at a 10 msec pulse rate and a sweep-frequency range between 0.7 to 12 kHz.

Processing. The raw JSF (Edgetech proprietary data format) files - which had already been match-filtered by the topside processor - were converted to industry-standard SEG-Y data for further processing. Processing of the Chirp sub-bottom data included mild swell filtering to compensate for sea conditions during survey operations, a bandpass filter to remove high- and low-frequency noise, compiling correct shotpoint navigation, and adjusting data gains for optimal interpretation. The resulting SEG-Y files were then imported to SMT Kingdom Suite for interpretation and analysis. A surface representing the top of the bedrock was identified in the turning basin area and picked as a horizon. Another horizon was picked along the seabed, and the time attribute was subtracted from the bedrock time attribute for each line. The result of this process is a thickness map with units in time (seconds). This was exported as a text file, converted to depths using a sound velocity value of 1,524 meters/second, and gridded in Surfer to produce sediment-thickness contours, which were subsequently imported to AutoCAD for charting. Chart 3B shows the thickness of sediments in the turning basins area.

2.6 Deeper Geology Mapping

Shallow seismic reflection data were concurrently collected along with the sub-bottom profiler data for later processing and interpretation. The seismic reflection system consisted of a single plate "boomer" seismic source, power and tow cable, one power supply, one 8-channel hydrophone streamer, shipboard electronics and recording instruments.

One Applied Acoustics Engineering CSP-D 3000 seismic energy source was used to power the Applied Acoustics AA200 single-plate "boomer" system. The boomer plate is an electro-mechanical transducer made of an insulated metal plate and a rubber diaphragm adjacent to a flat wound electrical coil. A short-duration, high-energy pulse is discharged from the energy source into the coil, and the resulting magnetic field repels the metal plate in the transducer. The plate motion is transferred to the water by the rubber diaphragm, generating a broadband acoustic pulse that does not have strong cavitations or ringing.

Raw data from the streamer was recorded using a Geometrics GeoEel seismic acquisition system. Data were stored on hard disk in SEG-Y format for later post-processing.

Processing. Seismic data processing was performed using Seismic Processing Workshop (SPW) software from Parallel Geoscience Corporation. The processing flow of the multichannel seismic reflection data follows the basic premise of the wavelet-processing method used in the petroleum exploration industry. Seismic data processing consists of: 1) filtering in time and space, 2) deconvolution to provide a sharper and more consistent seismic wavelet for interpretation, 3)

correction of normal move-out (NMO) due to varying subsurface velocity structure, 4) stacking of data traces to increase the signal-to-noise ratio, and 5) post-stack time migration to put the reflecting horizons back into their proper lateral positions. Additionally, the data were processed to the zero-phase, American normal polarity wavelet model, where an increase in acoustic impedance correlates to a positive amplitude event with wavelet energy equally divided on either side of the displacement axis. The fully-processed boomer data (SEG-Y files) were loaded into Kingdom Suite for interpretation and analysis to supplement the sub-bottom profiler interpretation of the top of bedrock. In a few instances, the boomer was able to better define the base of sediments in the deeper parts of the turning basin area, where the sub-bottom profiler lacked penetration. Surfaces picked on the boomer sections were merged with sub-bottom profiler surfaces prior to thickness calculations.

3. DATA QUALITY AND LIMITATIONS

This section discusses the field data quality and limitations for each geophysical system. Each system is discussed in its appropriate subsection.

3.1 Bathymetry Data Quality and Limitations

Bathymetry data were delivered as XYZ data files with a horizontal bin spacing of 0.5 meters. The data are of very high quality as the effect of roll and tides are negligible. To check the data quality, a small section of the XYZ data file containing data from the western end of the trestle route as well as part of the berthing area was extracted at random. Slight roll artifacts of ~0.05 meters are evident on the outermost beams of the outermost lines, but absent where coverage is greater than 200%. Crab pots (traps) with sizes of ~0.8 meters are also evident in the data, indicating the data were not over-smoothed. With this in mind, the accuracy of the bathymetry data is better than +/- 0.3 meters. Figure 3-1 is a 3D plot of this quality check area depicting roll artifacts and crab pots (traps).

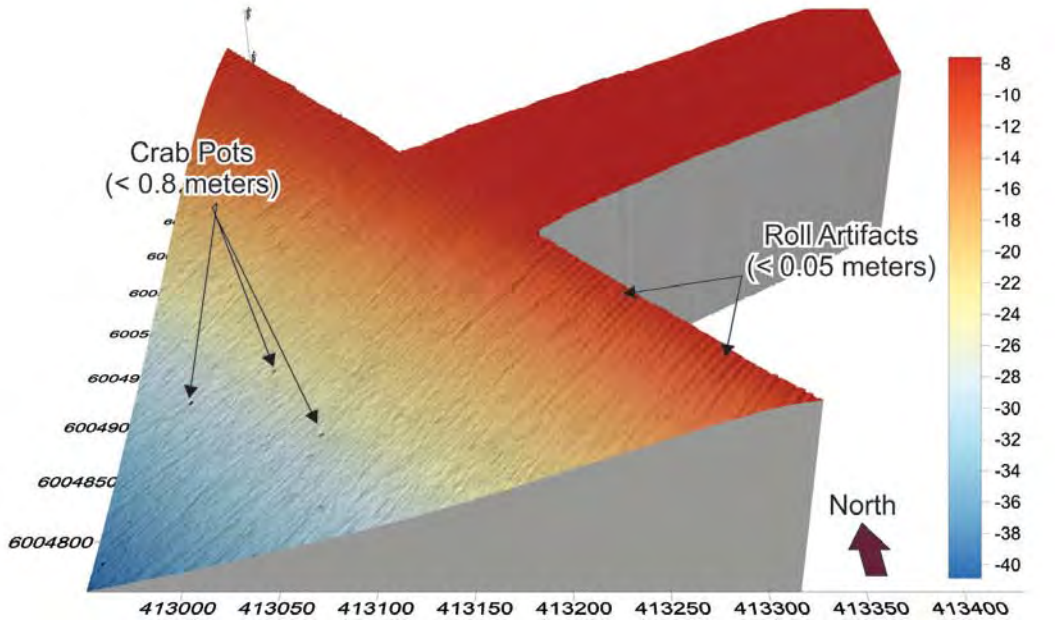

Figure 3-1. Quality Check of the Bathymetry Data.

3.2 Magnetometer Data Quality and Limitations

The magnetometer data were saved to various ASCII data formats and imported to SonarWiz Mag for interpretation in conjunction with sonar interpretation. Magnetometer sensitivity is 0.001 gammas, and positional resolution is 0.1 meters. Total field measurements were acquired nominally every 1.0 seconds.

Background noise levels are approximately 0.4 gammas in areas of flat magnetic gradients. In areas of steeper gradients, background noise is undetectable. The survey area is magnetically characterized by natural magnetic fluctuations in the 150-200 gamma range. These broad, long-

period fluctuations in the magnetometer record are believed to be caused by abrupt changes in the underlying metamorphic bedrock in the survey area and not by man-made artifacts. A portion of Line 17 is depicted in Figure 3-2; this is a screen grab from the magnetometer interpretation program. The red lines are detected anomalies.

The magnetometer detected a number of crab pots (traps) as well as other anomalies of unknown origin. Given that the magnetometer could detect crab pots (traps), it is likely the magnetometer sensor could detect much larger objects that may impact future construction activities. There is a possibility that such potential objects might lie between survey lines and hence go undetected.

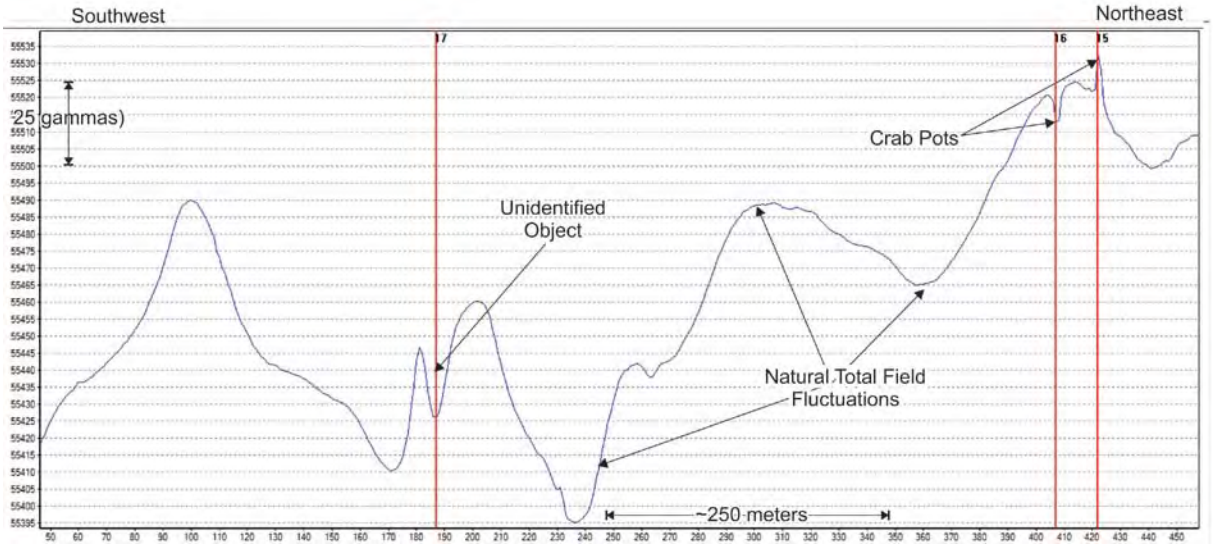

Figure 3-2. Magnetometer Example – Line 17.

3.3 Side Scan Sonar Data Quality and Limitations

The side scan sonar data were recorded in Edgetech JSF format and imported to SonarWiz for interpretation. Coverage is generally greater than 200%, and resolution is less than 1 meter, as small crab pots (traps) and ripple marks with crest-crest spacing of 0.4 meters are clearly identifiable on the sonograms. In a few instances, the cable connecting a line of crab pots (traps) appears as a thin dark line (indicating a resolution of centimeters). Figure 3-3 is a sonogram for Line 16A. The cable connecting crab pots (traps) is clearly visible. The mounds to the south are believed to be caused by sediment build-ups around clumps of vegetation. The vertical relief of these mounds is measured in centimeters, as the sonar towfish was necessarily towed within a couple meters of the seabed. For this survey, small sub-meter objects are easily detected, and the positioning accuracy should be considered to be at approximately 3.0 meters.

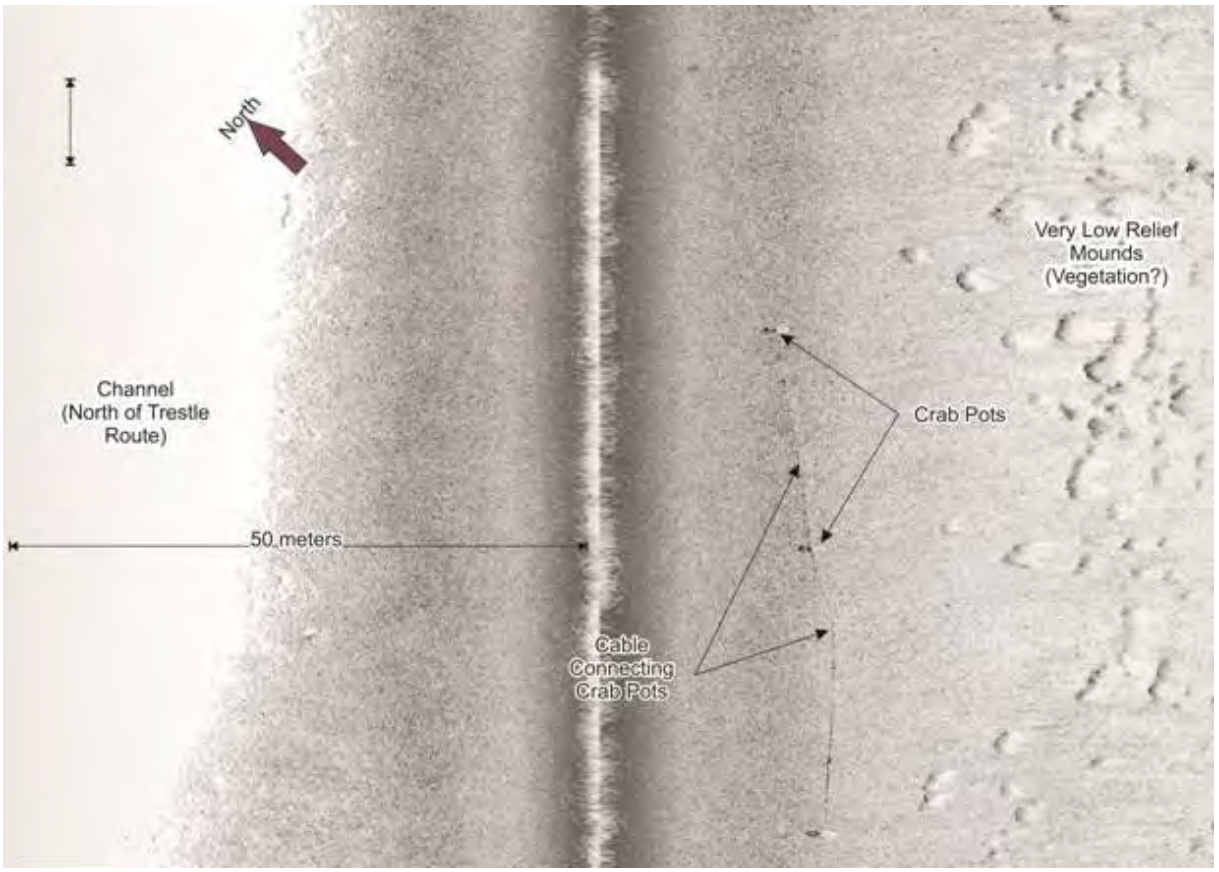

Figure 3-3. Sonogram for Line 16A.

3.4 Sub-bottom Profiler Data Quality and Limitations

The sub-bottom profiler data files - 55 in total - were delivered in SEG-Y, and then imported to SMT Kingdom Suite for analysis and interpretation. No trace equalization procedures were required in post-processing as the amplitudes are consistent and the effect of swell is negligible. With a resolution of approximately 0.3 meters, these data are considered good for this survey. Although layered sediments are common offshore, the surficial sand and clay deposit in the survey corridors is apparently mixed and un-layered, and are therefore unavoidably unconducive to defining reflectors in the shallow subsurface. Soil borings will therefore be necessary to confirm or refute interpretations in these areas. The top of bedrock is not evident in the sub-bottom profiler data within the trestle area, but it is clear beneath sediments in the turning basin area of the survey. In the trestle area, the sub-bottom data reveal distinguishable subsurface characteristics over an indistinct and variable horizon at an average depth of approximately 2.5 meters, though depths of 5 meters are common. The erratic bedrock in the turning basin area generally limits subsurface visualization to a similar depth range, but the strata of local mini-basin deposits are locally revealed to depths in excess of 15 meters. Figure 3-4 is a representative sub-bottom profile from the turning basin area.

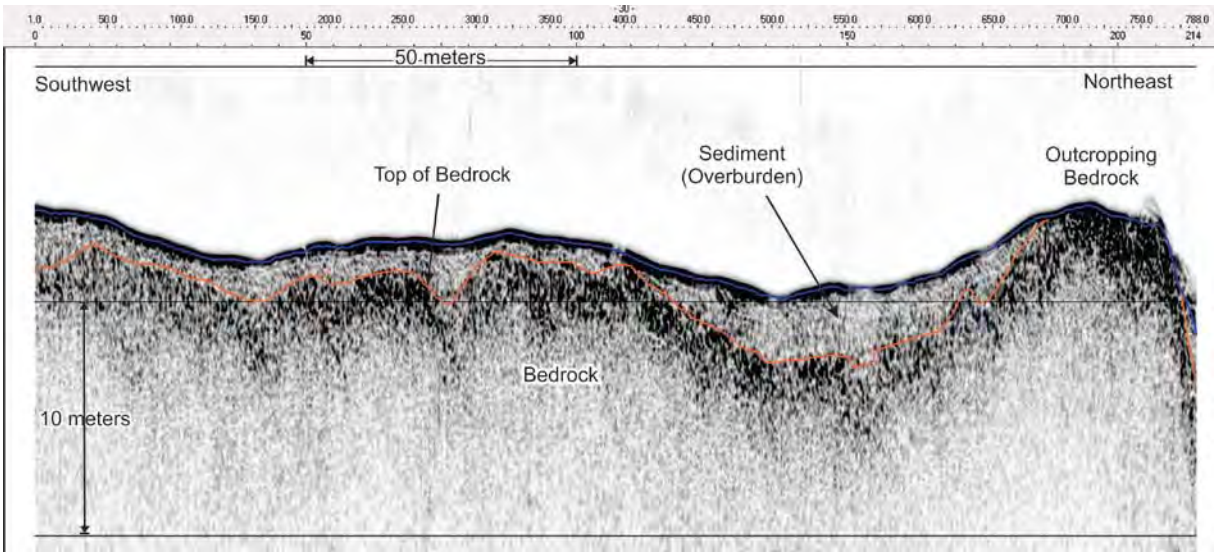

Figure 3-4. Sub-bottom Profiler Example in Turning Basin – Line 30.

3.5 Boomer Data Quality and Limitations

The 8-channel stacked and migrated boomer data were processed by Fugro and delivered as SEG-Y data for interpretation. The boomer is a lower frequency system than the sub-bottom profiler. The lower frequency has the advantage of penetrating coarse-grained sediment better than the sub-bottom profiler; however, a longer pulse combined with a characteristic reverberation will sacrifice resolution in very shallow sediments. Figure 3-5 is the boomer profile from Line 30 (same as the sub-bottom profiler line above). The seabed is shown as a blue line, and the orange line is the top of bedrock as resolved from the sub-bottom profiler data. As depicted in this figure, the top of bedrock is partially masked by the seafloor double reflection (doublet). Various processing routines - such as pre- and post-stack deconvolution, FX/FK noise filters, and zero-phase convolution - were tested to improve the resolution and signal-to-noise quality. None of these techniques were able to improve the data interpretability beyond what the CHIRP sub-bottom profiler was able to achieve, therefore the boomer data quality is judged as fair for this survey and except for areas where bedrock is deeply buried, the CHIRP sub-bottom profiler data are preferred for interpretation over the boomer data.

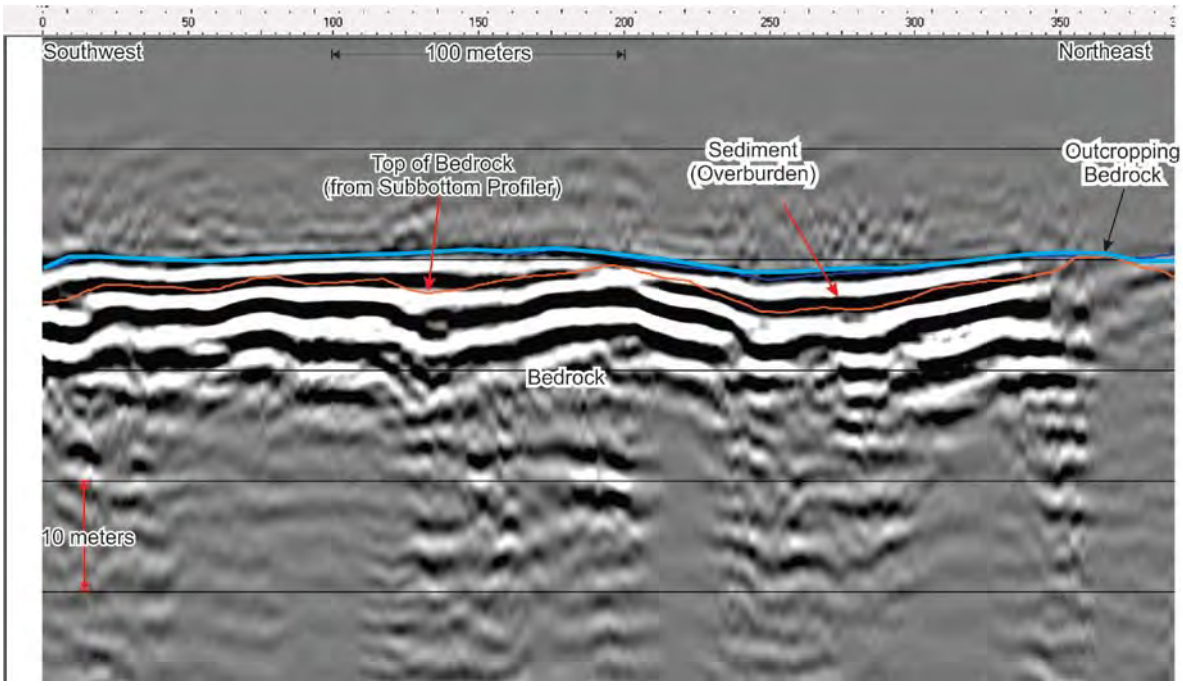

Figure 3-5. Boomer Profile Example in Turning Basin – Line 30.

4. RESULTS – DATA INTERPRETATION

4.1 General

The following interpretation is based upon all available data, and illustrated with charts (Appendix F, Charts 1 Suite A and B through Charts 4 Suite A and B) and figure examples (Figures 4-1 through 4-10). The interpretation also incorporates local geological information, as described below.

4.2 Bathymetry

In the following sub-sections, bathymetry is discussed separately for the trestle/berthing area and the turning basin area, as are seabed slopes. All seafloor elevations are referenced to Orthometric CVD28BC .

4.2.1 Trestle and Berthing Area

The seafloor elevations in the trestle and berthing areas range from -1.8 meters in the northeast near shore to -46.8 meters at the southwestern edge of the berthing area. The elevation at the southwest end of the trestle route is approximately -10 meters. Figure 4-1 is a 3D depiction of the seabed in the trestle and berthing area. The trestle route extends straight out from shore to a topographic break along the northeastern margin of the berthing area, where the seabed drops off abruptly towards the southwest.

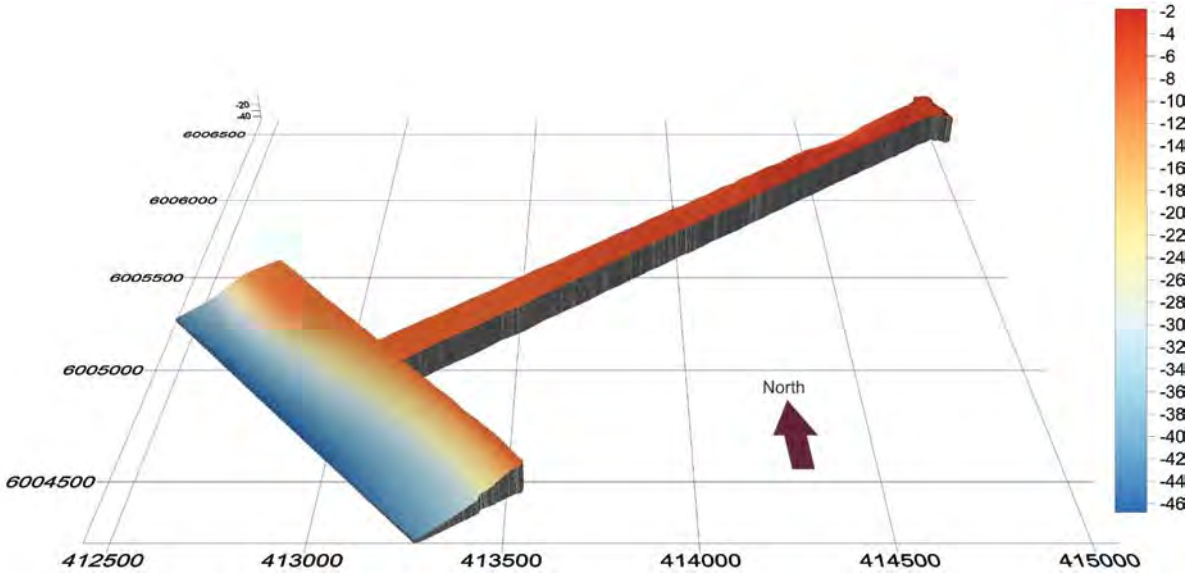

Figure 4-1. 3D Perspective of the Seabed – Trestle and Berthing Areas.

Slopes along the trestle route are generally less than 1°. Figure 4-2 shows an overview of the slopes; the blue colors are less than 5° and the red colors are greater than 10°. From the shore end (northeast) for a distance of 1000 meters, the slopes are slightly more interesting, as small bathymetric changes of less than 0.5 meters form intricate patterns on the seabed. The patterns are due to small mounds believed to be associated with vegetation, though they may also be subtle

bedforms formed by tidal oscillations. Figure 4-3 shows a detailed plot of the slopes at the northeastern-most kilometer of the trestle route.

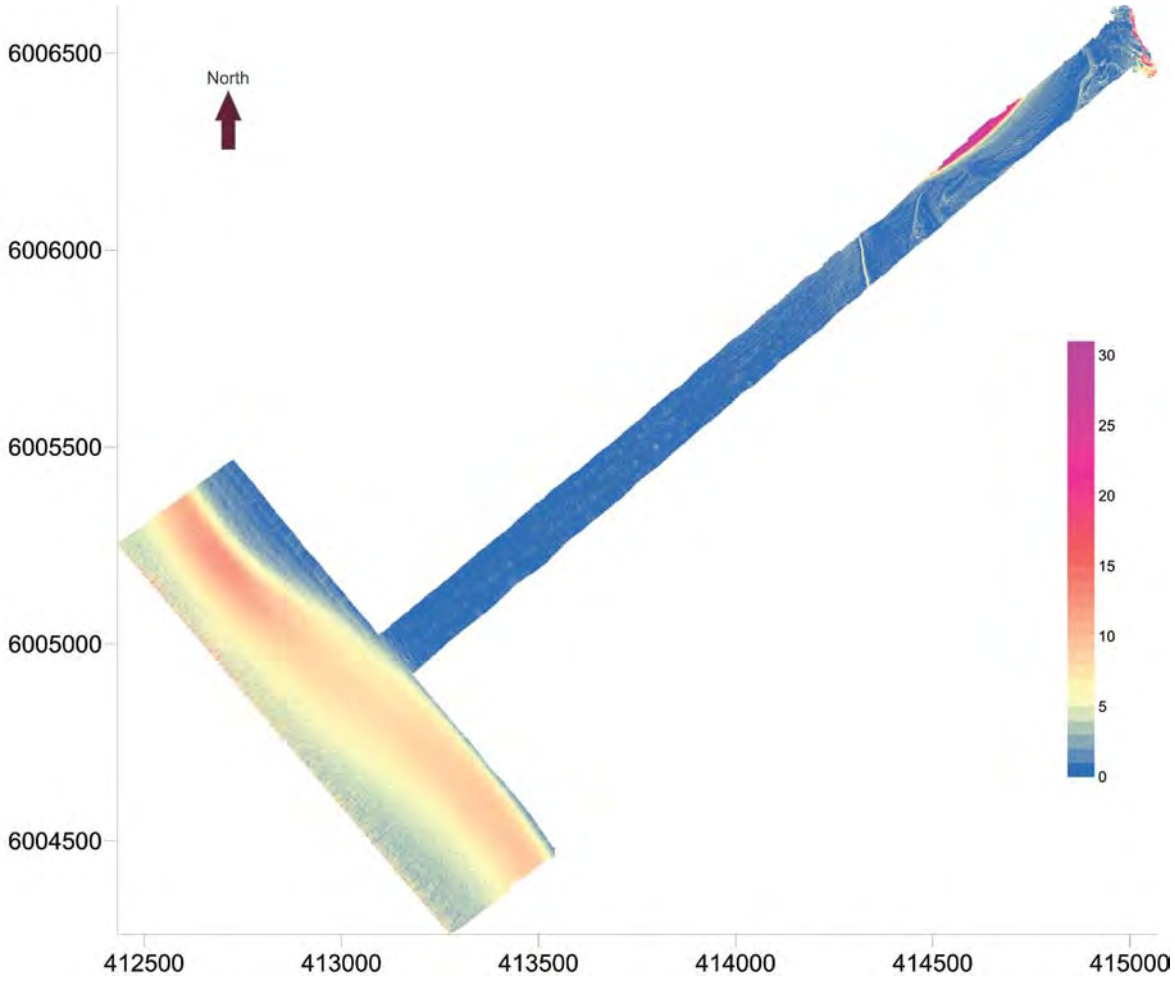

Figure 4-2. Seabed Slopes in the Trestle and Berthing Area.

