Appendix 5-D

Brucejack Project: Geotechnical Stability Assessment of Waste Rock Deposition in Brucejack Lake

ERM

PRETIUM RESOURCES INC.

BRUCEJACK PROJECT

GEOTECHNICAL STABILITY ASSESSMENT OF WASTE ROCK DEPOSITION IN BRUCEJACK LAKE

FINAL

PROJECT NO.:	1008010-006	DISTRIBUTION:	
DATE:	April 30, 2014	PRETIUM:	2 copies
DOCUMENT NO.:	BJ-2014-14	BGC:	2 copies

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April 30, 2014
Project No.: 1008010-006

Mr. Ian Chang, Vice President, Project Development
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Vancouver, B.C., V6C 3P1

Dear Mr. Chang,

Re: Brucejack Project - Geotechnical Stability Assessment of Waste Rock Deposition in Brucejack Lake

Please find attached a copy of the above referenced report dated April 30, 2014. Should you have any questions or comments, please do not hesitate to contact the undersigned. We appreciate the continued opportunity to take part in the development of the Brucejack Project.

Yours sincerely,

BGC ENGINEERING INC.
per:

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EXECUTIVE SUMMARY

Pretium Resources Inc. (Pretium) is undertaking studies related to development of the Brucejack Project, located in northern British Columbia, Canada. The Brucejack Project consists of a proposed underground mine and related surface infrastructure. As part of the project description, waste rock generated from site activities will be disposed in Brucejack Lake to limit the material's ability to generate acid rock drainage. In 2013, BGC Engineering Inc. (BGC) completed a conceptual layout for the disposal of waste rock in Brucejack Lake. As part of that study, BGC recommended that additional information be collected on the nature of the lake bottom sediments to facilitate a geotechnical stability assessment of the waste rock pile. Later in 2013, Pretium requested that BGC move forward with the assessment. This report summarizes the results of this geotechnical stability assessment.

To facilitate the stability assessment, overwater geophysical surveys consisting of bathymetric and sub-bottom acoustic profiling were completed on Brucejack Lake to develop bathymetric contours of the lake and to assess the thickness of the lake bottom sediments. Disturbed samples of the lake bottom sediments were also collected to assess the material's strength and behaviour characteristics through advanced laboratory analyses (e.g. consolidated isotropic undrained triaxial tests). The investigations indicated that Brucejack Lake reaches depths of up to 70 m in the area proposed for waste rock disposal and that the lake bottom sediments are typically up to 15 m thick, with thicker deposits up to 30 m thick located near the shoreline and in the deeper areas of the lake. At depth, the sediments primarily consist of low plastic silts to high plastic clays, whereas closer to shore they can be classified as silty sand to sandy silt. The fine grained sediments typically display low undrained shear strengths. However, as a result of the sampling method, samples could only be collected from the surface of the lake bottom. Therefore, it is likely that the samples represent the softest and weakest sediments from this area, and it is possible that denser and stronger sediments may be present below the surface of the lake bottom.

Updated layouts were developed for the waste rock pile, and a construction laydown pad, to store approximately 1.5 million m^3 of potentially acid generating (PAG) waste rock a minimum of 1 m below the low water elevation of the lake. It is anticipated that the construction laydown pad and waste rock pile will be constructed by advancing a platform out into the lake. Waste rock will be end dumped from haul trucks onto the platform and then either a dozer will be used to push it over the side or an excavator will be used to cast it over the side. Based on the results of the laboratory testing, the waste rock will be advanced over lake bottom sediments that display low shear strength under undrained loading conditions. Therefore, it is highly likely that the waste rock pile will undergo lateral spreading type failures as it is advanced. This will result in an overall slope of the waste rock pile (measured from toe to crest) that is flatter than the material's subaerial angle-of-repose. For this assessment, it was assumed that the waste

rock pile will have a final flatter slope face ranging from 1.5H:1V to 2H:1V (expressed as a ratio of horizontal distance (H) to vertical distance (V)).

Two dimensional, limit equilibrium stability analyses were completed based on the waste rock pile layouts, and the results of the geophysical surveys and laboratory testing. The stability analyses indicate that, under drained loading, the waste rock pile will have a factor of safety ranging from approximately 1.1 to 1.4 when applying strength estimates to the lake bottom sediments based on the results of laboratory testing. However, when applying possible lower bound strength estimates based on values from literature, the factor of safety ranges from approximately 0.9 to 1.2. The BC Mine Waste Rock Pile Research Committee (1991) suggests that, under static loading conditions, a minimum factor of safety of 1.1 to 1.5 be applied to short term developments (e.g. during mine operations) and that a minimum factor of safety of 1.3 to 1.5 be applied to the long term (e.g. post-closure) stability of waste rock piles. The upper bound analyses results generally meet the recommended criteria for short term developments, but the lower bound results suggest that the waste rock pile will be inherently unstable. These results are, however, based on the assumption that soft, weak lake bottom sediments extend all the way down to bedrock. It is considered possible that denser and stronger sediments may be present below the surface of the lake bottom. Further investigations, consisting of drilling and sampling should be conducted to confirm this. For better definition of the strengths, undisturbed samples should be collected and in-situ vane shear strength profiling should be completed. This will allow for a more confident estimate of the waste rock pile's stability.

The stability analyses also indicate that, under undrained loading, the waste rock pile will have a factor of safety below 1 and will be inherently unstable. Rapid advancement of waste rock over the sediments may result in undrained loading. Based on the waste rock deposition schedule, the annual volume of PAG waste rock disposed of in Brucejack Lake is the highest from Years -2 to 1. Following this, the annual volume of waste rock disposed of in Brucejack Lake decreases. Therefore, Years -2 to 1 are likely when the advancement rate of waste rock out into the lake will be the highest and is the period of time when instability near the face should be expected. Undrained loading may also occur following Year 1, but the advancement rate of the waste rock pile will likely be reduced so instabilities may be less frequent.

The results of the analyses demonstrate that the overall stability of the waste rock pile can be expected to vary significantly depending on the slope geometry, shear strength of the lake bottom sediments, and loading conditions. The estimated factors of safety are generally lower than those typically applied to subaerial waste rock piles. However, this is not unexpected given that the waste rock pile will be developed by end dumping and pushing material into a subaqueous environment that contains soft, plastic sediments. To utilize this dumping method at Brucejack, safe operating procedures will need to be put in place, and instabilities near the advancing crest will need to be anticipated throughout the development of the waste rock pile and construction laydown pad. Deformations due to creep should also be anticipated over the long term. To minimize undrained loading of the lake bottom sediments, active dumping areas should be maintained sufficiently large to reduce the crest advancement rate as much as possible. Based on the waste rock deposition schedule, it is anticipated that it will be possible to maintain a crest advancement rate of less than 1 m/day. Haul trucks should also maintain a minimum distance from the active crest when dumping their loads. Based on the results of the analyses, it is recommended that haul trucks dump their loads no closer than 10 m from the active crest. This minimum distance can be re-evaluated as operational, site specific experience is gained. The dumping platform will also require ongoing monitoring throughout the life of the mine to assess whether it is safe for personnel and equipment to be operating in this area. Safe working procedures will need to be developed specifically for this area and visual monitoring for signs of deformation should be completed continuously while work is actively being conducted on the waste rock pile. Procedures utilized at existing or pre-existing operations that disposed waste rock in bodies of water, such as the Eskay Creek Mine, should be considered.

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1.0 INTRODUCTION

Pretium Resources Inc. (Pretium) is undertaking studies related to development of the Brucejack Project, located in northern British Columbia, Canada. The Brucejack Project consists of a proposed underground mine and related surface infrastructure. As part of the project description, waste rock generated from site activities will be disposed in Brucejack Lake to limit the material's ability to generate acid rock drainage. In 2013, BGC Engineering Inc. (BGC) completed a conceptual layout for the disposal of waste rock in Brucejack Lake (BGC, 2013b). As part of that study, BGC recommended that additional information be collected on the nature of the lake bottom sediments to facilitate a geotechnical stability assessment of the waste rock pile. Later in 2013, Pretium requested that BGC move forward with the assessment. This report summarizes the results of this geotechnical stability assessment.

1.1. Project Description

The Brucejack Project is located in northwestern BC, approximately 70 km north-northwest of Stewart, BC (Figure 1-1). The deposit is located in the high alpine in the Sulphurets District of the Iskut River region, approximately 30 km west of Bowser Lake. The project proposes to develop an underground mine targeting high-grade gold and silver mineralization utilizing longhole open stoping methods. Primary processing of the ore will be completed at a mill building located adjacent to Brucejack Lake. Flotation tailings from this mill will be deposited in Brucejack Lake along with waste rock from the site development and underground mine. Waste rock and paste thickened tailings will also be used to backfill portions of the underground mine. Concentrate produced at the mine site will be hauled off-site by truck along a 74 km long access road that connects to Highway 37.

1.2. Scope of the Current Study

The scope of the current study is to complete a geotechnical assessment of the physical stability of the waste rock pile that will be formed in Brucejack Lake. This work is based on BGC's proposal, dated October 31, 2013 (BGC, 2013a). The stability assessment consists of estimating preliminary factors of safety of the waste rock pile at key stages of development. As part of this study, the conceptual layout of the waste rock pile previously provided by BGC (2013b) was updated as a result of changes made to the site layout by Pretium (I. Chang, pers. comm., January 16, 2014). Water quality and geochemical evaluations, including acid generation and metal leaching, are not addressed in this document, nor are any environmental, permitting, or option acceptability aspects of the project.

Figure 1-1. Site Location

2.0 GEOTECHNICAL INFORMATION

2.1. Geophysical Survey

In August 2013, overwater geophysical surveys consisting of bathymetric and sub-bottom acoustic profiling were completed on Brucejack Lake by Frontier Geoscience Inc. (Frontier). The purpose of the surveys was to develop bathymetric contours of the lake and assess the thickness of the lake bottom sediments. Details regarding the survey equipment, procedures and interpretive methods can be found in a report issued by Frontier (Appendix C). Bathymetric contours and an isopach showing the thickness of the lake bottom sediments, based on the geophysical survey data, are provided on Drawings 1 and 2, respectively. In their report, Frontier indicates that depths to subsurface boundaries derived from overwater acoustic profiling are generally accurate to within 10% of the true depth to the boundary. No geotechnical drilling was undertaken at the current phase, however, to provide direct measurements for calibration of the geophysical results.

2.2. Sampling and Laboratory Analyses

Between September 30 and October 1, 2013, BGC personnel collected eight samples of sediment from the lake bottom of Brucejack Lake. The location of the samples are shown on Drawings 1 and 2. The samples were collected from a boat using a petite ponar grab sampler and were sent to BGC's laboratory for testing. As a result of the sampling method, only disturbed samples could be collected from the surface of the lake bottom. Therefore, it is likely that the samples represent the softest and weakest sediments from this area, and it is possible that denser and stronger sediments may be present below the surface of the lake bottom. Collecting sediment samples from below a lake is very difficult and it is considered likely that some of the material was lost during retrieval of the grab sampler. Both index and advanced testing were completed on the disturbed lake bottom sediment samples. The index testing consisted of particle size analyses (wash sieve and hydrometer) and Atterberg Limits. The advanced testing consisted of undrained triaxial tests and direct simple shear tests. Complete laboratory reports are provided in Appendix A.

2.2.1. Index Test Results

The results of the particle size analyses (ASTM D6913) and the Atterberg Limits testing (ASTM D4318) for the lake bottom sediment samples are summarized in Tables 2-1 and 2-2, respectively. The testing indicates that samples LS-03, LS-04 and LS-07 are primarily composed of fines (i.e. particles finer than 0.075 mm) with LS-03 and LS-04 classified as low plastic silt and LS-04 classified as high plastic clay. Samples LS-06 is also primarily composed of fines but can be classified as sandy silt. Sample LS-05 was the coarsest sample tested and can be classified as silty sand.

Table 2-1. Summary of Particle Size Distribution

Sample ID	Percent Finer Than by Weight (%)[1]							
	19 mm (3/4")	9.5 mm (3/8")	4.75 mm (#4)	2.00 mm (#10)	0.425 mm (#40)	0.250 mm (#60)	0.106 mm (#140)	0.075 mm (#200)
LS-03	-	-	-	100	99.8	99.8	99.5	99.4
LS-04	-	-	-	100	99.9	99.9	99.9	99.8
LS-05	100	96.1	94.4	90.7	83.8	75.5	32.5	24.4
LS-06	-	-	-	100	99.5	97.7	70.5	52.7
LS-07	-	-	-	100	99.6	99.3	96.3	90.9

Notes:
1. Metric sieve size with comparable U.S. standard sieve size in brackets.

Table 2-2. Summary of Atterberg Limits Testing

Sample ID	LL[1] (%)	PL[1] (%)	PI[1] (%)	USCS[2]
LS-03	45.7	30.3	15.5	ML
LS-04	54.2	23.6	30.6	CH
LS-07	35.4	34.3	1.1	ML

Notes:
1. LL = liquid limit; PL = plastic limit; PI = plasticity index.
2. USCS is as per Unified Soil Classification System. ML = low plastic silt; CH = high plastic clay.

2.2.2. Triaxial Test Results

A total of five consolidated isotropic undrained (CIU) triaxial tests (ASTM D4767) with pore pressure measurements were completed on three of the primarily fine grained, disturbed samples of the lake bottom sediments (LS-03, LS-04 and LS-07). Tests were repeated on samples LS-03 and LS-04 to check for consistency in the results. The duplicate testing completed on LS-03 and LS-04 indicated consistent results so a duplicate test was not performed on LS-07. As disturbed samples had been collected, the in-situ density of the material was unknown. Therefore, it was assumed that the material is normally consolidated in-situ. Two approaches were used to prepare the samples. The first involved lightly compacting them into moulds so that they would just standup under their own weight and then applying effective confining stresses considered high enough to consolidate the material to a point on its virgin compression line. For the duplicate tests on samples LS-03 and LS-04, the samples were removed from the cells after the consolidation phase and then trimmed to a smaller diameter to remove irregularities in shape arising during consolidation. The samples were then replaced in the cell and reconsolidated prior to shearing.

To ensure saturation of the specimens, the back pressure was increased until a minimum B-bar coefficient of 0.95 was achieved. The resulting back pressures ranged from approximately 400 to 550 kPa. Effective confining stresses ranging from approximately 295 to 993 kPa were then applied and the samples were allowed to consolidate. Excess pore water pressures were measured during consolidation. The samples were loaded axially after the excess pore pressures had dissipated and loads, deformations, and pore pressures were logged electronically to a data acquisition system. Stress path plots from the testing are shown in Figure 2-1 and the undrained shear strengths measured at 5% axial strain versus the vertical effective consolidation pressures are shown in Figure 2-2. Complete laboratory reports are provided in Appendix A.

As can be seen from the stress path plots (Figure 2-1), the samples acted normally consolidated under loading before displaying strain hardening behaviour. Based on this data, an effective friction angle (ϕ') of 27° has been estimated for the primarily fine grained samples. From Figure 2-2, it can be seen that the ratio of undrained shear strengths (taken at 5% axial strain) to the vertical effective consolidation pressure ranged from approximately 0.27 to 0.40.

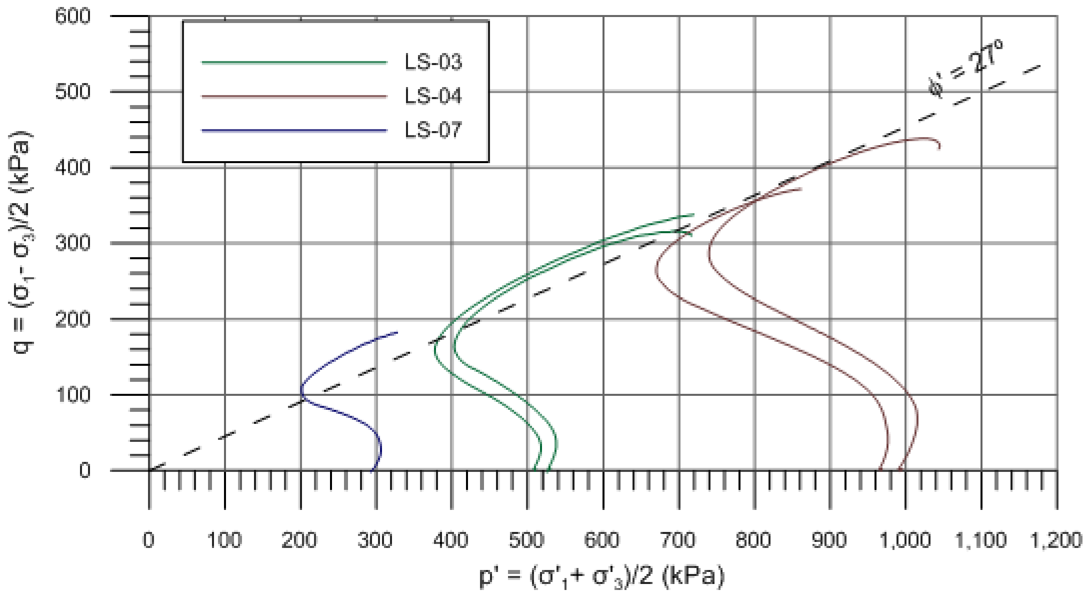

Figure 2-1. Stress Path Plot for Triaxial Tests

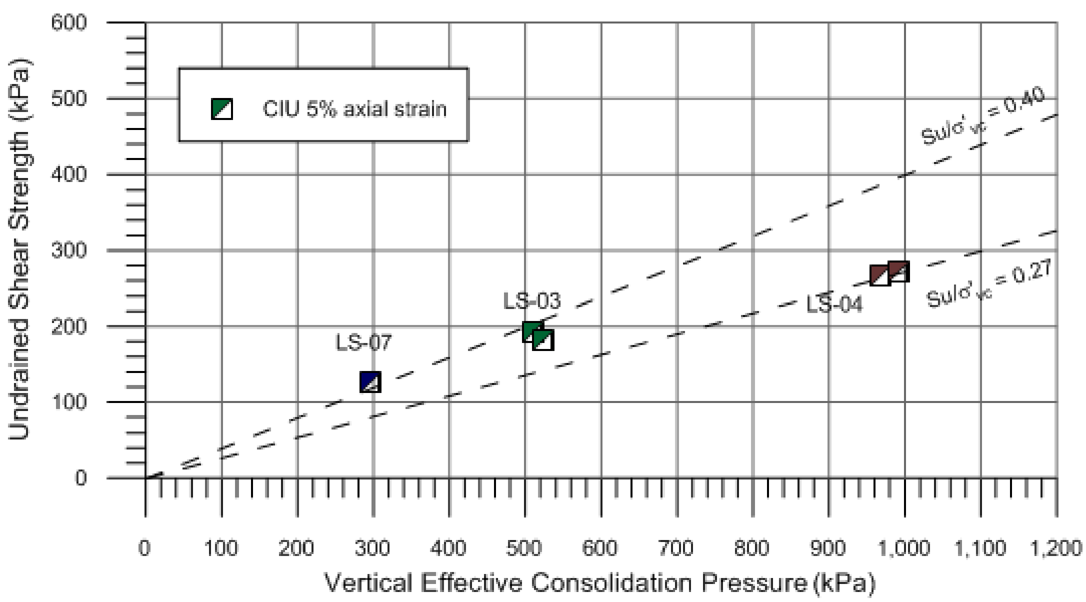

Figure 2-2. Undrained Shear Strength versus Vertical Effective Stress from CIU Triaxial Tests

2.2.3. Direct Simple Shear Test Results

Consolidated constant volume direct simple shear (DSS) tests (ASTM D6528) were completed on five disturbed samples of lake bottom sediments (LS-03, LS-04, LS-05, LS-06 and LS-07). The samples were prepared by lightly compacting them into simple shear rings. The samples were then consolidated under effective vertical stresses ranging from approximately 180 to 910 kPa. Excess pore pressures were allowed to dissipate and then the samples were loaded under simple shear conditions. The lateral loads and displacement were logged electronically throughout the test to a data acquisition system. The vertical displacement was also monitored to confirm that it remained zero. Stress path plots from the testing are shown in Figure 2-3. Complete laboratory reports are provided in Appendix A.

As can be seen from the stress path plots (Figure 2-3), the samples acted normally consolidated under loading before displaying strain hardening behaviour. Based on this data, an effective friction angle of 27° has been estimated for the fine grained samples (LS-03, LS-04 and LS-07) and an effective friction angle of 33° has been estimated for the silty sand and sandy silt samples (LS-05 and LS-06).

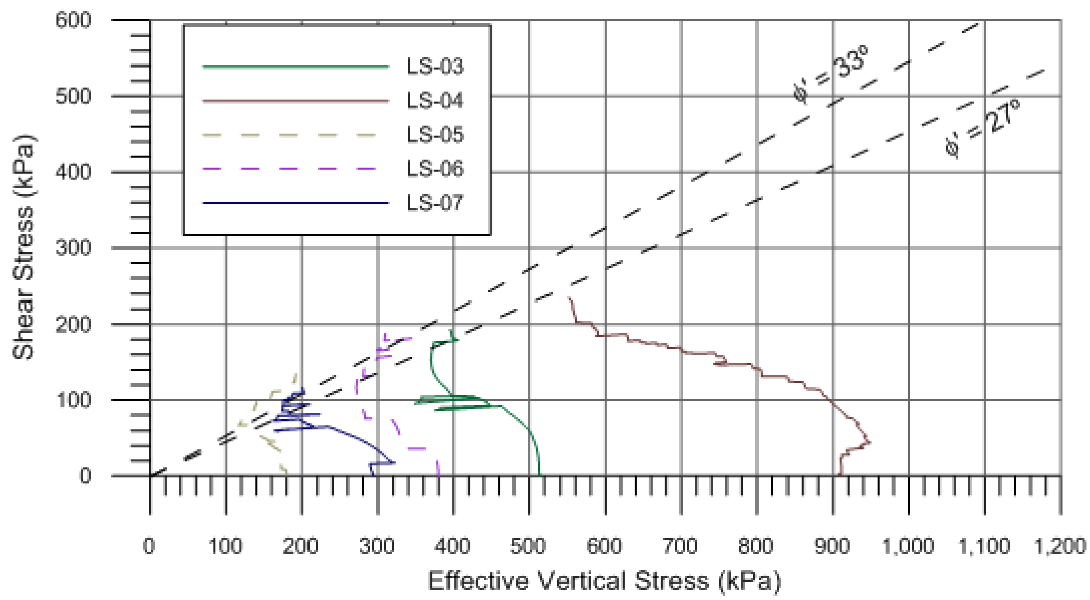

Figure 2-3. Stress Path Plot for DSS Tests

3.0 WASTE ROCK STORAGE AREA LAYOUT

The Brucejack Project proposes to dispose of a portion of the waste rock generated from civil and mining activities in Brucejack Lake. The primary purpose of the subaqueous disposal is to limit the waste material's ability to generate acid drainage. BGC has developed conceptual layouts for the disposal of waste rock in the lake. The layouts were developed to facilitate a geotechnical stability assessment and are an update to the conceptual layout previously completed by BGC (2013b). The following subsections outline the basis and details for the waste rock layouts.