At the eastern end of the trestle right adjacent to the shoreline there are bedrock outcrops which have slopes as high as 32°. Other high slopes are noted at the northwestern margin of the route, where a northeast-southwest trending channel is located. The slope descending into this channel approaches 32°. Approximately 900 meters from shore is a slight rise of 0.8 meters that forms a north-south trending slope break. This break is interpreted as the expression of a large-scale bedform or low relief sand dune with a steep eastern face. The horizontal distance from the dune crest to the eastern swale is 25 meters.

Superimposed over the corridor between 800 and 1100 meters from the shoreline are a series of northwest-southeast trending bedforms with reliefs of less than 0.2 meters and crest-crest distances of 6 meters. These bedforms are likely created by tidal oscillations; the slightly steeper slopes on the southwestern faces suggest the main component is the ebb tide.

For the remainder of the trestle route from 1100 meters from shore to the slope break, the slopes are generally less than 2.5°, with most localized slopes less than 1°. The steepest slopes in the berthing area are 12.5° near the northwest end.

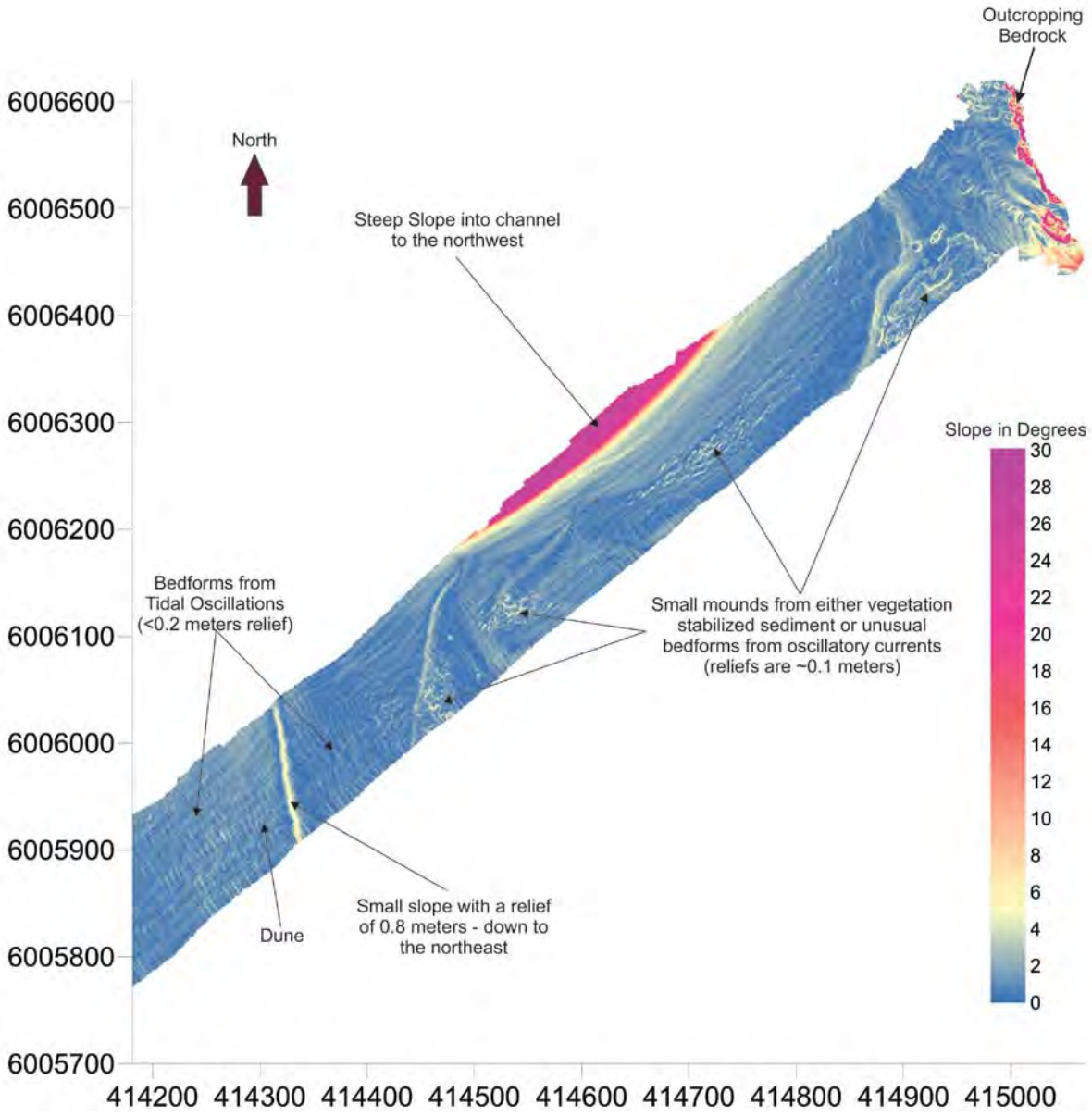

Figure 4-3. Seabed Slopes, Eastern end of the Trestle Area (Note outcrops adjacent to shoreline).

4.2.2 Turning Basin Area

The turning basin area has seabed elevations ranging from -3 meters to -31 meters. The basin is U-shaped, deeper in the central area and relatively steep slopes on both sides. There are bedrock outcrops protruding from its steep edges and through its partially in-filled central floor, especially in the northeastern half of the survey corridor. Figure 4-4 is a 3D perspective of the turning basin area.

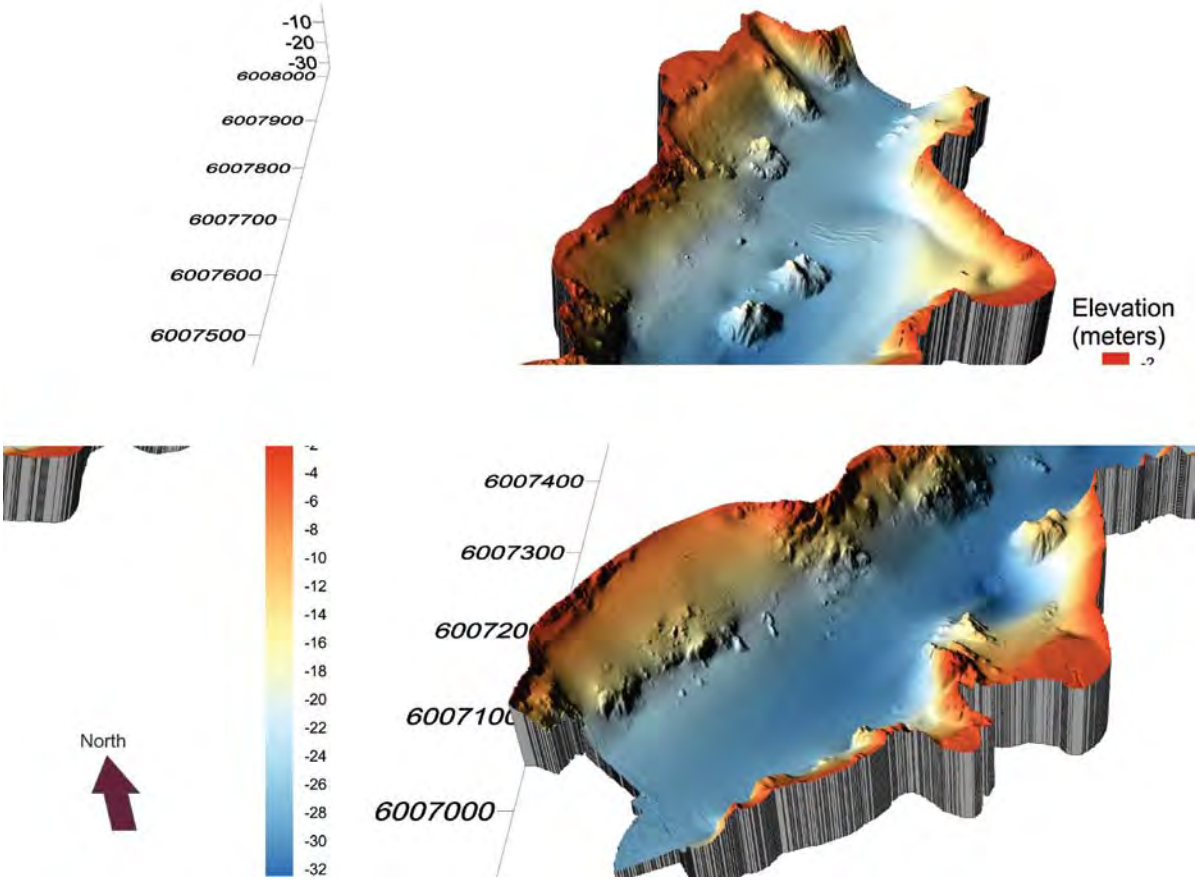

Figure 4-4. 3D Perspective of the Seabed – Turning Basin Area.

At the base of the slopes along the basin floor margins are small, rocky protuberances that may either be small tips of bedrock jutting up through the sediments or detached boulders that have fallen down the steep basin margin slopes. Small bedforms (sediment waves) are present on the basin floor near the northeastern end.

Slopes in the turning basin approach 60°, as depicted in Figure 4-5. As expected, the steepest slopes occur along the edges of the bedrock outcrops, while the basin floor generally has slopes of less than 5°.

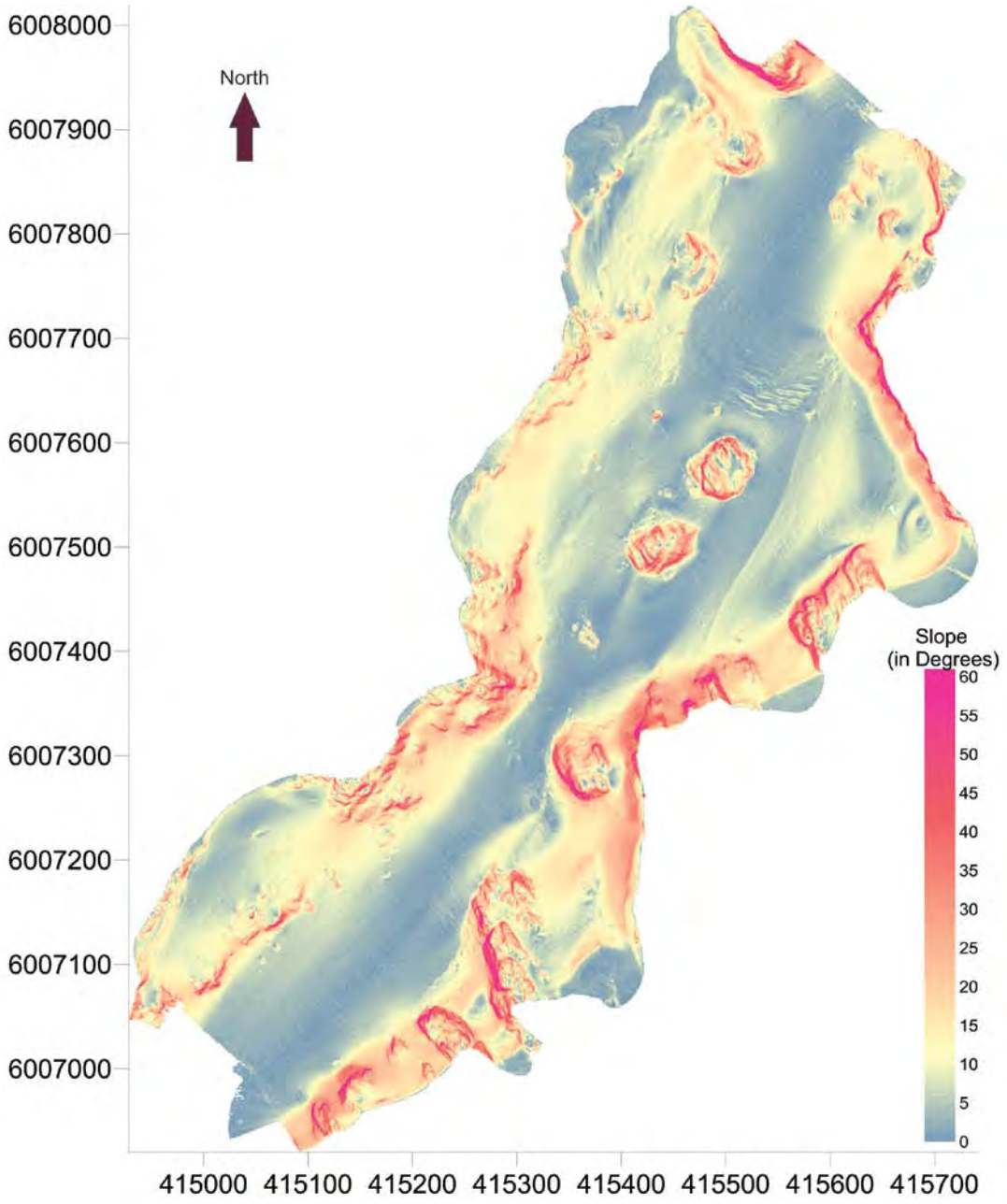

Figure 4-5. Seabed Slopes in the Turning Basin Area.

4.3 Man-made Surficial Features

4.3.1 Trestle and Berthing Area

The most prominent man-made features in the trestle and berthing areas are the numerous crab pots (traps). These appear as small objects that rise 0.4 meters above the seabed on the sonograms. The crab pots (traps) are usually connected by a cable, and are spaced 15-25 meters apart. It is quite likely that these objects have been picked up and re-deployed in other places since they were initially surveyed. Crab pots (traps) were also detected with the magnetometer, resulting in small, low-intensity anomalies (see Appendices C and D).

A few sonar contacts that may be related to man-made objects are included in Appendices B and C. These include sonar contacts SC_0007, SC_0018, SC_0021, and SC_0053.

4.3.2 Turning Basin Area

The crab pots (traps), which are so prevalent in the trestle and berthing area, are absent from the turning basin area. Two objects were detected on the sonograms that are probably tires (SC_0067 and SC_0054). A sinuous linear feature was seen on one sonogram (SC_0077) that may be a length of cable. Alternatively, this could be a scar on the seabed, or even an oddly-shaped bedform.

The most prominent feature seen was an array of parallel linear objects nearly 20 meters long. This object was seen on the outer ranges of the sonogram for Line 30 (looking downslope). It is barely noticeable on the adjacent line looking upslope. SC_0060 in Appendix C shows this feature, which, if man-made, may be a sunken structure of some sort. A few other contacts are probably rock outcrops or rocks detached from the slopes at the basin margins. The rest of the sonar contacts are interpreted as sunken logs.

The magnetometer returned four anomalies for this area. Of these, anomalies 24 and 26 are very close together, and may correspond to a possible structure on a small island off the northwestern coastline. Figure 4-6 depicts this possible structure as seen on the sonar mosaic; the two magnetic anomalies are 26 meters to the southeast. It is believed that this might be the base of a beacon or similar structure.

This structure is located at 54° 12.4524'N; 130° 17.9627'W (Grid Coordinates X=415253; Y=6007393), which is at the southwestern edge of the alternate turning basin at the tip of a small peninsula that extends southeast from the shoreline. It is possible that this structure may be visible (exposed above sea level) during low tides, however it is outside of the turning basin and presents no hazard to vessel navigation.

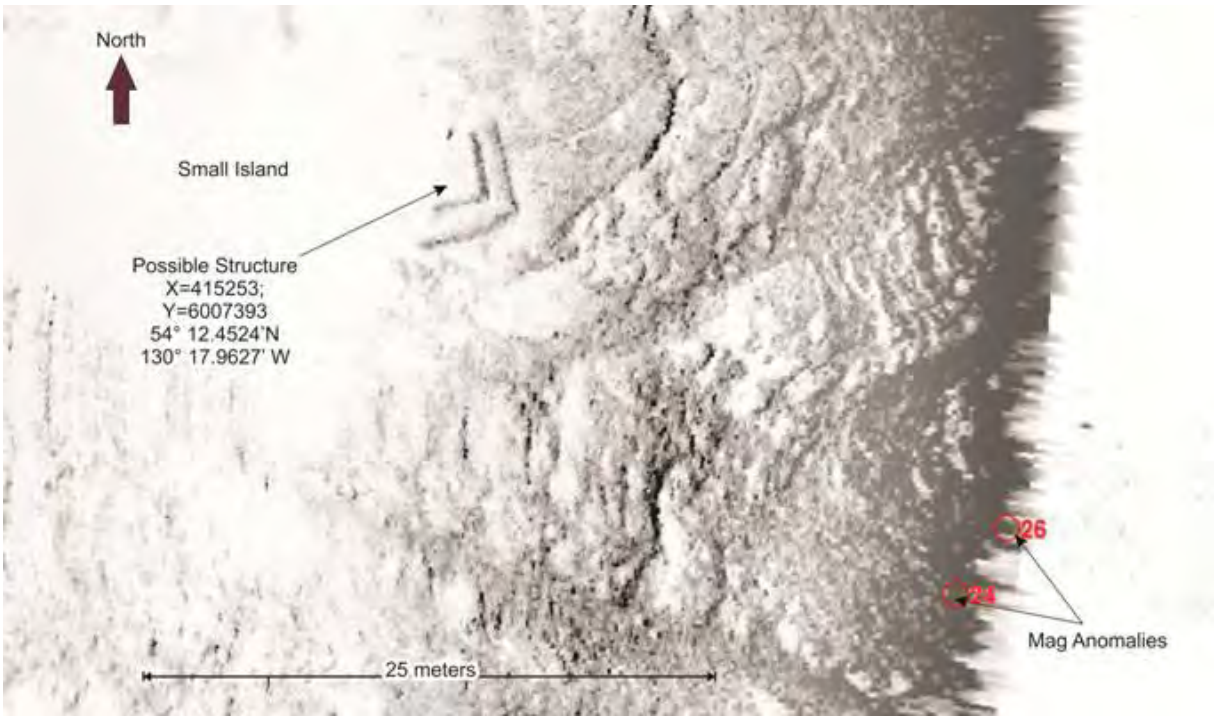

Figure 4-6. Possible Structure Outside of the Turning Basin.

4.4 Seabed Classification

4.4.1 Trestle and Berthing Area

The seabed is classified on Charts 1A & 1B as Bedrock Outcrop, Overburden Material (Silt, Sand, and Clay) and Vegetation areas. Bedrock is easily identified on the sonograms, as it displays a rugged appearance. The Vegetation areas are classified from the sonar data as very low-relief mounds and very low-relief ledge-like features where the reliefs are in the order of 0.2 to 0.5 meters. It cannot be ascertained whether vegetation actually created these small topographic irregularities. The assumption is that kelp and seaweeds may be trapping sediments into small mounds; however, it cannot be ruled out that these are unusually shaped bedforms caused by tide and wave currents. The Vegetation zones are all concentrated in the area of the trestle route between the shoreline and 850 meters southwest of the shoreline.

Based on geotechnical sediment sampling the remainder of the area is classified as recently deposited Overburden Material consisting of Silt, Sand, and Clay down to about 20 meters below the seabed and Clay down to about 50 meters. A few traces of ripples were seen in a few sonograms farther offshore, near the berthing area. The overburden material contains more fine sands and clays farther offshore in the berthing area.

The northeastern end of the trestle area features a steep exposure of bedrock adjacent to the shoreline with a small (~25 meter-wide) slump at its base. Both bedrock outcrop and slump can be seen in side-scan sonar results, as depicted in Figure 4-7 and shown on Plate 2A.

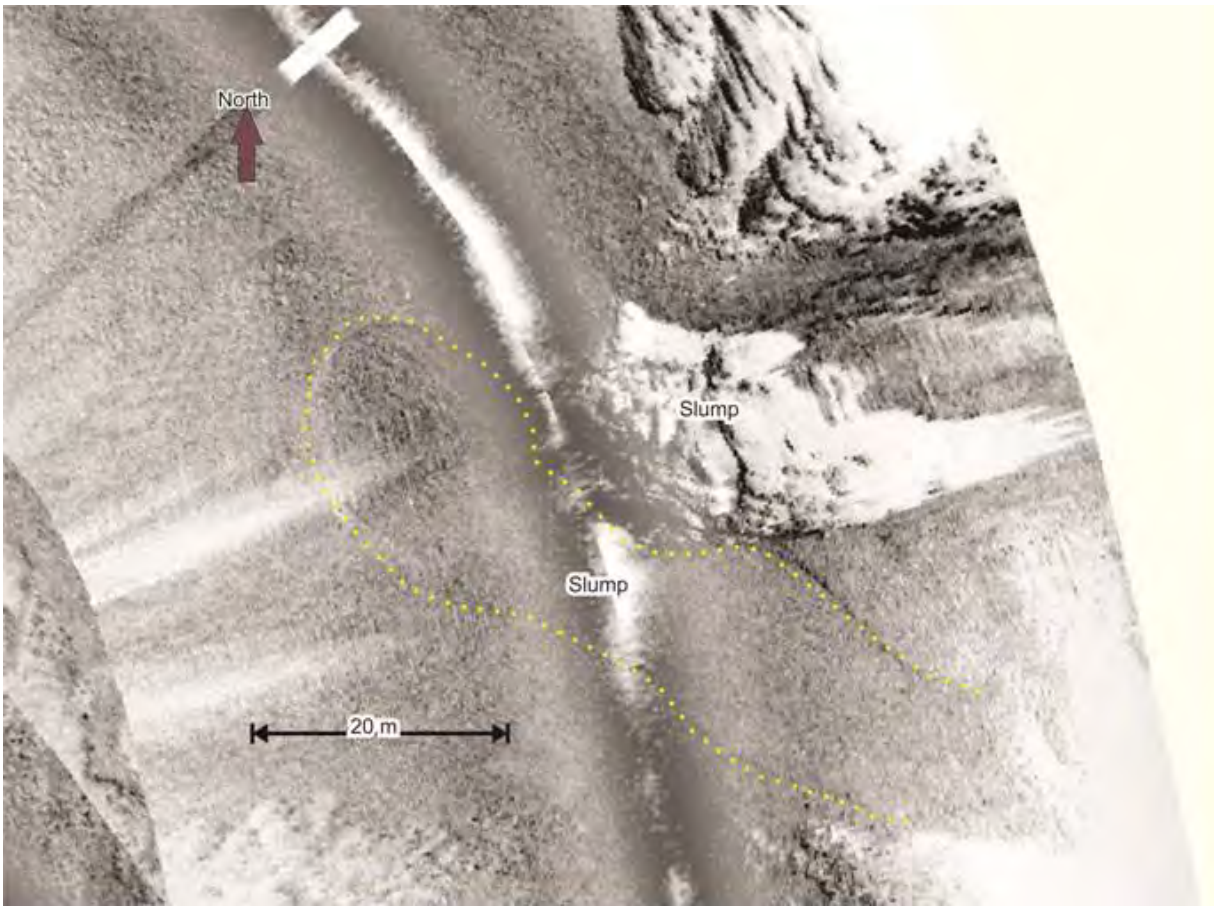

Figure 4-7. Slump at Eastern End of Trestle Route Adjacent to the Shoreline

4.4.2 Turning Basin Area

Turning Basin - located northeast of the trestle area - separates Lelu Island from Ridley Island to the northwest. The geomorphology of the turning basin appears to match that of glacially carved fjords. The basin is distinctly U-shaped, with steep, rocky margins and a sediment-laden central trough. In the northeast quarter of the turning basin, through-channel currents and the mobile seabed have produced sandwaves, which transverse the channel and range from 3-10 meters crest-to-crest. Several mid-trough, rounded rocky protuberances were noted in the bathymetry and side-scan sonar records; the sub-bottom data indicate that these are bedrock outcrops rather than drumlins or other glacial till deposits.

The turning basin area is relatively simple to classify. The seabed types are Bedrock and Overburden Material, consisting of Sand, Silt and Clay. Chart 1 shows the location of the outcropping bedrock around the turning basin margins, while the overburden material is situated in the basin floor. The Overburden classification was based on the presence of silt and sand waves in the northwestern part of the turning basin; smaller ripples were noted elsewhere in the basin. The likelihood that finer grained sediments are present is rather low given the strong tidal currents that tend to scour the basin floor.

4.5 Shallow Geology

4.5.1 Trestle and Berthing Area

Figure 4-8 shows a sub-bottom profiler image along a portion of the centerline in the trestle area. The dune mentioned previously is apparent here. Beneath the dune, a dipping strong reflector was interpreted as a patch of gravel, or even a patch of buried boulders. This particular patch is traceable from line to line, and rises slightly to the northwest and dips down to the southeast. Several isolated point reflections interpreted as possible buried boulders are seen elsewhere in the sediments above the orange line, which delineates the top of an indistinct horizon within the overburden sediments.

The surficial overburden deposits show a uniform seabed signature, indicating that the sediment type does not appreciably change until about 100 meters from the seaward end of the trestle route, where the signature indicates a slight decrease in sediment grainsize. The mapped Vegetation areas were scrutinized for seabed signature changes, but none were noted. This suggests that silt and sand also dominate in the mapped Vegetation area.

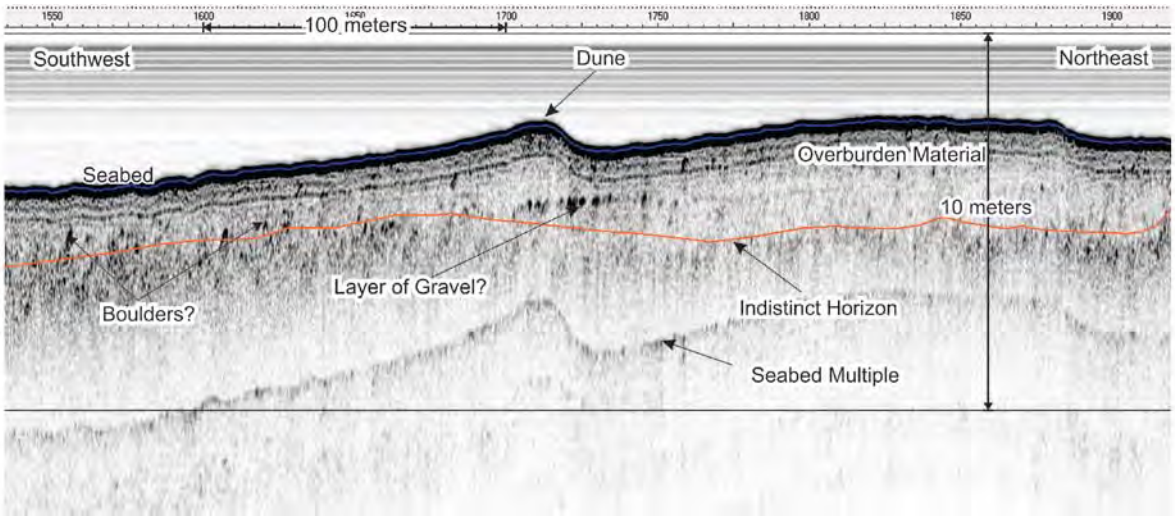

Figure 4-8. Sub-bottom Profile in Trestle Area – Line 15.

In the berthing area, like the trestle route, the top of bedrock is not apparent in the geophysical data record. The seabed signature character is typical for fine sand or clayey sand.

4.5.2 Turning Basin Area

In the turning basin area, the distinction between bedrock and surficial silt and sand is much easier to deduce. Generally, the sub-bottom profiler data were adequate to resolve the top of bedrock beneath the surficial overburden of silt and sand deposits. Where the amount of sediment increased beyond what the sub-bottom profiler could penetrate, the boomer data were used to extend the interpretations. The sub-bottom profiler signal usually penetrated 10 meters; beyond that, the boomer data were used.

Figure 4-9 is a profile across the central part of the turning basin along the basin axis. As this figure depicts, the overburden material is amorphous or un-layered. Chart 3B shows the thickness of the overburden material in the turning basin area. Because of the steep gradients and abrupt changes in thickness, a 5-meter contour interval was used.

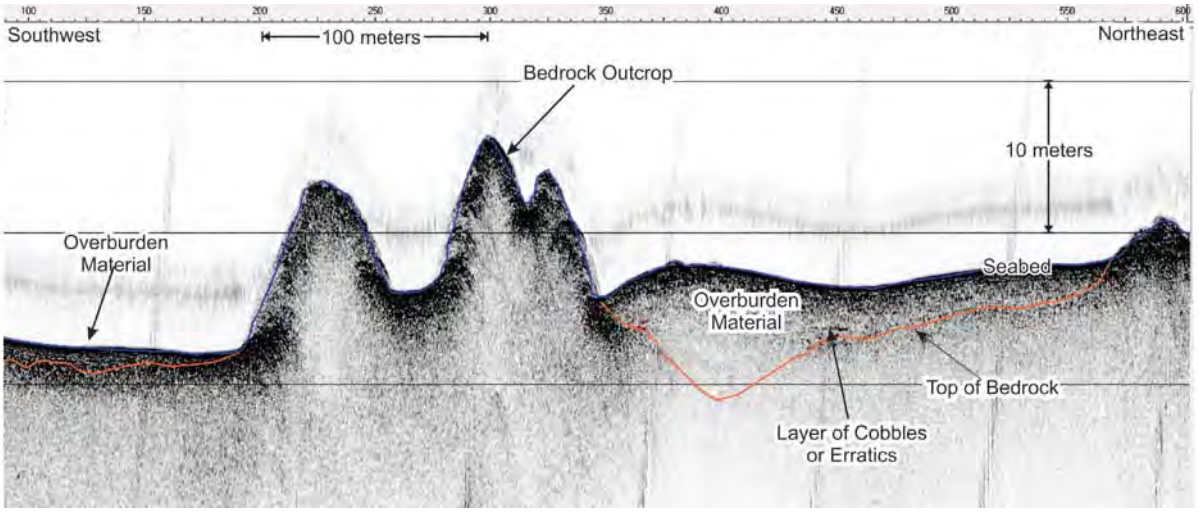

Figure 4-9. Sub-bottom Profile in Turning Basin – Line 52.

4.6 Background Geology

Folded and fractured late Mesozoic and early Cenozoic crystalline rocks dominate the geology of the Lelu Island region. Much of the island and its surrounding bedrock consists of foliated metamorphic rocks created during mid-Cretaceous accretionary events, though scattered plutons were also emplaced throughout the region during this time. Many millions of years later, Pleistocene and Quaternary glacial episodes scoured great valleys as they crept seaward. When the glaciers retreated, the rising ocean flooded the coastal regions, and the valleys became fjords divided by islands large and small. The fjords commonly trend along regional faults, which generally parallel the coastline of the continent. Lelu Island lies nearly 200 km east of the Queen Charlotte Fault and around 50 km east of the Kitkatla Fault, which are occasional sources of seismicity and possible triggering mechanisms for various geologic hazards (see Figure 4-10).

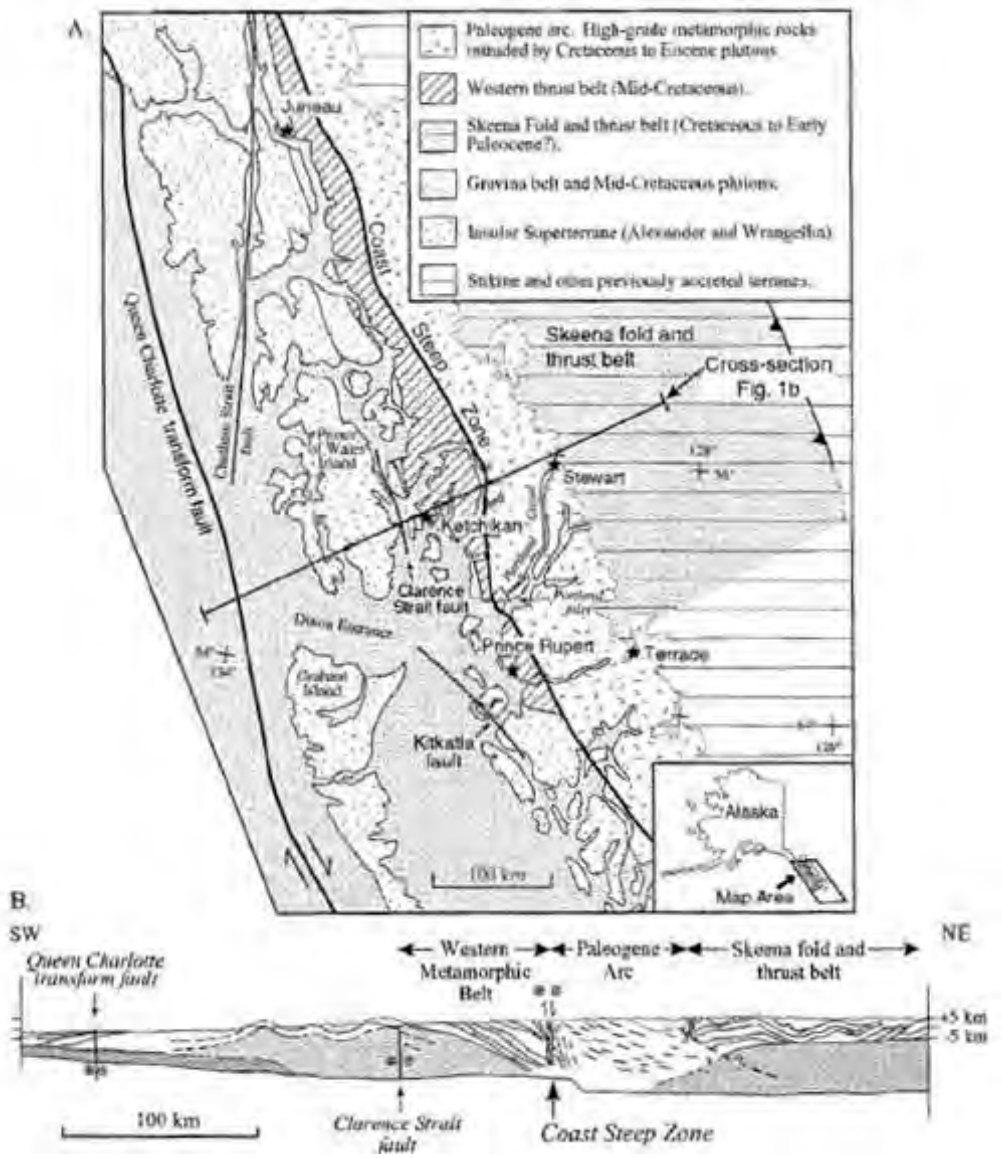

Figure 4-10. Tectonic Map.

A) Tectonic map of Southeast Alaska and Northwest British Columbia showing major metamorphic and stratigraphic units. Study area is approximately located by the town of Prince Rupert. B) Simplified cross-section of region. From Davidson et al., 2000.

4.6.1 Tectonic Setting

4.6.1.1 Historical Geology

Accretion of the Alexander Terrain to the North American continent during Mid-Cretaceous time (~100-90 Ma) produced a belt of foliated, moderate- to high-pressure (i.e. greenschist to upper amphibolite facies) metasedimentary rocks that parallels the present coastline (Crawford et al., 1999; Davidson et al., 2000). Lelu Island and the whole of Prince Rupert Sound are located within this Western Metamorphic Belt (WMB), which is bounded on east by the Paleogene (~65-52 Ma) plutonic Central Belt (CB) that comprises the Coast Mountains (Figure 4-11).

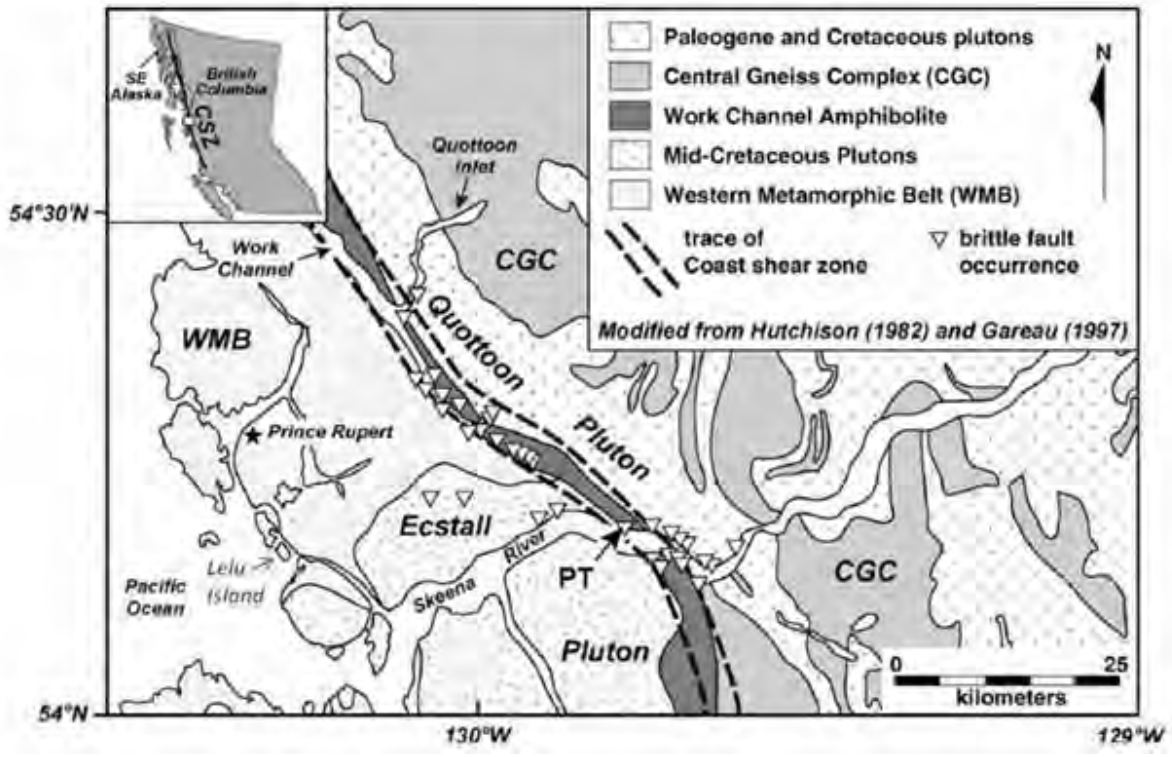

Figure 4-11. Lelu Regional Tectonic Map.

Map showing Lelu Island and its tectonic surroundings. Modified from Davidson et al., 2003.

4.6.1.2 Lithostratigraphy

Pleistocene glacial scouring and subsequent stream and wave erosion exposed Lelu Island's complex bedrock (Figure 4-12), and the rapid glacial retreat during late Pleistocene time left the island uncovered approximately 13,000 years ago (Clague and Ward, 2011). Any sedimentary package deposited on bedrock in this region is therefore 13,000 years old or younger. Offshore, bedrock is covered by a thin and discontinuous dense layer of glacial till, which is overlain by a soft silty clay layer with a minor component of fine sand. These finer sediments were also deposited on the island, indicating that they were deposited approximately 10,500 years ago, when global deglaciation produced eustatic levels that cut shorelines around Prince Rupert from 40-135 meters higher than they are today (Clague, 1984). These glaciomarine and marine sediments have virtually no bearing strength when saturated (Clague, 1984).

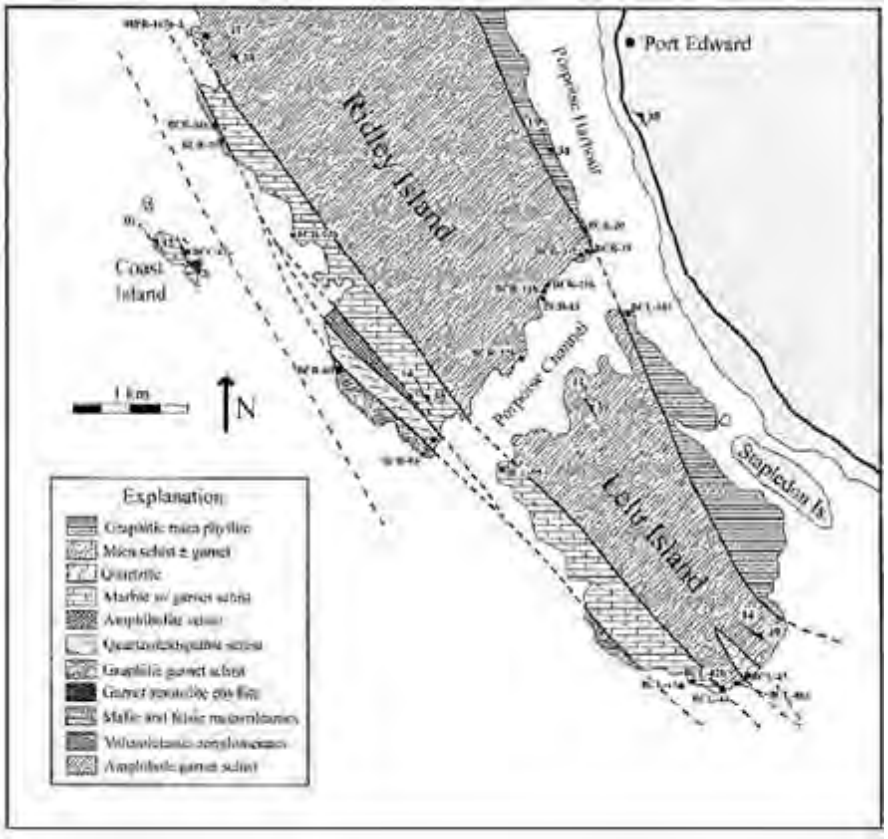

Figure 4-12. Lelu Island Bedrock Geology.

Geologic map of bedrock lithology of Lelu and southern Ridley Islands. Note the inferred continuity of lithologies beneath Porpoise Channel, where the Turning Basin portion of this geophysical study is located. Modified from Clor, 2000.

4.6.2 Seismology

4.6.2.1 Seismicity

The study area is located in close proximity to major transform faults, but no significant earthquake epicenters have been recorded there (NGDC, 2013). While the Queen Charlotte transform fault represents an active plate boundary, and regularly produces magnitude >7.0 earthquakes, its distance from the Lelu site (~200 km) minimizes the risk of direct earthquake effects, such as surface rupture.

4.6.2.2 Tsunami

Although the National Geophysical Data Center (NGDC) has no record of historical tsunami sources or run-ups in the study area (NGDC, 2013), such events are likely in the greater Prince Rupert region. A 1975 submarine landslide caused an 8.5-m tsunami run-up in the Kitimat Inlet, roughly 130 km southeast of the study area.

5. CONCLUSIONS AND RECOMMENDATIONS

The bathymetry (multibeam) results are accurate and may be used for planning purposes. Steep slopes are present near the northwestern margin of the trestle route, and along the margins of the turning basin.

Bedforms are present in the form of dunes and low-relief ripples and sand waves of various sizes. The large dunes along the trestle route indicate they have been built up from bottom currents flowing to the east. These currents may be storm induced or seasonal, and the bedforms may migrate from time to time. The smaller sand waves in the trestle route are likely formed from ebb tidal currents, and may migrate on a daily basis. Bedforms in the turning basin (sand waves) are likely formed from ebb tidal currents.

There were abundant crab pots (traps) seen in the trestle route and berthing areas. Crab pots (traps) are absent from the turning basin area. The presence of crab pots (traps) indicates the areas are popular for fishermen, and this may need to be considered when planning construction activities. Because the crab pots (traps) are likely to be moved since the initial survey, they are not included on Charts 1A & 1B and Charts 2A & 2B.

There are no major man-made objects in the trestle route and berthing areas, although there are a few magnetic anomalies and minor sonar contacts that should be considered before construction activities commence. A small structure was detected lying outside the turning basins, and may be located on a small island just off the shoreline. It is likely this structure will be visible to mariners and construction personnel entering the turning basin area but will pose no hazard to vessels.

The surficial (seabed) is classified as: Sand, Silt, and Clay; Vegetation; and Bedrock along the trestle route. The Vegetation areas are where seaweed or kelp has likely trapped small amounts of silt and sand forming sub-meter hillocks and ledges. Overburden material consisting of Silt, Sand, and Clay blanket the seabed along the trestle route, with a few bedrock outcrops adjacent to the shoreline. The Overburden likely grades to a muddy or finer material near the berthing area, where clay and fine sand/silt likely predominates. In the turning basin, the sediment is either the same overburden material or outcropping bedrock.

A small slump was detected at the extreme eastern end of the trestle route, where the overburden material has failed in a narrow (25 meter-wide) gap between two bedrock outcrops. This slump is at the extreme edge of the multibeam coverage adjacent to the shoreline. The fact that this nearshore area is prone to failure should be considered when designing structures near the shoreline. This slump is not considered a fatal flaw for future construction, rather the potential for a small amount of failure along the shoreline should be considered for the steep slopes within 100 meters of the shoreline.

The top of the bedrock was not seen in the geophysical data for the trestle route and berthing areas. The top of the bedrock was apparent beneath a surficial overburden deposit in the turning basin area, where Chart 3B contours the thickness of overburden material overlying the bedrock. In the southern turning basin, the only bedrock shallower than the -12.5 meter dredge elevation are the rock outcrops encountered adjacent to the shoreline, which does not appear to warrant another borehole.

There are numerous apparent buried erratics (boulders) in the shallow sediment along the trestle route; these erratics are generally absent from the berthing area. There are erratics in the turning basin, both on the seabed and buried in the sediment.

To eliminate the presence of geophysical Fatal Flaws, Fugro focused attention on four conditions; active faults, potential landslides, slump features, and an indication of side slope stability based on slope steepness as per the requirements of KBR. Based on these four geophysical characteristics no “Fatal Flaws” were discovered that would require abandoning the project.

APPENDICES

A DAILY PROGRESS REPORTS

B SIDE SCAN SONAR TARGET TABLE

C SIDE SCAN SONAR TARGET REPORT

D MAGNETOMETER ANOMALY TABLE

E REFERENCES CITED

F DIGITAL FILES

G CHARTS

1A BATHYMETRY AND SURFICIAL FEATURES – TRESTLE AND MOORING AREA
1B BATHYMETRY AND SURFICIAL FEATURES – TURNING BASINS
2A SIDE SCAN SONAR MOSAIC – TRESTLE AND MOORING AREA
2B SIDE SCAN SONAR MOSAIC – TURNING BASINS
3A ISOPACH CONTOURS – TRESTLE AND MOORING AREA
3B ISOPACH CONTOURS – TURNING BASINS
4A BATHYMETRY AND SLOPE INTERPRETATION – TRESTLE AND MOORING AREA
4B BATHYMETRY AND SLOPE INTERPRETATION – TURNING BASINS

A DAILY PROGRESS REPORTS

(35 pages)

DAILY PROGRESS REPORT

Fugro Pelagos Inc.
4820 McGrath St., Suite 100, Ventura CA 93003
Phone: 805-650-7000 Fax: 805-658-6679

CLIENT:	KBR	DIVISION:	
JOB DESCRIPTION:	Hydrographic/Geophysical	REPORT No.:	1
VESSEL:		DATE:	May 2, 2013
LOCATION:	Lelu Island, BC	JOB No.:	23.00007028
HORIZONTAL DATUM/ZONE:	UTM 9	PROJ. MANAGER:	
VERTICAL DATUM:	MLW	TELEPHONE:	805.650.7000

PERSONNEL	Name	Hours	HEALTH AND SAFETY:
PARTY CHIEF	G. Suarez	12	
SENIOR SURVEYOR			
MBES ENGINEER	A. Tardiff	12	WEATHER:
GEOPHYSICAL TECH	D. Ebuna	12	
GEOPHYSICAL TECH	M. Williams	12	GENERAL CONDITIONS:
SURVEY TECHNICIAN			

TIME	EVENT
0600	Depart Ventura Office
0730	At LAX
1300	Obtained work permit Vancouver, BC
1930	Arrived to Prince Rupert, BC

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CLIENT:	KBR	DIVISION:	
JOB DESCRIPTION:	Hydrographic/Geophysical	REPORT No.:	2
VESSEL:		DATE:	May 3, 2013
LOCATION:	Lelu Island, BC	JOB No.:	23.00007028
HORIZONTAL DATUM/ZONE:	UTM 9	PROJ. MANAGER:	
VERTICAL DATUM:	MLW	TELEPHONE:	805.650.7000

PERSONNEL	Name	Hours	HEALTH AND SAFETY:
PARTY CHIEF	G. Suarez	12	
SENIOR SURVEYOR			
MBES ENGINEER	A. Tardiff	12	Clear / sunny
GEOPHYSICAL TECH	D. Ebuna	12	
GEOPHYSICAL TECH	M. Williams	12	GENERAL CONDITIONS:
SURVEY TECHNICIAN			

TIME	EVENT
0700	Safety meeting
0800	Site reconnaissance - Port Edwards
0930	Met with John Turpin and checked out survey boat Rain Coast Explorer
1100	Picked up Keys for Equipment container
1300	Met seismic gear delivery truck at Port Edwads and stored in contoainer
1400	At survey boat to check on MB bracket installation
1800	Met with McElhanney surveyor, traveled to Port Edward to recover survey control point
1900	Back to Prince Rupert

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CLIENT:	KBR	DIVISION:	
JOB DESCRIPTION:	Hydrographic/Geophysical	REPORT No.:	3
VESSEL:	Rain Coast Explorer	DATE:	May 4, 2013
LOCATION:	Lelu Island, BC	JOB No.:	23.00007028
HORIZONTAL DATUM/ZONE:	UTM 9	PROJ. MANAGER:	
VERTICAL DATUM:	MLW	TELEPHONE:	805.650.7000

PERSONNEL	Name	Hours	HEALTH AND SAFETY:
PARTY CHIEF	G. Suarez	12	
SENIOR SURVEYOR			
MBES ENGINEER	A. Tardiff	12	Clear / sunny
GEOPHYSICAL TECH	D. Ebuna	12	
GEOPHYSICAL TECH	M. Williams	12	GENERAL CONDITIONS:
SURVEY TECHNICIAN			

TIME	EVENT
0700	Safety meeting
0800	Heading to Port Edward to begin equipment Mobilization
0830	At Port Edward
0900	Safety meeting / begin Survey equipment installation
1030	G.S. heading to Prince Rupert for generation and other items
1400	G. S. back at Port Edward
1730	MB ans SS sonar equipment installed / heading to Prince Rupert
1745	At Prince Rupert

DAILY PROGRESS REPORT

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Party Chief		Approval	
	Fugro Consultant Inc.		Company representative

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CLIENT:	KBR	DIVISION:	
JOB DESCRIPTION:	Hydrographic/Geophysical	REPORT No.:	4
VESSEL:	Rain Coast Explorer	DATE:	May 5, 2013
LOCATION:	Lelu Island, BC	JOB No.:	23.00007028
HORIZONTAL DATUM/ZONE:	UTM 9	PROJ. MANAGER:	
VERTICAL DATUM:	MLW	TELEPHONE:	805.650.7000

PERSONNEL	Name	Hours	HEALTH AND SAFETY:
PARTY CHIEF	G. Suarez	12	
SENIOR SURVEYOR			
MBES ENGINEER	A. Tardiff	12	Fog (am) / Sunny (pm)
GEOPHYSICAL TECH	D. Ebuna	12	
GEOPHYSICAL TECH	M. Williams	12	GENERAL CONDITIONS:
SURVEY TECHNICIAN			

TIME	EVENT
0700	Heading to Port Edward
0730	At Port Edward / thick fog in the area
0745	Safety meeting / continue with mob
1100	Fog begin to disipate
1200	leaving dock, heading to crane dock to move generator to roof
1225	Base station set
1330	Begin MB patch test
1530	Testing SS / moved BS to new point (highr ground location)
1600	Heading to Survey area
1700	Testin mag
1800	testing complete, heading back to dock / Base station demobed
1830	At dock / Heading to Prince Rupert
1945	At Prince rupert

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CLIENT:	KBR	DIVISION:	
JOB DESCRIPTION:	Hydrographic/Geophysical	REPORT No.:	5
VESSEL:	Rain Coast Explorer	DATE:	May 6, 2013
LOCATION:	Lelu Island, BC	JOB No.:	23.00007028
HORIZONTAL DATUM/ZONE:	UTM 9	PROJ. MANAGER:	
VERTICAL DATUM:	MLW	TELEPHONE:	805.650.7000

PERSONNEL	Name	Hours	HEALTH AND SAFETY:
PARTY CHIEF	G. Suarez	12	
SENIOR SURVEYOR			GENERAL CONDITIONS:
MBES ENGINEER	A. Tardiff	12	Light wind in the early morning (about5 knts) increasing to 10-15knts by afternoon. Swell increase in afternoon, wind chops increase by beginning of afternoon. Strong currents all day.
GEOPHYSICAL TECH	D. Ebuna	12	
GEOPHYSICAL TECH	M. Williams	12	
SURVEY TECHNICIAN			

TIME	EVENT
0700	Heading to Port Edward
0730	At Port Edward / fog in the area
0800	Safety meeting
0830	Depart dock for survey area
0900	Start Base Station
0945	Begin MB survey at offshore area
1345	Wind picks up - small whit caps
1400	Wind increase - white caps, will move to turning basin due to weather
1445	Begin turning basin area
1630	Surveyed turning basin - will need to survey shorelines at high tide
1645	Heading back to dock
1715	At dock
1730	Heading to Prince Rupert
1800	At Prince Rupert

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CLIENT:	KBR	DIVISION:	
JOB DESCRIPTION:	Hydrographic/Geophysical	REPORT No.:	6
VESSEL:	Rain Coast Explorer	DATE:	May 7, 2013
LOCATION:	Lelu Island, BC	JOB No.:	23.00007028
HORIZONTAL DATUM/ZONE:	UTM 9	PROJ. MANAGER:	
VERTICAL DATUM:	MLW	TELEPHONE:	805.650.7000

PERSONNEL	Name	Hours
PARTY CHIEF	G. Suarez	12
SENIOR SURVEYOR		
MBES ENGINEER	A. Tardiff	12
GEOPHYSICAL TECH	D. Ebuna	12
GEOPHYSICAL TECH	M. Williams	12
SURVEY TECHNICIAN		

HEALTH AND SAFETY:

GENERAL CONDITIONS:

Fog in the morning starts decreasing by 1000. Sea state: calm in morning. 1030 fog has lift off for the most part. 1125 clear sky. 1200 strong currents

TIME	EVENT
0700	Heading to Port Edward
0730	At Port Edward / fog in the area
0740	Safety meeting
0800	Revised settings on hypack (riased motion from 25hz to 50hz)
0915	Start Base Station
0945	Depart dock - fog decreasing
1015	Continue to survey trestle area
1200	Heading to finnish turning basin shallow areas at high tide
1315	Finished turning basin, will continue with trestle area
1430	Finished MB survey / setting up for SS and Mag survey
1510	Begin SS and mag survey in trestle area
1717	Finished SS and mag for the day, heading to port
1745	At dock
1800	Heading to Prince Rupert
1820	At Prince Rupert

DAILY PROGRESS REPORT

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	Fugro Consultant Inc.		Company representative

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CLIENT:	KBR	DIVISION:	
JOB DESCRIPTION:	Hydrographic/Geophysical	REPORT No.:	7
VESSEL:	Rain Coast Explorer	DATE:	May 8, 2013
LOCATION:	Lelu Island, BC	JOB No.:	23.00007028
HORIZONTAL DATUM/ZONE:	UTM 9	PROJ. MANAGER:	
VERTICAL DATUM:	MLW	TELEPHONE:	805.650.7000

PERSONNEL	Name	Hours	HEALTH AND SAFETY:
PARTY CHIEF	G. Suarez	12	
SENIOR SURVEYOR			
MBES ENGINEER	A. Tardiff	12	GENERAL CONDITIONS:
GEOPHYSICAL TECH	D. Ebuna	12	fog in am - burned away by 1000. Light wind in afternoon. Sea states calm for the most part. Sunny afternoon.
GEOPHYSICAL TECH	M. Williams	12	
SURVEY TECHNICIAN			