3.1. Layout Basis

3.1.1. Storage Requirements

Waste rock will be generated from two sources at the project site: general civil construction activities during mine site development; and mining activities throughout the life of the mine. It was assumed that all of the waste rock generated from these two sources will be potentially acid generating (PAG). Based on this assumption and on information provided by Tetra Tech Inc. (N. Schwab, pers. comm., November 20, 2013) and AMC Mining Consultants Ltd. (C. Keogh, pers. com., May 2, 2013), approximately 1.5 million (M) m^3 of PAG waste rock will be disposed of in Brucejack Lake. All PAG material disposed of in Brucejack Lake must be placed more than 1 m below the low water level elevation of the lake to limit oxidation of this material as per the project description (Rescan, 2013). The water level elevation of Brucejack Lake was estimated to range from 1,364 to 1,366 m above sea level (m asl) based on lake level data from 2011 to 2012. This is a small data set and, thus, these levels should be reassessed as additional data is collected. For the purposes of this study, it was assumed that all PAG waste rock will be placed below 1,363 m asl and that all material placed above 1,363 m asl will be non-potentially acid generating (NAG). The annual schedule for disposal of PAG waste rock in the lake is shown in Table 3-1.

Based on the site layout provided by Tetra Tech, a pad will be constructed out into the lake during mine site development to accommodate the helipad, fuel storage, and batch plant (Drawing 1). It is anticipated that between 0.9 and 1.0 Mm^3 of waste rock will be required to construct this pad, depending on the final slope of its submerged face. Of this, approximately 0.6 to 0.7 Mm^3 will be below 1,363 m asl and can be constructed from PAG waste rock. Therefore, the conceptual layout of the waste rock pile developed by BGC was sized for the remaining 0.8 to 0.9 Mm^3 of PAG waste rock generated from the site development and mining activities. It was assumed that the waste rock pile would reach a maximum elevation of 1,370 m asl to match the construction laydown pad and that all material placed above 1,363 m asl will be NAG waste rock.

Table 3-1. Volume of PAG Waste Rock Scheduled for Disposal in Brucejack Lake

Mine Year	Incremental		Total
	Construction(1) (m³)	Mining(2) (m³)	Cumulative (m³)
-2	307,000	287,500	594,500
-1		246,200	840,700
1	-	215,000	1,055,700
2	-	85,200	1,140,900
3	-	56,000	1,196,900
4	-	71,600	1,268,500
5	-	26,600	1,295,100
6	-	25,100	1,320,200
7	-	10,800	1,331,000
8	-	56,600	1,387,600
9	-	27,800	1,415,400
10	-	14,700	1,430,100
11	-	15,100	1,445,200
12	-	14,200	1,459,400
13	-	10,500	1,469,900
14	-	7,400	1,477,300
15	-	3,300	1,480,600
16	-	1,500	1,482,100
17	-	2,500	1,484,600
18	-	1,600	1,486,200
19	-	1,000	1,487,200
20	-	1,800	1,489,000
21	-	600	1,489,600
22	-	300	1,489,900

Notes:

1. Data provided by Tetra Tech Inc., November 20, 2013 (12919902.00-CAL-C0002-00.xlsx). It was assumed that all of the waste rock generated from civil construction would occur from Mine Year -2 to -1.
2. Data provided by AMC Mining Consultants Ltd., May 2, 2013 (bjfs_LOM_waste_output_v2_030_130502.xlsx). Volumes have been estimated assuming a density of 2 tonnes/m³.
3. All volumes are rounded to the nearest 100 m³.

3.1.2. Bathymetry

The 5 m bathymetric contours provided by Frontier (2013) were used to develop the layout of the waste rock pile.

3.1.3. Overall Slope

Based on the results of the sub-bottom geophysical profiling survey and the samples collected from the lake bottom, it is anticipated that the waste rock pile will be developed over fine grained sediments that are up to 30 m thick. The laboratory testing conducted indicates that these materials will have low shear strengths under undrained loading conditions. Therefore, it is highly likely that the waste rock pile will undergo lateral spreading type failures as it is advanced. This will result in an overall slope of the waste rock pile (measured from toe to crest) that is flatter than the material's subaerial angle-of-repose of approximately 1.25H:1V (expressed as a ratio of horizontal distance (H) to vertical distance (V)). For this assessment, it was assumed that the waste rock pile will have a final shallower slope face ranging from 1.5H:1V to 2H:1V. It is possible that flatter slopes could also result if the lake bottom sediments are weaker than observed or if high loading rates generate excess pore pressures and instability.

3.2. Layout Details

Layouts were developed for both 1.5H:1V and 2H:1V slopes using the software package Muck3D (Wruffware, 2011, version 2.0.1). Drawings 1 and 2 show the crests and toes of the ultimate layouts for these two scenarios and Drawing 3 shows the ultimate layouts in cross section. The layouts were developed to take advantage of the deeper portion of the lake and to keep the waste rock pile from blocking the outlet of the lake located to the west. At its ultimate configuration the waste rock pile reaches a height of approximately 70 m (measured vertically from crest to toe). As noted earlier, all of the PAG waste rock will be disposed of below 1,363 m asl and above this elevation, NAG waste rock will be placed. It is estimated that between 90,000 and 120,000 m^3 of NAG waste rock will be required to construct the waste rock pile out into the lake. This estimate does not include the volume of NAG waste rock required to construct the construction laydown pad, which is estimated to be approximately 325,000 m^3. These estimates assume that both the waste rock pile and the construction laydown pad will be constructed to an elevation of 1,370 m asl.

3.3. Construction

It is anticipated that the waste rock pile will be constructed by advancing a platform out into the lake from the construction laydown pad as shown on Drawing 1. Waste rock will be end dumped from haul trucks onto the platform and then, either a dozer will be used to push it over the side or an excavator will be used to cast it over the side. Safe working procedures will need to be developed specifically for all activities undertaken in this area. Visual monitoring for signs of deformation and haul truck driver direction, will be required while active waste rock placement is occurring.

4.0 STABILITY ANALYSES

4.1. Methodology

The stability of the waste rock pile was assessed under static loading conditions using the two-dimensional, limit equilibrium software package Slide (Rocscience, 2010, version 6.006). Preliminary factors of safety were estimated using the Morgenstern-Price method.

4.2. Material Properties

Material properties used in the stability assessment were based on laboratory testing and literature values. A summary of the relevant material properties is provided in Table 4-1. It has been assumed that the waste rock is free draining and will not develop excess pore pressures and that failure surfaces will not propagate into the bedrock. In addition, ranges of effective stress parameters (outlined in Section 4.2.2) have been estimated for the lake bottom sediments to evaluate preliminary upper and lower bound factors of safety.

Table 4-1. Summary of Material Properties used in Stability Analyses

Material Type	Unit Weight (kN/m^3)	Effective Stress Parameters	Undrained Shear Strength
Waste Rock	20	Non-linear strength function[(1)]	N/A
Lake Bottom Sediment	16	ϕ' = 22 to 27^0, c' = 0 kPa[(2)]	Su = 0.27 σ'_{vc} [(3)]

Notes:
1. See Section 4.2.1.
2. See Section 4.2.2. ϕ' = effective friction angle; c' = cohesion.
3. See Section 4.2.2. Su = undrained shear strength; σ'_{vc} = effective vertical consolidation pressure.

4.2.1. Waste Rock

The shear strength of the waste rock was estimated using a method outlined by Leps (1970) for compacted rockfill. Leps compiled data from a number of large scale triaxial tests on gravel and rockfill to develop stress dependent shear strength estimates for the following broad categories: high density, well graded rockfill with strong particles; low density, poorly graded rockfill with weak rock particles; and average rockfill (Figure 4-1). Leps defined weak rock particles as having an unconfined compressive strength (UCS) ranging from approximately 3 to 17 MPa (500 to 2,500 psi), average rock particles as having a UCS ranging from 17 to 69 MPa (2,500 to 10,000 psi) and strong rock particles as having a UCS ranging from 69 to 207 MPa (10,000 to 30,000 psi). Based on previous geotechnical studies conducted by BGC (2013c and 2013d), the rock at Brucejack can generally be described as having UCS values ranging from approximately 30 MPa to over 100 MPa. Therefore, the waste rock will generally be composed of average to strong particles according to the descriptions provided by Leps. However, given that the waste rock will be placed in a relatively loose state and not subjected to any compactive effort, the relationship provided by Leps for low density, poorly graded rockfill is likely more representative of the Brucejack waste rock and, therefore, was used for the stability analyses.

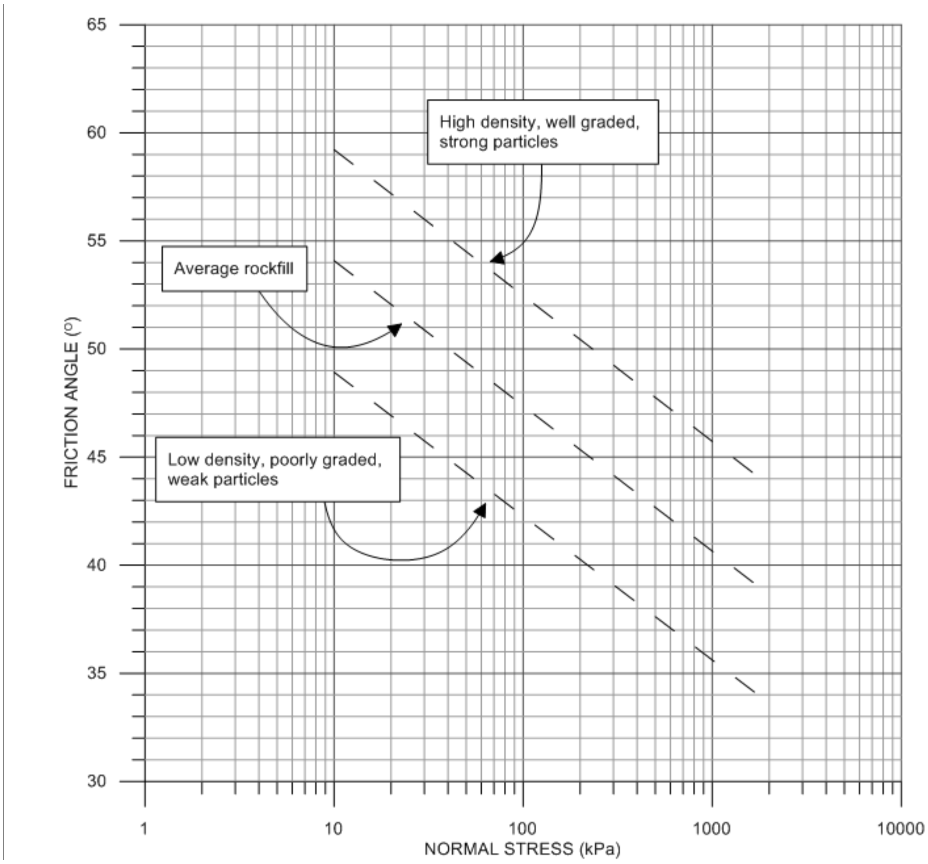

Figure 4-1. Shear Strength of Rockfill adapted from Leps (1970)

4.2.2. Lake Bottom Sediments

The shear strength of the lake bottom sediments was estimated based on the results of the laboratory testing completed on disturbed samples outlined in Section 2.2 and on values available in the literature. The laboratory testing suggests that a friction angle of 27 and 33^0 can be estimated for the fine grained and the sandier lake bottom sediments, respectively. Insufficient data is available to spatially define the extent of sandier sediments from the fine grained sediments. However, it is anticipated that the sandier sediments will be closer to shore in the shallower portions of the lake and the fine grained sediments will be in the deeper portions of the lake. The layouts of the waste rock piles extend to the deeper portions of the lake and therefore, the strength of the sandier sediments have not been considered in the stability analyses. In addition, it is likely that the waste rock pile will undergo lateral spreading type failures as it is advanced (Section 3.1.3) and thus the overall stability of the waste rock pile may be controlled by the residual friction angle of the lake bottom sediments. Values have been presented by Stark and Eid (1994) showing a relationship between the residual friction angle and liquid limit of soils with various clay-size fractions (defined as the fraction as particles smaller than 0.002 mm). The clay-size fraction of samples LS-03, LS-04 and LS-07 ranged from approximately 25 to 55% and the liquid limits ranged from approximately 35 to 55%. Based on this data, a residual friction angle of approximately 22^0 has be estimated for these soils. Therefore, under drained loading conditions the lake bottom sediments were assigned an effective friction angle ranging from 22 to 27^0.

Under undrained loading conditions an undrained shear strength (Su) equivalent to 0.27 times the vertical effective consolidation stress (σ'_{vc}) was estimated based on the laboratory testing outlined in Section 2.2.

4.3. Cases Considered

Representative cross sections were developed through the waste rock pile as shown on Drawing 3. Stability analyses were completed along Cross Sections A and B for both the 1.5H:1V and 2H:1V slopes at the following stages of development:

- Ultimate layout of the waste rock pile
- Completion of the construction laydown pad (i.e. prior to development of the waste rock pile).

For all cases considered, the analyses assessed deep seated failure surfaces.

4.4. Results

The stability analyses indicate that, under drained loading, the ultimate configuration of the waste rock pile will have a factor of safety ranging from approximately 1.1 to 1.4 when applying strength estimates based on the results of the laboratory testing. However, when applying the lower bound strength estimates based on values from literature, the factor of safety ranges from approximately 0.9 to 1.2. The analyses also indicate that, under undrained loading conditions, the waste rock pile will have a factor of safety below 1. Prior to development of the waste rock pile, under drained loading conditions, the construction laydown pad will have a factor of safety ranging from approximately 1.0 to 1.5 for the cases considered. The construction laydown pad will also have a factor of safety below or near 1 under undrained loading conditions. A summary of the stability analysis results is provided in Table 4-2 and images from the stability models are provided in Appendix B.

Table 4-2. Stability Analysis Results

Cross Section	Stage of Development	Slope	Factor of Safety	
			Drained	Undrained
A	Ultimate Configuration	1.5H:1V	0.90 - 1.08	0.72
B	Ultimate Configuration	1.5H:1V	1.06 - 1.24	0.84
A	Ultimate Configuration	2H:1V	1.06 - 1.29	0.82
B	Ultimate Configuration	2H:1V	1.20 - 1.40	0.93
A	Construction Laydown	1.5H:1V	1.12 - 1.28	0.86
B	Construction Laydown	1.5H:1V	0.99 - 1.12	0.78
A	Construction Laydown	2H:1V	1.32 - 1.51	1.02
B	Construction Laydown	2H:1V	1.15 - 1.36	0.88

4.5. Discussion

The BC Mine Waste Rock Pile Research Committee (1991) suggests that under static loading conditions a minimum factor of safety of 1.1 to 1.5 be applied to short term developments (e.g. during mine operations) and that a minimum factor of safety of 1.3 to 1.5 be applied to the long term (e.g. post-closure) stability of waste rock piles. The criteria applied depends on the confidence in the analysis parameters and mechanisms, interpretation of conditions, and consequence of failure. Under drained loading, the ultimate configuration of the waste rock pile is estimated to have a factor of safety ranging approximately from approximately 0.9 to 1.4 depending on the slope geometry and strength estimate utilized. The upper bound results generally meet the recommended criteria for short term developments, but the lower bound results suggest that the waste rock pile will be inherently unstable. The suggested criteria for long term stability is only met when considering upper bound strengths in conjunction with overall slopes of 2H:1V. These results are, however, based on the assumption that soft, weak lake bottom sediments extend all the way down to bedrock. It is considered possible that denser and stronger sediments may be present below the surface of the lake bottom. Further investigations, consisting of drilling and sampling should be conducted to confirm this. For better definition of the strengths, undisturbed samples should be collected and in-situ vane shear strength profiling should be completed. This will allow for a more confident estimate of the waste rock pile's stability.

The stability analyses also indicate that, under undrained loading, the waste rock pile will have a factor of safety below 1 and will be inherently unstable. Rapid advancement of waste rock over the sediments may result in undrained loading. Based on the PAG waste rock deposition schedule (Table 3-1), the annual volume of PAG waste rock disposed of in Brucejack Lake is the highest from Years -2 to 1, with annual volumes ranging from 215,000 to nearly 600,000 m^3. From Years 2 to 9, the annual volume of PAG waste rock disposed of in the lake decreases to between 10,800 to 85,200 m^3. Following this, the annual volume ranges from 300 to 15,100 m^3 for the remainder of the mine life. Therefore, Years -2 to 1 are likely when the advancement rate of waste rock out into the lake will be the highest. This is the period of time when the waste rock will be used to develop the construction laydown pad and is when instability near the face should be expected. Undrained loading may also occur following Year 1, but the advancement rate of the waste rock pile will likely be reduced so instabilities may be less frequent.

Seismic loading from an earthquake has not been assessed as part of this analysis. However, seismic loading could result in undrained loading of the lake bottom sediments, resulting in factors of safety below 1. Additional information on the in-situ characteristics of the lake bottom sediments is needed to further assess the material's behaviour under this type of loading.

The results of the analyses demonstrate that the overall stability of the waste rock pile can be expected to vary significantly depending on the slope geometry, shear strength of the lake bottom sediments, and loading conditions. The estimated factors of safety are generally lower than those typically applied to subaerial waste rock piles. However, this is not unexpected given that the waste rock pile will be developed by end dumping and pushing material into a subaqueous environment that contains soft, plastic sediments.

To utilize this dumping method at Brucejack, safe working procedures will need to be put in place, and instabilities near the advancing crest will need to be anticipated throughout the development of the construction laydown pad and waste rock pile. Deformations due to creep should also be anticipated over the long term.

To minimize undrained loading of the lake bottom sediments, active dumping areas should be maintained sufficiently large to reduce the crest advancement rate as much as possible. Based on the PAG waste rock deposition schedule (Table 3-1), it is anticipated that it will be possible to maintain a crest advancement rate of less than 1 m/day. Haul trucks should also maintain a minimum distance from the active crest when dumping their loads. Based on the results of the analyses, it is recommended that haul trucks dump their loads no closer than 10 m from the active crest. This minimum distance can be re-evaluated as operational, site specific experience is gained.

The dumping platform will also require ongoing monitoring throughout the life of the mine to assess whether it is safe for personnel and equipment to be operating in this area. Safe working procedures will need to be developed specifically for this area and visual monitoring for signs of deformation should be completed continuously while work is actively being conducted on the waste rock pile. Procedures utilized at existing or pre-existing operations that disposed waste rock in bodies of water, such as the Eskay Creek Mine, should be considered.

5.0 ADDITIONAL CONSIDERATIONS

Below are some additional considerations for the disposal of waste rock in Brucejack Lake:

1. Climatic conditions at the site may cause difficulties for the proposed subaqueous deposition. The water adjacent to the advancing face of the waste rock pile will need to remain unfrozen, or at least have an ice cover thin enough for the waste rock to break through it, in order for waste rock to be deposited. If safe work procedures can be developed, it may be possible to use the bucket of an excavator to break through the ice prior to depositing waste rock. Alternatively, an aerator could be placed in the lake near the advancing face during the freezing period.
2. Snow removal and clearly marked paths will be required on the dumping platform for safety during active dumping.
3. The waste rock will likely contain other waste materials, such as blasting caps, detonator cord, etc. Screens or fences should be installed near the outlet of Brucejack Lake to collect these items so that they can be disposed of in a proper manner.
4. The aspects of geochemical input and resultant water quality impacts to the lake water need to be assessed in detail.
5. Any failures of the waste rock pile that do occur will likely generate suspended solids into the water column of the lake for some time period. Based on the disturbed samples collected, some of the lake bottom sediments contain a high content of clay-sized particles. These particles may remain in suspension for extended periods of time. It is not currently known if this will become a water treatment discharge issue (versus discharge criteria for suspended solids) but this will need to be addressed, both in terms of a lake quality assessment and possibly in terms of mitigation strategies, including but not limited to, the use of flocculants, silt curtains, and/or sediment separation dykes.
6. Suspended solids generated from fines washing off the waste rock as it is initially submerged and from displacement of lake bottom sediments as the waste rock is initially dumped will also need to be assessed.
7. Reclamation and/or mine closure plans should be developed for the waste rock pile.

6.0 CONCLUSIONS AND RECOMMENDATIONS

Key aspects of the geotechnical stability assessment and recommendations for subsequent levels of study are summarized below:

1. Geophysical surveys indicate that Brucejack Lake reaches depths of up to 70 m in the area proposed for waste rock disposal. Throughout this area lake bottom sediments typically range up to 15 m thick with thicker deposits up to 30 m thick located near the shoreline and in the deeper areas of the lake. Laboratory analyses of disturbed samples of the lake bottom sediments indicate that the material ranges from low plastic silt to high plastic clay in deeper portions of the lake and from silty sand to sandy silt in shallower portions of the lake. As a result of the sampling method, only disturbed samples could be collected from the surface of the lake bottom. No geotechnical drilling and sampling was undertaken to assess the ground conditions beneath the surfical lake bottom sediments.
2. The results of the stability assessment are generally based on the assumption that soft, weak lake bottom sediments extend all the way down to bedrock. It is possible that denser and stronger sediments may be present below the surface of the lake bottom. Further investigations, consisting of drilling and sampling should to be conducted to confirm this. For better definition of the strengths, undisturbed samples should be collected and in-situ vane shear strength profiling should be completed.
3. It is highly likely that the waste rock pile will undergo lateral spreading type failures as it is advanced over the lake bottom sediments. This will result in an overall slope of the waste rock pile (measured from toe to crest) that is flatter than the material's subaerial angle-of-repose (approximately 1.25H:1V). For this assessment, it was assumed that the waste rock pile will have a final shallower slope face ranging from 1.5H:1V to 2H:1V, with shallower angles also possible.
4. The geotechnical stability assessment indicates that, under drained loading, the ultimate configuration of the waste rock pile will have a factor of safety ranging from approximately 0.9 to 1.4 depending on the slope geometry and strength estimate considered. The upper bound results generally meet the criteria suggested by the BC Mine Waste Rock Pile Research Committee (1991) for short term developments, but the lower bound results suggest that the waste rock pile will be inherently unstable. The suggested criteria for long term stability is only met when upper bound strengths are considered in conjunction with overall slopes of 2H:1V. As noted earlier, further investigations, consisting of drilling, sampling, in-situ testing, and laboratory testing are recommended to provide more confident estimates of the lake bottom sediments strength and behaviour characteristics.
5. The geotechnical stability assessment also indicates that, under undrained loading, the ultimate configuration of the waste rock pile will have a factor of safety below 1 and will be inherently unstable. Therefore, advancement of the waste rock pile will need to be minimized to reduce the possibility of undrained loading. Based on the PAG waste rock deposition schedule (Table 3-1), it is anticipated that it will be possible to maintain

a crest advancement rate of less than 1 m/day. The crest advancement rate should be maintained as low as possible.

6. Haul trucks should maintain a minimum distance from the active crest when dumping their loads. Based on the results of the analyses, it is recommended that haul trucks dump their loads no closer than 10 m from the active crest. This minimum distance can be re-evaluated as operational, site specific experience is gained.
7. The dumping platform will require ongoing monitoring throughout construction and operation to assess whether it is safe for personnel and equipment to be operating in this area. Safe working procedures will need to be developed specifically for this area. Procedures utilized at existing or pre-existing operations that disposed of waste rock in bodies of water, such as the Eskay Creek Mine, should be considered.

7.0 CLOSURE

We trust the above satisfies your requirements at this time. Should you have any questions or comments, please do not hesitate to contact us.

Yours sincerely,

BGC ENGINEERING INC.
per:

Brent McAfee, P.Eng.
Geotechnical Engineer

Reviewed by:

Vinod K. Garga, Ph.D., P.Eng.
Senior Geotechnical Engineer

TC/VG/jwc/ht

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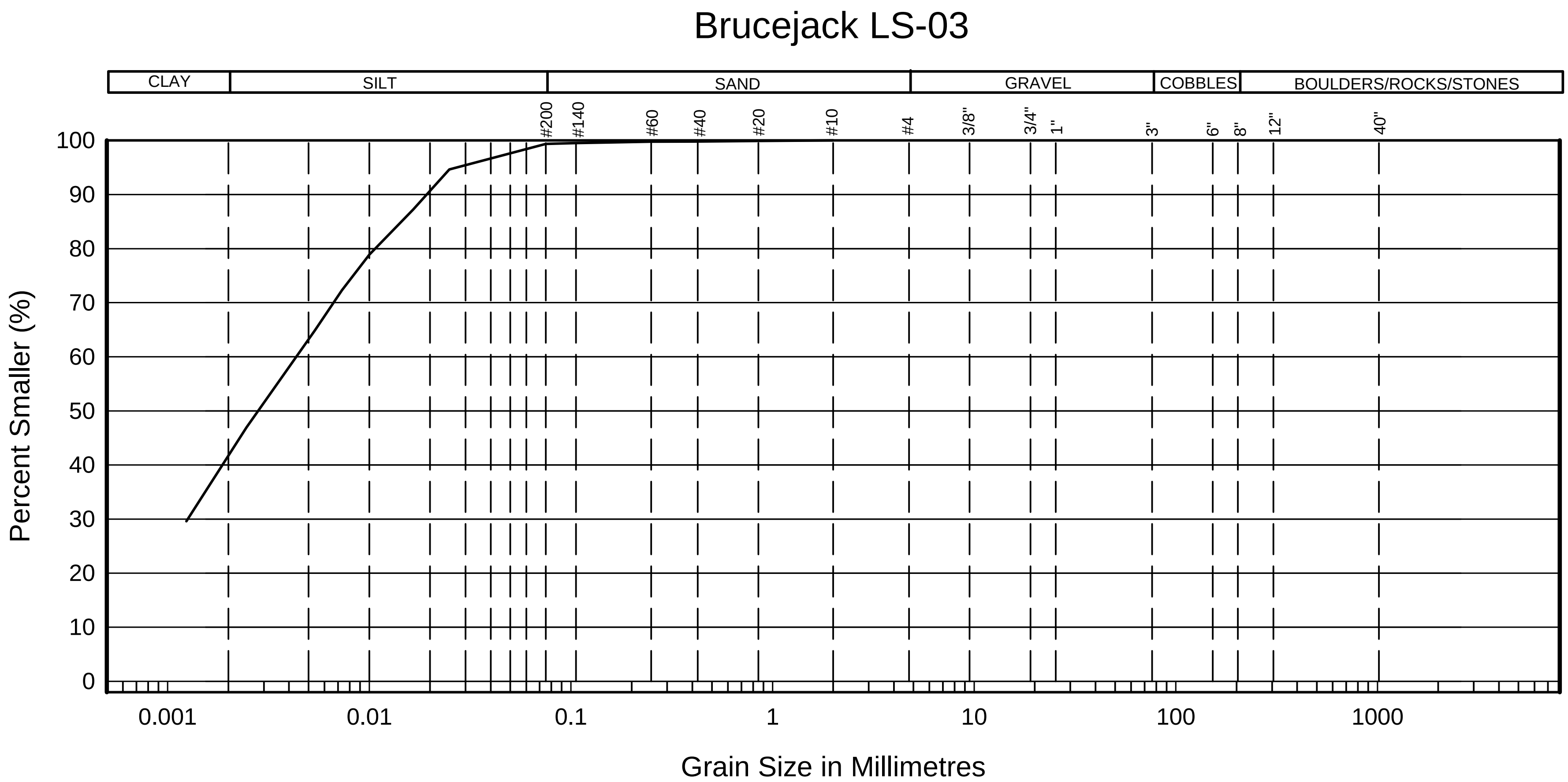
APPENDIX A
LABORATORY TESTING RESULTS



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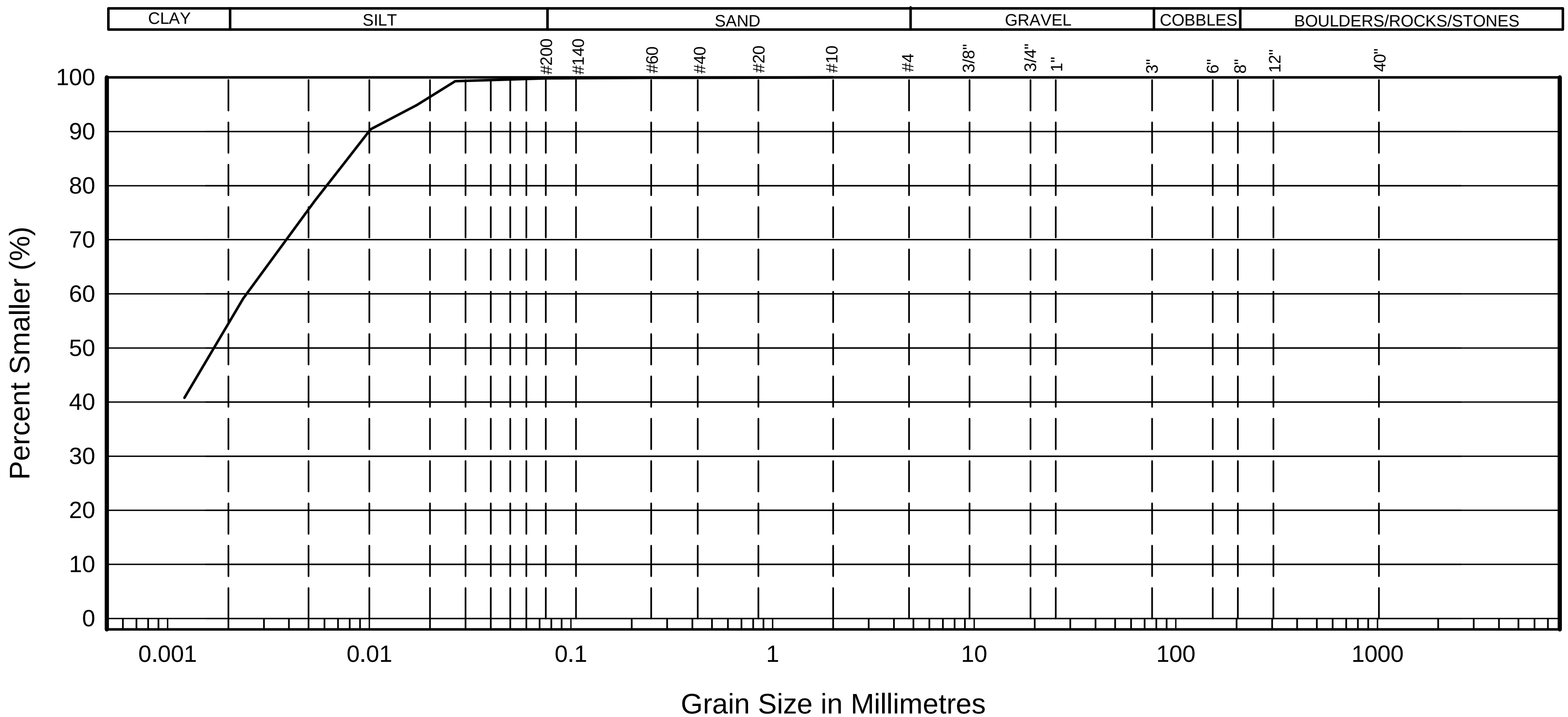
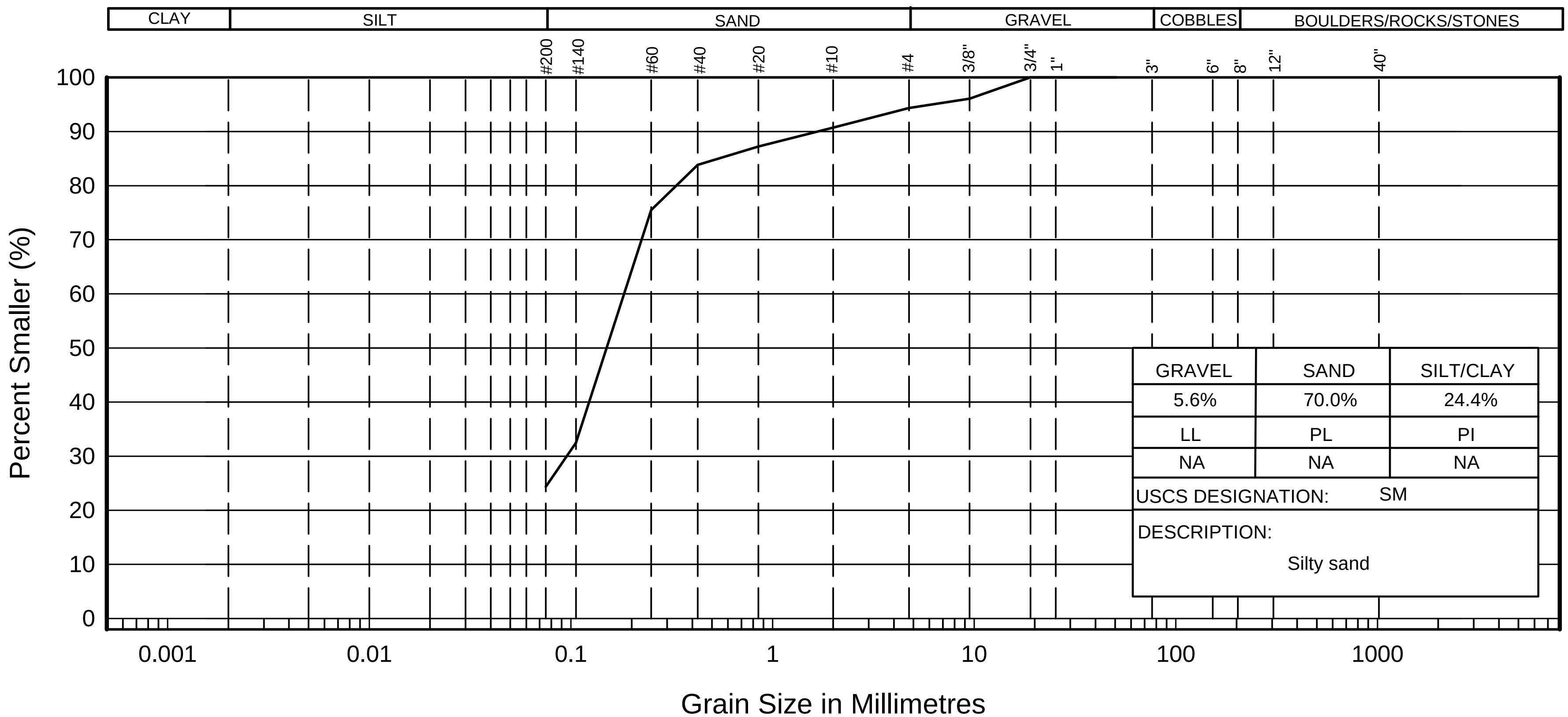
1008-010

Brucejack
Hydrometer Analysis

Brucejack LS-04



Brucejack LS-05



GRAVEL	SAND	SILT/CLAY
5.6%	70.0%	24.4%
LL	PL	PI
NA	NA	NA
USCS DESIGNATION:	SM	
DESCRIPTION:	Silty sand	

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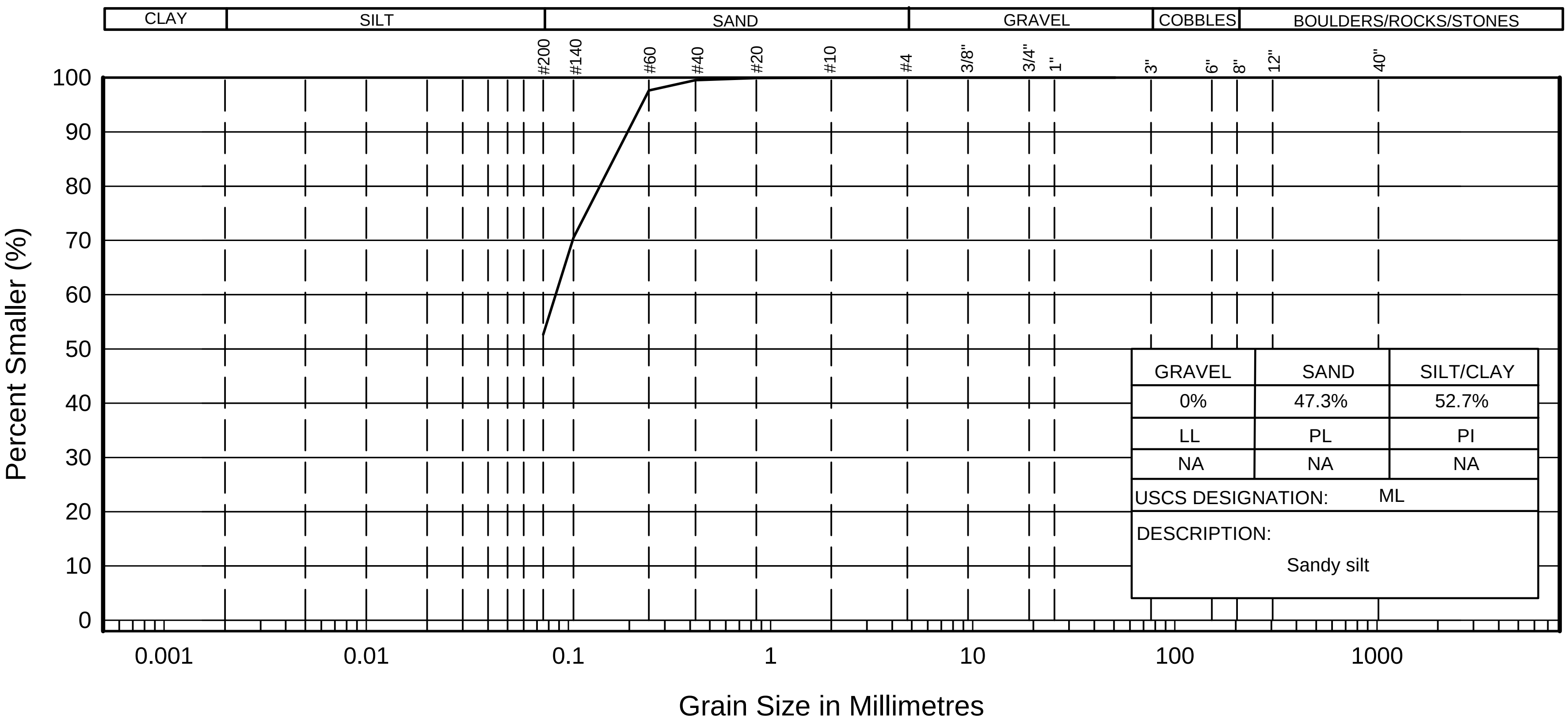
Brucejack
Grain Size Analyses

Brucejack LS-06



GRAVEL	SAND	SILT/CLAY
0%	47.3%	52.7%
LL	PL	PI
NA	NA	NA
USCS DESIGNATION: ML		
DESCRIPTION: Sandy silt		

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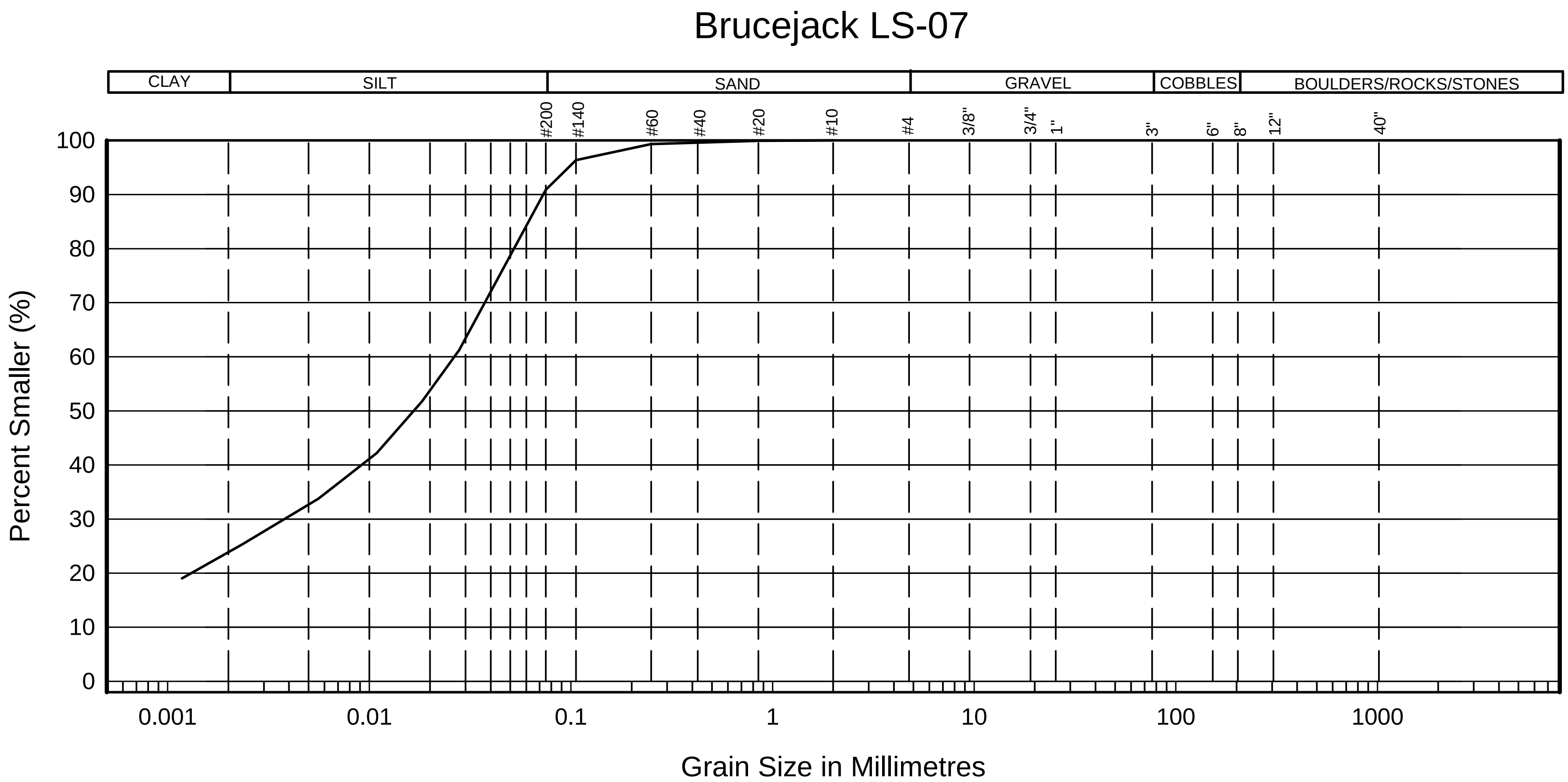
Brucejack
Grain Size Analyses



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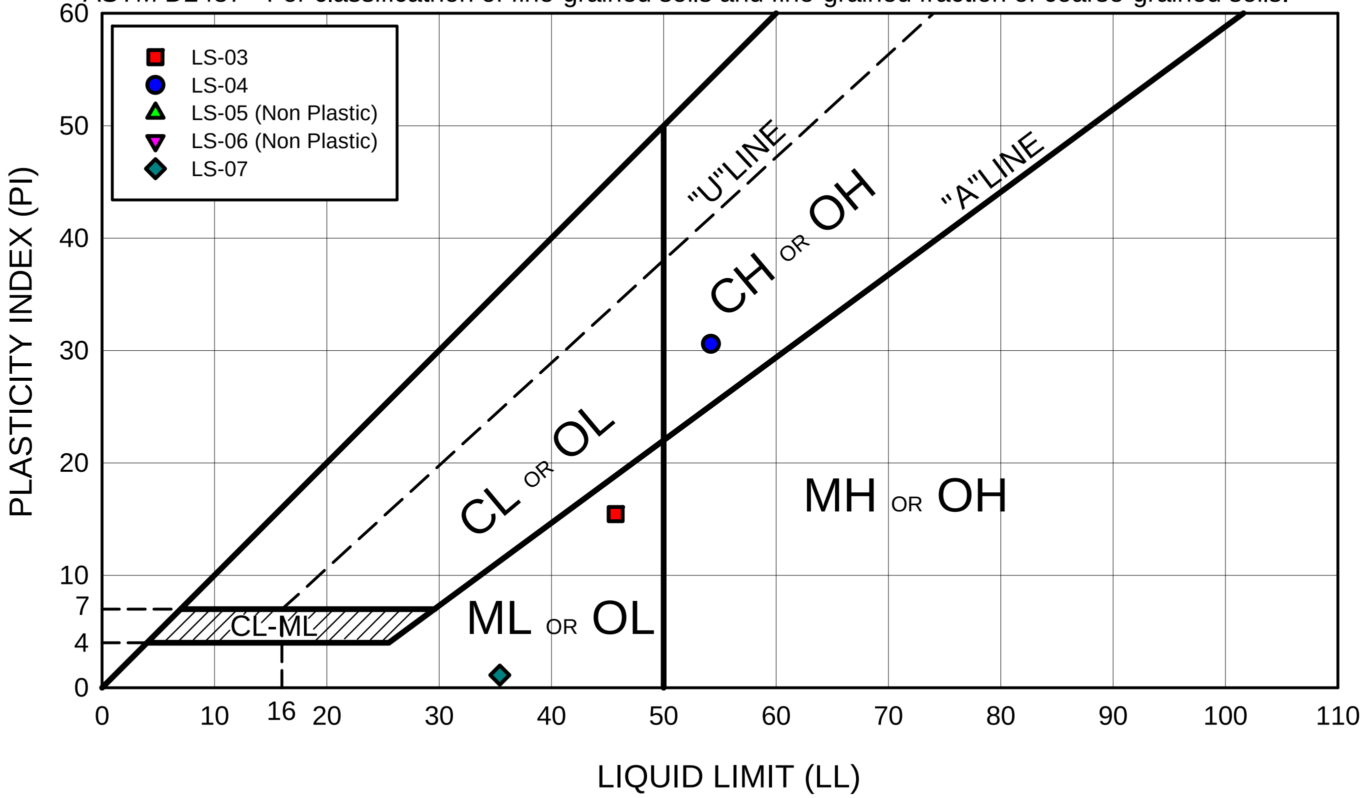
1008-010

Brucejack
Hydrometer Analysis

PLASTICITY CHART

ASTM D2487 - For classificatrion of fine-grained soils and fine-grained fraction of coarse-grained soils.