TIME	EVENT
0730	Heading to Port Edward
0800	At Port Edward / fog in the area
0900	Safety meeting
0915	Prepared gear for SS and Mag survey
1030	Fog lifted, departing dock
1100	On site, begin SS and Mag survey
1830	Finished survey, equipment on deck, heading to dock
1900	At dock / backing up data
1930	Heading to Prince Rupert
2000	At Prince Rupert

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CLIENT:	KBR	DIVISION:	
JOB DESCRIPTION:	Hydrographic/Geophysical	REPORT No.:	8
VESSEL:	Rain Coast Explorer	DATE:	May 9, 2013
LOCATION:	Lelu Island, BC	JOB No.:	23.00007028
HORIZONTAL DATUM/ZONE:	UTM 9	PROJ. MANAGER:	
VERTICAL DATUM:	MLW	TELEPHONE:	805.650.7000

PERSONNEL	Name	Hours	HEALTH AND SAFETY:
PARTY CHIEF	G. Suarez	12	
SENIOR SURVEYOR			
MBES ENGINEER	A. Tardiff	12	GENERAL CONDITIONS:
GEOPHYSICAL TECH	D. Ebuna	12	
GEOPHYSICAL TECH	M. Williams	12	
SURVEY TECHNICIAN			Sea state calm for most part. Fair day

TIME	EVENT
0800	At hotel Lobby
0830	At marina inspecting My Lady vessel
0900	heading to Port Edward / will stop for fuel for generator
0945	At Port Edward
1000	Conference call to Ventura Office
1015	Safety meeting / waiting for My Lady to aarive and begin seismic gear mob
1130	My Lady on site
1145	Heading to continue with second turning Basin MB survey
1200	Base station started
1215	Heading to Prince rupert to purchase materials for My Lady Seismic gear mobilization
1400	Back to ort Edward
1710	Finished MB survey will continue with SS and Mag tomorrow
1730	Rain Coast Explorer at dock
1800	Heading to Prince Rupert
1830	At Prince Rupert

DAILY PROGRESS REPORT

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CLIENT:	KBR	DIVISION:	
JOB DESCRIPTION:	Hydrographic/Geophysical	REPORT No.:	9
VESSEL:	Rain Coast Explorer	DATE:	May 10, 2013
LOCATION:	Lelu Island, BC	JOB No.:	23.00007028
HORIZONTAL DATUM/ZONE:	UTM 9	PROJ. MANAGER:	
VERTICAL DATUM:	MLW	TELEPHONE:	805.650.7000

PERSONNEL	Name	Hours	HEALTH AND SAFETY:
PARTY CHIEF	G. Suarez	12	
SENIOR SURVEYOR			
MBES ENGINEER	A. Tardiff	12	Fog (am) / Sunny (pm)
GEOPHYSICAL TECH	D. Ebuna	12	
GEOPHYSICAL TECH	M. Williams	12	GENERAL CONDITIONS:
SURVEY TECHNICIAN			

TIME	EVENT
0900	At hotel Lobby / heading to Port Edward
0930	At Port Edward
0945	Safety meeting
1000	Continue with mob on My Lady / preparing to run SS and Mag on Turning Basin 2
1100	Rain Coast Explorer leaving dock
1500	Rain Coast Explorer back at dock, finished SS and Mag survey
1530	Begin demobing equipment from Rain Coast Explorer
1630	Changing generators from Rain Coast Explorer to My Lady
1830	Finished demobing survey equipment from Rain Coas Explorer, heading to Prince Rupert
1900	At Prince Rupert

DAILY PROGRESS REPORT

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CLIENT:	KBR	DIVISION:	
JOB DESCRIPTION:	Hydrographic/Geophysical	REPORT No.:	10
VESSEL:	Rain Coast Explorer	DATE:	May 11, 2013
LOCATION:	Lelu Island, BC	JOB No.:	23.00007028
HORIZONTAL DATUM/ZONE:	UTM 9	PROJ. MANAGER:	
VERTICAL DATUM:	MLW	TELEPHONE:	805.650.7000

PERSONNEL	Name	Hours	HEALTH AND SAFETY:
PARTY CHIEF	G. Suarez	12	
SENIOR SURVEYOR			
MBES ENGINEER	A. Tardiff	12	Rain / Wind (pm)
GEOPHYSICAL TECH	D. Ebuna	12	
GEOPHYSICAL TECH	M. Williams	12	GENERAL CONDITIONS:
SURVEY TECHNICIAN			

TIME	EVENT
0800	At hotel Lobby / heading to Port Edward
0830	At Port Edward
0845	Safety meeting
0900	Testing Sub buttom and Streamer system
1300	Depart dock / will test sytems / and prepare for survey at high tide
1730	My Lady back at dock, problems with sending GPS time to seismic computer
1930	Issue with GPS timming not resolved, will call Mike B, in the morning
1945	Heading to Prince Rupert
2010	At Prince Rupert

DAILY PROGRESS REPORT

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	Fugro Consultant Inc.		Company representative

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CLIENT:	KBR	DIVISION:	
JOB DESCRIPTION:	Hydrographic/Geophysical	REPORT No.:	11
VESSEL:	Rain Coast Explorer	DATE:	May 12, 2013
LOCATION:	Lelu Island, BC	JOB No.:	23.00007028
HORIZONTAL DATUM/ZONE:	UTM 9	PROJ. MANAGER:	
VERTICAL DATUM:	MLW	TELEPHONE:	805.650.7000

PERSONNEL	Name	Hours	HEALTH AND SAFETY:
PARTY CHIEF	G. Suarez	12	
SENIOR SURVEYOR			
MBES ENGINEER			Rain / Wind (pm)
GEOPHYSICAL TECH	D. Ebuna	12	
GEOPHYSICAL TECH	M. Williams	12	GENERAL CONDITIONS:
SURVEY TECHNICIAN			

TIME	EVENT
0800	At hotel Lobby / heading to Port Edward
0830	At Port Edward
0845	Safety meeting
0900	Called Mike Barth in regards to timing issues with seismic laptop (issue resolved)
1030	Depart dock / will test systems / and prepare for survey at turning basins 1 and 2
1100	Deployed SB and Streamer
1230	Hypack crashing not logging - created new file
1400	Begin logging seismic data
1656	Finished survey in turning basin 1 and 2 areas
1700	Recovering SB and Streamer
1735	Back at dock / backing up data
1750	Heading to Prince Rupert
1815	At prince Rupert

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Phone: 805-650-7000 Fax: 805-658-6679

CLIENT:	KBR	DIVISION:	
JOB DESCRIPTION:	SB - Seismic survey	REPORT No.:	12
VESSEL:	My Lady	DATE:	May 13, 2013
LOCATION:	Lelu Island, BC	JOB No.:	23.00007028
HORIZONTAL DATUM/ZONE:	UTM 9	PROJ. MANAGER:	
VERTICAL DATUM:	MLW	TELEPHONE:	805.650.7000

PERSONNEL	Name	Hours
PARTY CHIEF	G. Suarez	12
SENIOR SURVEYOR		
MBES ENGINEER		
GEOPHYSICAL TECH	D. Ebuna	12
GEOPHYSICAL TECH	M. Williams	12
SURVEY TECHNICIAN		

HEALTH AND SAFETY:

WEATHER CONDITIONS:

Consistent rain and offshore wind (from East) in AM; in early afternoon winds shift and intensify to ~20 knots from S, up to 3 ft wind waves

TIME	EVENT
0830	At hotel Lobby / heading to Port Edward
0900	At Port Edward
0915	Safety meeting
1050	Depart dock / will test systems / and prepare for survey at trestle area
1120	At offshore trestle survey area - assesing weather conditions
	Wind 10-15 knots from East, 1-2 ft wind chop - will deploy systems and check data quality
1145	Equipment deployed - begin running survey lines
1210	First survey line completed running against current; data noisy - will run all subsequent lines with current
1320	Change of wind direction and increasing intensity - now ~20 knots from South, wind waves up to 3 ft
1345	Fifth survey line of day completed, but may need to be re-run - poor data quality even running w/ current
	End of day's data collection due to weather - recovering equipment and returning to dock
1430	Back at dock
1500	Heading to Prince Rupert
1530	At Prince Rupert

DAILY PROGRESS REPORT

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CLIENT:	KBR	DIVISION:	
JOB DESCRIPTION:	SB - Seismic survey	REPORT No.:	13
VESSEL:	My Lady	DATE:	May 14, 2013
LOCATION:	Lelu Island, BC	JOB No.:	23.00007028
HORIZONTAL DATUM/ZONE:	UTM 9	PROJ. MANAGER:	
VERTICAL DATUM:	MLW	TELEPHONE:	805.650.7000

PERSONNEL	Name	Hours	HEALTH AND SAFETY:
PARTY CHIEF			
SENIOR SURVEYOR			
MBES ENGINEER			WEATHER CONDITIONS:
GEOPHYSICAL TECH	D. Ebuna	12	AM: Consistent rain and increasing wind; whitecaps
GEOPHYSICAL TECH	M. Williams	12	observed throughout survey area, estimated wind
SURVEY TECHNICIAN			waves up to 3 ft; wind ~25 knots from South

TIME	EVENT
0900	At hotel Lobby / awaiting availability of vessel captain
0905	Received report of ~25 knot winds from South at work site from local boat captain with weather forecast
	predicting 20-30 knots thoughout morning, building to 30-40 knots from SE in the afternoon
0925	Heading to Port Edward area to observe onsite weather conditions firsthand
1000	Drove along coast south of Port Edward to point overlooking trestle survey area
	-Confirmed high winds (est. 20-25 knots) and rough sea state (~2-3 ft wind chop) using binoculars;
	conditions not conducive to good quality seismic data collection - Called weather day
1030	Contacted replacement vessel captain to confirm down on weather / Returning to Prince Rupert
1100	Back at hotel in Prince Rupert / Switching day's focus to further QC and preliminary processing of data
1205	Received phone call from Kevin (vessel captain from 05/12-05/13) confirming weather severity on-site
1635	Received phone call from John Turpin to further discuss weather conditions and tomorrow's survey ops.

DAILY PROGRESS REPORT

Fugro Pelagos Inc.
4820 McGrath St., Suite 100, Ventura CA 93003
Phone: 805-650-7000 Fax: 805-658-6679

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Party Chief		Approval	
	Fugro Consultant Inc.		Company representative

DAILY PROGRESS REPORT

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CLIENT:	KBR	DIVISION:	
JOB DESCRIPTION:	SB - Seismic survey	REPORT No.:	14
VESSEL:	My Lady	DATE:	May 15, 2013
LOCATION:	Lelu Island, BC	JOB No.:	23.00007028
HORIZONTAL DATUM/ZONE:	UTM 9	PROJ. MANAGER:	
VERTICAL DATUM:	MLW	TELEPHONE:	805.650.7000

PERSONNEL	Name	Hours	HEALTH AND SAFETY:
PARTY CHIEF			
SENIOR SURVEYOR			
MBES ENGINEER			WEATHER CONDITIONS:
GEOPHYSICAL TECH	D. Ebuna	13	Consistent rain, 5-15 kts, calm - 2 ft wind waves; see
GEOPHYSICAL TECH	M. Williams	13	below for specific conditions throughout the day
SURVEY TECHNICIAN			

TIME	EVENT
0745	Meet at hotel Lobby for breakfast
0800	Depart hotel for Port Edward
0830	Arrive at Port Edward / Daily Safety meeting
0845	Vessel departs dock to check weather at survey site
	WEATHER (in channel) - overcast and heavy rain, 5 kts SE wind, calm sea state
0905	Arrive at offshore survey site
	WEATHER - occasional white caps, ~15 kts SE wind, 1-2 ft wind waves
	-will deploy equipment and check data quality
0925	Equipment deployed and began data collection - data quality not great but acceptable
1050	Pulled in streamer to investigate semi-regular noise in data - looks fine, re-deploy
1115	WEATHER - 10-15 kts SE wind, 1-2 ft wind waves
1150	Noise in data appears to coincide with prop. wash - increasing streamer offsets
1235	Pause in data collection to perform quick QC of data to see if new offsets have improved data quality
	-Prop. wash/noise still interfering with data in shallow section of survey area
	-Problem solving - Contacted Mike Barth - Confirmed only solution is to move source and streamer
	offsets even further back
	WEATHER - has improved to 5-10 kts SE wind, 1 ft wind waves
1400	Changing offsets as far back as boomer plate power cable allows; src=25m, near=31.25m, far=43.75m
1420	Repeated freezes of GeoEel software at start of lines, but working through it
1525	Prop. noise has decreased but direct arrival of boomer pulse interfering with seafloor return
	-Moving near offset closer to source in hopes of bringing direct arrival up in profile
1530	Continued freezing/crashing/"GeoEel not responding" errors, but working through it
	WEATHER - 5-10 kts SE wind, calm sea state
1555	Channels being overdriven and very poor data quality due to source being too close to streamer
	-Returning to previous offsets - apparently not possible to avoid direct arrival interfering with seafloor
	return in shallow areas of survey - hope to be able to remove/minimize during data processing
1625	Streamer caught up on boomer sled - recovered and re-deployed equipment
	-GeoEel computer problems persist throughout rest of day, but working through it
1820	WEATHER - 10 kts S wind, 1 ft wind waves, slack high tide
1958	End of data collection - have run all offshore mooring and trestle lines and relevant tie lines at least once
2000	Recovering equipment
2010	Returning to dock
2030	Back at dock / returning to Prince Rupert
2100	Back at hotel in Prince Rupert

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CLIENT:	KBR	DIVISION:	
JOB DESCRIPTION:	SB - Seismic survey	REPORT No.:	15
VESSEL:	My Lady	DATE:	May 16, 2013
LOCATION:	Lelu Island, BC	JOB No.:	23.00007028
HORIZONTAL DATUM/ZONE:	UTM 9	PROJ. MANAGER:	
VERTICAL DATUM:	MLW	TELEPHONE:	805.650.7000

PERSONNEL	Name	Hours	HEALTH AND SAFETY:
PARTY CHIEF			
SENIOR SURVEYOR			
MBES ENGINEER			WEATHER CONDITIONS:
GEOPHYSICAL TECH	D. Ebuna	12	At Port Edward: Warm and sunny with calm winds
GEOPHYSICAL TECH	M. Williams	12	in the morning and partly cloudy with calm winds in
SURVEY TECHNICIAN			the afternoon

TIME	EVENT
0900	Depart hotel for Port Edward
0930	Arrive at Port Edward / Daily safety meeting
0940	Begin demobilization of vessel My Lady
1300	All equipment off of vessel / Continue to organize, pack, and secure equipment for shipping
1430	Vessel My Lady departs Port Edward for Prince Rupert
1630	All equipment palletized according to shipping invoice and ready for pick-up tomorrow morning
1700	Back in Prince Rupert returning rented generator
1730	Back at hotel printing shipping documents and labels

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CLIENT:	KBR	DIVISION:	
JOB DESCRIPTION:	SB - Seismic survey	REPORT No.:	16
VESSEL:	My Lady	DATE:	May 17, 2013
LOCATION:	Lelu Island, BC	JOB No.:	23.00007028
HORIZONTAL DATUM/ZONE:	UTM 9	PROJ. MANAGER:	
VERTICAL DATUM:	MLW	TELEPHONE:	805.650.7000

PERSONNEL	Name	Hours	HEALTH AND SAFETY:
PARTY CHIEF			
SENIOR SURVEYOR			
MBES ENGINEER			WEATHER CONDITIONS:
GEOPHYSICAL TECH	D. Ebuna	12	At Port Edward: Overcast and rainy, 5-10 knot winds
GEOPHYSICAL TECH	M. Williams	12	
SURVEY TECHNICIAN			

TIME	EVENT
1000	Depart hotel for Port Edward
1030	Arrive at Port Edward / Applying new shipping lables to pallets
1140	Truck arrives to pick up main shipment (10 pallets)
1240	Second truck arrives to pick up ITAR controlled yellow tote
1300	Depart Port Edward for Prince Rupert
1330	Arrive back at hotel in Prince Rupert

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CLIENT:	KBR	DIVISION:	
JOB DESCRIPTION:	Hydrographic/Geophysical	REPORT No.:	17
VESSEL:		DATE:	May 18, 2013
LOCATION:	Lelu Island, BC	JOB No.:	23.00007028
HORIZONTAL DATUM/ZONE:	UTM 9	PROJ. MANAGER:	
VERTICAL DATUM:	MLW	TELEPHONE:	805.650.7000

PERSONNEL	Name	Hours	HEALTH AND SAFETY:
PARTY CHIEF			
SENIOR SURVEYOR			
MBES ENGINEER			WEATHER CONDITIONS:
GEOPHYSICAL TECH	D. Ebuna	12	In Prince Rupert: Overcast and rainy, 5 knot winds
GEOPHYSICAL TECH	M. Williams	12	
SURVEY TECHNICIAN			

TIME	EVENT
0800	Depart hotel to return rental vehicle and board shuttle to Prince Rupert airport
1045	Depart Prince Rupert airport for Vancouver International Airport
1230	Arrive at Vancouver International Airport
1830	Depart Vancouver International Airport for Los Angeles International Airport
2115	Arrive at LAX / Claiming baggage and getting rental car to return to Ventura
2300	Back in Ventura

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B SIDE SCAN SONAR TARGET TABLE

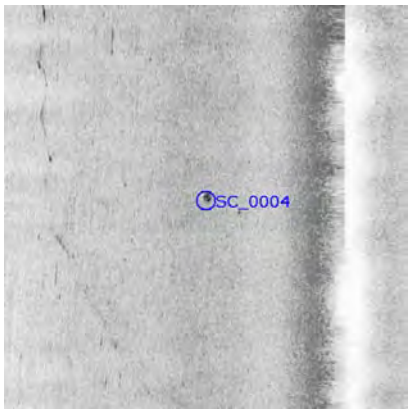
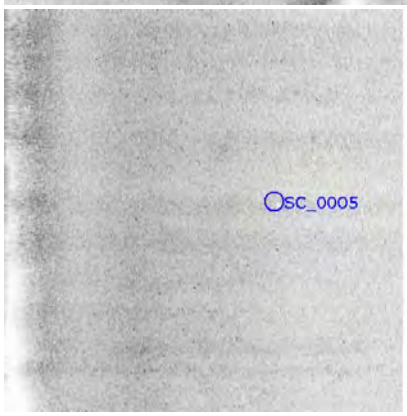
Target No.	Easting	Northing	Length	Width	Height	Description
	UTM Zone 9 North Meters		Meters			
SC_0007	412715	6005429	3.6	0.9	0.2	Unidentified Small Target
SC_0012	412800	6005052	2.7	1.9	0.6	Unidentified Target - Probable Boulders
SC_0018	412895	6005260	1.3	1.0	0.4	Unidentified Small Target - Possible Dropstone
SC_0021	413071	6005025	4.5	1.0	0.4	Nondescript Isolated Target - Possible Large Dropstone or Unidentified Debris
SC_0022	413137	6004781	3.2	0.5	0.2	Unidentified Target - Probable Log
SC_0025	413180	6004909	1.6	1.2	0.3	Unidentified Target - Possible Large Rocks
SC_0029	413256	6004835	7.3	0.6	0.1	Unidentified Target - Probable Log
SC_0039	413447	6005134	1.3	1.1	0.1	Unidentified Target - Possible Large Rocks
SC_0045	413715	6005511	3.8	1.1	0.3	Unidentified Target - Probable Log
SC_0053	414830	6006447	6.1	1.1	0.3	Unidentified Linear Target with 2 Other Targets Nearby
SC_0054	414937	6007123	0.6	0.5	0.2	Unidentified Target - Probable Tires
SC_0055	414949	6007106	1.8	0.6	0.2	Unidentified Target - Possible Large Rocks
SC_0056	414962	6007150	3.8	0.4	0.3	Unidentified Target - Probable Log
SC_0058	415046	6007147	12.3	3.4	3.3	Very Large and Tall Target - Possible Rock Outcrop
SC_0059	415040	6007224	1.5	1.5	0.6	Unidentified Target - Possible Large Rocks
SC_0060	415134	6007207	19.2	9.2	0.1	Unusual array of linear targets. Possible man-made sunken structure
SC_0061	415151	6007126	2.6	2.3	0.8	Unidentified Target - Possible Large Rocks
SC_0062	415174	6006984	4.0	0.3	0.1	Unidentified Target - Probable Log

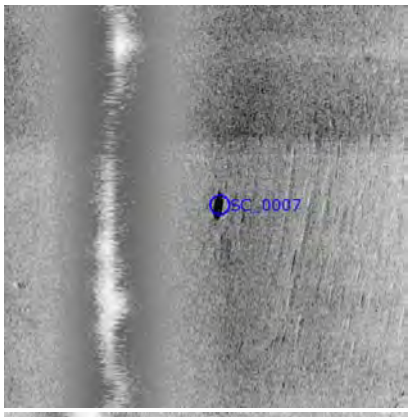
Target No.	Easting	Northing	Length	Width	Height	Description
	UTM Zone 9 North Meters		Meters			
SC_0063	415179	6007202	2.0	2.0	0	Unidentified Target - Possible Large Rocks
SC_0064	415266	6007509	4.6	1.2	0.6	Unidentified Target - Possible Large Rocks
SC_0065	415274	6007547	0.6	1.0	0.1	Unidentified Target - Possible Large Rocks
SC_0067	415302	6007588	0.9	1.2	0.1	Unidentified Target - Probable Tires
SC_0069	415346	6007842	7.5	0.7	0.1	Unidentified Target - Probable Log
SC_0070	415353	6007887	3.5	0.8	0.2	Unidentified Target - Probable Log
SC_0071	415358	6007159	8.3	0.6	0.2	Unidentified Target - Probable Log
SC_0073	415375	6007769	11.6	0.8	0.5	Unidentified Target - Probable Log
SC_0074	415373	6007587	2.7	3.0	1.3	Unidentified Target - Probable Boulders
SC_0075	415380	6007757	14.7	0.7	0.3	Unidentified Target - Probable Log
SC_0076	415405	6007935	10.2	0.9	0.1	Unidentified Target - Probable Log
SC_0077	415410	6007921	75.0	0.1	0.0	Unidentified Target with Sinuous Shape - Possible Length of Cable or Possible Scar
SC_0078	415413	6007947	9.3	1.2	0.1	Unidentified Target - Probable Log
SC_0079	415428	6007912	10.1	0.8	0.1	Unidentified Target - Probable Log
SC_0080	415429	6007751	11.5	0.8	0.3	Unidentified Target - Probable Log
SC_0081	415453	6007917	5.9	0.7	0.1	Unidentified Target - Probable Log
SC_0082	415470	6007986	0.5	0.7	0.2	Unidentified Target - Probable Log

C SIDE SCAN SONAR TARGET REPORT

Side Scan Sonar Contact Report

Generated by Sonarwiz5 on 6/18/2013

Contact Image	Contact Info	User Entered Info
	**SC_0004** • Sonar Time at Target: 05/07/2013 22:34:34 • Click Position (Lat/Lon Coordinates) 54° 11.41169' N 130° 20.31342' W (WGS84) • Map Proj: UTM84-9N • Acoustic Source File: S:\0-Fugro_LELU_Data_SSS\4125Lelu\Line_1H.xtf • Ping Number: 26698 • Range to Target: 17.15 Meters • Fish Height: 8.09 Meters • Heading: 140.190 degrees	**Dimensions** Target Height: = 0.0 Meters Target Length: 0.0 Meters Target Shadow: 0.0 Meters Target Width: 0.0 Meters Description: Crab Pot
	**SC_0005** • Sonar Time at Target: 05/07/2013 22:34:06 • Click Position (Lat/Lon Coordinates) 54° 11.45393' N 130° 20.30000' W (WGS84) • Map Proj: UTM84-9N • Acoustic Source File: S:\0-Fugro_LELU_Data_SSS\4125Lelu\Line_1H.xtf • Ping Number: 26293 • Range to Target: 33.42 Meters • Fish Height: 7.52 Meters • Heading: 260.200 degrees	**Dimensions** Target Height: = 0.0 Meters Target Length: 0.0 Meters Target Shadow: 0.0 Meters Target Width: 0.0 Meters Description: Crab Pot
	SC_0006 • Sonar Time at Target: 05/07/2013 22:35:13 • Click Position (Lat/Lon Coordinates) 54° 11.36072' N 130° 20.28184' W (WGS84) • Map Proj: UTM84-9N • Acoustic Source File: S:\0-Fugro_LELU_Data_SSS\4125Lelu\Line_12H.xtf • Ping Number: 27266 • Range to Target: 35.95 Meters • Fish Height: 6.82 Meters • Heading: 113.800 degrees	**Dimensions** Target Height: = 0.0 Meters Target Length: 0.0 Meters Target Shadow: 0.0 Meters Target Width: 0.0 Meters Description: Crab Pot

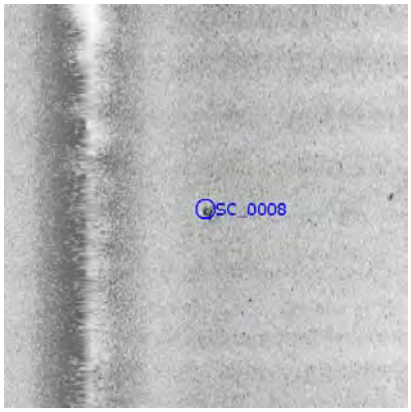


SC_0007

- Sonar Time at Target: 05/07/2013 22:29:41
- Click Position (Lat/Lon Coordinates)
  54° 11.36836' N 130° 20.26278' W (WGS84)
- Map Proj: UTM84-9N
- Acoustic Source File: S:\0-Fugro_LELU_Data_SSS\4125Lelu\Line_1H.xtf
- Ping Number: 22494
- Range to Target: 13.06 Meters
- Fish Height: 6.26 Meters
- Heading: 71.590 degrees

Dimensions
Target Height: = 0.2 Meters
Target Length: 3.6 Meters
Target Shadow: 0.4 Meters
Target Width: 0.9 Meters

Description: Unidentified Small Target

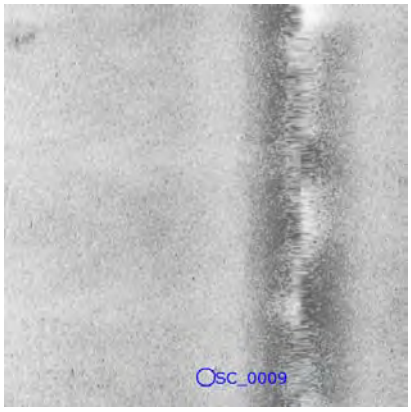


SC_0008

- Sonar Time at Target: 05/07/2013 22:33:51
- Click Position (Lat/Lon Coordinates)
  54° 11.43923' N 130° 20.25091' W (WGS84)
- Map Proj: UTM84-9N
- Acoustic Source File: S:\0-Fugro_LELU_Data_SSS\4125Lelu\Line_1H.xtf
- Ping Number: 26085
- Range to Target: 14.71 Meters
- Fish Height: 7.17 Meters
- Heading: 288.790 degrees

Dimensions
Target Height: = 0.5 Meters
Target Length: 1.5 Meters
Target Shadow: 1.2 Meters
Target Width: 1.7 Meters

Description: Crab Pot

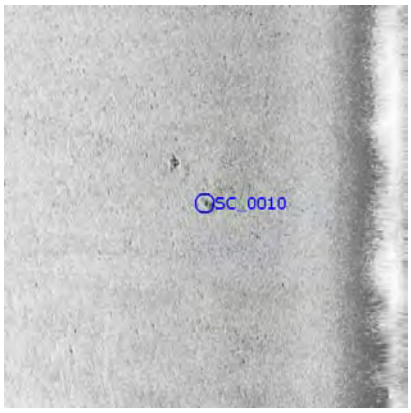


SC_0009

- Sonar Time at Target: 05/07/2013 22:35:06
- Click Position (Lat/Lon Coordinates)
  54° 11.38514' N 130° 20.25900' W (WGS84)
- Map Proj: UTM84-9N
- Acoustic Source File: S:\0-Fugro_LELU_Data_SSS\4125Lelu\Line_1H.xtf
- Ping Number: 27164
- Range to Target: 11.69 Meters
- Fish Height: 7.24 Meters
- Heading: 113.400 degrees

Dimensions
Target Height: = 0.3 Meters
Target Length: 1.5 Meters
Target Shadow: 0.6 Meters
Target Width: 1.5 Meters

Description: Crab Pot

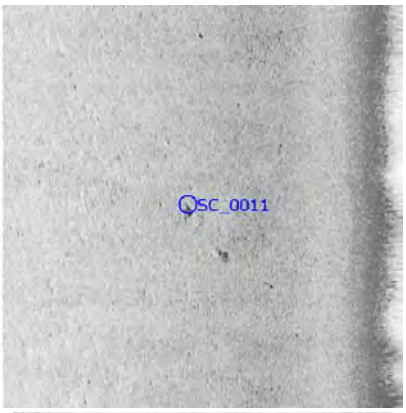


SC_0010

- Sonar Time at Target: 05/07/2013 22:33:40
- Click Position (Lat/Lon Coordinates)
  54° 11.41208' N 130° 20.24292' W (WGS84)
- Map Proj: UTM84-9N
- Acoustic Source File: S:\0-Fugro_LELU_Data_SSS\4125Lelu\Line_1H.xtf
- Ping Number: 25919
- Range to Target: 22.60 Meters
- Fish Height: 6.88 Meters
- Heading: 308.390 degrees

Dimensions
Target Height: = 0.0 Meters
Target Length: 0.0 Meters
Target Shadow: 0.0 Meters
Target Width: 0.0 Meters

Description: Crab Pot



SC_0011

- Sonar Time at Target: 05/07/2013 22:33:38
- Click Position (Lat/Lon Coordinates)
  54° 11.40857' N 130° 20.24119' W (WGS84)
- Map Proj: UTM84-9N
- Acoustic Source File: S:\0-Fugro_LELU_Data_SSS\4125Lelu\Line_1H.xtf
- Ping Number: 25890
- Range to Target: 26.40 Meters
- Fish Height: 6.84 Meters
- Heading: 316.390 degrees

Dimensions
Target Height: = 0.0 Meters
Target Length: 0.0 Meters
Target Shadow: 0.0 Meters
Target Width: 0.0 Meters

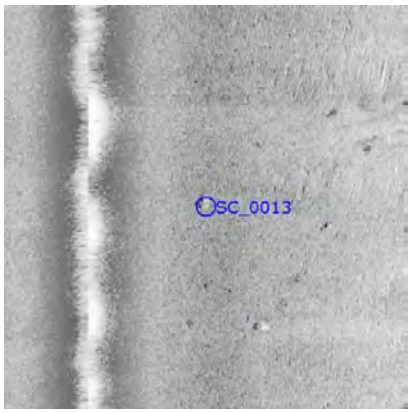
Description: Crab Pot

SC_0012

- Sonar Time at Target: 05/08/2013 23:33:04
- Click Position (Lat/Lon Coordinates)
  54° 11.16561' N 130° 20.17823' W (WGS84)
- Map Proj: UTM84-9N
- Acoustic Source File: S:\0-Fugro_LELU_Data_SSS\4125Lelu\2H.xtf
- Ping Number: 188047
- Range to Target: 38.78 Meters
- Fish Height: 20.30 Meters
- Heading: 115.400 degrees

Dimensions
Target Height: = 0.6 Meters
Target Length: 2.7 Meters
Target Shadow: 1.3 Meters
Target Width: 1.9 Meters

Description: Unidentified Target - Probable Boulders

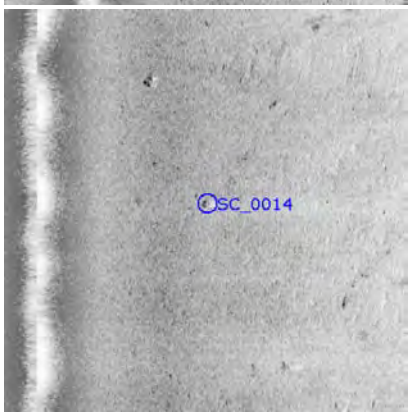


SC_0013

- Sonar Time at Target: 05/07/2013 22:36:15
- Click Position (Lat/Lon Coordinates)
  54° 11.29972' N 130° 20.16589' W (WGS84)
- Map Proj: UTM84-9N
- Acoustic Source File: S:\0-Fugro_LELU_Data_SSS\4125Lelu\Line_12H.xtf
- Ping Number: 28147
- Range to Target: 14.52 Meters
- Fish Height: 5.80 Meters
- Heading: 105.800 degrees

Dimensions
Target Height: = 0.0 Meters
Target Length: 0.0 Meters
Target Shadow: 0.0 Meters
Target Width: 0.0 Meters

Description: Crab Pot

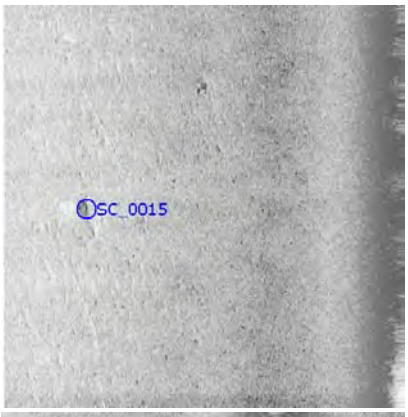


SC_0014

- Sonar Time at Target: 05/07/2013 22:36:21
- Click Position (Lat/Lon Coordinates)
  54° 11.29148' N 130° 20.16068' W (WGS84)
- Map Proj: UTM84-9N
- Acoustic Source File: S:\0-Fugro_LELU_Data_SSS\4125Lelu\Line_12H.xtf
- Ping Number: 28225
- Range to Target: 21.04 Meters
- Fish Height: 5.65 Meters
- Heading: 113.400 degrees

Dimensions
Target Height: = 0.3 Meters
Target Length: 1.0 Meters
Target Shadow: 1.1 Meters
Target Width: 1.1 Meters

Description: Crab Pot

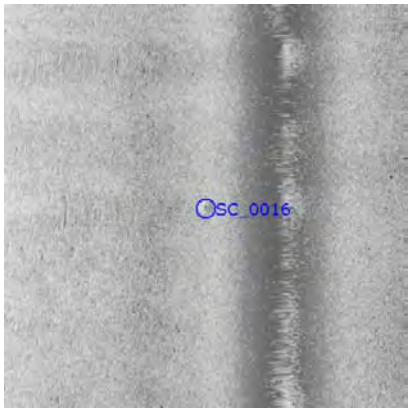


SC_0015

- Sonar Time at Target: 05/07/2013 22:32:49
- Click Position (Lat/Lon Coordinates)
  54° 11.35160' N 130° 20.14742' W (WGS84)
- Map Proj: UTM84-9N
- Acoustic Source File: S:\0-Fugro_LELU_Data_SSS\4125Lelu\Line_1H.xtf
- Ping Number: 25191
- Range to Target: 39.16 Meters
- Fish Height: 6.13 Meters
- Heading: 316.500 degrees

Dimensions
Target Height: = 0.0 Meters
Target Length: 0.0 Meters
Target Shadow: 0.0 Meters
Target Width: 0.0 Meters

Description: Crab Pot

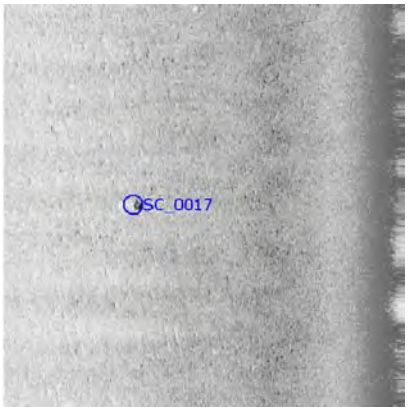


SC_0016

- Sonar Time at Target: 05/07/2013 22:31:04
- Click Position (Lat/Lon Coordinates)
  54° 11.29084' N 130° 20.12406' W (WGS84)
- Map Proj: UTM84-9N
- Acoustic Source File: S:\0-Fugro_LELU_Data_SSS\4125Lelu\Line_1H.xtf
- Ping Number: 23682
- Range to Target: 9.45 Meters
- Fish Height: 6.05 Meters
- Heading: 115.590 degrees

Dimensions
Target Height: = 0.0 Meters
Target Length: 0.0 Meters
Target Shadow: 0.0 Meters
Target Width: 0.0 Meters

Description: Crab Pot

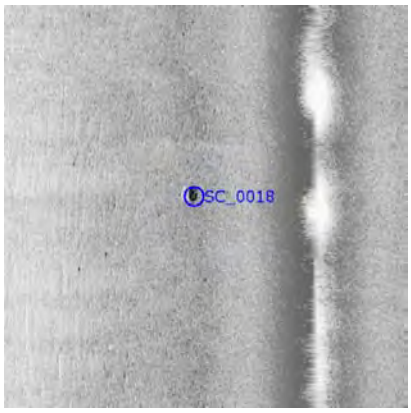


SC_0017

- Sonar Time at Target: 05/07/2013 22:32:33
- Click Position (Lat/Lon Coordinates)
  54° 11.33832' N 130° 20.11539' W (WGS84)
- Map Proj: UTM84-9N
- Acoustic Source File: S:\0-Fugro_LELU_Data_SSS\4125Lelu\Line_1H.xtf
- Ping Number: 24961
- Range to Target: 33.42 Meters
- Fish Height: 5.75 Meters
- Heading: 314.890 degrees

Dimensions
Target Height: = 0.0 Meters
Target Length: 1.4 Meters
Target Shadow: 0.0 Meters
Target Width: 2.0 Meters

Description: Crab Pot

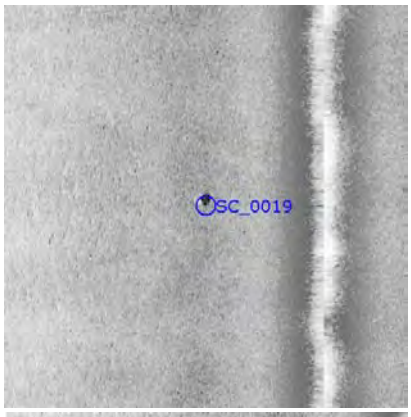


SC_0018

- Sonar Time at Target: 05/07/2013 22:31:22
- Click Position (Lat/Lon Coordinates)
  54° 11.27883' N 130° 20.09420' W (WGS84)
- Map Proj: UTM84-9N
- Acoustic Source File: S:\0-Fugro_LELU_Data_SSS\4125Lelu\Line_1H.xtf
- Ping Number: 23948
- Range to Target: 14.81 Meters
- Fish Height: 5.62 Meters
- Heading: 98.400 degrees

Dimensions
Target Height: = 0.4 Meters
Target Length: 1.3 Meters
Target Shadow: 1.1 Meters
Target Width: 1.0 Meters

Description: Unidentified Small Target - Possible Dropstone

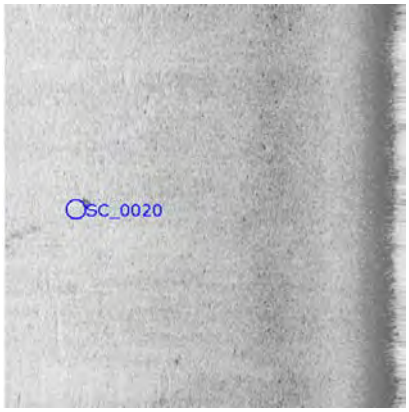


SC_0019

- Sonar Time at Target: 05/07/2013 22:36:48
- Click Position (Lat/Lon Coordinates)
  54° 11.27387' N 130° 20.09081' W (WGS84)
- Map Proj: UTM84-9N
- Acoustic Source File: S:\0-Fugro_LELU_Data_SSS\4125Lelu\Line_12H.xtf
- Ping Number: 28623
- Range to Target: 14.52 Meters
- Fish Height: 5.31 Meters
- Heading: 112.500 degrees

Dimensions
Target Height: = 0.0 Meters
Target Length: 0.0 Meters
Target Shadow: 0.0 Meters
Target Width: 0.0 Meters

Description: Crab Pot



SC_0020

- Sonar Time at Target: 05/07/2013 22:37:19
- Click Position (Lat/Lon Coordinates)
  54° 11.24973' N 130° 20.02265' W (WGS84)
- Map Proj: UTM84-9N
- Acoustic Source File: S:\0-Fugro_LELU_Data_SSS\4125Lelu\Line_12H.xtf
- Ping Number: 29075
- Range to Target: 40.72 Meters
- Fish Height: 5.50 Meters
- Heading: 111.590 degrees

Dimensions
Target Height: = 0.0 Meters
Target Length: 0.0 Meters
Target Shadow: 0.0 Meters
Target Width: 0.0 Meters

Description: Crab Pot

SC_0021

- Sonar Time at Target: 05/08/2013 19:35:32
- Click Position (Lat/Lon Coordinates)
  54° 11.15430' N 130° 19.92814' W (WGS84)
- Map Proj: UTM84-9N
- Acoustic Source File: S:\0-Fugro_LELU_Data_SSS\4125Lelu\17H.xtf
- Ping Number: 34388
- Range to Target: 32.83 Meters
- Fish Height: 8.94 Meters
- Heading: 221.000 degrees

Dimensions
Target Height: = 0.4 Meters
Target Length: 4.5 Meters
Target Shadow: 1.4 Meters
Target Width: 1.0 Meters

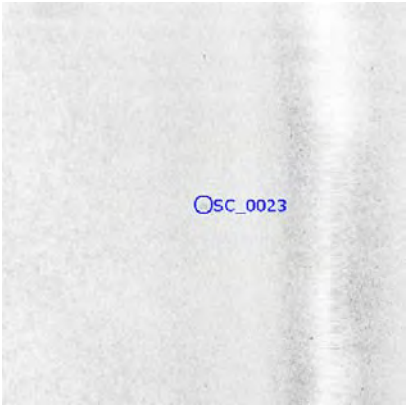
Description: Nondescript Isolated Target - Possible Large Dropstone or Unidentified Debris

SC_0022

- Sonar Time at Target: 05/08/2013 23:16:36
- Click Position (Lat/Lon Coordinates)
  54° 11.02333' N 130° 19.86370' W (WGS84)
- Map Proj: UTM84-9N
- Acoustic Source File: S:\0-Fugro_LELU_Data_SSS\4125Lelu\6H.xtf
- Ping Number: 178099
- Range to Target: 40.24 Meters
- Fish Height: 12.80 Meters
- Heading: 302.200 degrees

Dimensions
Target Height: = 0.2 Meters
Target Length: 3.2 Meters
Target Shadow: 0.7 Meters
Target Width: 0.5 Meters

Description: Unidentified Target - Probable Log

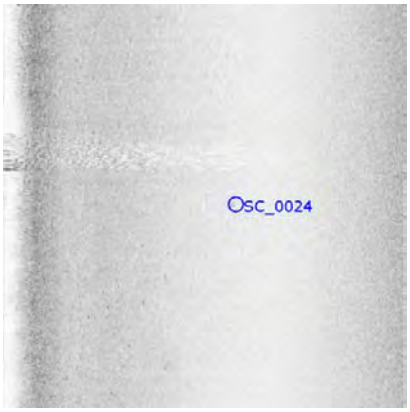


SC_0023

- Sonar Time at Target: 05/08/2013 20:17:09
- Click Position (Lat/Lon Coordinates)
  54° 11.10915' N 130° 19.85180' W (WGS84)
- Map Proj: UTM84-9N
- Acoustic Source File: S:\0-Fugro_LELU_Data_SSS\4125Lelu\13AH.xtf
- Ping Number: 70249
- Range to Target: 15.78 Meters
- Fish Height: 8.99 Meters
- Heading: 23.790 degrees

Dimensions
Target Height: = 0.5 Meters
Target Length: 1.3 Meters
Target Shadow: 1.1 Meters
Target Width: 1.3 Meters

Description: Crab Pot



SC_0024

- Sonar Time at Target: 05/09/2013 00:41:08
- Click Position (Lat/Lon Coordinates)
  54° 10.88927' N 130° 19.82990' W (WGS84)
- Map Proj: UTM84-9N
- Acoustic Source File: S:\0-Fugro_LELU_Data_SSS\4125Lelu\4H.xtf
- Ping Number: 227422
- Range to Target: 43.17 Meters
- Fish Height: 8.83 Meters
- Heading: 116.590 degrees

Dimensions
Target Height: = 0.0 Meters
Target Length: 0.0 Meters
Target Shadow: 0.0 Meters
Target Width: 0.0 Meters

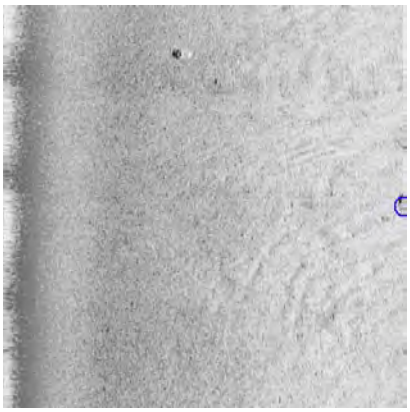
Description: Crab Pot

SC_0025

- Sonar Time at Target: 05/08/2013 20:17:09
- Click Position (Lat/Lon Coordinates)
  54° 11.09280' N 130° 19.82611' W (WGS84)
- Map Proj: UTM84-9N
- Acoustic Source File: S:\0-Fugro_LELU_Data_SSS\4125Lelu\13AH.xtf
- Ping Number: 70254
- Range to Target: 25.43 Meters
- Fish Height: 8.94 Meters
- Heading: 31.100 degrees

Dimensions
Target Height: = 0.3 Meters
Target Length: 1.6 Meters
Target Shadow: 1.1 Meters
Target Width: 1.2 Meters

Description: Unidentified Target - Possible Large Rocks

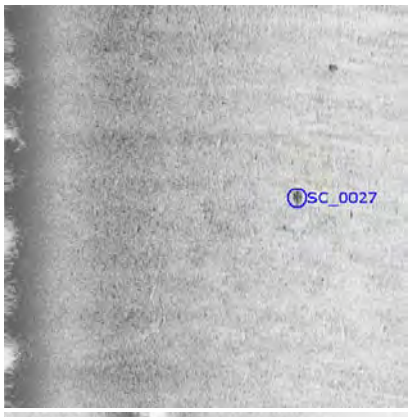


SC_0026

- Sonar Time at Target: 05/07/2013 22:50:37
- Click Position (Lat/Lon Coordinates)
  54° 11.09078' N 130° 19.79129' W (WGS84)
- Map Proj: UTM84-9N
- Acoustic Source File: S:\0-Fugro_LELU_Data_SSS\4125Lelu\Line_13H.xtf
- Ping Number: 40537
- Range to Target: 49.59 Meters
- Fish Height: 4.82 Meters
- Heading: 27.200 degrees

Dimensions
Target Height: = 0.0 Meters
Target Length: 0.0 Meters
Target Shadow: 0.0 Meters
Target Width: 0.0 Meters

Description: Crab Pot

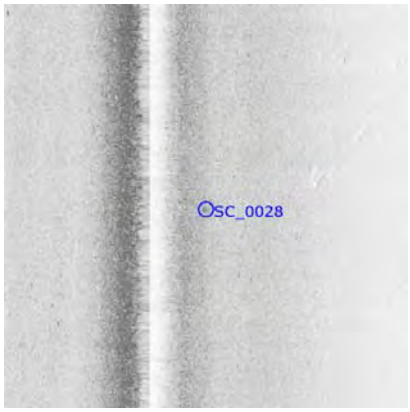


SC_0027

- Sonar Time at Target: 05/07/2013 23:51:38
- Click Position (Lat/Lon Coordinates)
  54° 11.19755' N 130° 19.77855' W (WGS84)
- Map Proj: UTM84-9N
- Acoustic Source File: S:\0-Fugro_LELU_Data_SSS\4125Lelu\15H.xtf
- Ping Number: 28295
- Range to Target: 36.19 Meters
- Fish Height: 4.58 Meters
- Heading: 222.500 degrees

Dimensions
Target Height: = 0.4 Meters
Target Length: 1.7 Meters
Target Shadow: 3.1 Meters
Target Width: 1.2 Meters

Description: Crab Pot

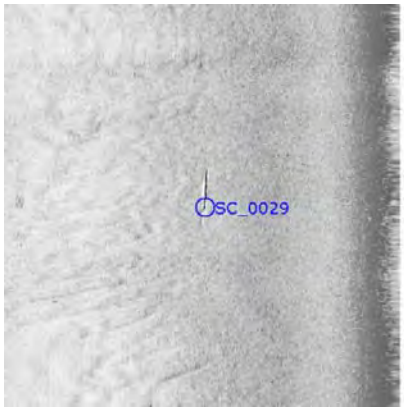


SC_0028

- Sonar Time at Target: 05/09/2013 00:41:50
- Click Position (Lat/Lon Coordinates)
  54° 10.86885' N 130° 19.76243' W (WGS84)
- Map Proj: UTM84-9N
- Acoustic Source File: S:\0-Fugro_LELU_Data_SSS\4125Lelu\4H.xtf
- Ping Number: 227825
- Range to Target: 10.39 Meters
- Fish Height: 9.88 Meters
- Heading: 117.300 degrees

Dimensions
Target Height: = 0.0 Meters
Target Length: 0.0 Meters
Target Shadow: 0.0 Meters
Target Width: 0.0 Meters

Description: Crab Pot

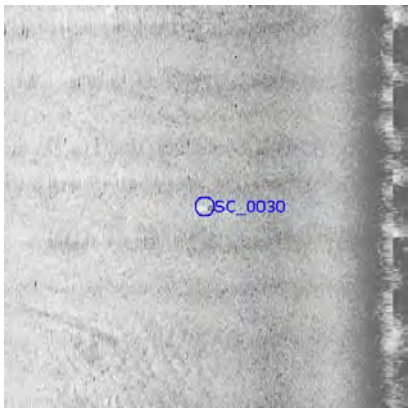


SC_0029

- Sonar Time at Target: 05/07/2013 22:40:09
- Click Position (Lat/Lon Coordinates)
  54° 11.05371' N 130° 19.75480' W (WGS84)
- Map Proj: UTM84-9N
- Acoustic Source File: S:\0-Fugro_LELU_Data_SSS\4125Lelu\Line_12H.xtf
- Ping Number: 31508
- Range to Target: 23.97 Meters
- Fish Height: 7.21 Meters
- Heading: 110.800 degrees

Dimensions
Target Height: = 0.1 Meters
Target Length: 7.3 Meters
Target Shadow: 0.5 Meters
Target Width: 0.6 Meters

Description: Unidentified Target - Probable Log



SC_0030

- Sonar Time at Target: 05/07/2013 23:51:34
- Click Position (Lat/Lon Coordinates)
  54° 11.17674' N 130° 19.73598' W (WGS84)
- Map Proj: UTM84-9N
- Acoustic Source File: S:\0-Fugro_LELU_Data_SSS\4125Lelu\15H.xtf
- Ping Number: 28241
- Range to Target: 23.09 Meters
- Fish Height: 4.58 Meters
- Heading: 219.000 degrees

Dimensions
Target Height: = 0.3 Meters
Target Length: 0.9 Meters
Target Shadow: 1.5 Meters
Target Width: 1.1 Meters

Description: Crab Pot

SC_0031

- Sonar Time at Target: 05/09/2013 00:42:31
- Click Position (Lat/Lon Coordinates)
  54° 10.82641' N 130° 19.73798' W (WGS84)
- Map Proj: UTM84-9N
- Acoustic Source File: S:\0-Fugro_LELU_Data_SSS\4125Lelu\4H.xtf
- Ping Number: 228223
- Range to Target: 44.34 Meters
- Fish Height: 10.10 Meters
- Heading: 116.590 degrees

Dimensions
Target Height: = 0.0 Meters
Target Length: 0.0 Meters
Target Shadow: 0.0 Meters
Target Width: 0.0 Meters

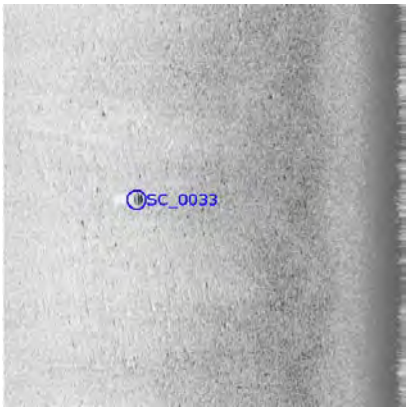
Description: Crab Pot

SC_0032

- Sonar Time at Target: 05/08/2013 20:17:52
- Click Position (Lat/Lon Coordinates)
  54° 11.14039' N 130° 19.73769' W (WGS84)
- Map Proj: UTM84-9N
- Acoustic Source File: S:\0-Fugro_LELU_Data_SSS\4125Lelu\13AH.xtf
- Ping Number: 70866
- Range to Target: 24.45 Meters
- Fish Height: 7.24 Meters
- Heading: 35.400 degrees

Dimensions
Target Height: = 0.0 Meters
Target Length: 2.6 Meters
Target Shadow: 0.0 Meters
Target Width: 2.1 Meters

Description: Crab Pot

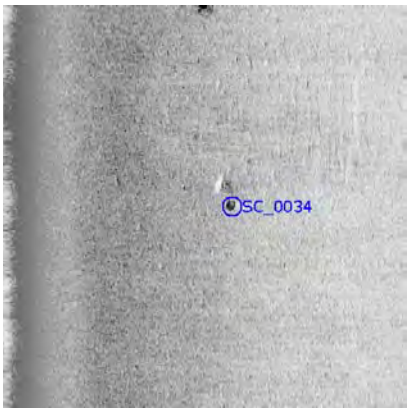


SC_0033

- Sonar Time at Target: 05/07/2013 22:51:31
- Click Position (Lat/Lon Coordinates)
  54° 11.18227' N 130° 19.73649' W (WGS84)
- Map Proj: UTM84-9N
- Acoustic Source File: S:\0-Fugro_LELU_Data_SSS\4125Lelu\Line_13H.xtf
- Ping Number: 41305
- Range to Target: 33.19 Meters
- Fish Height: 4.04 Meters
- Heading: 34.790 degrees

Dimensions
Target Height: = 0.3 Meters
Target Length: 1.6 Meters
Target Shadow: 2.6 Meters
Target Width: 1.3 Meters

Description: Crab Pot

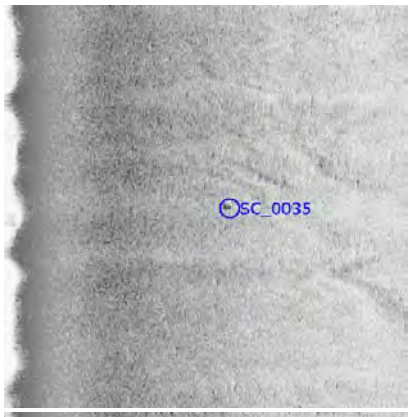


SC_0034

- Sonar Time at Target: 05/07/2013 22:51:18
- Click Position (Lat/Lon Coordinates)
  54° 11.14353' N 130° 19.72713' W (WGS84)
- Map Proj: UTM84-9N
- Acoustic Source File: S:\0-Fugro_LELU_Data_SSS\4125Lelu\Line_13H.xtf
- Ping Number: 41114
- Range to Target: 28.35 Meters
- Fish Height: 3.95 Meters
- Heading: 37.200 degrees

Dimensions
Target Height: = 0.3 Meters
Target Length: 1.3 Meters
Target Shadow: 2.0 Meters
Target Width: 1.1 Meters