1008-010-006-3

BRUCEJACK PROJECT, BRITISH COLUMBIA

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GENERAL	
Date test completed	Nov. 14, 2013
Type of Sample	Reconstituted
Specimen orientation	NA

INITIAL		
Diameter	(mm)	73.0
Height	(mm)	109.3
Moisture content (before test)	(%)	30.1
Bulk Density	(Mg/m^3)	2.05
Dry Density	(Mg/m^3)	1.57
Void ratio	-	0.72
Moisture content (after test)	(%)	-
Specific Gravity SG	-	2.7 (assumed)

Consolidation Stresses

σ_c : 910 kPa

$\sigma_{c'}$: 510 kPa

u : 400 kPa

OCR = 1

Saturation Parameters

Initial Degree of Saturation Sr : - %
Back Pressure at Start of Test : 400 kPa
Skempton's coefficient Bbar : 0.98

Shearing Parameters

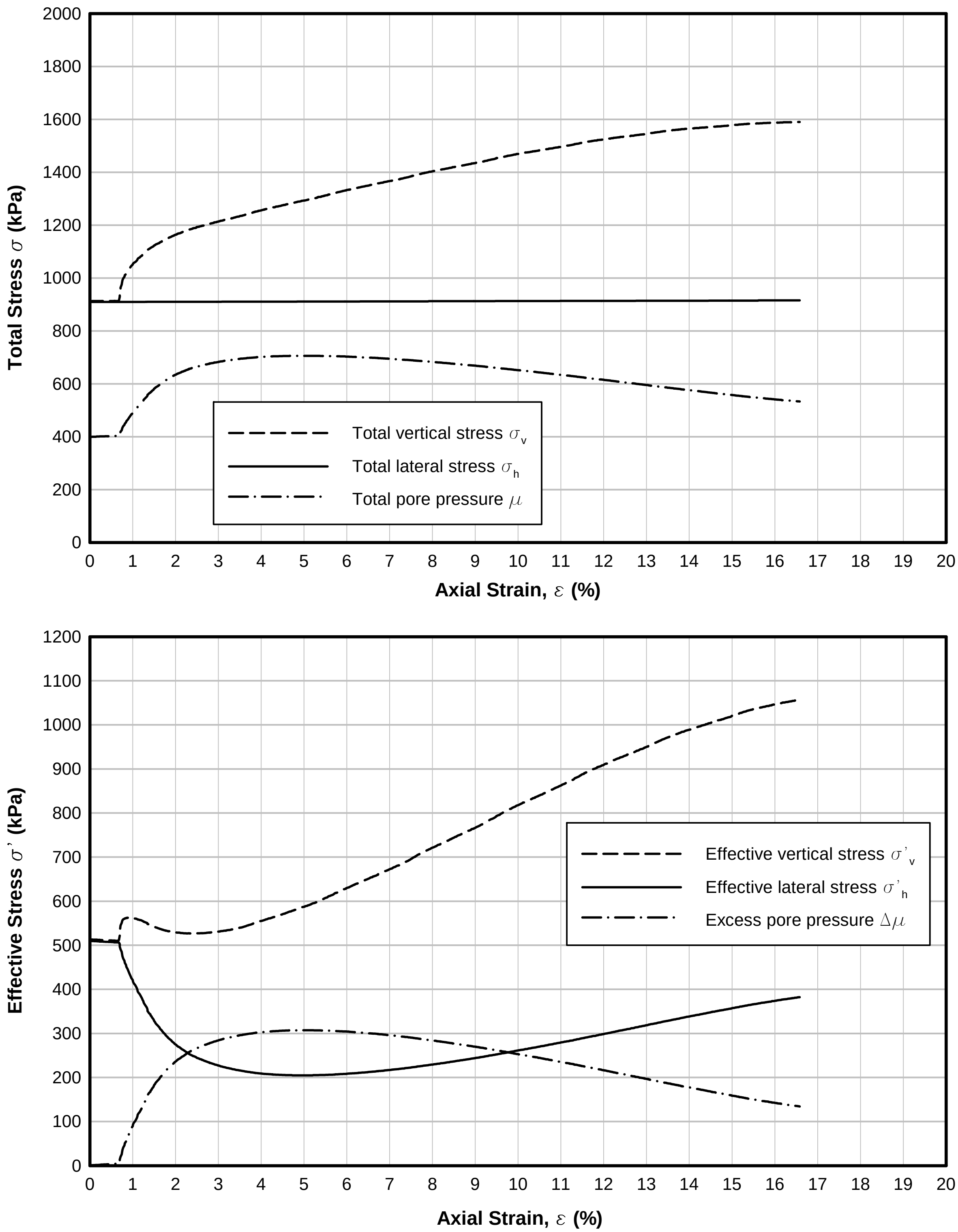
Rate of Strain : 5.4 %/hr

CONSOLIDATED ISOTROPIC
UNDRAINED TRIAXIAL COMPRESSION TEST (CIU)

LSS-03 Trial 1

1008-010-006-3

BRUCEJACK PROJECT, BRITISH COLUMBIA



CONSOLIDATED ISOTROPIC
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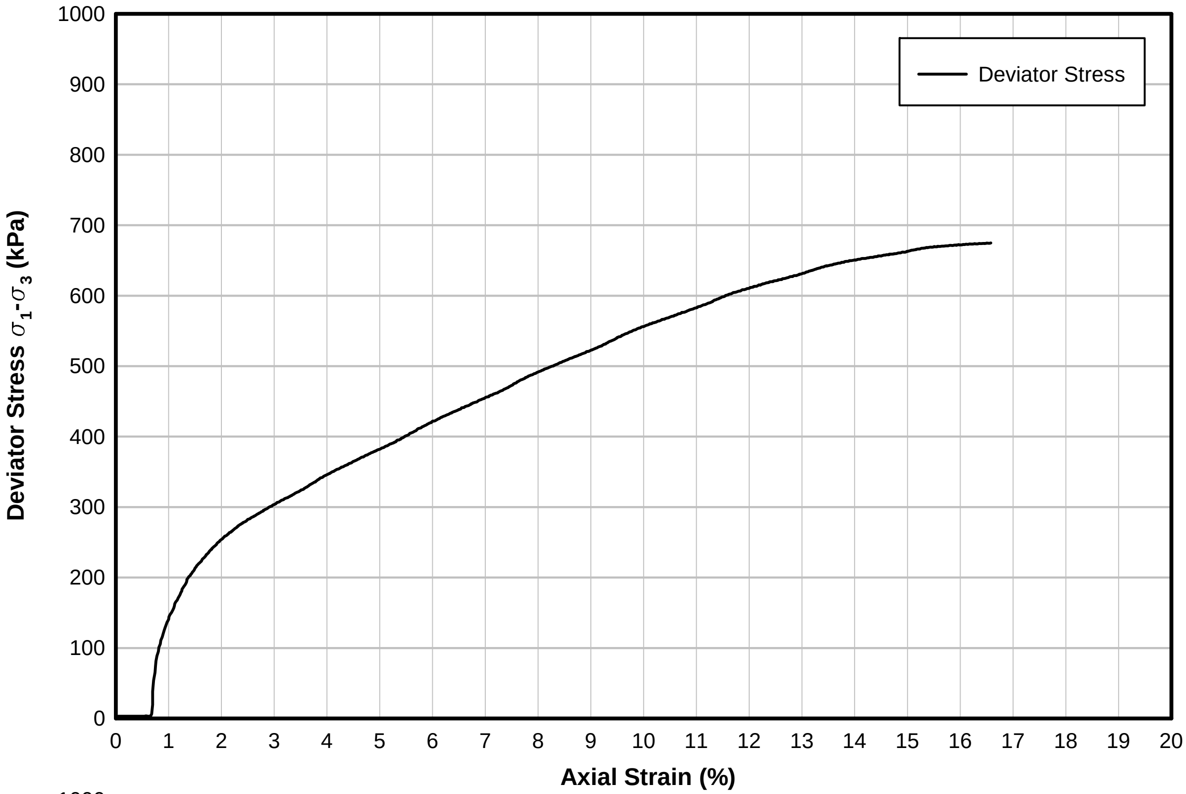
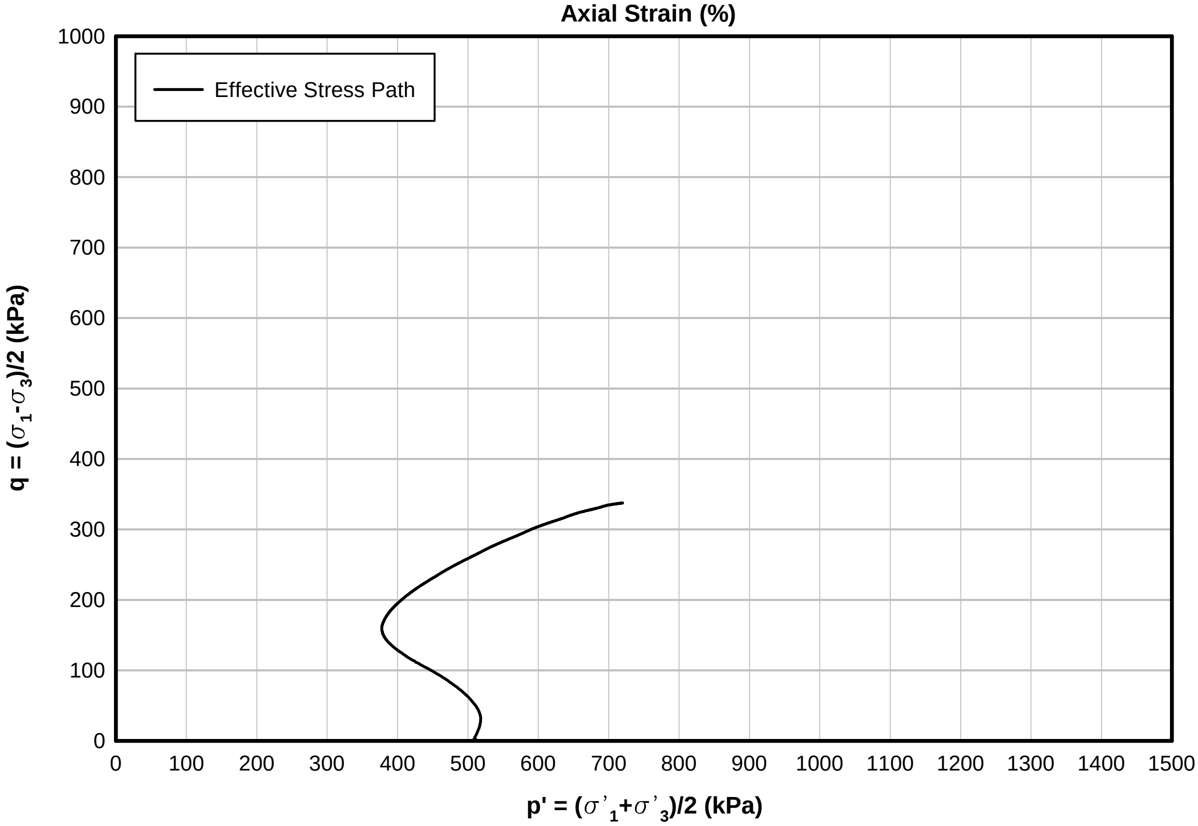
LSS-03 Trial 1

1008-010-006-3

BRUCEJACK PROJECT, BRITISH COLUMBIA





CONSOLIDATED ISOTROPIC
UNDRAINED TRIAXIAL COMPRESSION TEST (CIU)

LSS-03 Trial 1

1008-010-006-3

BRUCEJACK PROJECT, BRITISH COLUMBIA

BGC ENGINEERING INC.
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GENERAL	
Date test completed	Nov. 14, 2013
Type of Sample	Reconstituted
Specimen orientation	NA

INITIAL		
Diameter	(mm)	62.2
Height	(mm)	97.5
Moisture content (before test)	(%)	25.4
Bulk Density	(Mg/m^3)	2.06
Dry Density	(Mg/m^3)	1.64
Void ratio	-	0.64
Moisture content (after test)	(%)	23.9
Specific Gravity SG	-	2.7 (assumed)

Consolidation Stresses

σ_c : 1074 kPa

$\sigma_{c'}$: 527 kPa

u : 547 kPa

OCR = 1

Saturation Parameters

Initial Degree of Saturation Sr : -%
Back Pressure at Start of Test : 400 kPa
Skempton's coefficient Bbar : 0.98

Shearing Parameters

Rate of Strain : 5.4 %/hr

CONSOLIDATED ISOTROPIC
UNDRAINED TRIAXIAL COMPRESSION TEST (CIU)

LSS-03 Trial 2

1008-010-006-3

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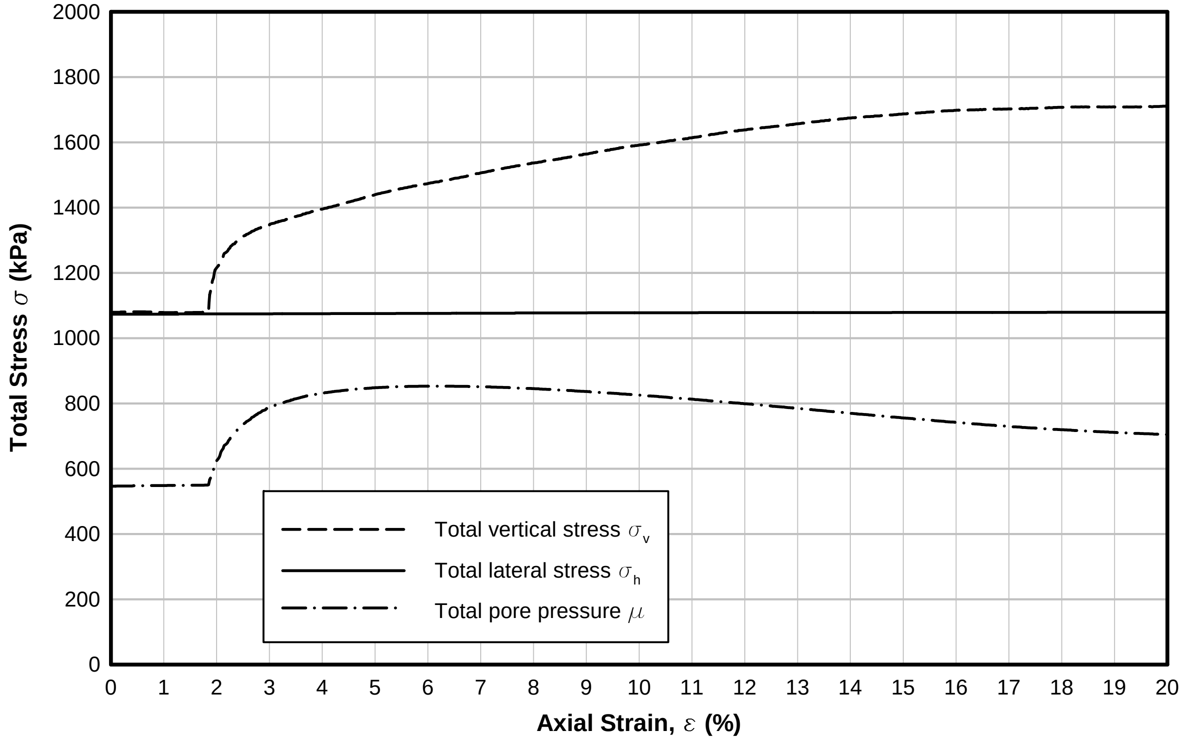

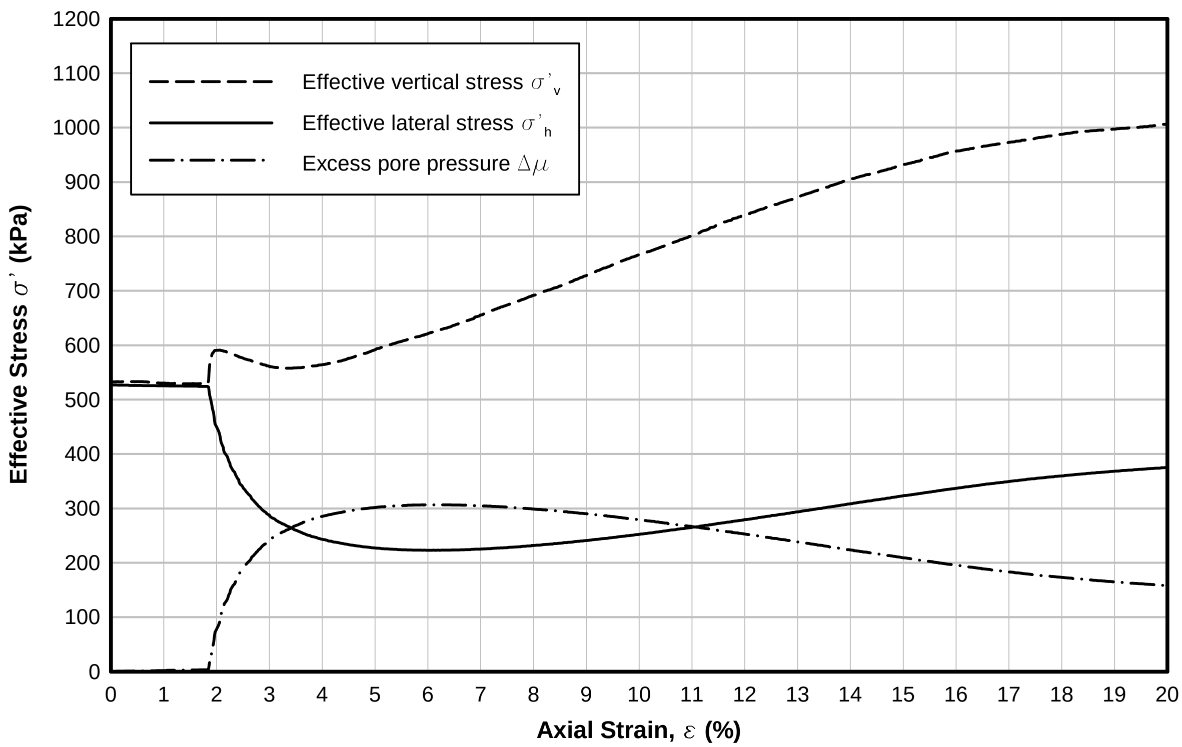

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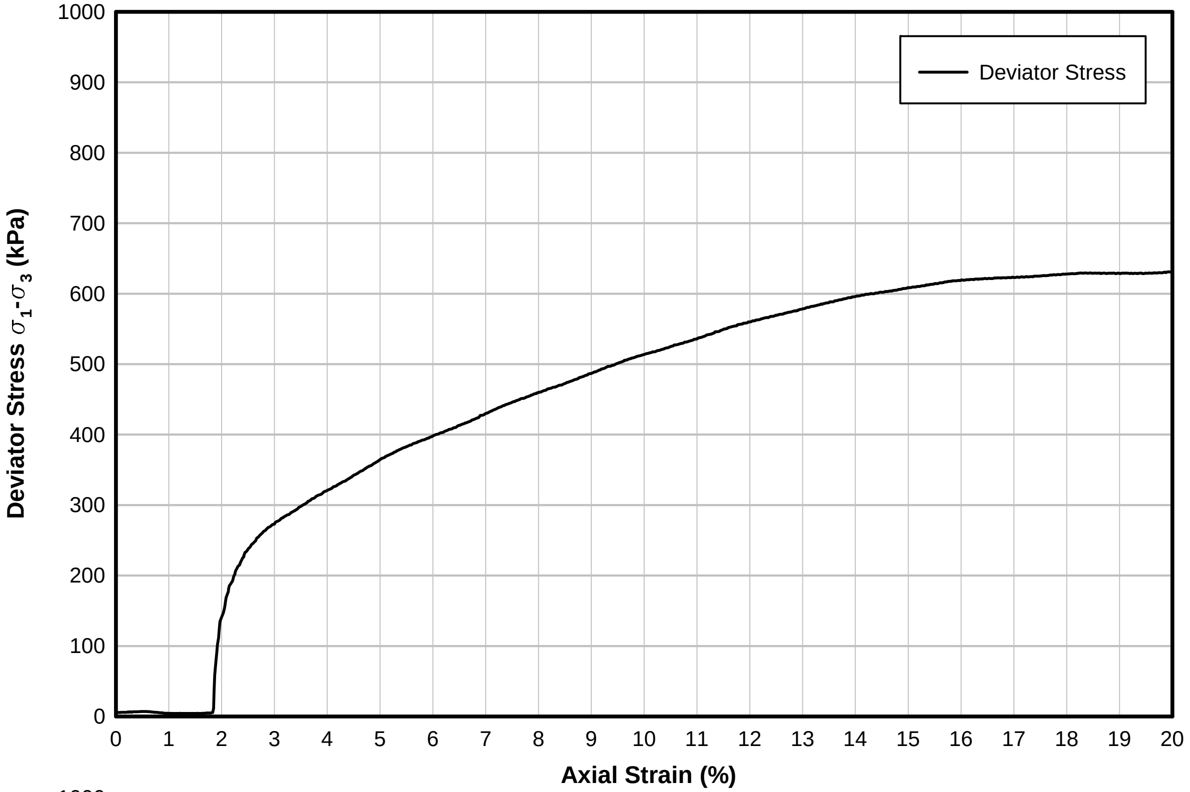

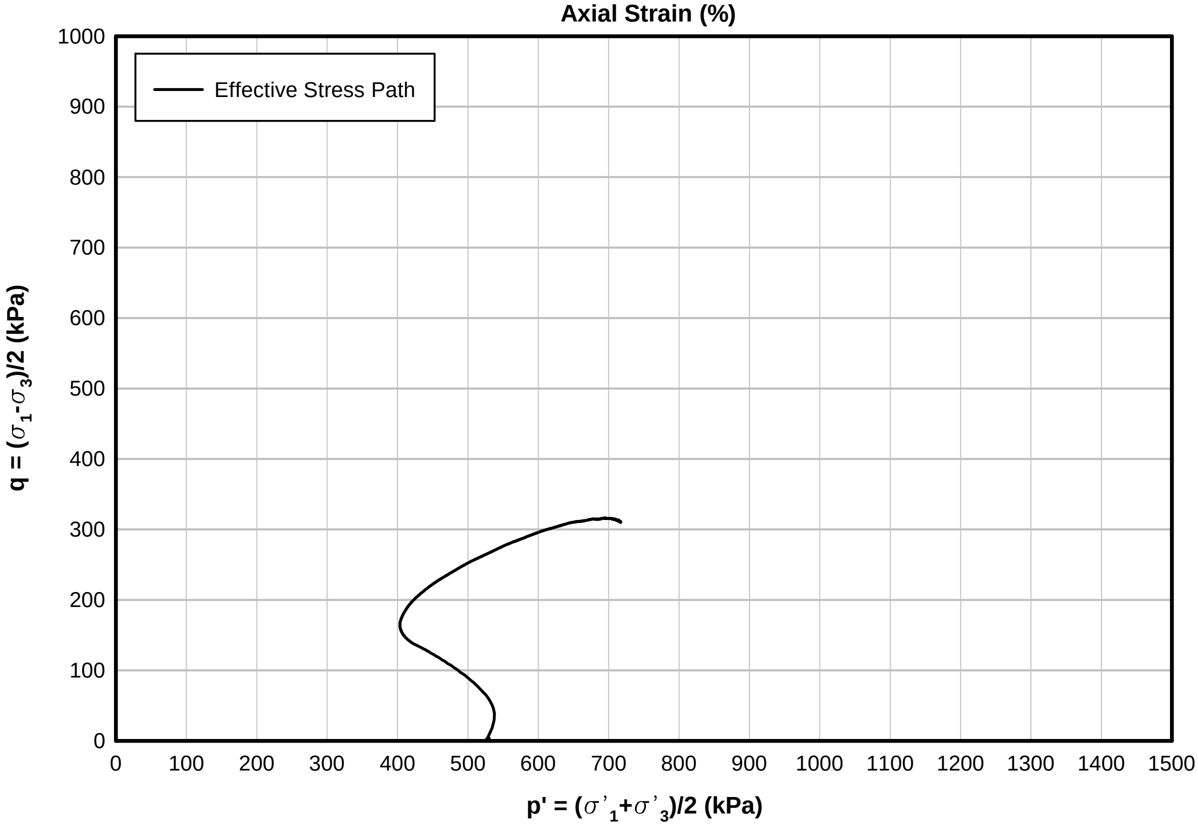

CONSOLIDATED ISOTROPIC
UNDRAINED TRIAXIAL COMPRESSION TEST (CIU)