Description: Crab Pot

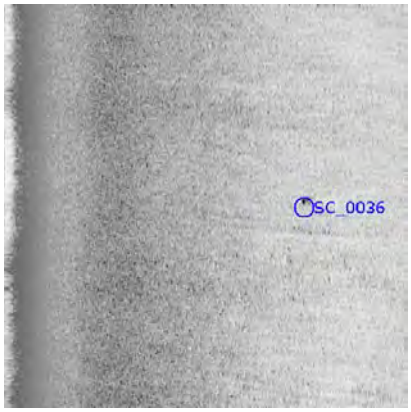


SC_0035

- Sonar Time at Target: 05/07/2013 23:51:07
- Click Position (Lat/Lon Coordinates)
  54° 11.22560' N 130° 19.71382' W (WGS84)
- Map Proj: UTM84-9N
- Acoustic Source File: S:\0-Fugro_LELU_Data_SSS\4125Lelu\15H.xtf
- Ping Number: 27857
- Range to Target: 27.96 Meters
- Fish Height: 4.19 Meters
- Heading: 192.000 degrees

Dimensions
Target Height: = 0.0 Meters
Target Length: 0.0 Meters
Target Shadow: 0.0 Meters
Target Width: 0.0 Meters

Description: Crab Pot

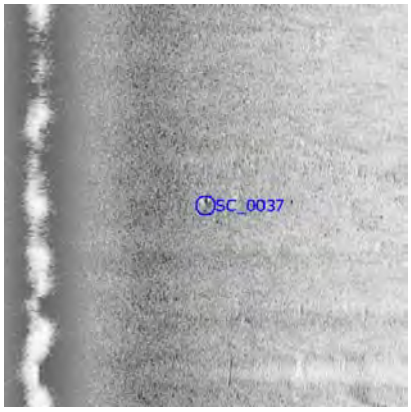


SC_0036

- Sonar Time at Target: 05/07/2013 22:51:36
- Click Position (Lat/Lon Coordinates)
  54° 11.15727' N 130° 19.68587' W (WGS84)
- Map Proj: UTM84-9N
- Acoustic Source File: S:\0-Fugro_LELU_Data_SSS\4125Lelu\Line_13H.xtf
- Ping Number: 41381
- Range to Target: 37.12 Meters
- Fish Height: 3.90 Meters
- Heading: 28.100 degrees

Dimensions
Target Height: = 0.3 Meters
Target Length: 1.3 Meters
Target Shadow: 3.0 Meters
Target Width: 1.1 Meters

Description: Crab Pot

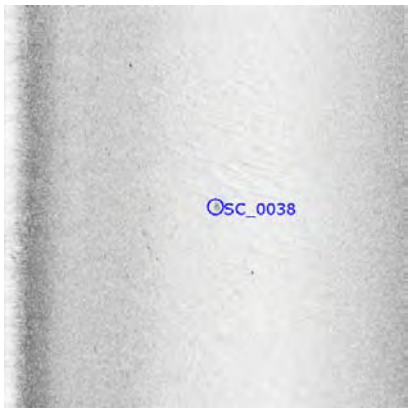


SC_0037

- Sonar Time at Target: 05/07/2013 23:50:35
- Click Position (Lat/Lon Coordinates)
  54° 11.25653' N 130° 19.64422' W (WGS84)
- Map Proj: UTM84-9N
- Acoustic Source File: S:\0-Fugro_LELU_Data_SSS\4125Lelu\15H.xtf
- Ping Number: 27396
- Range to Target: 20.65 Meters
- Fish Height: 4.43 Meters
- Heading: 206.390 degrees

Dimensions
Target Height: = 0.0 Meters
Target Length: 0.0 Meters
Target Shadow: 0.0 Meters
Target Width: 0.0 Meters

Description: Crab Pot

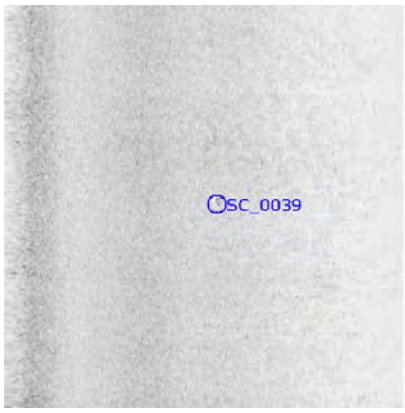


SC_0038

- Sonar Time at Target: 05/09/2013 00:44:09
- Click Position (Lat/Lon Coordinates)
  54° 10.76547' N 130° 19.60201' W (WGS84)
- Map Proj: UTM84-9N
- Acoustic Source File: S:\0-Fugro_LELU_Data_SSS\4125Lelu\4H.xtf
- Ping Number: 229163
- Range to Target: 39.22 Meters
- Fish Height: 8.12 Meters
- Heading: 117.500 degrees

Dimensions
Target Height: = 0.0 Meters
Target Length: 0.0 Meters
Target Shadow: 0.0 Meters
Target Width: 0.0 Meters

Description: Crab Pot

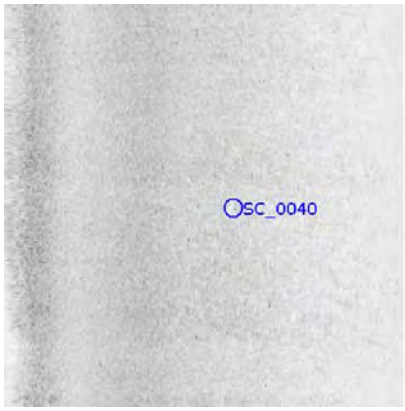


SC_0039

- Sonar Time at Target: 05/08/2013 20:19:03
- Click Position (Lat/Lon Coordinates)
  54° 11.21667' N 130° 19.58403' W (WGS84)
- Map Proj: UTM84-9N
- Acoustic Source File: S:\0-Fugro_LELU_Data_SSS\4125Lelu\13AH.xtf
- Ping Number: 71888
- Range to Target: 26.30 Meters
- Fish Height: 7.31 Meters
- Heading: 34.290 degrees

Dimensions
Target Height: = 0.1 Meters
Target Length: 1.3 Meters
Target Shadow: 0.3 Meters
Target Width: 1.1 Meters

Description: Unidentified Target - Possible Large Rocks

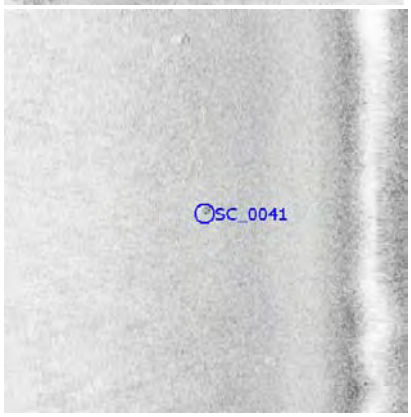


SC_0040

- Sonar Time at Target: 05/08/2013 20:19:24
- Click Position (Lat/Lon Coordinates)
  54° 11.23830' N 130° 19.53840' W (WGS84)
- Map Proj: UTM84-9N
- Acoustic Source File: S:\0-Fugro_LELU_Data_SSS\4125Lelu\13AH.xtf
- Ping Number: 72188
- Range to Target: 28.35 Meters
- Fish Height: 7.27 Meters
- Heading: 23.500 degrees

Dimensions
Target Height: = 0.0 Meters
Target Length: 0.0 Meters
Target Shadow: 0.0 Meters
Target Width: 0.0 Meters

Description: Crab Pot

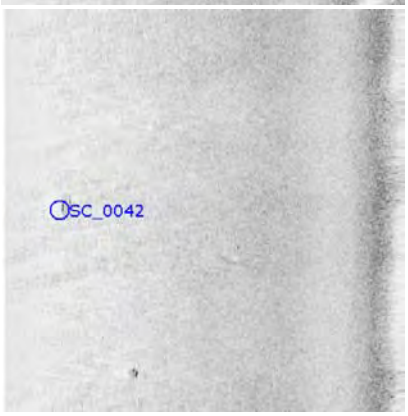


SC_0041

- Sonar Time at Target: 05/08/2013 19:43:03
- Click Position (Lat/Lon Coordinates)
  54° 11.33385' N 130° 19.49228' W (WGS84)
- Map Proj: UTM84-9N
- Acoustic Source File: S:\0-Fugro_LELU_Data_SSS\4125Lelu\15AH.xtf
- Ping Number: 40870
- Range to Target: 21.14 Meters
- Fish Height: 6.42 Meters
- Heading: 21.000 degrees

Dimensions
Target Height: = 0.2 Meters
Target Length: 1.0 Meters
Target Shadow: 0.6 Meters
Target Width: 1.0 Meters

Description: Crab Pot

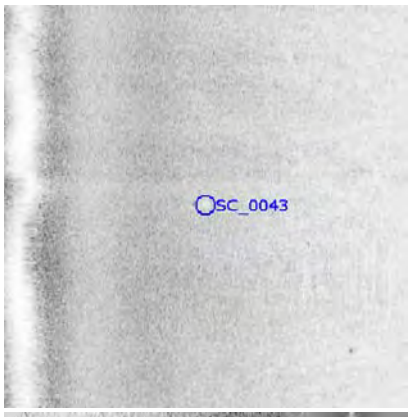


SC_0042

- Sonar Time at Target: 05/08/2013 19:31:48
- Click Position (Lat/Lon Coordinates)
  54° 11.33576' N 130° 19.47137' W (WGS84)
- Map Proj: UTM84-9N
- Acoustic Source File: S:\0-Fugro_LELU_Data_SSS\4125Lelu\17H.xtf
- Ping Number: 31177
- Range to Target: 42.57 Meters
- Fish Height: 6.21 Meters
- Heading: 215.800 degrees

Dimensions
Target Height: = 0.0 Meters
Target Length: 0.0 Meters
Target Shadow: 0.0 Meters
Target Width: 0.0 Meters

Description: Crab Pot

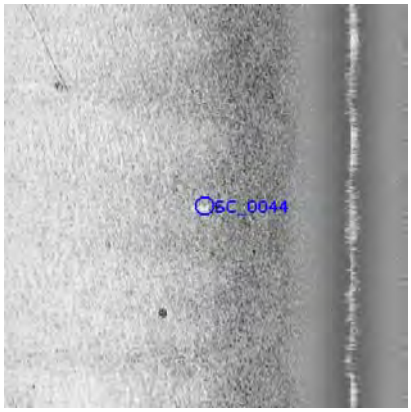


SC_0043

- Sonar Time at Target: 05/08/2013 19:43:21
- Click Position (Lat/Lon Coordinates)
  54° 11.33753' N 130° 19.42649' W (WGS84)
- Map Proj: UTM84-9N
- Acoustic Source File: S:\0-Fugro_LELU_Data_SSS\4125Lelu\15AH.xtf
- Ping Number: 41125
- Range to Target: 22.41 Meters
- Fish Height: 5.99 Meters
- Heading: 11.190 degrees

Dimensions
Target Height: = 0.0 Meters
Target Length: 0.0 Meters
Target Shadow: 0.0 Meters
Target Width: 0.0 Meters

Description: Crab Pot

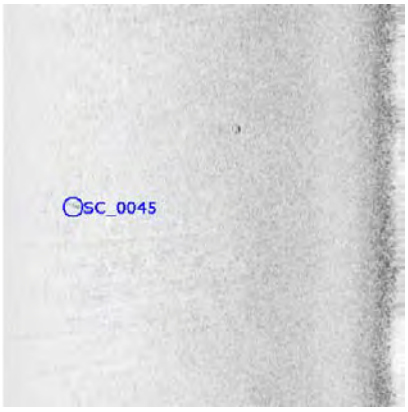


SC_0044

- Sonar Time at Target: 05/07/2013 22:54:05
- Click Position (Lat/Lon Coordinates)
  54° 11.33901' N 130° 19.40442' W (WGS84)
- Map Proj: UTM84-9N
- Acoustic Source File: S:\0-Fugro_LELU_Data_SSS\4125Lelu\Line_13H.xtf
- Ping Number: 43521
- Range to Target: 17.93 Meters
- Fish Height: 2.92 Meters
- Heading: 26.790 degrees

Dimensions
Target Height: = 0.0 Meters
Target Length: 0.0 Meters
Target Shadow: 0.0 Meters
Target Width: 0.0 Meters

Description: Crab Pot

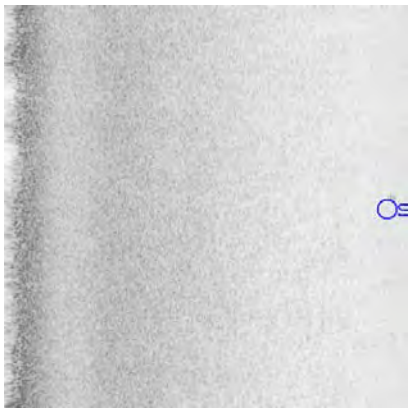


SC_0045

- Sonar Time at Target: 05/08/2013 19:44:15
- Click Position (Lat/Lon Coordinates)
  54° 11.42274' N 130° 19.34455' W (WGS84)
- Map Proj: UTM84-9N
- Acoustic Source File: S:\0-Fugro_LELU_Data_SSS\4125Lelu\15AH.xtf
- Ping Number: 41897
- Range to Target: 40.92 Meters
- Fish Height: 5.38 Meters
- Heading: 40.000 degrees

Dimensions
Target Height: = 0.3 Meters
Target Length: 3.8 Meters
Target Shadow: 2.0 Meters
Target Width: 1.1 Meters

Description: Unidentified Target - Probable Log

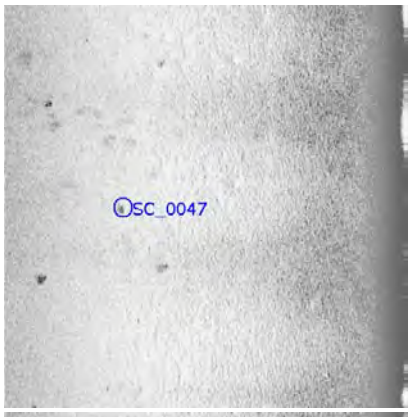


SC_0046

- Sonar Time at Target: 05/08/2013 19:29:34
- Click Position (Lat/Lon Coordinates)
  54° 11.49829' N 130° 19.27869' W (WGS84)
- Map Proj: UTM84-9N
- Acoustic Source File: S:\0-Fugro_LELU_Data_SSS\4125Lelu\17H.xtf
- Ping Number: 29253
- Range to Target: 47.35 Meters
- Fish Height: 4.97 Meters
- Heading: 193.600 degrees

Dimensions
Target Height: = 0.0 Meters
Target Length: 0.0 Meters
Target Shadow: 0.0 Meters
Target Width: 0.0 Meters

Description: Crab Pot

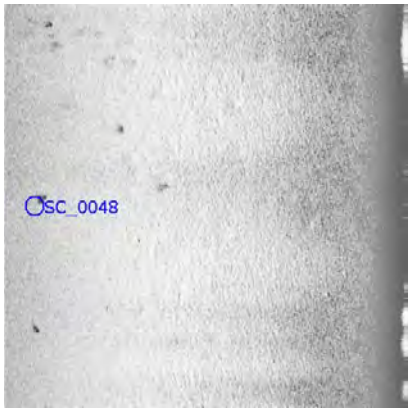


SC_0047

- Sonar Time at Target: 05/07/2013 22:55:17
- Click Position (Lat/Lon Coordinates)
  54° 11.42302' N 130° 19.26951' W (WGS84)
- Map Proj: UTM84-9N
- Acoustic Source File: S:\0-Fugro_LELU_Data_SSS\4125Lelu\Line_13H.xtf
- Ping Number: 44545
- Range to Target: 35.07 Meters
- Fish Height: 1.54 Meters
- Heading: 35.900 degrees

Dimensions
Target Height: = 0.0 Meters
Target Length: 1.3 Meters
Target Shadow: 1.0 Meters
Target Width: 1.1 Meters

Description: Crab Pot

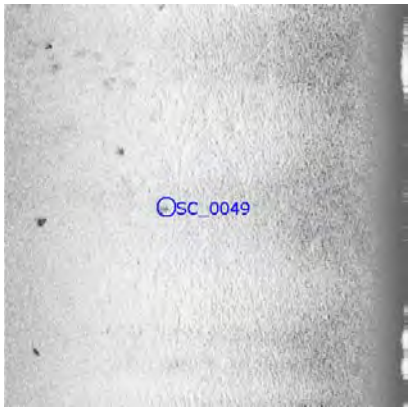


SC_0048

- Sonar Time at Target: 05/07/2013 22:55:20
- Click Position (Lat/Lon Coordinates)
  54° 11.43108' N 130° 19.26787' W (WGS84)
- Map Proj: UTM84-9N
- Acoustic Source File: S:\0-Fugro_LELU_Data_SSS\4125Lelu\Line_13H.xtf
- Ping Number: 44595
- Range to Target: 45.98 Meters
- Fish Height: 2.00 Meters
- Heading: 33.500 degrees

Dimensions
Target Height: = 0.0 Meters
Target Length: 0.0 Meters
Target Shadow: 0.0 Meters
Target Width: 0.0 Meters

Description: Crab Pot

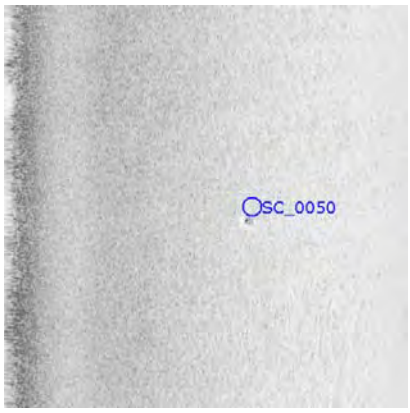


SC_0049

- Sonar Time at Target: 05/07/2013 22:55:19
- Click Position (Lat/Lon Coordinates)
  54° 11.42311' N 130° 19.26108' W (WGS84)
- Map Proj: UTM84-9N
- Acoustic Source File: S:\0-Fugro_LELU_Data_SSS\4125Lelu\Line_13H.xtf
- Ping Number: 44581
- Range to Target: 29.71 Meters
- Fish Height: 2.13 Meters
- Heading: 25.200 degrees

Dimensions
Target Height: = 0.0 Meters
Target Length: 0.0 Meters
Target Shadow: 0.0 Meters
Target Width: 0.0 Meters

Description: Crab Pot



SC_0050

- Sonar Time at Target: 05/08/2013 19:28:58
- Click Position (Lat/Lon Coordinates)
  54° 11.52746' N 130° 19.19783' W (WGS84)
- Map Proj: UTM84-9N
- Acoustic Source File: S:\0-Fugro_LELU_Data_SSS\4125Lelu\17H.xtf
- Ping Number: 28724
- Range to Target: 30.69 Meters
- Fish Height: 4.77 Meters
- Heading: 215.190 degrees

Dimensions
Target Height: = 0.0 Meters
Target Length: 0.0 Meters
Target Shadow: 0.0 Meters
Target Width: 0.0 Meters

Description: Crab Pot

SC_0051

- Sonar Time at Target: 05/08/2013 19:27:43
- Click Position (Lat/Lon Coordinates)
  54° 11.59726' N 130° 19.06191' W (WGS84)
- Map Proj: UTM84-9N
- Acoustic Source File: S:\0-Fugro_LELU_Data_SSS\4125Lelu\17H.xtf
- Ping Number: 27649
- Range to Target: 29.71 Meters
- Fish Height: 5.41 Meters
- Heading: 207.690 degrees

Dimensions
Target Height: = 0.0 Meters
Target Length: 0.0 Meters
Target Shadow: 0.0 Meters
Target Width: 0.0 Meters

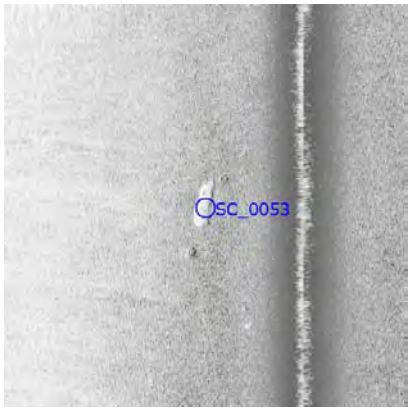
Description: Crab Pot

SC_0052

- Sonar Time at Target: 05/08/2013 19:27:41
- Click Position (Lat/Lon Coordinates)
  54° 11.59964' N 130° 19.06022' W (WGS84)
- Map Proj: UTM84-9N
- Acoustic Source File: S:\0-Fugro_LELU_Data_SSS\4125Lelu\17H.xtf
- Ping Number: 27626
- Range to Target: 31.76 Meters
- Fish Height: 5.41 Meters
- Heading: 212.600 degrees

Dimensions
Target Height: = 0.0 Meters
Target Length: 0.0 Meters
Target Shadow: 0.0 Meters
Target Width: 0.0 Meters

Description: Crab Pot

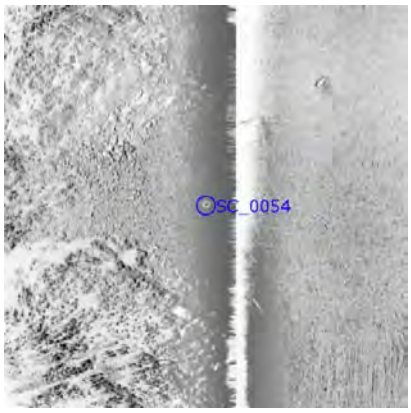


SC_0053

- Sonar Time at Target: 05/08/2013 19:15:51
- Click Position (Lat/Lon Coordinates)
  54° 11.93846' N 130° 18.33573' W (WGS84)
- Map Proj: UTM84-9N
- Acoustic Source File: S:\0-Fugro_LELU_Data_SSS\4125Lelu\16AH.xtf
- Ping Number: 16929
- Range to Target: 12.08 Meters
- Fish Height: 2.78 Meters
- Heading: 40.590 degrees

Dimensions
Target Height: = 0.3 Meters
Target Length: 6.1 Meters
Target Shadow: 1.3 Meters
Target Width: 1.1 Meters
10

Description: Unidentified Linear Target with 2 Other Targets Nearby



SC_0054

- Sonar Time at Target: 05/08/2013 20:57:29
- Click Position (Lat/Lon Coordinates)
  54° 12.30381' N 130° 18.24864' W (WGS84)
- Map Proj: UTM84-9N
- Acoustic Source File: S:\0-Fugro_LELU_Data_SSS\4125Lelu\32H.xtf
- Ping Number: 105003
- Range to Target: 3.70 Meters
- Fish Height: 4.43 Meters
- Heading: 339.290 degrees

Dimensions
Target Height: = 0.2 Meters
Target Length: 0.6 Meters
Target Shadow: 0.3 Meters
Target Width: 0.5 Meters

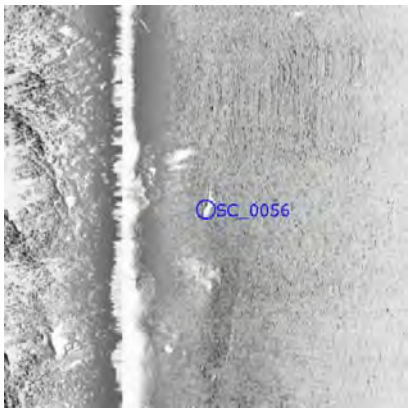
Description: Unidentified Target - Probable Tires

SC_0055

- Sonar Time at Target: 05/08/2013 20:57:23
- Click Position (Lat/Lon Coordinates)
  54° 12.29484' N 130° 18.23714' W (WGS84)
- Map Proj: UTM84-9N
- Acoustic Source File: S:\0-Fugro_LELU_Data_SSS\4125Lelu\32H.xtf
- Ping Number: 104913
- Range to Target: 10.42 Meters
- Fish Height: 6.38 Meters
- Heading: 353.700 degrees

Dimensions
Target Height: = 0.2 Meters
Target Length: 1.8 Meters
Target Shadow: 0.3 Meters
Target Width: 0.6 Meters

Description: Unidentified Target - Possible Large Rocks

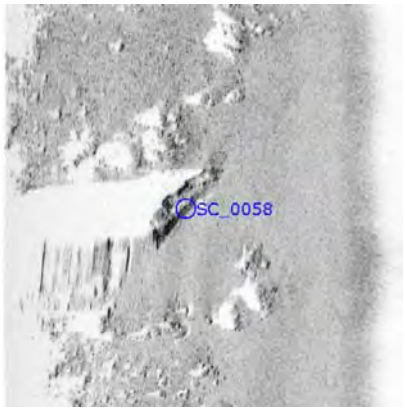


SC_0056

- Sonar Time at Target: 05/08/2013 20:57:43
- Click Position (Lat/Lon Coordinates)
  54° 12.31850' N 130° 18.22622' W (WGS84)
- Map Proj: UTM84-9N
- Acoustic Source File: S:\0-Fugro_LELU_Data_SSS\4125Lelu\32H.xtf
- Ping Number: 105210
- Range to Target: 10.33 Meters
- Fish Height: 3.17 Meters
- Heading: 5.500 degrees

Dimensions
Target Height: = 0.3 Meters
Target Length: 3.8 Meters
Target Shadow: 0.9 Meters
Target Width: 0.4 Meters

Description: Unidentified Target - Probable Log

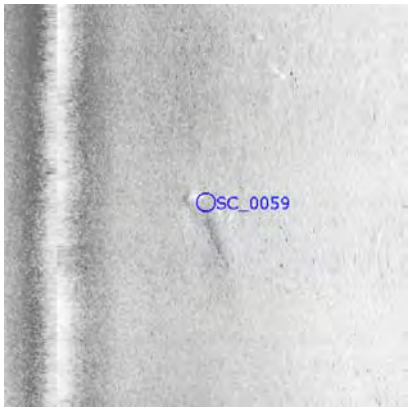


SC_0058

- Sonar Time at Target: 05/08/2013 22:05:17
- Click Position (Lat/Lon Coordinates)
  54° 12.31818' N 130° 18.14916' W (WGS84)
- Map Proj: UTM84-9N
- Acoustic Source File: S:\0-Fugro_LELU_Data_SSS\4125Lelu\30H.xtf
- Ping Number: 140364
- Range to Target: 26.79 Meters
- Fish Height: 8.18 Meters
- Heading: 200.100 degrees

Dimensions
Target Height: = 3.3 Meters
Target Length: 12.3 Meters
Target Shadow: 18.7 Meters
Target Width: 3.4 Meters

Description: Very Large and Tall Target - Possible Rock Outcrop

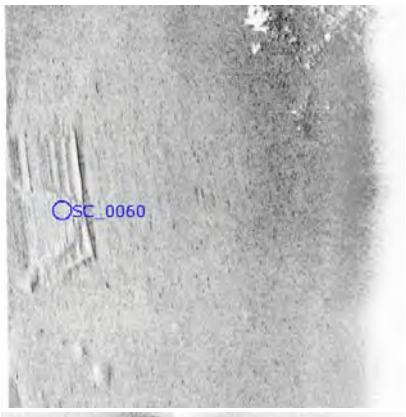


SC_0059

- Sonar Time at Target: 05/08/2013 20:58:29
- Click Position (Lat/Lon Coordinates)
  54° 12.35942' N 130° 18.15595' W (WGS84)
- Map Proj: UTM84-9N
- Acoustic Source File: S:\0-Fugro_LELU_Data_SSS\4125Lelu\32H.xtf
- Ping Number: 105860
- Range to Target: 16.28 Meters
- Fish Height: 6.38 Meters
- Heading: 32.400 degrees

Dimensions
Target Height: = 0.6 Meters
Target Length: 1.5 Meters
Target Shadow: 1.9 Meters
Target Width: 1.5 Meters

Description: Unidentified Target - Possible Large Rocks

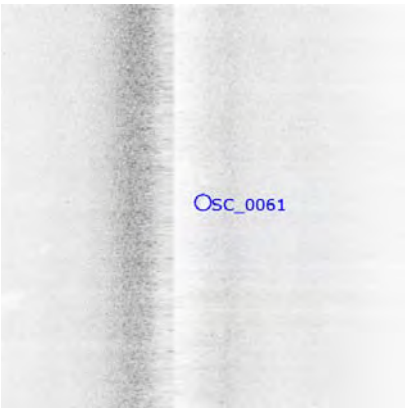


SC_0060

- Sonar Time at Target: 05/08/2013 22:04:35
- Click Position (Lat/Lon Coordinates)
  54° 12.35125' N 130° 18.06919' W (WGS84)
- Map Proj: UTM84-9N
- Acoustic Source File: S:\0-Fugro_LELU_Data_SSS\4125Lelu\30H.xtf
- Ping Number: 139761
- Range to Target: 42.28 Meters
- Fish Height: 8.04 Meters
- Heading: 211.190 degrees

Dimensions
Target Height: = 0.1 Meters
Target Length: 19.2 Meters
Target Shadow: 0.8 Meters
Target Width: 9.2 Meters

Description: Unusual array of linear targets. Possible man-made sunken structure

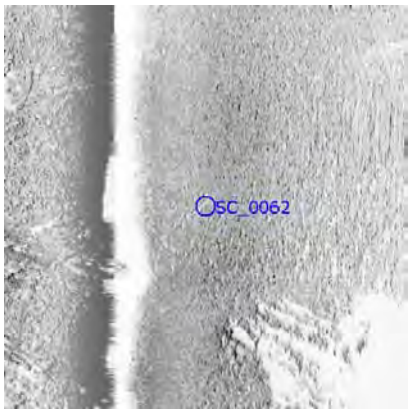


SC_0061

- Sonar Time at Target: 05/08/2013 21:39:11
- Click Position (Lat/Lon Coordinates)
  54° 12.30750' N 130° 18.05199' W (WGS84)
- Map Proj: UTM84-9N
- Acoustic Source File: S:\0-Fugro_LELU_Data_SSS\4125Lelu\26H.xtf
- Ping Number: 126171
- Range to Target: 7.22 Meters
- Fish Height: 25.47 Meters
- Heading: 18.890 degrees

Dimensions
Target Height: = 0.8 Meters
Target Length: 2.6 Meters
Target Shadow: 0.8 Meters
Target Width: 2.3 Meters

Description: Unidentified Target - Possible Large Rocks

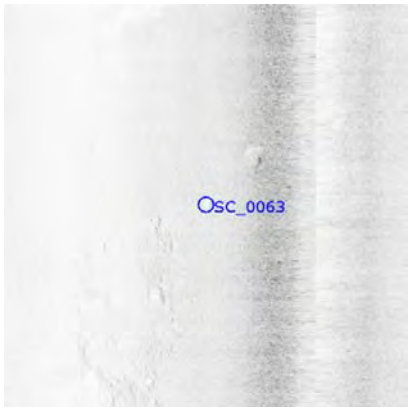


SC_0062

- Sonar Time at Target: 05/08/2013 20:53:48
- Click Position (Lat/Lon Coordinates)
  54° 12.23147' N 130° 18.02833' W (WGS84)
- Map Proj: UTM84-9N
- Acoustic Source File: S:\0-Fugro_LELU_Data_SSS\4125Lelu\20H.xtf
- Ping Number: 101827
- Range to Target: 11.30 Meters
- Fish Height: 5.36 Meters
- Heading: 229.100 degrees

Dimensions
Target Height: = 0.1 Meters
Target Length: 4.0 Meters
Target Shadow: 0.3 Meters
Target Width: 0.3 Meters

Description: Unidentified Target - Probable Log

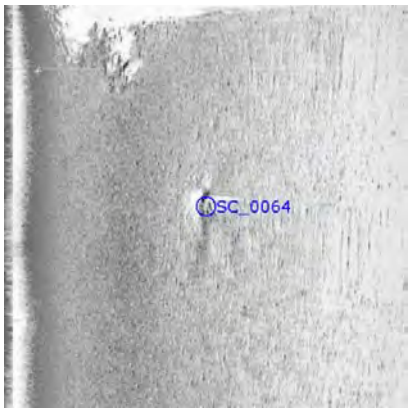


SC_0063

- Sonar Time at Target: 05/08/2013 21:39:49
- Click Position (Lat/Lon Coordinates)
  54° 12.34900' N 130° 18.02769' W (WGS84)
- Map Proj: UTM84-9N
- Acoustic Source File: S:\0-Fugro_LELU_Data_SSS\4125Lelu\26H.xtf
- Ping Number: 126450
- Range to Target: 27.13 Meters
- Fish Height: 26.44 Meters
- Heading: 29.890 degrees

Dimensions
Target Height: = 0.0 Meters
Target Length: 0.0 Meters
Target Shadow: 0.0 Meters
Target Width: 0.0 Meters

Description: Unidentified Target - Possible Large Rocks



SC_0064

- Sonar Time at Target: 05/10/2013 21:59:30
- Click Position (Lat/Lon Coordinates)
  54° 12.51509' N 130° 17.95265' W (WGS84)
- Map Proj: UTM84-9N
- Acoustic Source File: S:\0-Fugro_LELU_Data_SSS\4125Lelu\114H.xtf
- Ping Number: 64768
- Range to Target: 23.87 Meters
- Fish Height: 3.90 Meters
- Heading: 347.890 degrees

Dimensions
Target Height: = 0.6 Meters
Target Length: 4.6 Meters
Target Shadow: 4.8 Meters
Target Width: 1.2 Meters

Description: Unidentified Target - Possible Large Rocks

SC_0065

- Sonar Time at Target: 05/10/2013 21:59:48
- Click Position (Lat/Lon Coordinates)
  54° 12.53602' N 130° 17.94590' W (WGS84)
- Map Proj: UTM84-9N
- Acoustic Source File: S:\0-Fugro_LELU_Data_SSS\4125Lelu\114H.xtf
- Ping Number: 65026
- Range to Target: 12.47 Meters
- Fish Height: 4.92 Meters
- Heading: 19.100 degrees

Dimensions
Target Height: = 0.1 Meters
Target Length: 0.6 Meters
Target Shadow: 0.2 Meters
Target Width: 1.0 Meters

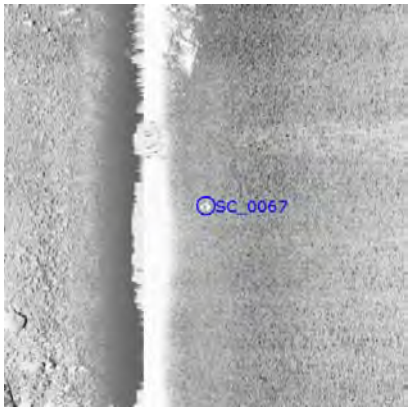
Description: Unidentified Target - Possible Large Rocks

SC_0066

- Sonar Time at Target: 05/08/2013 21:28:25
- Click Position (Lat/Lon Coordinates)
  54° 12.40932' N 130° 17.92481' W (WGS84)
- Map Proj: UTM84-9N
- Acoustic Source File: S:\0-Fugro_LELU_Data_SSS\4125Lelu\28H.xtf
- Ping Number: 121499
- Range to Target: 29.50 Meters
- Fish Height: 26.54 Meters
- Heading: 206.100 degrees

Dimensions
Target Height: = 0.6 Meters
Target Length: 2.3 Meters
Target Shadow: 0.9 Meters
Target Width: 1.9 Meters

Description: Crab Pot

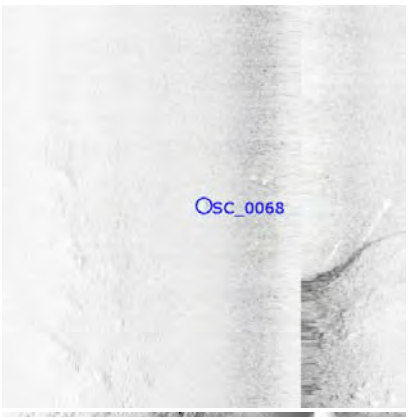


SC_0067

- Sonar Time at Target: 05/10/2013 22:00:08
- Click Position (Lat/Lon Coordinates)
  54° 12.55842' N 130° 17.92060' W (WGS84)
- Map Proj: UTM84-9N
- Acoustic Source File: S:\0-Fugro_LELU_Data_SSS\4125Lelu\114H.xtf
- Ping Number: 65305
- Range to Target: 7.70 Meters
- Fish Height: 4.77 Meters
- Heading: 23.790 degrees

Dimensions
Target Height: = 0.1 Meters
Target Length: 0.9 Meters
Target Shadow: 0.3 Meters
Target Width: 1.2 Meters

Description: Unidentified Target - Probable Tires

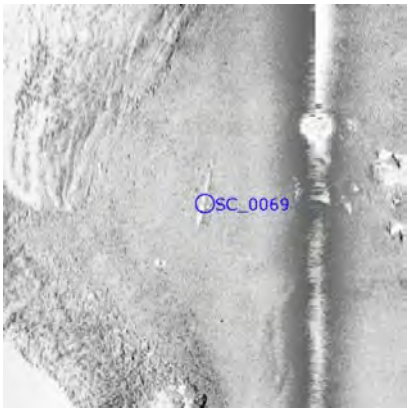


SC_0068

- Sonar Time at Target: 05/08/2013 21:41:17
- Click Position (Lat/Lon Coordinates)
  54° 12.41240' N 130° 17.92050' W (WGS84)
- Map Proj: UTM84-9N
- Acoustic Source File: S:\0-Fugro_LELU_Data_SSS\4125Lelu\26H.xtf
- Ping Number: 127088
- Range to Target: 24.00 Meters
- Fish Height: 27.71 Meters
- Heading: 20.100 degrees

Dimensions
Target Height: = 1.0 Meters
Target Length: 3.0 Meters
Target Shadow: 1.3 Meters
Target Width: 1.6 Meters

Description: Crab Pot

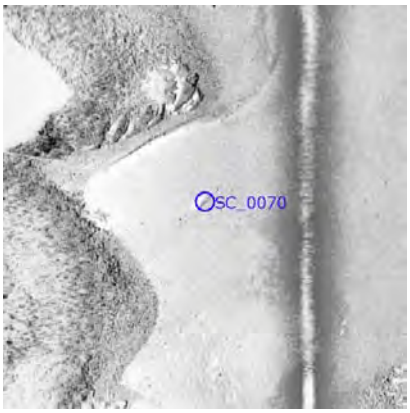


SC_0069

- Sonar Time at Target: 05/10/2013 22:01:52
- Click Position (Lat/Lon Coordinates)
  54° 12.69547' N 130° 17.88499' W (WGS84)
- Map Proj: UTM84-9N
- Acoustic Source File: S:\0-Fugro_LELU_Data_SSS\4125Lelu\114H.xtf
- Ping Number: 66798
- Range to Target: 13.64 Meters
- Fish Height: 3.14 Meters
- Heading: 332.790 degrees

Dimensions
Target Height: = 0.1 Meters
Target Length: 7.5 Meters
Target Shadow: 0.7 Meters
Target Width: 0.7 Meters

Description: Unidentified Target - Probable Log

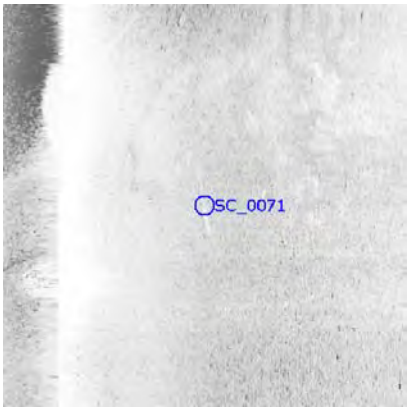


SC_0070

- Sonar Time at Target: 05/10/2013 22:02:08
- Click Position (Lat/Lon Coordinates)
  54° 12.71976' N 130° 17.87916' W (WGS84)
- Map Proj: UTM84-9N
- Acoustic Source File: S:\0-Fugro_LELU_Data_SSS\4125Lelu\114H.xtf
- Ping Number: 67038
- Range to Target: 12.67 Meters
- Fish Height: 2.49 Meters
- Heading: 348.100 degrees

Dimensions
Target Height: = 0.2 Meters
Target Length: 3.5 Meters
Target Shadow: 0.9 Meters
Target Width: 0.8 Meters

Description: Unidentified Target - Probable Log

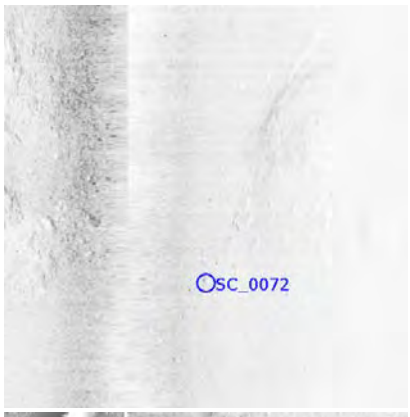


SC_0071

- Sonar Time at Target: 05/08/2013 20:52:21
- Click Position (Lat/Lon Coordinates)
  54° 12.32723' N 130° 17.86187' W (WGS84)
- Map Proj: UTM84-9N
- Acoustic Source File: S:\0-Fugro_LELU_Data_SSS\4125Lelu\20H.xtf
- Ping Number: 100576
- Range to Target: 18.12 Meters
- Fish Height: 12.18 Meters
- Heading: 204.890 degrees

Dimensions
Target Height: = 0.2 Meters
Target Length: 8.3 Meters
Target Shadow: 0.3 Meters
Target Width: 0.6 Meters

Description: Unidentified Target - Probable Log



SC_0072

- Sonar Time at Target: 05/08/2013 21:57:38
- Click Position (Lat/Lon Coordinates)
  54° 12.42755' N 130° 17.87108' W (WGS84)
- Map Proj: UTM84-9N
- Acoustic Source File: S:\0-Fugro_LELU_Data_SSS\4125Lelu\27.001H.xtf
- Ping Number: 134190
- Range to Target: 19.32 Meters
- Fish Height: 28.30 Meters
- Heading: 30.700 degrees

Dimensions
Target Height: = 0.0 Meters
Target Length: 0.0 Meters
Target Shadow: 0.0 Meters
Target Width: 0.0 Meters

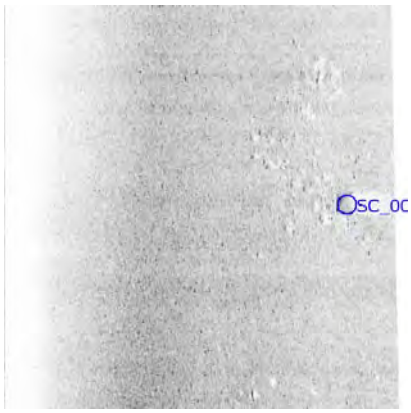
Description: Crab Pot

SC_0073

- Sonar Time at Target: 05/10/2013 22:01:24
- Click Position (Lat/Lon Coordinates)
  54° 12.65636' N 130° 17.85707' W (WGS84)
- Map Proj: UTM84-9N
- Acoustic Source File: S:\0-Fugro_LELU_Data_SSS\4125Lelu\114H.xtf
- Ping Number: 66396
- Range to Target: 16.95 Meters
- Fish Height: 4.97 Meters
- Heading: 347.000 degrees

Dimensions
Target Height: = 0.5 Meters
Target Length: 11.6 Meters
Target Shadow: 1.8 Meters
Target Width: 0.8 Meters

Description: Unidentified Target - Probable Log

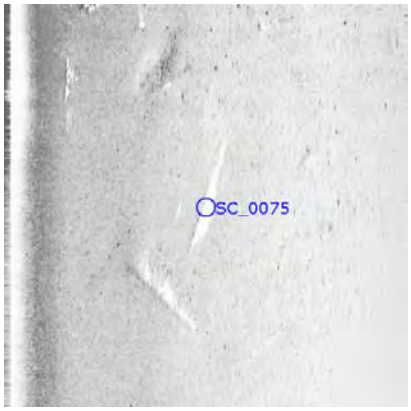


SC_0074

- Sonar Time at Target: 05/10/2013 21:40:52
- Click Position (Lat/Lon Coordinates)
  54° 12.55856' N 130° 17.85546' W (WGS84)
- Map Proj: UTM84-9N
- Acoustic Source File: S:\0-Fugro_LELU_Data_SSS\4125Lelu\113H.xtf
- Ping Number: 48707
- Range to Target: 42.38 Meters
- Fish Height: 12.42 Meters
- Heading: 358.700 degrees

Dimensions
Target Height: = 1.3 Meters
Target Length: 2.7 Meters
Target Shadow: 5.3 Meters
Target Width: 3.0 Meters

Description: Unidentified Target - Probable Boulders

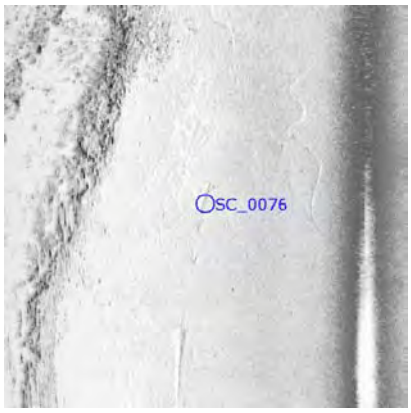


SC_0075

- Sonar Time at Target: 05/10/2013 22:01:20
- Click Position (Lat/Lon Coordinates)
  54° 12.65031' N 130° 17.85229' W (WGS84)
- Map Proj: UTM84-9N
- Acoustic Source File: S:\0-Fugro_LELU_Data_SSS\4125Lelu\114H.xtf
- Ping Number: 66340
- Range to Target: 24.16 Meters
- Fish Height: 4.58 Meters
- Heading: 347.100 degrees

Dimensions
Target Height: = 0.3 Meters
Target Length: 14.7 Meters
Target Shadow: 1.7 Meters
Target Width: 0.7 Meters

Description: Unidentified Target - Probable Log

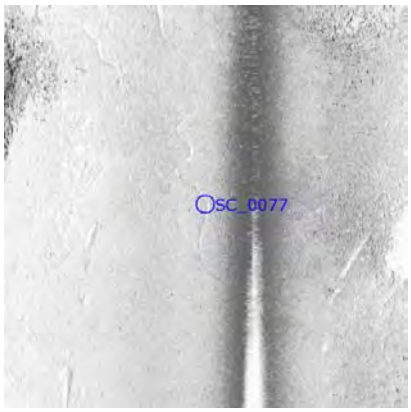


SC_0076

- Sonar Time at Target: 05/10/2013 22:02:37
- Click Position (Lat/Lon Coordinates)
  54° 12.74607' N 130° 17.83148' W (WGS84)
- Map Proj: UTM84-9N
- Acoustic Source File: S:\0-Fugro_LELU_Data_SSS\4125Lelu\114H.xtf
- Ping Number: 67449
- Range to Target: 19.58 Meters
- Fish Height: 2.48 Meters
- Heading: 41.090 degrees

Dimensions
Target Height: = 0.1 Meters
Target Length: 10.2 Meters
Target Shadow: 0.5 Meters
Target Width: 0.9 Meters

Description: Unidentified Target - Probable Log

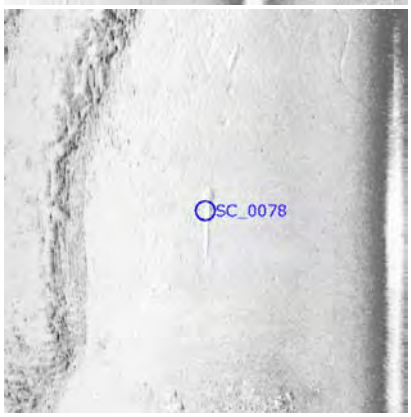


SC_0077

- Sonar Time at Target: 05/10/2013 22:02:35
- Click Position (Lat/Lon Coordinates)
  54° 12.73883' N 130° 17.82683' W (WGS84)
- Map Proj: UTM84-9N
- Acoustic Source File: S:\0-Fugro_LELU_Data_SSS\4125Lelu\114H.xtf
- Ping Number: 67420
- Range to Target: 5.72 Meters
- Fish Height: 2.48 Meters
- Heading: 37.290 degrees

Dimensions
Target Height: = 0.0 Meters
Target Length: 0.0 Meters
Target Shadow: 0.0 Meters
Target Width: 0.0 Meters

Description: Unidentified Target with Sinuous Shape - Possible Length of Cable or Possible Scar

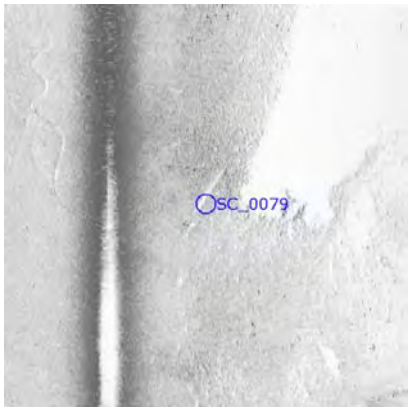


SC_0078

- Sonar Time at Target: 05/10/2013 22:02:45
- Click Position (Lat/Lon Coordinates)
  54° 12.75263' N 130° 17.82510' W (WGS84)
- Map Proj: UTM84-9N
- Acoustic Source File: S:\0-Fugro_LELU_Data_SSS\4125Lelu\114H.xtf
- Ping Number: 67559
- Range to Target: 23.19 Meters
- Fish Height: 2.56 Meters
- Heading: 27.200 degrees

Dimensions
Target Height: = 0.1 Meters
Target Length: 9.3 Meters
Target Shadow: 0.6 Meters
Target Width: 1.2 Meters

Description: Unidentified Target - Probable Log

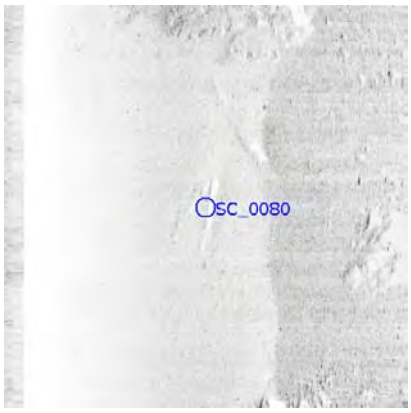


SC_0079

- Sonar Time at Target: 05/10/2013 22:02:39
- Click Position (Lat/Lon Coordinates)
  54° 12.73397' N 130° 17.81062' W (WGS84)
- Map Proj: UTM84-9N
- Acoustic Source File: S:\0-Fugro_LELU_Data_SSS\4125Lelu\114H.xtf
- Ping Number: 67469
- Range to Target: 12.18 Meters
- Fish Height: 2.48 Meters
- Heading: 38.700 degrees

Dimensions
Target Height: = 0.1 Meters
Target Length: 10.1 Meters
Target Shadow: 0.7 Meters
Target Width: 0.8 Meters

Description: Unidentified Target - Probable Log

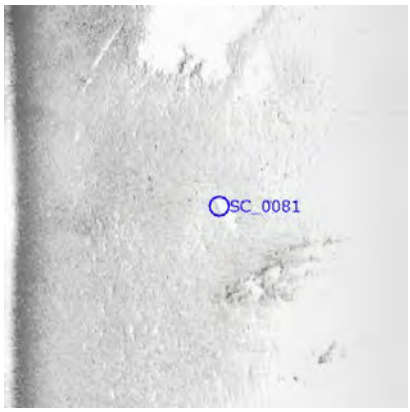


SC_0080

- Sonar Time at Target: 05/10/2013 21:41:56
- Click Position (Lat/Lon Coordinates)
  54° 12.64747' N 130° 17.80712' W (WGS84)
- Map Proj: UTM84-9N
- Acoustic Source File: S:\0-Fugro_LELU_Data_SSS\4125Lelu\113H.xtf
- Ping Number: 49622
- Range to Target: 22.41 Meters
- Fish Height: 12.18 Meters
- Heading: 1.000 degrees

Dimensions
Target Height: = 0.3 Meters
Target Length: 11.5 Meters
Target Shadow: 0.6 Meters
Target Width: 0.8 Meters

Description: Unidentified Target - Probable Log

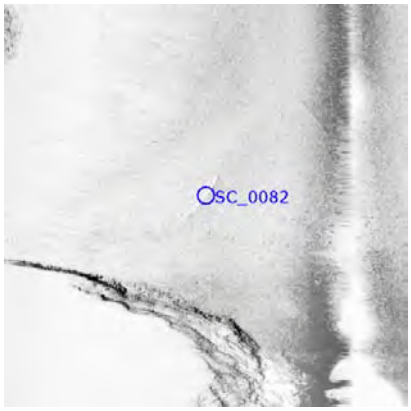


SC_0081

- Sonar Time at Target: 05/10/2013 22:02:46
- Click Position (Lat/Lon Coordinates)
  54° 12.73715' N 130° 17.78756' W (WGS84)
- Map Proj: UTM84-9N
- Acoustic Source File: S:\0-Fugro_LELU_Data_SSS\4125Lelu\114H.xtf
- Ping Number: 67580
- Range to Target: 26.60 Meters
- Fish Height: 2.57 Meters
- Heading: 29.000 degrees

Dimensions
Target Height: = 0.1 Meters
Target Length: 5.9 Meters
Target Shadow: 1.4 Meters
Target Width: 0.7 Meters

Description: Unidentified Target - Probable Log



SC_0082

- Sonar Time at Target: 05/10/2013 22:03:11
- Click Position (Lat/Lon Coordinates)
  54° 12.77420' N 130° 17.77325' W (WGS84)
- Map Proj: UTM84-9N
- Acoustic Source File: S:\0-Fugro_LELU_Data_SSS\4125Lelu\114H.xtf
- Ping Number: 67929
- Range to Target: 17.63 Meters
- Fish Height: 6.93 Meters
- Heading: 29.290 degrees

Dimensions
Target Height: = 0.2 Meters
Target Length: 0.5 Meters
Target Shadow: 0.6 Meters
Target Width: 0.0 Meters

Description: Unidentified Target - Probable Log

SC_0083

- Sonar Time at Target: 05/10/2013 21:33:22
- Click Position (Lat/Lon Coordinates)
  54° 12.53543' N 130° 17.59463' W (WGS84)
- Map Proj: UTM84-9N
- Acoustic Source File: S:\0-Fugro_LELU_Data_SSS\4125Lelu\120H.xtf
- Ping Number: 42241
- Range to Target: 27.18 Meters
- Fish Height: 11.98 Meters
- Heading: 35.400 degrees

Dimensions
Target Height: = 0.0 Meters
Target Length: 0.0 Meters
Target Shadow: 0.0 Meters
Target Width: 0.0 Meters

Description: Crab Pot

D MAGNETOMETER ANOMALY TABLE

Anomaly ID	Easting	Northing	Gammas	Duration	Type	Description
	WGS 84 UTM Zone 9 M					
1	414830	6006360	14	27.4	DIPOLE	Crab Pot
2	414393	6005993	9.5	29.3	DIPOLE	Crab Pot
3	414306	6005923	8.7	32.6	DIPOLE	Unknown - No Sonar Contacts
4	413385	6005149	8.1	27.4	MONOPOLE	Unknown - No Sonar Contacts
5	413282	6005096	18.9	140.5	COMPLEX	Probably Several Crab Pots (Traps)
6	413852	6005575	7.8	57.1	DIPOLE	Crab Pot (Trap)
7	414012	6005711	9.4	41.4	DIPOLE	Crab Pot (Trap)
8	414793	6006367	33.5	36.7	DIPOLE	Crab Pot (Trap)
9	414847	6006410	10.3	37.6	DIPOLE	Crab Pot (Trap)
10	414834	6006434	39.8	25.6	DIPOLE	Crab Pot (Trap)
11	414146	6005855	4.7	15.2	MONOPOLE	Crab Pot (Trap)
12	414123	6005835	8.5	18.1	MONOPOLE	Crab Pot (Trap)
13	414096	6005811	7	21.2	MONOPOLE	Crab Pot (Trap)
14	413481	6005328	14.6	85.6	DIPOLE	No Sonar Contact - Probable Crab Pot (Trap)
15	414475	6006166	14.1	17.8	MONOPOLE	Crab Pot (Trap)
16	414509	6006192	8.1	20.2	MONOPOLE	Crab Pot (Trap)
18	414505	6006056	6.6	29.2	MONOPOLE	Unknown- In Areas of Rocks
19	413729	6005403	8.9	37.5	MONOPOLE	Crab Pot (Trap)
20	413499	6005210	16.2	86.2	MONOPOLE	Crab Pot (Trap)
21	413373	6005105	13.6	176	COMPLEX	Probable Crab Pots (Traps)/Cable
22	412824	6005245	6.8	12.9	MONOPOLE	Crab Pot (Trap)
23	412647	6005546	9.1	31.8	MONOPOLE	Crab Pot (Trap)
24	415273	6007376	200.6	83	MONOPOLE	Unknown Large Anomaly - Probable Structure Near Shoreline
25	414960	6007146	47.1	78.6	COMPLEX	Probable Nearshore Debris
26	415275	6007378	163.5	70.5	MONOPOLE	Probable Large Structure Near Shore
27	415254	6007527	105.5	186.5	COMPLEX	Either Debris Field or Magnetometer Dragging the Seabed