LSS-03 Trial 2

1008-010-006-3

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GENERAL	
Date test completed	Nov. 15, 2013
Type of Sample	Reconstituted
Specimen orientation	NA

INITIAL		
Diameter	(mm)	73.2
Height	(mm)	137.0
Moisture content (before test)	(%)	-
Bulk Density	(Mg/m^3)	1.87
Dry Density	(Mg/m^3)	-
Void ratio	-	-
Moisture content (after test)	(%)	-
Specific Gravity SG	-	2.62 (assumed)

Consolidation Stresses

σ_c : 1373 kPa

$\sigma_{c'}$: 967 kPa

u : 406 kPa

OCR = 1

Saturation Parameters

Initial Degree of Saturation Sr : -%
Back Pressure at Start of Test : 406 kPa
Skempton's coefficient Bbar : 0.97

Shearing Parameters

Rate of Strain : 4.4 %/hr

CONSOLIDATED ISOTROPIC
UNDRAINED TRIAXIAL COMPRESSION TEST (CIU)

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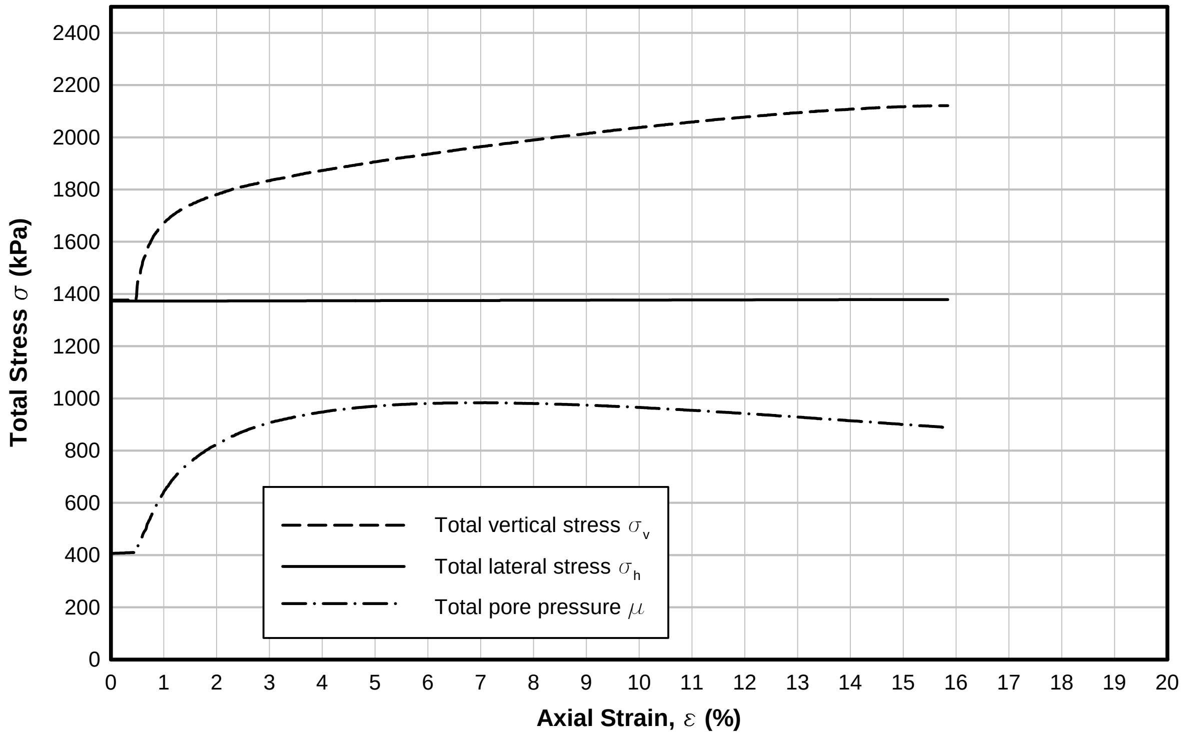

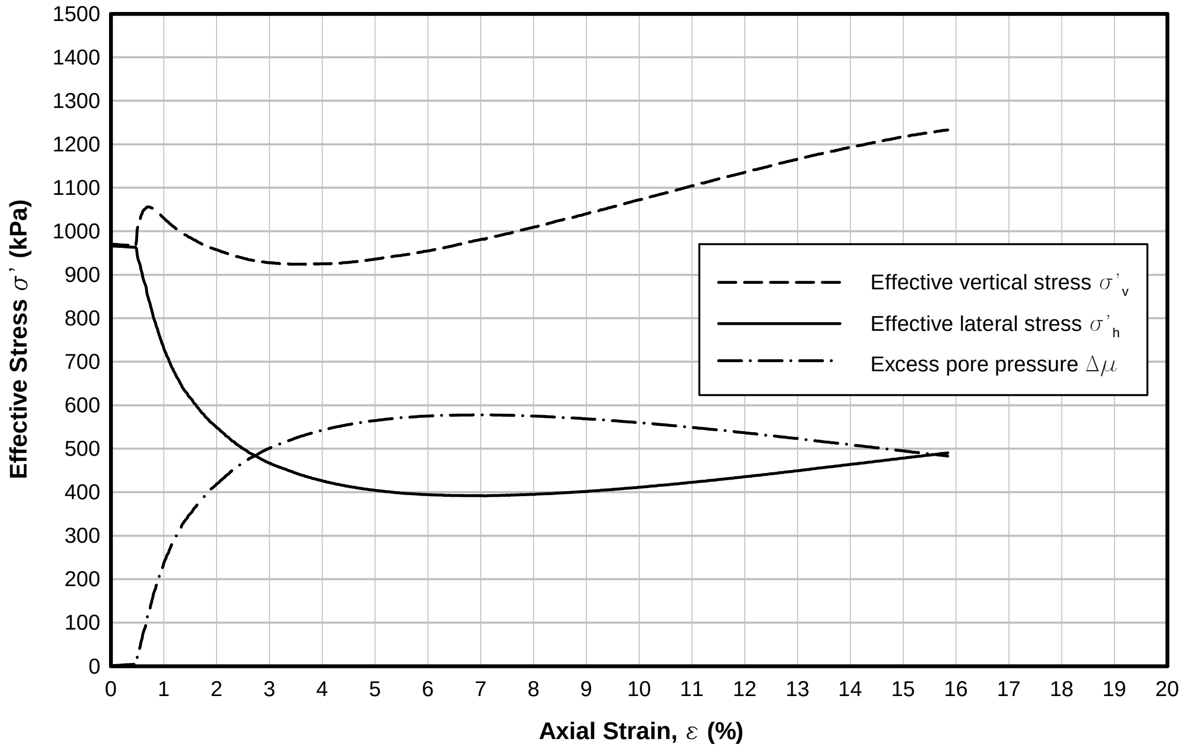

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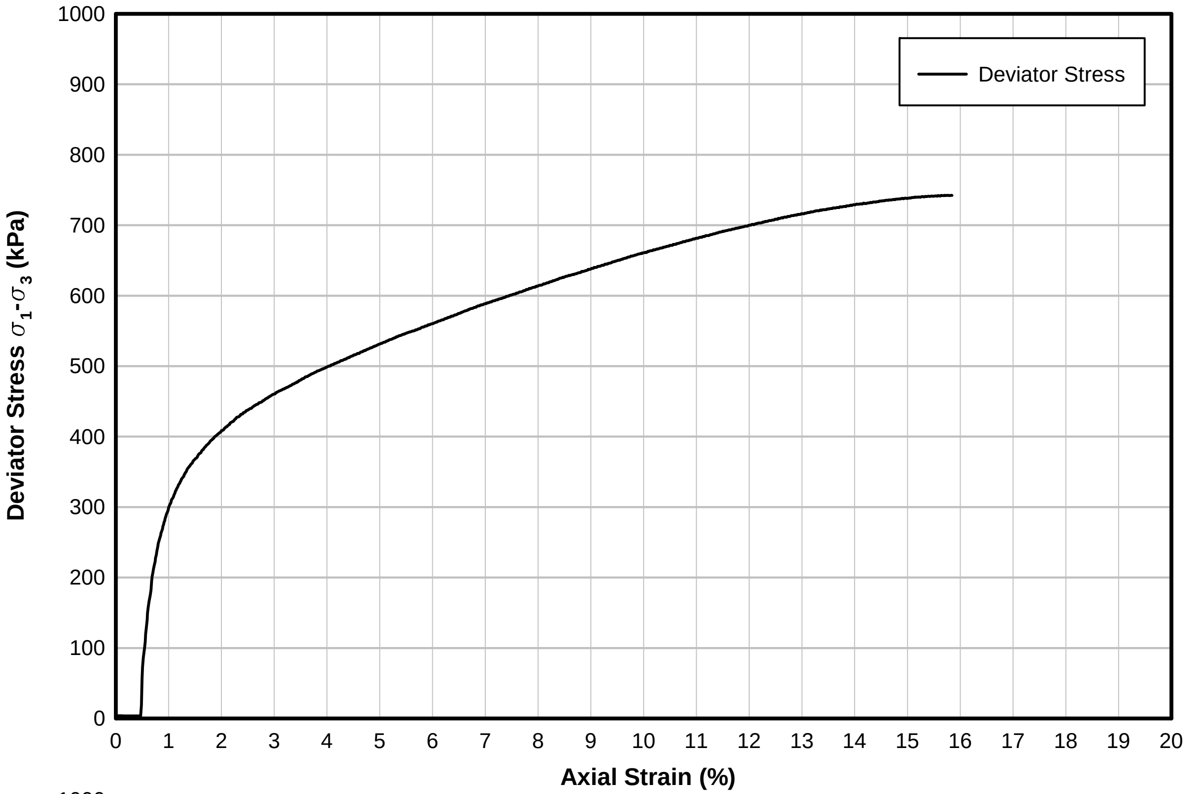

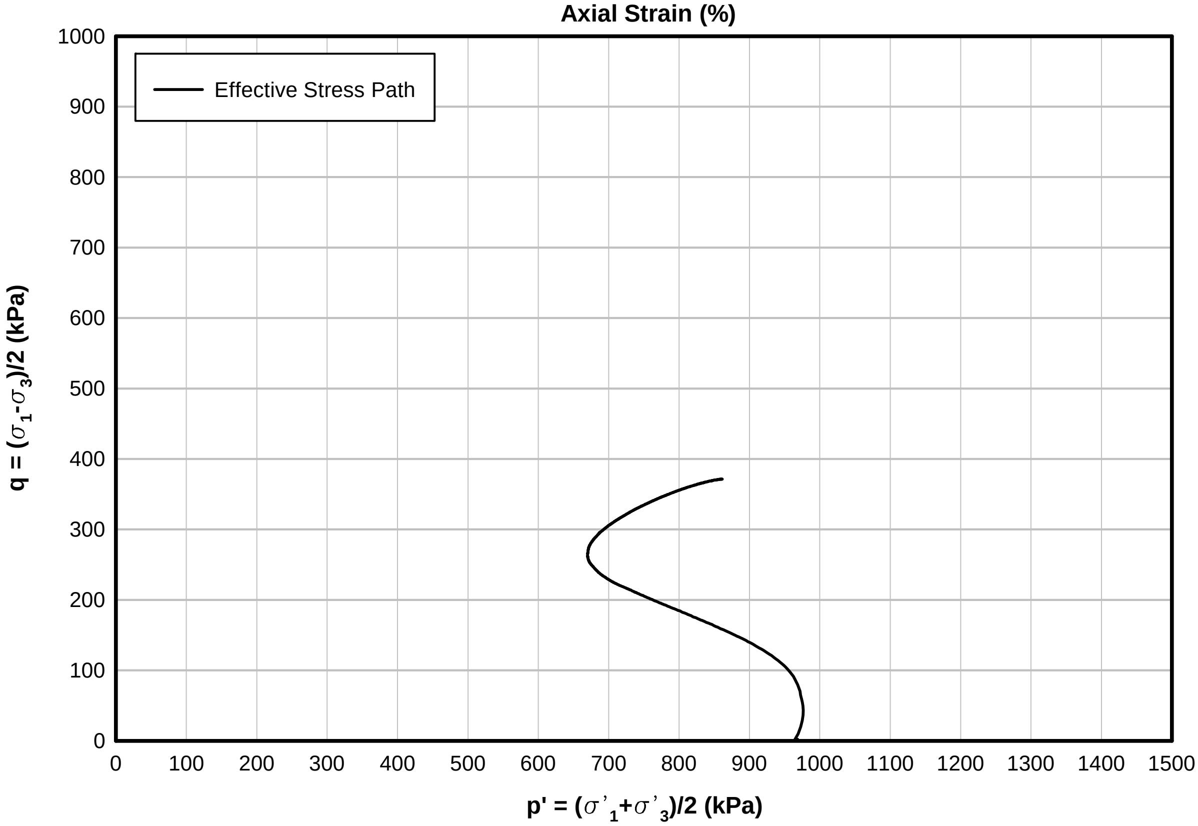

CONSOLIDATED ISOTROPIC
UNDRAINED TRIAXIAL COMPRESSION TEST (CIU)

LSS-04 Trial 1

1008-010-006-3

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GENERAL	
Date test completed	Nov. 19, 2013
Type of Sample	Reconstituted
Specimen orientation	NA

INITIAL		
Diameter	(mm)	61.5
Height	(mm)	106.6
Moisture content (before test)	(%)	26.1
Bulk Density	(Mg/m^3)	2.04
Dry Density	(Mg/m^3)	1.62
Void ratio	-	0.62
Moisture content (after test)	(%)	24.8
Specific Gravity SG	-	2.62 (assumed)

Consolidation Stresses

σ_c : 1484 kPa

$\sigma_{c'}$: 993 kPa

u : 491 kPa

OCR = 1

Saturation Parameters

Initial Degree of Saturation Sr : -%
Back Pressure at Start of Test : 491 kPa
Skempton's coefficient Bbar : 0.96

Shearing Parameters

Rate of Strain : 5.6 %/hr

CONSOLIDATED ISOTROPIC
UNDRAINED TRIAXIAL COMPRESSION TEST (CIU)

LSS-04 Trial 2

1008-010-006-3

BRUCEJACK PROJECT, BRITISH COLUMBIA

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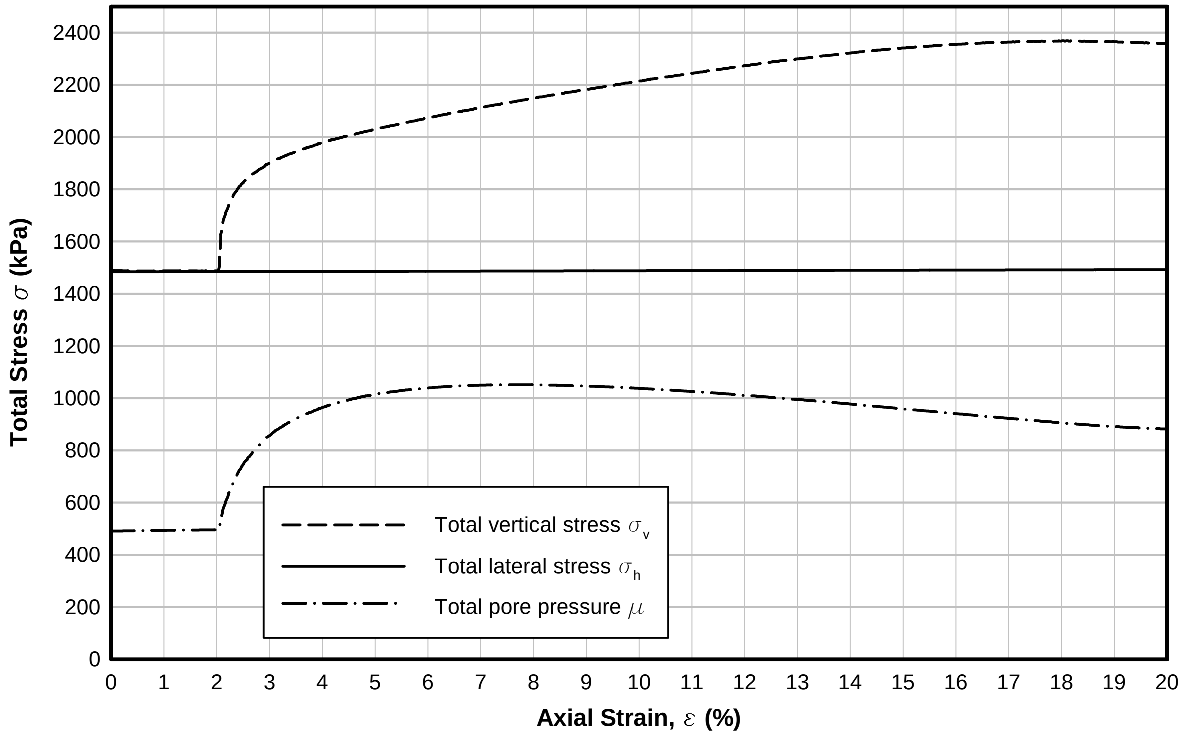
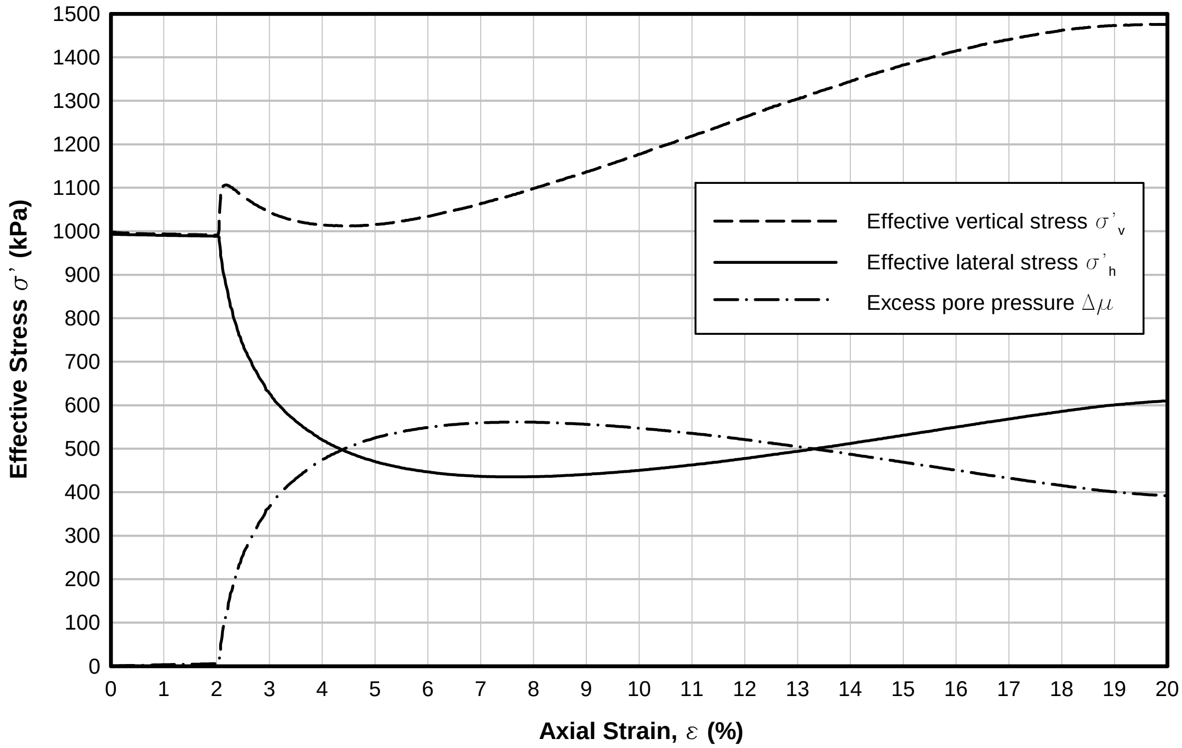


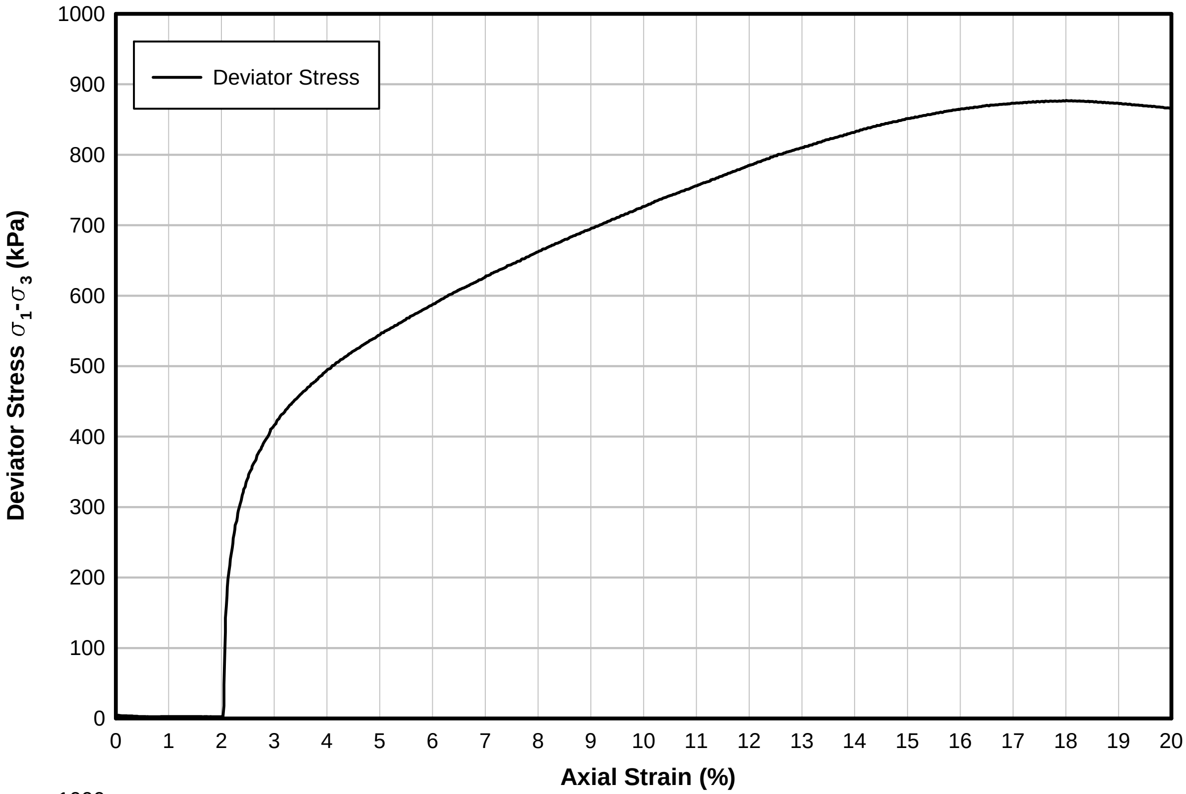


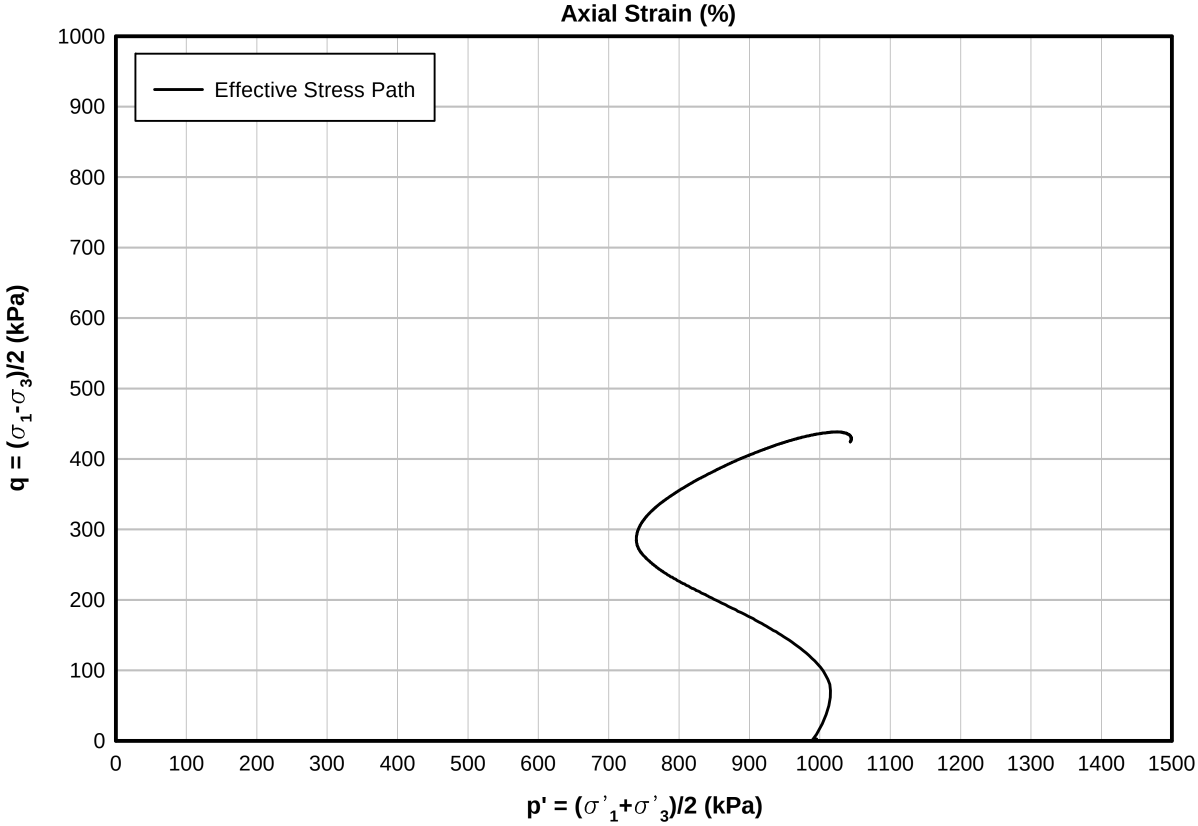
CONSOLIDATED ISOTROPIC
UNDRAINED TRIAXIAL COMPRESSION TEST (CIU)

LSS-04 Trial 2

1008-010-006-3

BRUCEJACK PROJECT, BRITISH COLUMBIA





CONSOLIDATED ISOTROPIC
UNDRAINED TRIAXIAL COMPRESSION TEST (CIU)

LSS-04 Trial 2

1008-010-006-3

BRUCEJACK PROJECT, BRITISH COLUMBIA

BGC ENGINEERING INC.
AN APPLIED EARTH SCIENCES COMPANY

GENERAL	
Date test completed	Nov. 15, 2013
Type of Sample	Reconstituted
Specimen orientation	NA

INITIAL		
Diameter	(mm)	62.4
Height	(mm)	95.03
Moisture content (before test)	(%)	31.3
Bulk Density	(Mg/m^3)	1.92
Dry Density	(Mg/m^3)	1.47
Void ratio	-	0.79
Moisture content (after test)	(%)	23.2
Specific Gravity SG	-	2.62 (assumed)

Consolidation Stresses

σ_c : 699 kPa

$\sigma_{c'}$: 295 kPa

u : 404 kPa

OCR = 1

Saturation Parameters

Initial Degree of Saturation Sr : -%

Back Pressure at Start of Test : 404 kPa

Skempton's coefficient Bbar : 0.94

Shearing Parameters

Rate of Strain : 5.0 %/hr

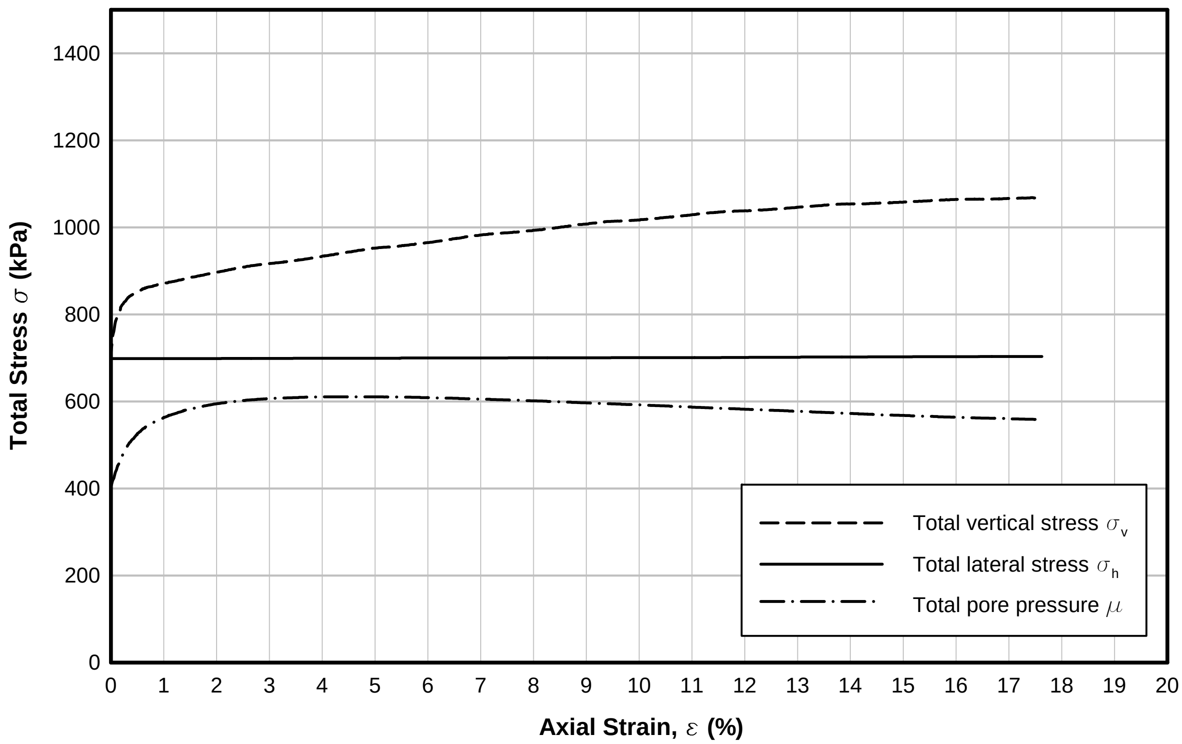
CONSOLIDATED ISOTROPIC

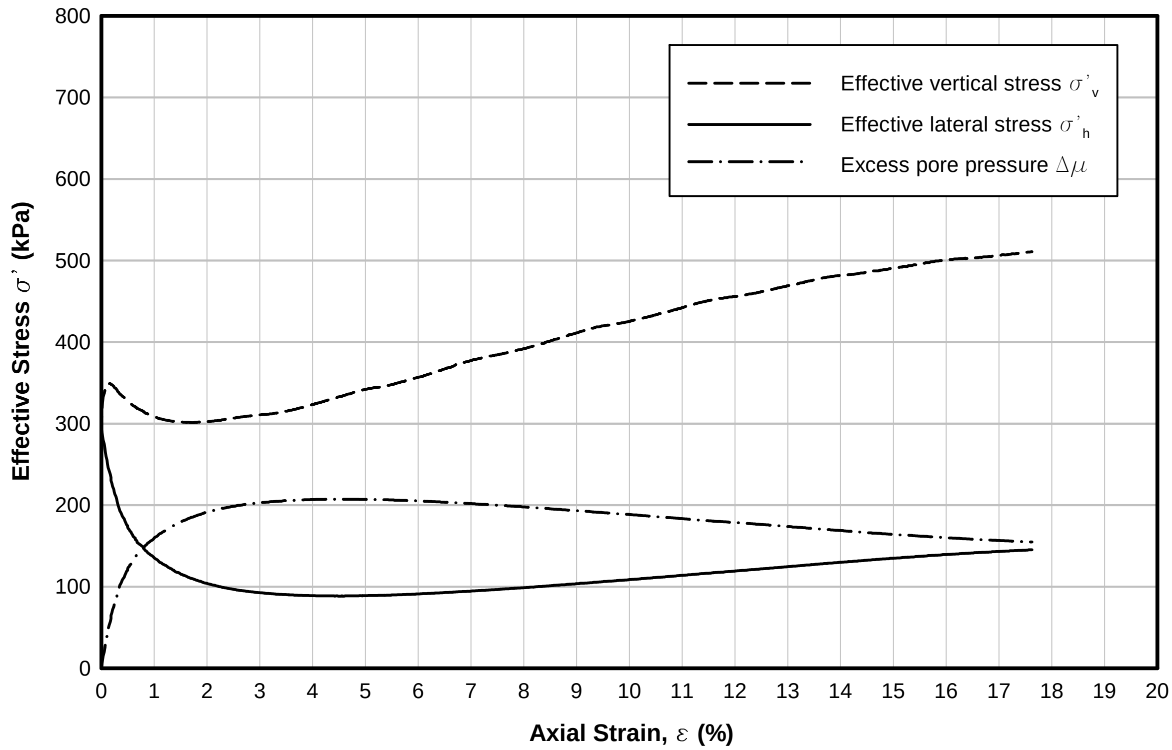
UNDRAINED TRIAXIAL COMPRESSION TEST (CIU)

LSS-07

1008-010-006-3

BRUCEJACK PROJECT, BRITISH COLUMBIA





CONSOLIDATED ISOTROPIC
UNDRAINED TRIAXIAL COMPRESSION TEST (CIU)

LSS-07

1008-010-006-3

BRUCEJACK PROJECT, BRITISH COLUMBIA

BGC ENGINEERING INC.
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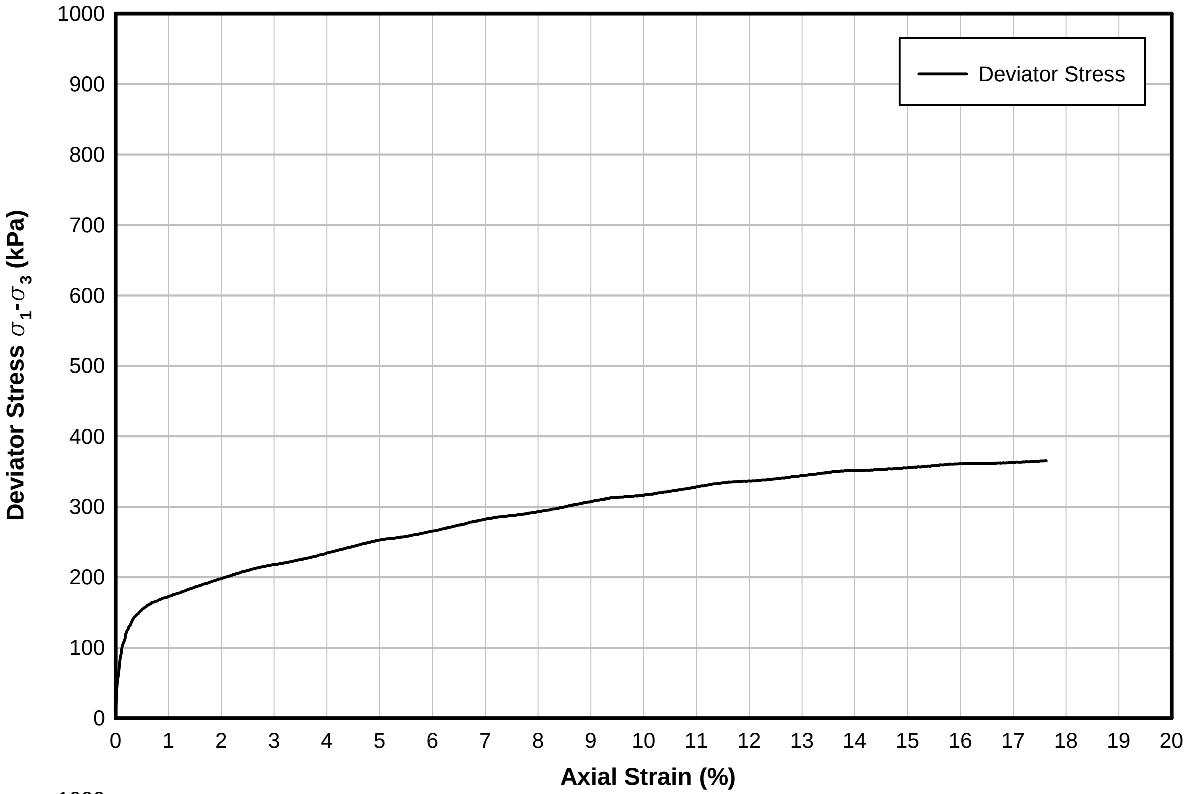
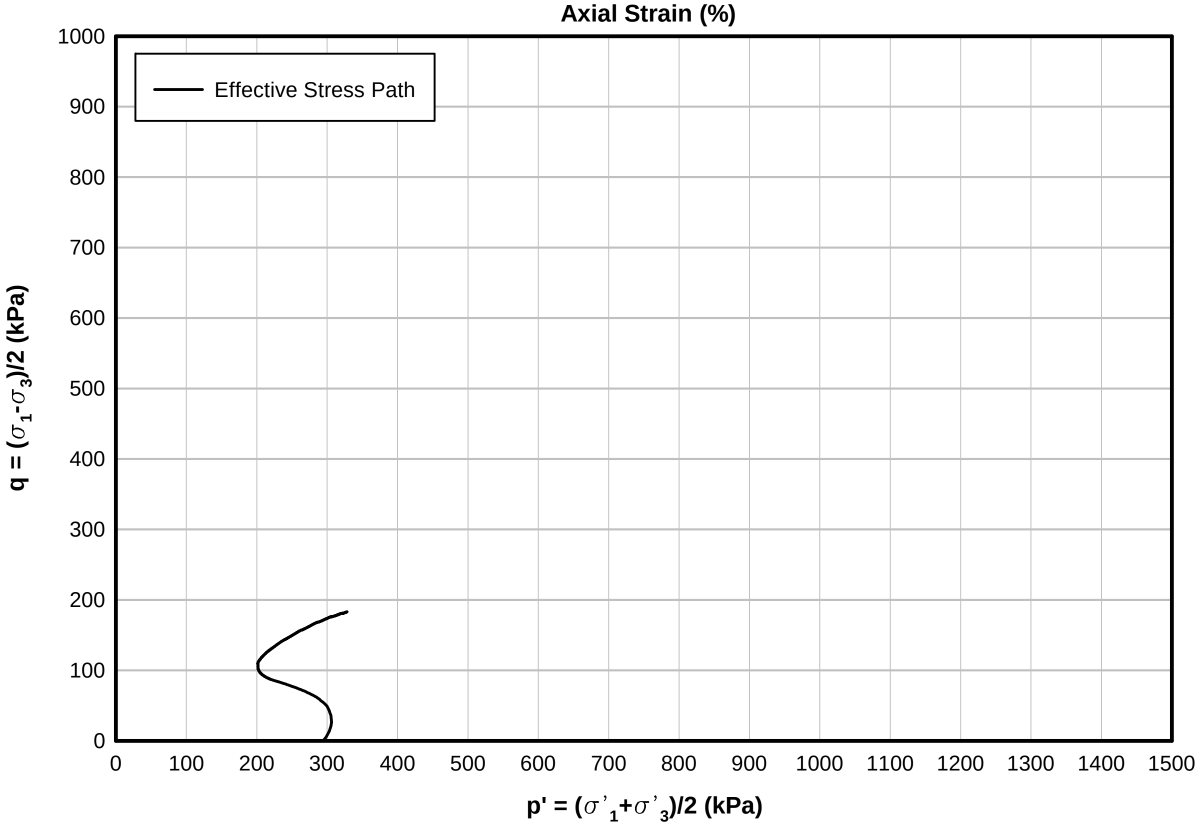




CONSOLIDATED ISOTROPIC
UNDRAINED TRIAXIAL COMPRESSION TEST (CIU)

LSS-07

1008-010-006-3

BRUCEJACK PROJECT, BRITISH COLUMBIA

GENERAL

Date test started	Nov. 15, 2013
Type of Sample	Reconstituted
Specimen orientation	NA

SOIL PROPERTIES MEASURED AFTER TEST

Diameter	(mm)	47.0
Height	(mm)	26.5
Height of shear zone	(mm)	17.5
Moisture content	(%)	23.7
Bulk Density	(Mg/m^3)	2.12
Dry Density	(Mg/m^3)	1.72
Void ratio		0.57
Degree of saturation	(%)	-

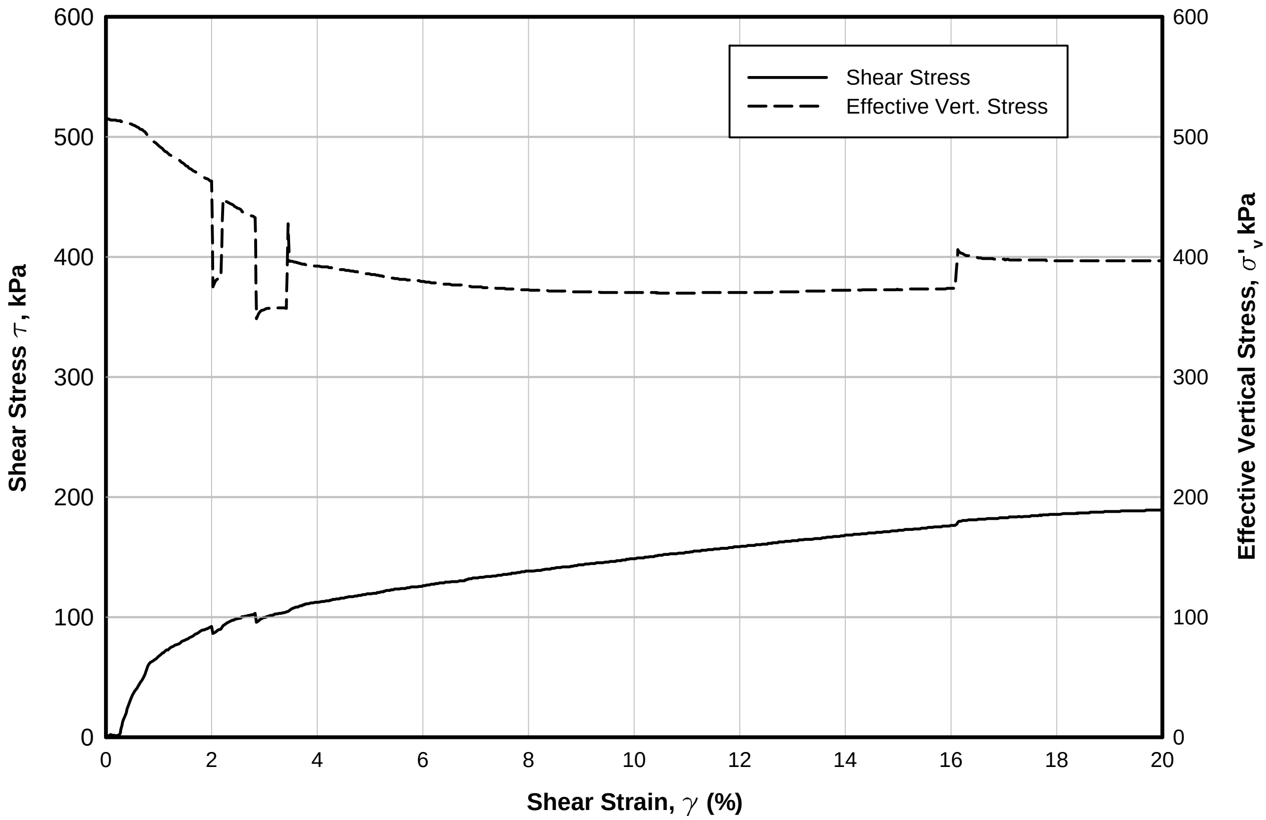
Consolidation Stresses	**Shearing Parameters**
$\sigma_{vc\ (max)}$: 516 kPa	Rate of Strain : 4.5 %/hr
σ_{vc}' : 516 kPa	

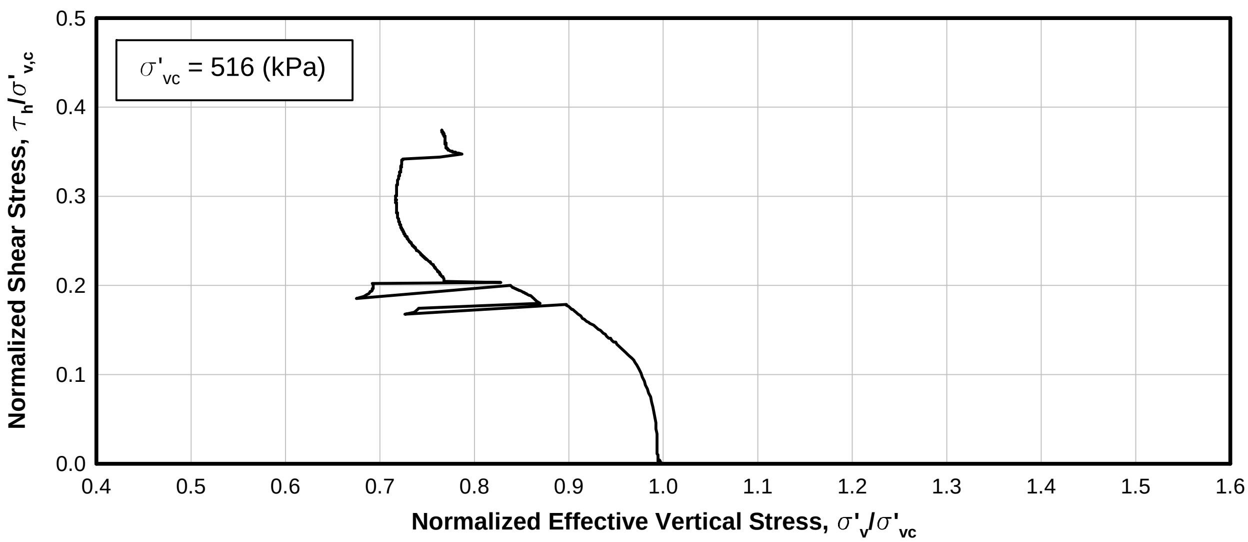
CONSOLIDATED CONSTANT VOLUME DSS TEST

LS-03

1008-010-006-3

BRUCEJACK PROJECT, BRITISH COLUMBIA





CONSOLIDATED CONSTANT VOLUME DSS TEST

LS-03

1008-010-006-3

BRUCEJACK PROJECT, BRITISH COLUMBIA

BGC ENGINEERING INC.
AN APPLIED EARTH SCIENCES COMPANY

GENERAL	
Date test started	Nov. 16, 2013
Type of Sample	Reconstituted
Specimen orientation	NA