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F DIGITAL FILES

Description	File Name	Format
Final Marine Geophysical Survey Report & Charts	\Reports and Charts\	PDF
Autocad Files	\ACAD\	
Folder containing basemap files used in charts	_01-Basemap\	
Folder containing background files used in charts	_02-Background\	
Folder containing data files used in charts	_03-Data\	
Folder containing grids used in charts	_04-Grids\	
Chart 1A Bathymetry and Surficial Features – Trestle and Mooring Area in Autocad format	FPI-7028-TRESTLE-001-NB-5000.dwg	DWG
Chart 1B Bathymetry and Surficial Features – Turning Basins in Autocad format	FPI-7028-TURNBASIN-001-NM-2500.dwg	DWG
Chart 2A Side Scan Sonar Mosaic – Trestle And Mooring Area in Autocad format	FPI-7028-TRESTLE-002-NS-5000.dwg	DWG
Chart 2B Side Scan Sonar Mosaic – Turning Basins in Autocad format	FPI-7028-TURNBASIN-002-NB-2500.dwg	DWG
Chart 3A Isopach Contours – Trestle And Mooring Area in Autocad format	FPI-7028-TRESTLE-003-NB-5000.dwg	DWG
Chart 3B Isopach Contours – Turning Basins in Autocad format	FPI-7028-TURNBASIN-003-NM-2500.dwg	DWG
Chart 4A Bathymetry and Slope Interpretation – Trestle And Mooring Area In Autocad Format	FPI-7028-TRESTLE-004-NS-5000.dwg	DWG
Chart 4B Bathymetry and Slope Interpretation – Turning Basins In Autocad Format	FPI-7028-TURNBASIN-004-NB-2500.dwg	DWG
Bathymetry Data	\Bathymetry Data\	
Processed XYZ bathymetry data – Trestle and Mooring Area	trestle_MB_CVD28BCvert.xyz	ASCII
Processed XYZ bathymetry data – Turning Basins	turningbasins_MB_CVD28BCvert.xyz	ASCII
Side Scan Sonar Mosaic	\ACAD_03-Data	
Trestle and Mooring Area	Lelu_TR-NAD83UTM9N.tif	GEOTIFF
Turning Basins	Lelu_TB-NAD83UTM9N.tif	GEOTIFF

G CHARTS

1A BATHYMETRY AND SURFICIAL FEATURES – TRESTLE AND MOORING AREA
1B BATHYMETRY AND SURFICIAL FEATURES – TURNING BASINS
2A SIDE SCAN SONAR MOSAIC – TRESTLE AND MOORING AREA
2B SIDE SCAN SONAR MOSAIC – TURNING BASINS
3A ISOPACH CONTOURS – TRESTLE AND MOORING AREA
3B ISOPACH CONTOURS – TURNING BASINS
4A BATHYMETRY AND SLOPE INTERPRETATION – TRESTLE AND MOORING AREA
4B BATHYMETRY AND SLOPE INTERPRETATION – TURNING BASINS

412200E
412800E
413400E
414000E
414600E
415200E
6006600N
6006000N
6005400N
6004800N
6004200N

Ridley Island
Lelu Island
Kitson Island

B-8
B-7
B-17
B-14
B-15
B-31
B-19
B-20
B-18
B-21
B-24
B-32
B-33
B-34
B-35
B-36
B-37

SC_0053
Slump
SC_0045
SC_0007
SC_0018
SC_0012
SC_0021
SC_0025
SC_0029
SC_0022
SC_0039

M-18
M-3
M-14
M-4
M-5
M-21

-5
-10
-15
-4
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-9
-45
-40
-35
-30
-25
-20
-15
-10

N

Jul 22, 2013 - 12:22pm Z:\ACAD\FPI-7028-TRESTLE-001-NB-5000.dwg

Legend

- Index Contours (5-meter interval)
- Contours (1-meter interval)
- Minor Contours (0.5-meter interval)
- Bore Hole Locations (KBR)
- Magnetometer Anomalies — M-ID
- Side Scan Sonar Contacts — SC_ID

Seafloor Classification

- Vegetation
- Overburden Material (Sand, Silt, and Clay)
- Bedrock
- Slump
- Area Too Shallow for Safe Vessel Operations

NOTES

1. Bathymetric contours are in meters and referenced to orthometric height (CVC28BC - Canadian Vertical Datum 1928) at a 0.5 meter interval.

2. Horizontal and vertical positioning achieved using RTK (Real-Time Kinematic), POS M/V inertial system and Trimble R8 GNSS receivers integrated with Hypack navigation software.

3. Horizontal and vertical data referenced to horizontal/vertical monument PE:
Northing: 6008493.674 m (UTM-9N)
Easting: 415834.964 m (UTM-9N)
Elevation: 5.034 m
(Provided by McElhanney Consulting Services Ltd.).

4. Survey equipment utilized during data acquisition included the following systems:
- Multibeam R2Sonic sonar,
- Marine Magnetics SeaSpy marine magnetometer, and
- Edgetech digital dual frequency side scan sonar.

5. Hydrographic and geophysical data were collected on May 4-10th, 2013 onboard the M/V Rain Coast Explorer.

6. Trestle and original mooring area have been obtained from AutoCAD drawings No. CV-AAA-CV69-0002 Rev B and CV-AAA-CV69-0003 Rev B provided by Kellogg Brown and Root, LLC. The locations of the North and South Turning Basins were digitized from AutoCAD drawing no. CV-F-217-SKETCH-TB provided by Kellogg Brown and Root, LLC.

7. Imagery source: Esri, i-cubed, USDA, AEX, GeoEye, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community. (c) OpenStreetMap and contributers, Creative Commons-Share Alike License (CC-BY-SA).

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GEODETIC INFORMATION

DATUM:	NAD83
PROJECTION:	UNIVERSAL TRANSVERSE MERCATOR
ZONE:	ZONE 9 NORTH
UNITS:	METERS

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Fax: (805) 658-6679
www.fugro-pelagos.com

Kellogg Brown and Root, LLC

SURFICIAL FEATURES & BATHYMETRY TRESTLE & MOORING AREA LELU ISLAND LNG FACILITY BRITISH COLUMBIA, CANADA

JUNE 2013

SCALE: 1:5,000

200 100 0 200 400 Meters

REV NO:	DATE:	DESCRIPTION:	DRAWN:	CHKD:	APPR:
1	June 2013	Surficial Features & Bathymetry	CE, CF	AT, CP	JJC
2	July 2013	Revised per Client Review	CE	CP	JJC
3	July 2013	Revised per Client Review	CE	CP	JJC

JOB NUMBER: 23.00007028

CHART NO.: 1A of 4

414600E
414900E
415200E
415500E
415800E
416100E
6007800N
6007500N
6007200N
6006900N

Ridley Island
Lelu Island
North Turning Basin
South Turning Basin

SC_0082
SC_0078
SC_0076
SC_0077
SC_0081
SC_0070
SC_0079
SC_0069
SC_0073
SC_0075
SC_0080
SC_0067
SC_0074
SC_0065
M-27
SC_0064
Possible Structure
X=415253
Y=6007393
M-26
M-24
B-39
SC_0059
SC_0060
SC_0063
SC_0056
M-25
SC_0058
SC_0054
SC_0055
SC_0061
SC_0071
SC_0062
B-6
B-38
B-8
B-7
B-9
B-13
B-12
B-10
B-11
B-17
B-14
B-16
B-15
B-22
B-5
B-3
B-4
B-21

N

Legend

- Index Contours (5-meter interval)
- Contours (1-meter interval)
- Minor Contours (0.5-meter interval)
- Bore Hole Locations (KBR)
- Magnetometer Anomalies — M-ID
- Side Scan Sonar Contacts — SC_ID

Seafloor Classification

- Vegetation
- Overburden Material (Sand, Silt, and Clay)
- Bedrock
- Isolated Rock

NOTES

1. Bathymetric contours are in meters and referenced to orthometric height (CVC28BC - Canadian Vertical Datum 1928) at a 0.5 meter interval.

2. Horizontal and vertical positioning achieved using RTK (Real-Time Kinematic), POS M/V inertial system and Trimble R8 GNSS receivers integrated with Hypack navigation software.

3. Horizontal and vertical data referenced to horizontal/vertical monument PE:
Northing: 6008493.674 m (UTM-9N)
Easting: 415834.964 m (UTM-9N)
Elevation: 5.034 m
(Provided by McElhanney Consulting Services Ltd.).

4. Survey equipment utilized during data acquisition included the following systems:
- Multibeam R2Sonic sonar,
- Marine Magnetics SeaSpy marine magnetometer, and
- Edgetech digital dual frequency side scan sonar.

5. Hydrographic and geophysical data were collected on May 4-10th, 2013 onboard the M/V Rain Coast Explorer.

6. Trestle and original mooring area have been obtained from AutoCAD drawings No. CV-AAA-CV69-0002 Rev B and CV-AAA-CV69-0003 Rev B provided by Kellogg Brown and Root, LLC. The locations of the North and South Turning Basins were digitized from AutoCAD drawing no. CV-F-217-SKETCH-TB provided by Kellogg Brown and Root, LLC.

7. Imagery source: Esri, i-cubed, USDA, AEX, GeoEye, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community. (c) OpenStreetMap and contributers, Creative Commons-Share Alike License (CC-BY-SA).

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GEODETIC INFORMATION

DATUM:	NAD83
PROJECTION:	UNIVERSAL TRANSVERSE MERCATOR
ZONE:	ZONE 9 NORTH
UNITS:	METERS

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Kellogg Brown and Root, LLC

SURFICIAL FEATURES & BATHYMETRY TURNING BASINS AREA LELU ISLAND LNG FACILITY BRITISH COLUMBIA, CANADA

JUNE 2013

SCALE: 1:2,500

100 50 0 100 200 Meters

REV NO:	DATE:	DESCRIPTION:	DRAWN:	CHKD:	APPR:
1	June 2013	Surficial Features & Bathymetry	CE, CF	AT, CP	JJC
2	July 2013	Revised per Client Review	CE	CP	JJC
3	July 2013	Revised per Client Review	CE	CP	JJC

JOB NUMBER: 23.00007028
CHART NO.: 1B of 4

Jul 22, 2013 - 3:25pm Z:\ACAD\FPL-7028-TURNBASIN-001-NB-2500.dwg

412200E
412800E
413400E
414000E
414600E
415200E
6006600N
6006000N
6005400N
6004800N
6004200N

Ridley Island
Lelu Island
Kitson Island

B-8
B-7
B-17
B-14
B-15
B-31
B-19
B-20
B-18
B-21
B-24
B-32
B-33
B-34
B-35
B-36
B-37

SC_0053
Slump
M-18
M-3
SC_0045
M-14
SC_0007
SC_0018
M-4
SC_0039
SC_0021
M-5
M-21
SC_0012
SC_0025
SC_0029
SC_0022

N

Jul 22, 2013 - 12:24pm Z:\ACAD\FPI-7028-TRESTLE-002-MM-5000.dwg

Legend

- Magnetometer Anomalies ID — M-4
- Side Scan Sonar Contacts ID — SC_004
- Bore Hole Locations (KBR)
- Area Too Shallow for Safe Vessel Operations

NOTES

1. Horizontal positioning achieved using RTK (Real-Time Kinematic), POS M/V inertial system and Trimble R8 GNSS receivers integrated with Hypack navigation software.

2. Survey equipment utilized during data acquisition included the following systems:
   - Multibeam R2Sonic sonar,
   - Marine Magnetics SeaSpy marine magnetometer, and
   - Edgetech digital dual frequency side scan sonar.

3. Hydrographic and geophysical data were collected May 4-10th, 2013 onboard the M/V Rain Coast Explorer.

4. Trestle and original mooring area have been obtained from AutoCAD drawings No. CV-AAA-CV69-0002 Rev B and CV-AAA-CV69-0003 Rev B provided by Kellogg Brown and Root, LLC. The locations of the North and South Turning Basins were digitized from AutoCAD drawing no. CV-F-217-SKETCH-TB provided by Kellogg Brown and Root, LLC.

5. Imagery source: Esri, i-cubed, USDA, AEX, GeoEye, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community. (c) OpenStreetMap and contributers, Creative Commons-Share Alike License (CC-BY-SA).

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ZONE:	ZONE 9 NORTH
UNITS:	METERS

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Kellogg Brown and Root, LLC

SIDE SCAN SONAR MOSAIC TRESTLE & MOORING AREA LELU ISLAND LNG FACILITY BRITISH COLUMBIA, CANADA

JUNE 2013

SCALE: 1:5,000

200 100 0 200 400 Meters

REV NO:	DATE:	DESCRIPTION:	DRAWN:	CHKD:	APPR:
1	June 2013	Side Scan Sonar Mosaic	CE, CF	AT, CP	JJC
2	July 2013	Revised per Client Review	CE	CP	JJC
3	July 2013	Revised per Client Review	CE	CP	JJC

JOB NUMBER: 23.00007028

CHART NO.: 2A of 4

414600E
414900E
415200E
415500E
415800E
416100E
6007800N
6007500N
6007200N
6006900N

Ridley Island

Lelu Island

North Turning Basin

South Turning Basin

SC_0082
SC_0078
SC_0076
SC_0077
SC_0081
SC_0070
SC_0079
SC_0069
SC_0073
SC_0075
SC_0080
SC_0067
SC_0074
SC_0065
M-27
SC_0064
SC_0059
SC_0060
SC_0063
SC_0056
M-25
SC_0058
SC_0071
SC_0054
SC_0061
SC_0055
SC_0062

Possible Structure
X=415253
Y=6007393

M-26
M-24

B-37
B-6
B-38
B-8
B-7
B-9
B-13
B-12
B-10
B-11
B-17
B-14
B-16
B-15
B-22
B-5
B-3
B-4

N

Legend

Magnetometer Anomalies ID — M-4
Side Scan Sonar Contacts ID — SC_004
Bore Hole Locations (KBR)

NOTES

1. Horizontal positioning achieved using RTK (Real-Time Kinematic), POS M/V inertial system and Trimble R8 GNSS receivers integrated with Hypack navigation software.

2. Survey equipment utilized during data acquisition included the following systems:
- Multibeam R2Sonic sonar,
- Marine Magnetics SeaSpy marine magnetometer, and
- Edgetech digital dual frequency side scan sonar.

3. Hydrographic and geophysical data were collected May 4-10th, 2013 onboard the M/V Rain Coast Explorer.

4. Trestle and original mooring area have been obtained from AutoCAD drawings No. CV-AAA-CV69-0002 Rev B and CV-AAA-CV69-0003 Rev B provided by Kellogg Brown and Root, LLC. The locations of the North and South Turning Basins were digitized from AutoCAD drawing no. CV-F-217-SKETCH-TB provided by Kellogg Brown and Root, LLC.

5. Imagery source: Esri, i-cubed, USDA, AEX, GeoEye, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community. (c) OpenStreetMap and contributers, Creative Commons-Share Alike License (CC-BY-SA).

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Kellogg Brown and Root, LLC

SIDE SCAN SONAR MOSAIC
TURNING BASINS AREA
LELU ISLAND LNG FACILITY
BRITISH COLUMBIA, CANADA

JUNE 2013

SCALE: 1:2,500

100 50 0 100 200 Meters

REV NO:	DATE:	DESCRIPTION:	DRAWN:	CHKD:	APPR:
1	June 2013	Side Scan Sonar Mosaic	CE, CF	AT, CP	JJC
2	July 2013	Revised per Client Review	CE	CP	JJC

JOB NUMBER: 23.00007028

CHART NO.: 2B of 4

Jul 22, 2013 - 3:26pm Z:\ACAD\FPL-7028-TURNBASIN-002-MM-2500.dwg

412200E
412800E
413400E
414000E
414600E
415200E
6006600N
6006000N
6005400N
6004800N
6004200N

Ridley Island
Lelu Island
Kitson Island

B-8
B-7
B-17
B-14
B-15
B-31
B-19
B-20
B-18
B-21
B-24
B-32
B-33
B-34
B-37
B-35
B-36

N

Jul 22, 2013 - 12:26pm Z:\ACAD\FPI-7028-TRESTLE-003-NS-5000.dwg

Legend

Isopach Contours, Contour Interval = 1 meter
Thickness of Overburden Material, Consisting of Sand, Silt, and Clay, to the First Reflector (Not Identified as Bedrock)

Bore Hole Locations (KBR)

Area Too Shallow for Safe Vessel Operations

NOTES

1. Horizontal positioning achieved using a Starfix II DGPS positioning system integrated with Hypack navigation package.

2. Survey equipment utilized during data acquisition included the following systems:
- Computer navigation/ acquisition system integrated with Starfix II DGPS system,
- Edgetech full spectrum profiler (Chirp) system, and
- Single-plate "Boomer" seismic source coupled with one 8-element hydrophone streamer.

3. Shallow geology data were collected May 12-16th, 2013 onboard M/V My Lady.

4. Trestle and original mooring area have been obtained from AutoCAD drawings No. CV-AAA-CV69-0002 Rev B and CV-AAA-CV69-0003 Rev B provided by Kellogg Brown and Root, LLC. The locations of the North and South Turning Basins were digitized from AutoCAD drawing no. CV-F-217-SKETCH-TB provided by Kellogg Brown and Root, LLC.

5. Imagery source: Esri, i-cubed, USDA, AEX, GeoEye, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community. (c) OpenStreetMap and contributers, Creative Commons-Share Alike License (CC-BY-SA).

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ZONE:	ZONE 9 NORTH
UNITS:	METERS

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Kellogg Brown and Root, LLC

ISOPACH MAP SHOWING THE THICKNESS OF OVERBURDEN MATERIAL TO THE FIRST REFLECTOR TRESTLE & MOORING AREA LELU ISLAND LNG FACILITY BRITISH COLUMBIA, CANADA

JUNE 2013

SCALE: 1:5,000

200 100 0 200 400 Meters

REV NO:	DATE:	DESCRIPTION:	DRAWN:	CHKD:	APPR:
1	June 2013	Isopach Contours	CE, CF	AT, CP	JJC
2	July 2013	Revised per Client Review	CE	CP	JJC
3	July 2013	Revised per Client Review	CE	CP	JJC

JOB NUMBER: 23.00007028

CHART NO.: 3A of 4

414600E
414900E
415200E
415500E
415800E
416100E
6007800N
6007500N
6007200N
6006900N
Ridley Island
Lelu Island
North Turning Basin
South Turning Basin
B-39
B-38
B-6
B-8
B-7
B-9
B-13
B-10
B-12
B-11
B-17
B-14
B-16
B-15
B-22
B-5
B-3
B-4
B-37
N

Legend

Isopach Contours, Contour Interval = 1 meter
(Thickness of Overburden Material, Consisting of Sand, Silt, and Clay, overlying bedrock)

Bore Hole Locations (KBR)

NOTES

1. Horizontal positioning achieved using a Starfix II DGPS positioning system integrated with Hypack navigation package.

2. Survey equipment utilized during data acquisition included the following systems:
- Computer navigation/ acquisition system integrated with Starfix II DGPS system,
- Edgetech full spectrum profiler (Chirp) system, and
- Single-plate "Boomer" seismic source coupled with one 8-element hydrophone streamer.

3. Shallow geology data were collected May 12-16th, 2013 onboard M/V My Lady.

4. Trestle and original mooring area have been obtained from AutoCAD drawings No. CV-AAA-CV69-0002 Rev B and CV-AAA-CV69-0003 Rev B provided by Kellogg Brown and Root, LLC. The locations of the North and South Turning Basins were digitized from AutoCAD drawing no. CV-F-217-SKETCH-TB provided by Kellogg Brown and Root, LLC.

5. Imagery source: Esri, i-cubed, USDA, AEX, GeoEye, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community. (c) OpenStreetMap and contributers, Creative Commons-Share Alike License (CC-BY-SA).

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GEODETIC INFORMATION

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UNITS:	METERS

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KBR

Kellogg Brown and Root, LLC

ISOPACH MAP SHOWING THE THICKNESS OF OVERBURDEN MATERIAL OVERLYING BEDROCK TURNING BASINS AREA LELU ISLAND LNG FACILITY BRITISH COLUMBIA, CANADA

JUNE 2013

SCALE: 1:2,500

100 50 0 100 200 Meters

REV NO:	DATE:	DESCRIPTION:	DRAWN:	CHKD:	APPR:
1	June 2013	Isopach Contours	CE, CF	AT, CP	JJC
2	July 2013	Revised per Client Review	CE	CP	JJC
3	July 2013	Revised per Client Review	CE	CP	JJC

JOB NUMBER: 23.00007028

CHART NO.: 3B of 4

Jul 22, 2013 - 12:30pm Z:\ACAD\FPL-2028-TURNBASIN-003-NS-2500.dwg

412200E
412800E
413400E
414000E
414600E
415200E
6006600N
6006000N
6005400N
6004800N
6004200N

Ridley Island
Lelu Island
Kitson Island

B-8
B-7
B-17
B-14
B-15
B-19
B-20
B-18
B-21
B-31
B-24
B-32
B-33
B-34
B-37
B-35
B-36

-5
-10
-15
-20
-25
-30
-35
-40
-45
-6
-7
-9

N

Jul 09, 2013 - 3:58pm M:\Ventura\ACAD\PPI-7028-TRESTLE-004-NB-5000.dwg

Legend

- Index Contours (5-meter interval)
- Contours (1-meter interval)
- Minor Contours (0.5-meter interval)
- Bore Hole Locations (KBR)
- Area Too Shallow for Safe Vessel Operations

Slope Interpretation (Degrees)

- > 30
- 25
- 20
- 15
- 10
- 5
- 0

NOTES

1. Bathymetric contours are in meters and referenced to orthometric height (CVC28BC - Canadian Vertical Datum 1928) at a 0.5 meter interval.

2. Horizontal and vertical positioning achieved using RTK (Real-Time Kinematic), POS M/V inertial system and Trimble R8 GNSS receivers integrated with Hypack navigation software.

3. Horizontal and vertical data referenced to horizontal/vertical monument PE:
Northing: 6008493.674 m (UTM-9N)
Easting: 415834.964 m (UTM-9N)
Elevation: 5.034 m
(Provided by McElhanney Consulting Services Ltd.).

4. Survey equipment utilized during data acquisition included the following systems:
- Multibeam R2Sonic sonar,
- Marine Magnetics SeaSpy marine magnetometer, and
- Edgetech digital dual frequency side scan sonar.

5. Hydrographic and geophysical data were collected on May 4-10th, 2013 onboard the M/V Rain Coast Explorer.

6. Trestle and original mooring area have been obtained from AutoCAD drawings No. CV-AAA-CV69-0002 Rev B and CV-AAA-CV69-0003 Rev B provided by Kellogg Brown and Root, LLC. The locations of the North and South Turning Basins were digitized from AutoCAD drawing no. CV-F-217-SKETCH-TB provided by Kellogg Brown and Root, LLC.

7. Imagery source: Esri, i-cubed, USDA, AEX, GeoEye, Getmapping, Aerogrid, IGN, IGP, and the GIS User Community. (c) OpenStreetMap and contributers, Creative Commons-Share Alike License (CC-BY-SA).

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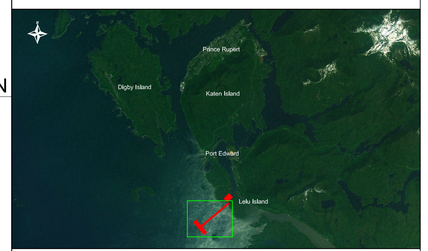
GEODETIC INFORMATION

DATUM:	NAD83
PROJECTION:	UNIVERSAL TRANSVERSE MERCATOR
ZONE:	ZONE 9 NORTH
UNITS:	METERS



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KBR

Kellogg Brown and Root, LLC

BATHYMETRY & SLOPE INTERPRETATION TRESTLE & MOORING AREA LELU ISLAND LNG FACILITY BRITISH COLUMBIA, CANADA

JUNE 2013

SCALE: 1:5,000

200 100 0 200 400
Meters

REV NO:	DATE:	DESCRIPTION:	DRAWN:	CHKD:	APPR:
1	June 2013	Slope Interpretation - Trestle & Mooring Area	CE, CF	AT, CP	JJC
2	July 2013	Revised per Client Review	CE	CP	JJC

JOB NUMBER: 23.00007028

CHART NO.: 4A of 4

414600E
414900E
415200E
415500E
415800E
416100E
6007800N
6007500N
6007200N
6006900N
Ridley Island
Lelu Island
B-39
B-6
B-38
B-8
B-7
B-3
B-4
B-5
B-9
B-13
B-12
B-10
B-11
B-17
B-14
B-16
B-15
B-22
B-31
N

Legend

- Index Contours (5-meter interval)
- Contours (1-meter interval)
- Minor Contours (0.5-meter interval)
- Bore Hole Locations (KBR)
- Area Too Shallow for Safe Vessel Operations

Slope Interpretation (Degrees)

- > 30
- 25
- 20
- 15
- 10
- 5
- 0

NOTES

1. Bathymetric contours are in meters and referenced to orthometric height (CVC28BC - Canadian Vertical Datum 1928) at a 0.5 meter interval.

2. Horizontal and vertical positioning achieved using RTK (Real-Time Kinematic), POS M/V inertial system and Trimble R8 GNSS receivers integrated with Hypack navigation software.

3. Horizontal and vertical data referenced to horizontal/vertical monument PE:
Northing: 6008493.674 m (UTM-9N)
Easting: 415834.964 m (UTM-9N)
Elevation: 5.034 m
(Provided by McElhanney Consulting Services Ltd.).

4. Survey equipment utilized during data acquisition included the following systems:
- Multibeam R2Sonic sonar,
- Marine Magnetics SeaSpy marine magnetometer, and
- Edgetech digital dual frequency side scan sonar.

5. Hydrographic and geophysical data were collected on May 4-10th, 2013 onboard the M/V Rain Coast Explorer.

6. Trestle and original mooring area have been obtained from AutoCAD drawings No. CV-AAA-CV69-0002 Rev B and CV-AAA-CV69-0003 Rev B provided by Kellogg Brown and Root, LLC. The locations of the North and South Turning Basins were digitized from AutoCAD drawing no. CV-F-217-SKETCH-TB provided by Kellogg Brown and Root, LLC.

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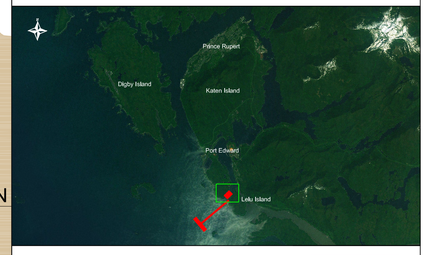
GEODETIC INFORMATION

DATUM:	NAD83
PROJECTION:	UNIVERSAL TRANSVERSE MERCATOR
ZONE:	ZONE 9 NORTH
UNITS:	METERS



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KBR

Kellogg Brown and Root, LLC

BATHYMETRY & SLOPE INTERPRETATION TURNING BASINS AREA LELU ISLAND LNG FACILITY BRITISH COLUMBIA, CANADA

JUNE 2013

SCALE: 1:2,500

100 50 0 100 200 Meters

REV NO:	DATE:	DESCRIPTION:	DRAWN:	CHKD:	APPR:
1	June 2013	Slope Interpretation - Turning Basins Area	CE, CF	AT, CP	JJC
2	July 2013	Revised per Client Review	CE	CP	JJC

JOB NUMBER: 23.00007028

CHART NO.: 4B of 4

Jul 10, 2013 - 3:23pm M:\Ventura\ACAD\FPI-7028-TURNBASIN-004-MB-2500.dwg