SOIL PROPERTIES MEASURED AFTER TEST		
Diameter	(mm)	47.0
Height	(mm)	21.7
Height of shear zone	(mm)	17.5
Moisture content	(%)	27.2
Bulk Density	(Mg/m^3)	2.26
Dry Density	(Mg/m^3)	1.77
Void ratio		0.52
Degree of saturation	(%)	-

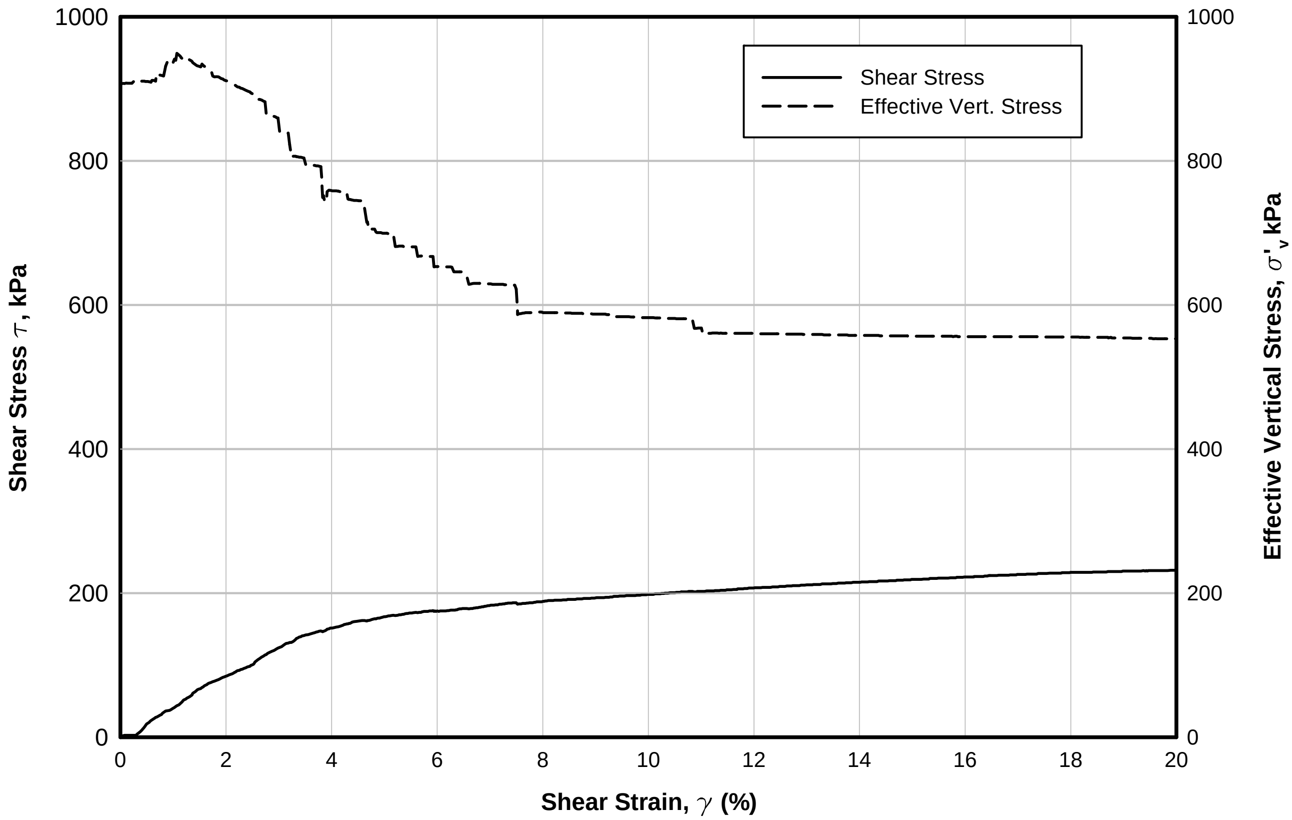
Consolidation Stresses	Shearing Parameters
$\sigma_{vc\ (max)}$: 909 kPa	Rate of Strain : 4.0 %/hr
σ_{vc}' : 909 kPa	

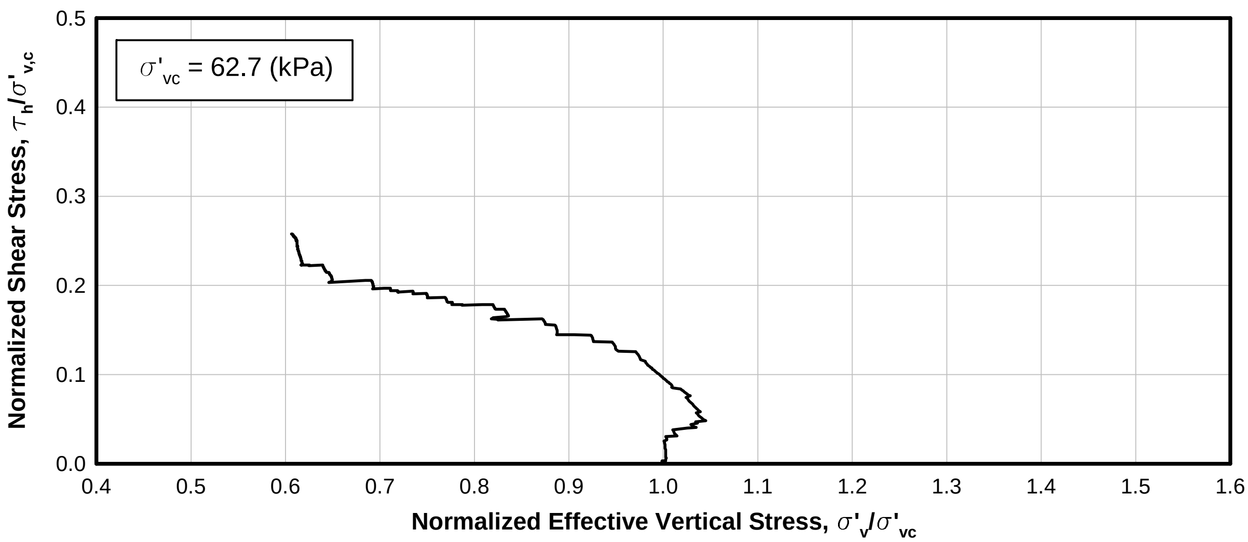
CONSOLIDATED CONSTANT VOLUME DSS TEST

LS-04

1008-010-006-3

BRUCEJACK PROJECT, BRITISH COLUMBIA





CONSOLIDATED CONSTANT VOLUME DSS TEST

LS-04

1008-010-006-3

BRUCEJACK PROJECT, BRITISH COLUMBIA

BGC ENGINEERING INC.
AN APPLIED EARTH SCIENCES COMPANY

GENERAL	
Date test started	Nov. 19, 2013
Type of Sample	Reconstituted
Specimen orientation	NA

INITIAL		
Diameter	(mm)	47.0
Height	(mm)	25.6
Height of shear zone	(mm)	17.5
Moisture content	(%)	18.6
Bulk Density	(Mg/m^3)	2.06
Dry Density	(Mg/m^3)	1.74
Void ratio		0.55
Degree of saturation	(%)	-

Consolidation Stresses	Shearing Parameters
$\sigma_{vc\ (max)}$: 180 kPa	Rate of Strain : 4.1 %/hr
σ_{vc}' : 180 kPa	

CONSOLIDATED CONSTANT VOLUME DSS TEST

LS-05

1008-010-006-3

BRUCEJACK PROJECT, BRITISH COLUMBIA

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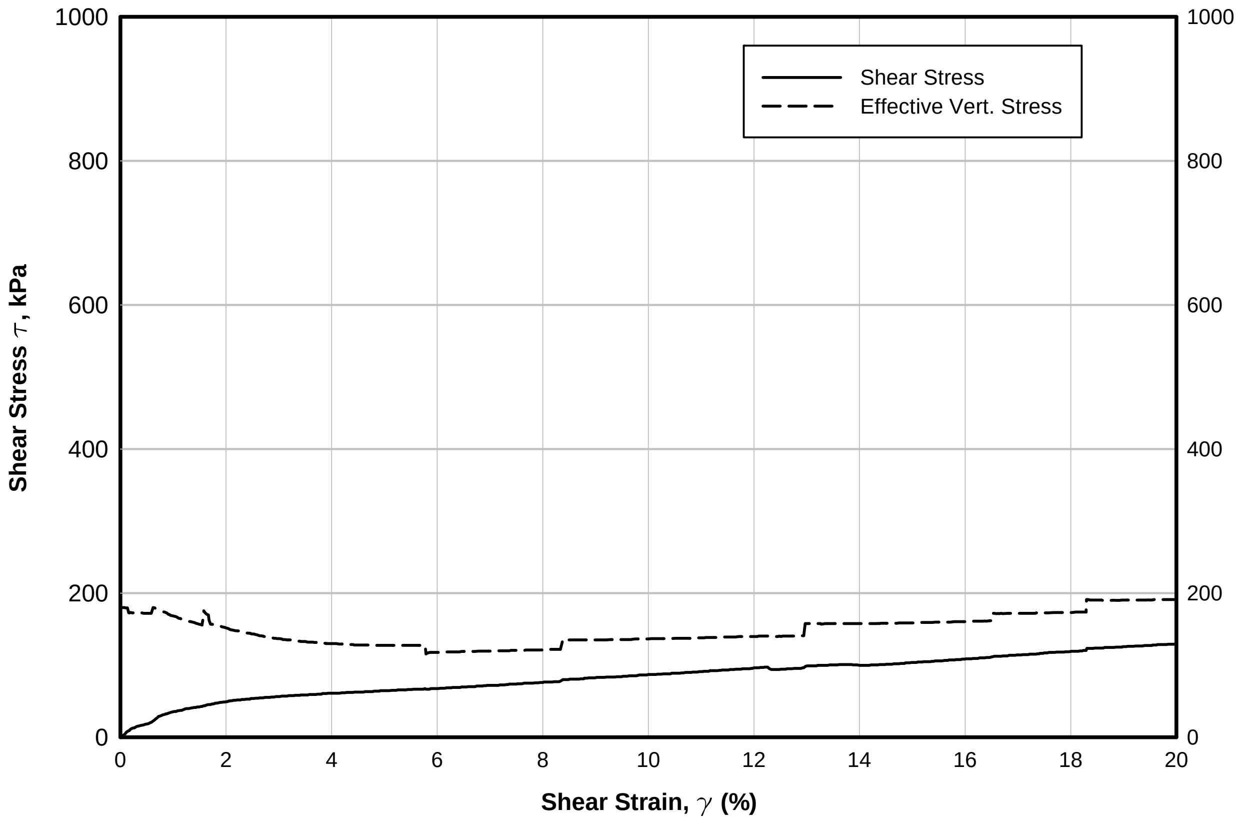
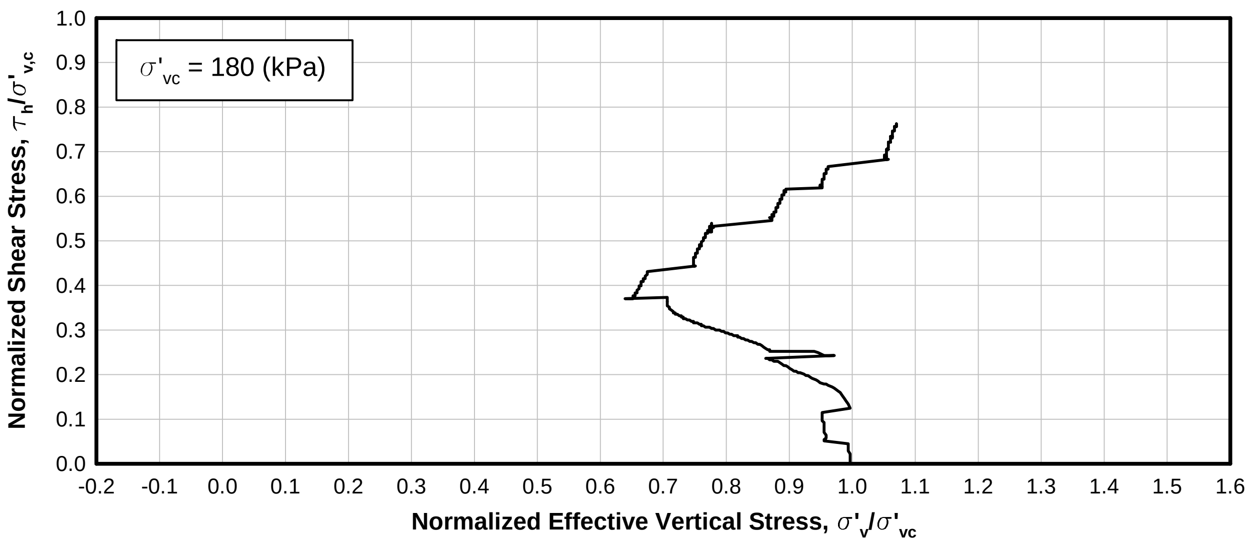




CONSOLIDATED CONSTANT VOLUME DSS TEST

LS-05

1008-010-006-3

BRUCEJACK PROJECT, BRITISH COLUMBIA

BGC ENGINEERING INC.
AN APPLIED EARTH SCIENCES COMPANY

GENERAL	
Date test started	Nov. 19, 2013
Type of Sample	Reconstituted
Specimen orientation	NA

SOIL PROPERTIED MEASURED AFTER TEST		
Diameter	(mm)	47.0
Height	(mm)	27.0
Height of shear zone	(mm)	17.5
Moisture content	(%)	20.3
Bulk Density	(Mg/m^3)	2.11
Dry Density	(Mg/m^3)	1.75
Void ratio		0.54
Degree of saturation	(%)	-

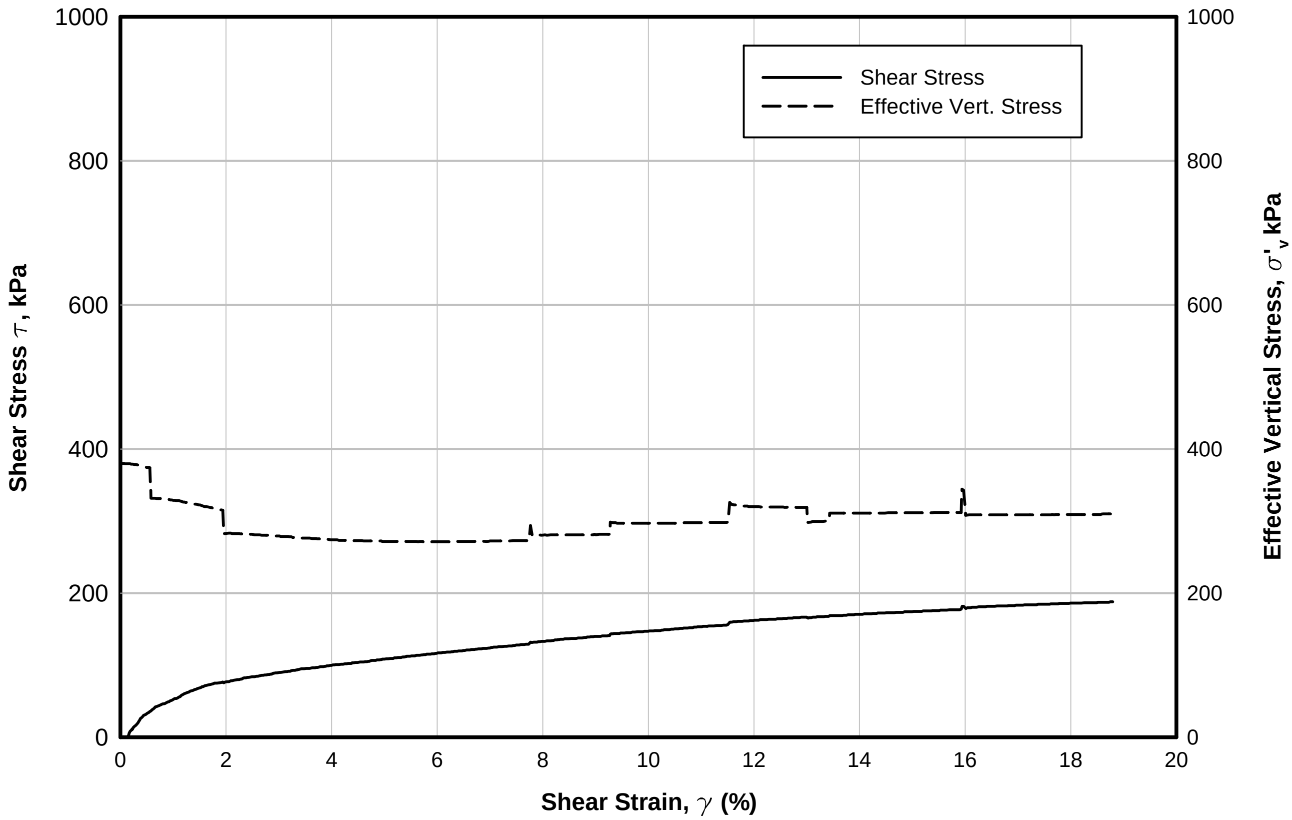
Consolidation Stresses	Shearing Parameters
$\sigma_{vc\ (max)}$: 368 kPa	Rate of Strain : 4.1 %/hr
σ_{vc}' : 368 kPa	

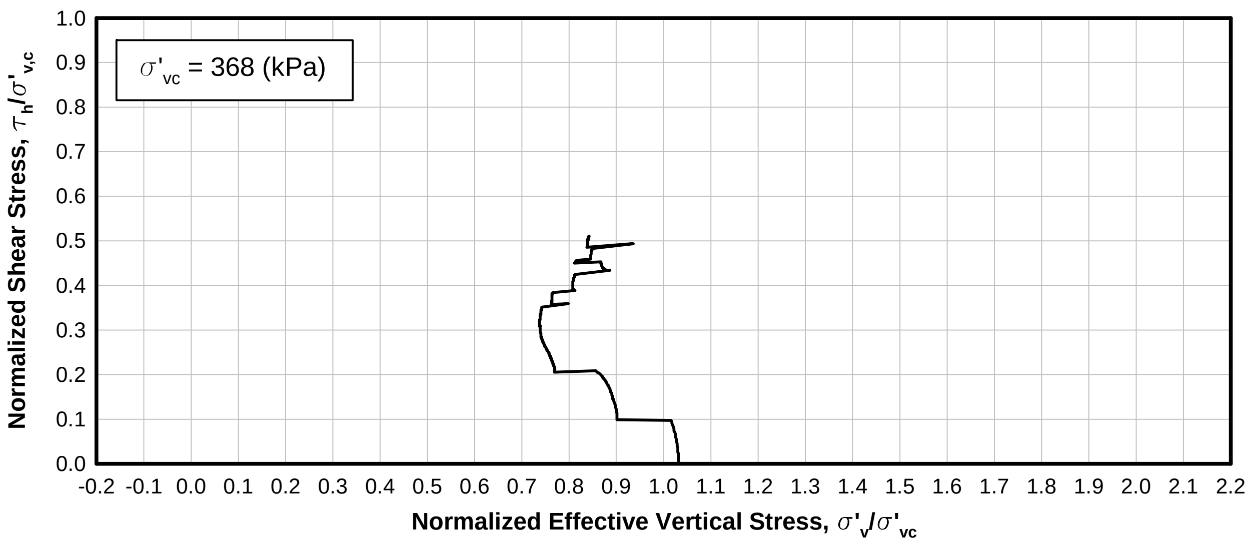
CONSOLIDATED CONSTANT VOLUME DSS TEST

LS-06

1008-010-006-3

BRUCEJACK PROJECT, BRITISH COLUMBIA





CONSOLIDATED CONSTANT VOLUME DSS TEST

LS-06

1008-010-006-3

BRUCEJACK PROJECT, BRITISH COLUMBIA

BGC ENGINEERING INC.
AN APPLIED EARTH SCIENCES COMPANY

GENERAL	
Date test started	Nov. 18, 2013
Type of Sample	Reconstituted
Specimen orientation	NA

SOIL PROPERTIED MEASURED AFTER TEST		
Diameter	(mm)	47.0
Height	(mm)	23.7
Height of shear zone	(mm)	17.5
Moisture content	(%)	24.4
Bulk Density	(Mg/m^3)	2.14
Dry Density	(Mg/m^3)	1.72
Void ratio		0.57
Degree of saturation	(%)	-

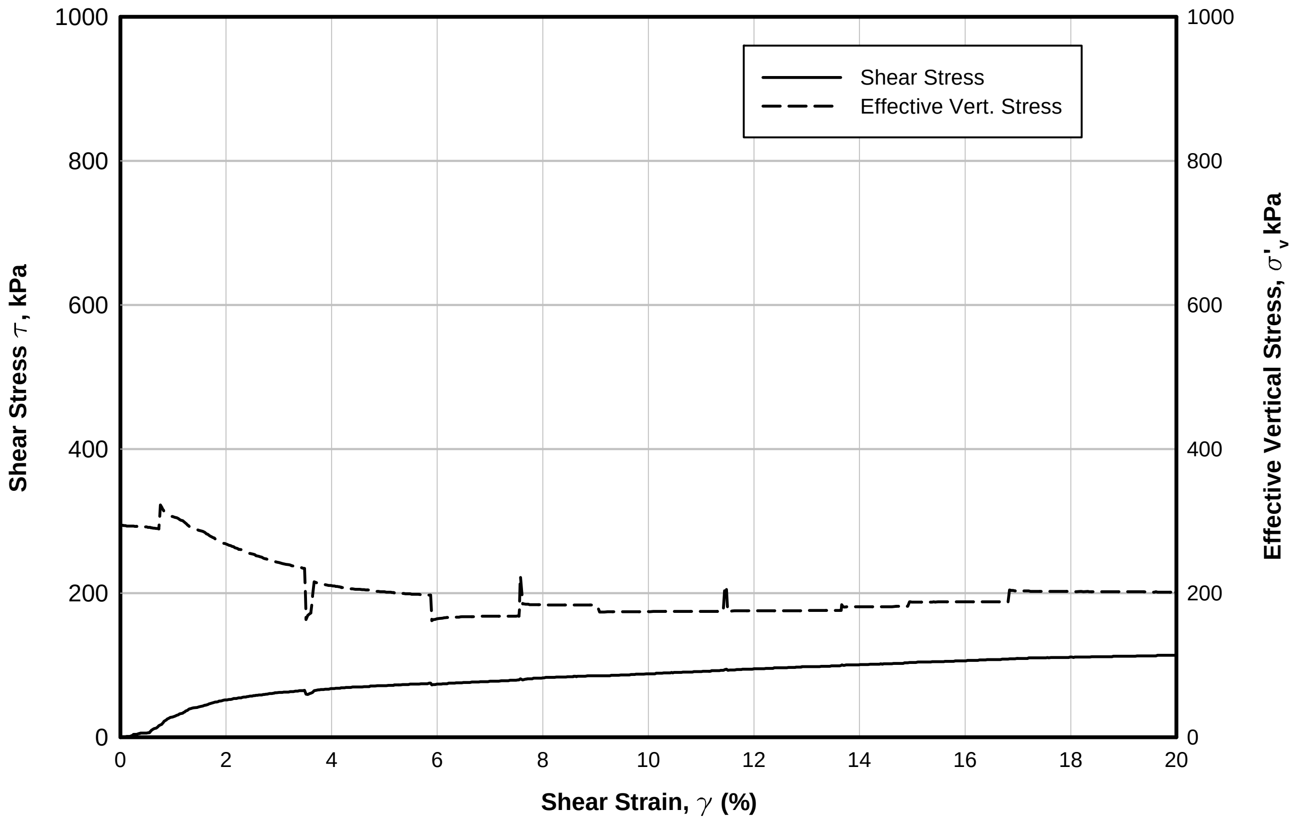
Consolidation Stresses	Shearing Parameters
$\sigma_{vc\ (max)}$: 296 kPa	Rate of Strain : 4.1 %/hr
σ_{vc}' : 296 kPa	

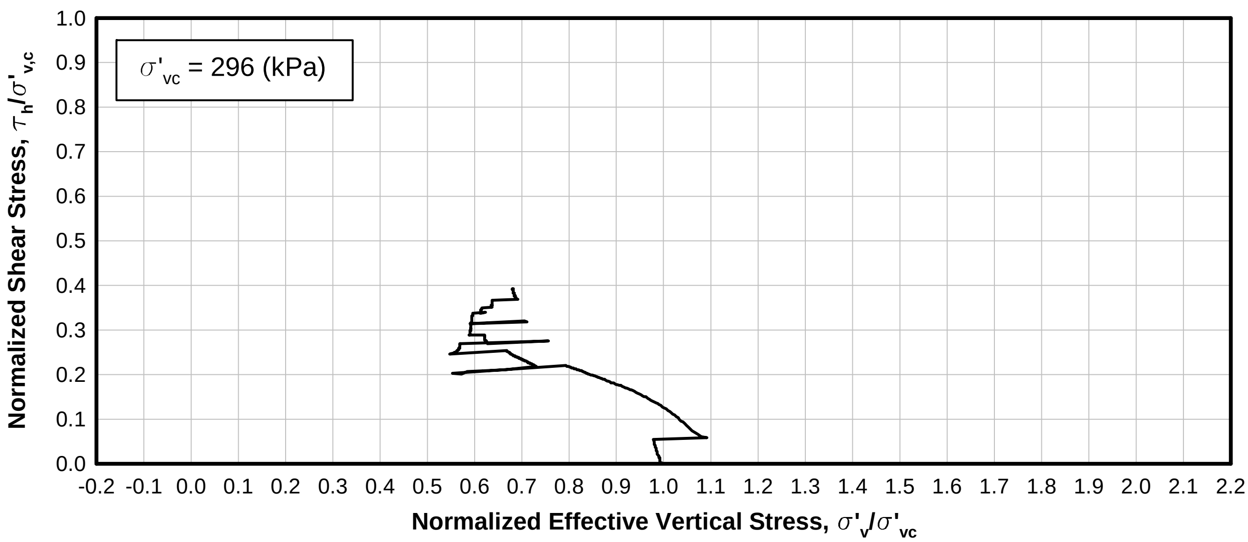
CONSOLIDATED CONSTANT VOLUME DSS TEST

LS-07

1008-010-006-3

BRUCEJACK PROJECT, BRITISH COLUMBIA





CONSOLIDATED CONSTANT VOLUME DSS TEST

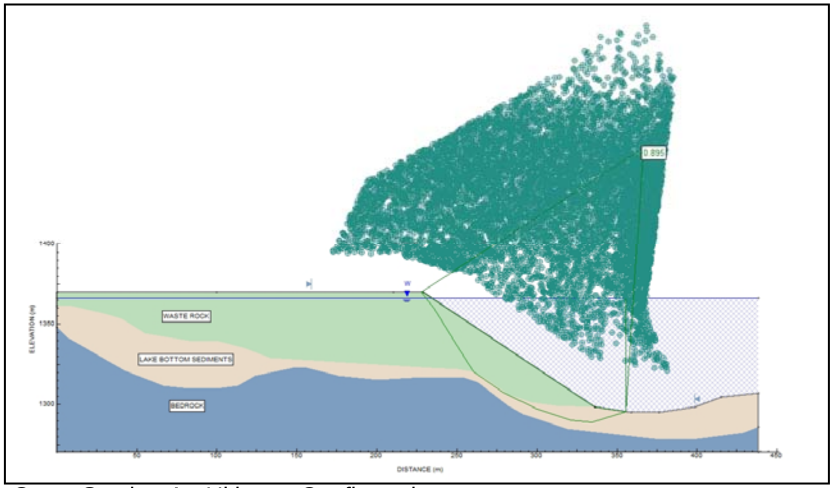
LS-07

1008-010-006-3

BRUCEJACK PROJECT, BRITISH COLUMBIA

APPENDIX B
STABILITY ANALYSIS RESULTS

Brucejack Project - Geotechnical Stability Assessment of Waste Rock Deposition in Brucejack Lake

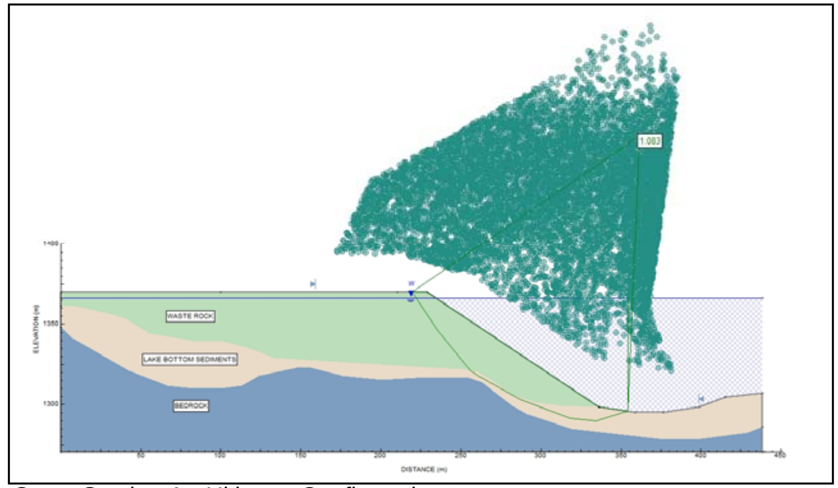


Cross Section A - Ultimate Configuration

Slope: 1.5H:1V

Lake Bottom Sediment Condition: Drained, $\phi' = 22^0$

Factor of Safety: 0.90

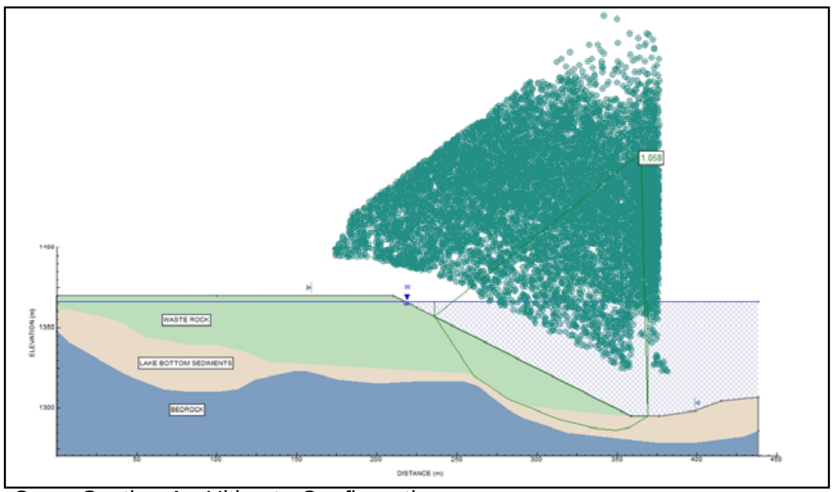


Cross Section A - Ultimate Configuration

Slope: 1.5H:1V

Lake Bottom Sediment Condition: Drained, $\phi' = 27^0$

Factor of Safety: 1.08

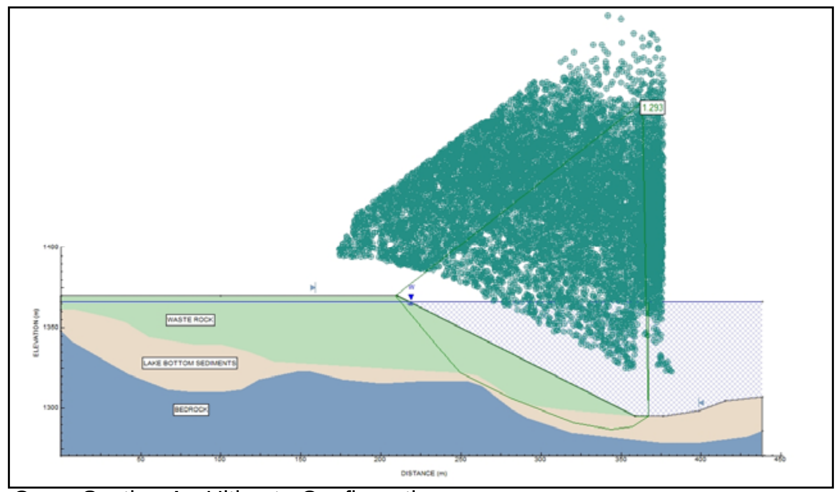


Cross Section A - Ultimate Configuration

Slope: 2H:1V

Lake Bottom Sediment Condition: Drained, $\phi' = 22^0$

Factor of Safety: 1.06



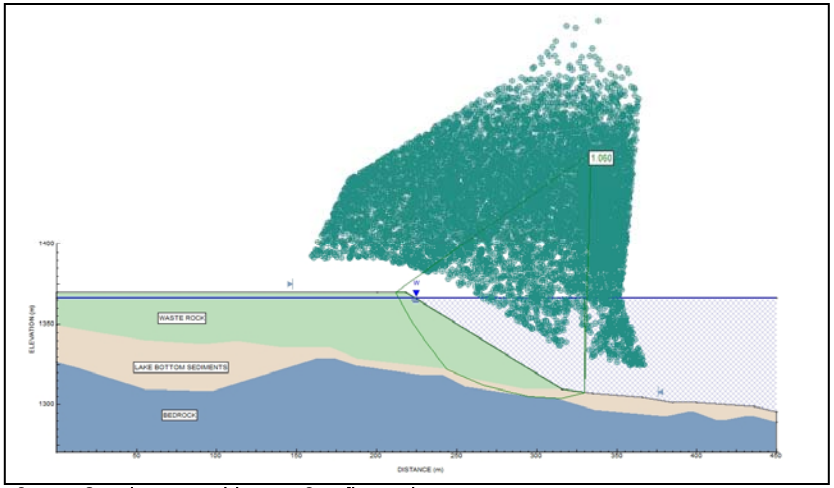
Cross Section A - Ultimate Configuration

Slope: 2H:1V

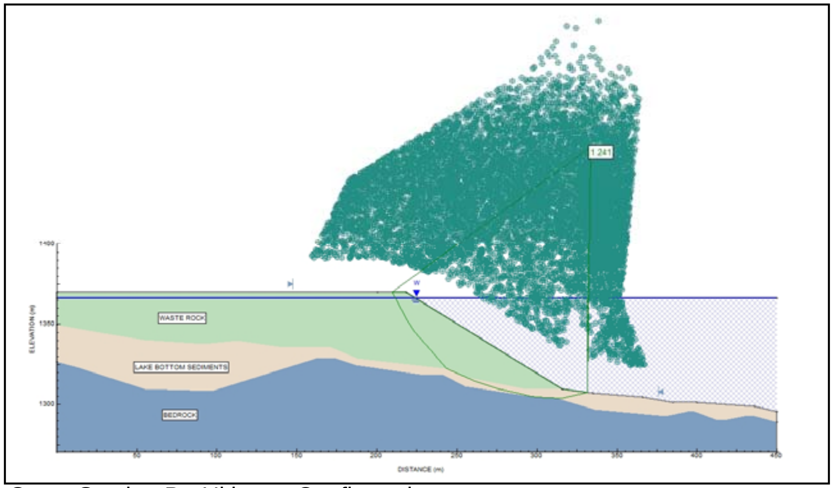
Lake Bottom Sediment Condition: Drained, $\phi' = 27^0$

Factor of Safety: 1.29

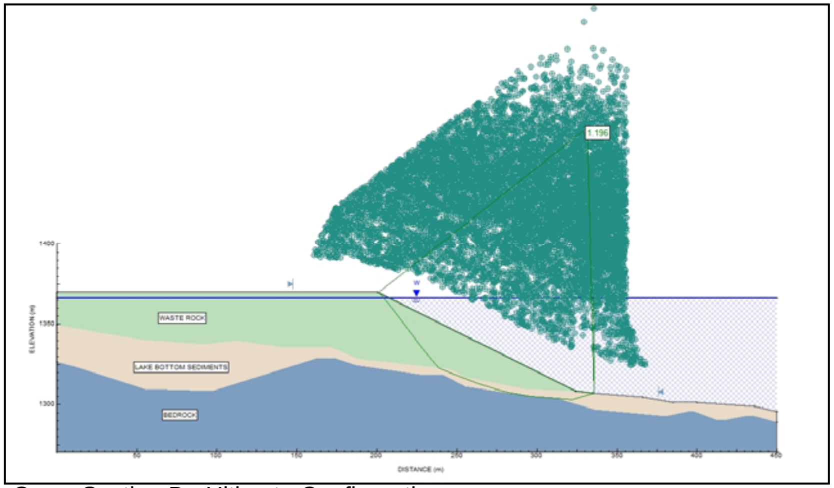
Brucejack Project - Geotechnical Stability Assessment of Waste Rock Deposition in Brucejack Lake



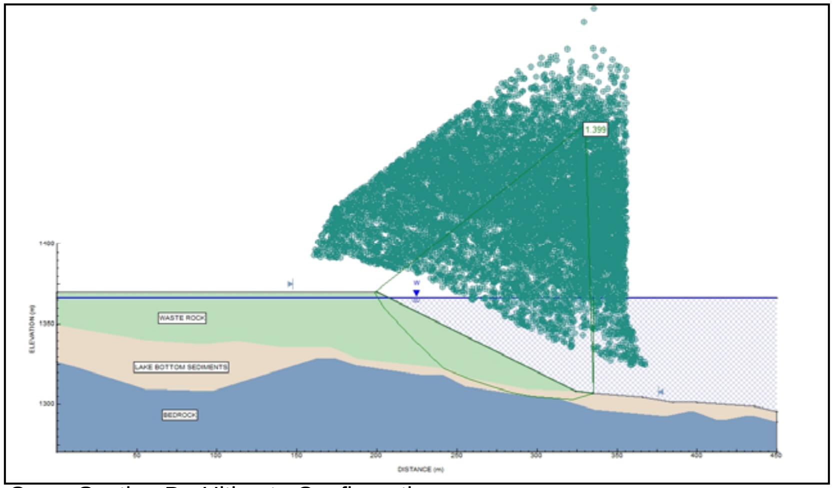
Cross Section B - Ultimate Configuration
Slope: 1.5H:1V
Lake Bottom Sediment Condition: Drained, $\phi' = 22^0$
Factor of Safety: 1.06



Cross Section B - Ultimate Configuration
Slope: 1.5H:1V
Lake Bottom Sediment Condition: Drained, $\phi' = 27^0$
Factor of Safety: 1.24

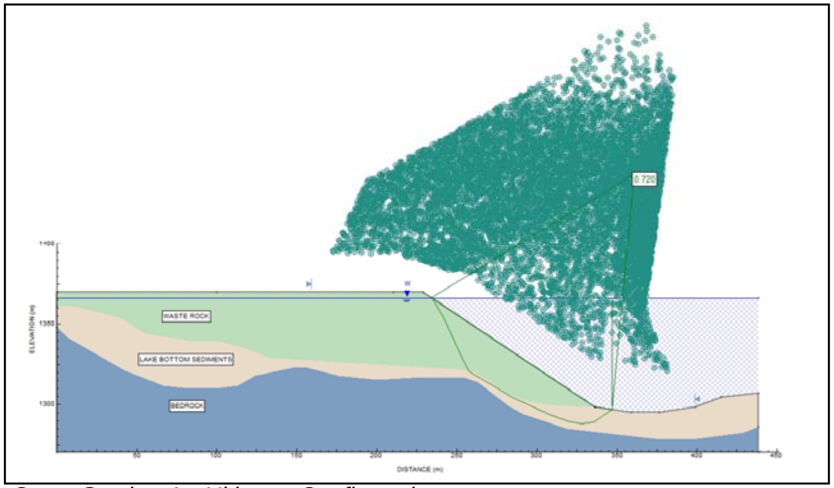


Cross Section B - Ultimate Configuration
Slope: 2H:1V
Lake Bottom Sediment Condition: Drained, $\phi' = 22^0$
Factor of Safety: 1.20

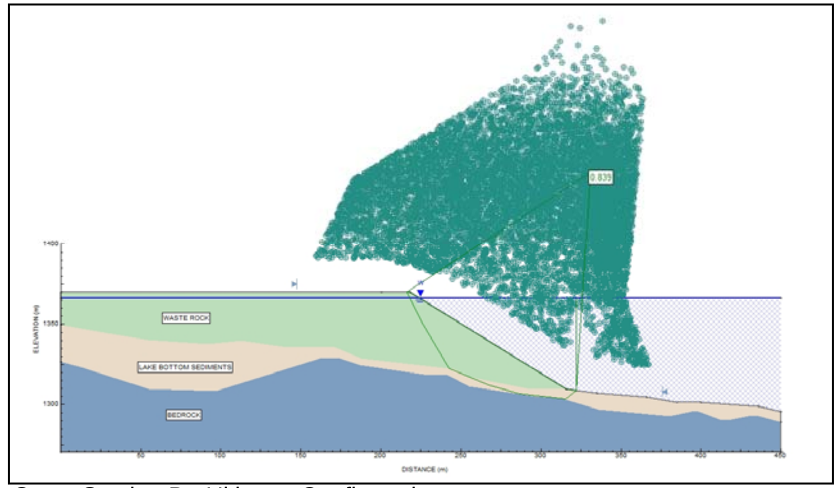


Cross Section B - Ultimate Configuration
Slope: 2H:1V
Lake Bottom Sediment Condition: Drained, $\phi' = 27^0$
Factor of Safety: 1.40

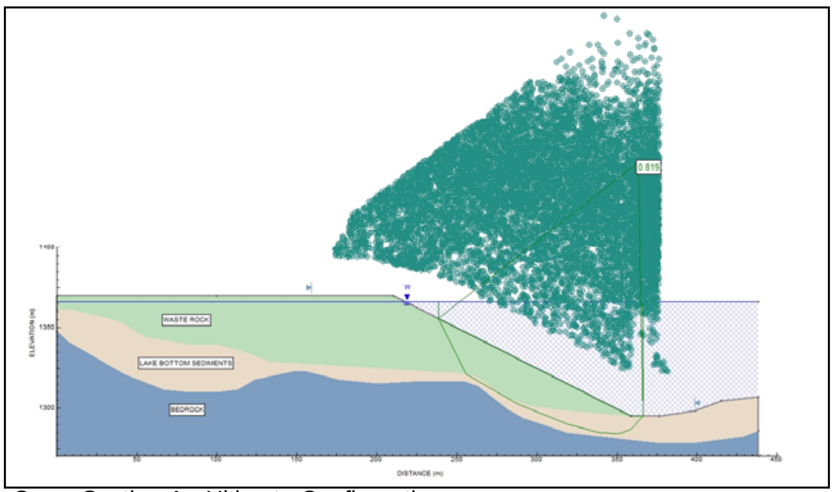
Brucejack Project - Geotechnical Stability Assessment of Waste Rock Deposition in Brucejack Lake



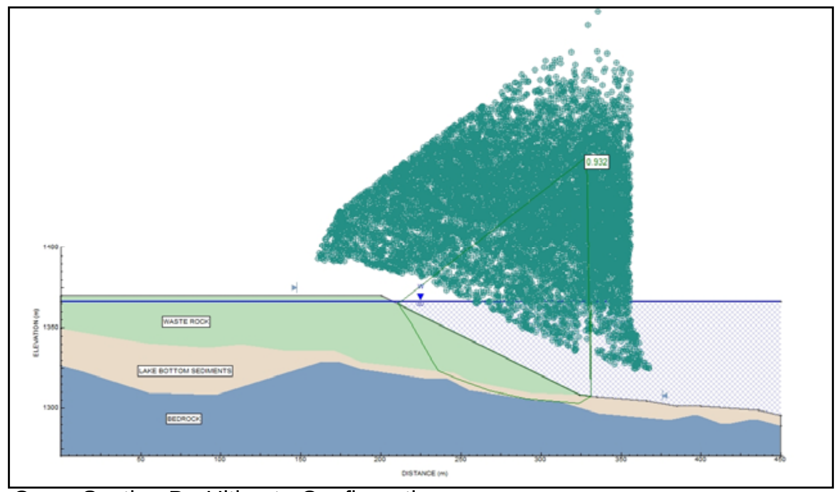
Cross Section A - Ultimate Configuration
Slope: 1.5H:1V
Lake Bottom Sediment Condition: Undrained, Su = 0.27 σ'_{vc}
Factor of Safety: 0.72



Cross Section B - Ultimate Configuration
Slope: 1.5H:1V
Lake Bottom Sediment Condition: Undrained, Su = 0.27 σ'_{vc}
Factor of Safety: 0.84

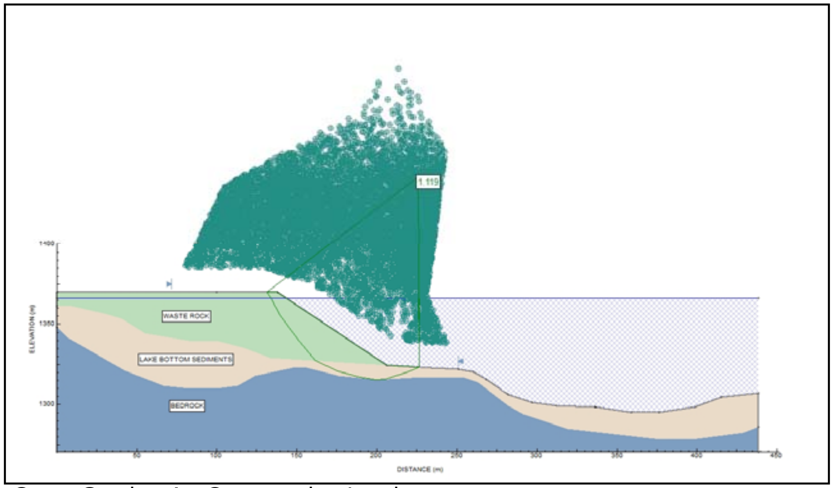


Cross Section A - Ultimate Configuration
Slope: 2H:1V
Lake Bottom Sediment Condition: Undrained, Su = 0.27 σ'_{vc}
Factor of Safety: 0.82



Cross Section B - Ultimate Configuration
Slope: 2H:1V
Lake Bottom Sediment Condition: Undrained, Su = 0.27 σ'_{vc}
Factor of Safety: 0.93

Brucejack Project - Geotechnical Stability Assessment of Waste Rock Deposition in Brucejack Lake

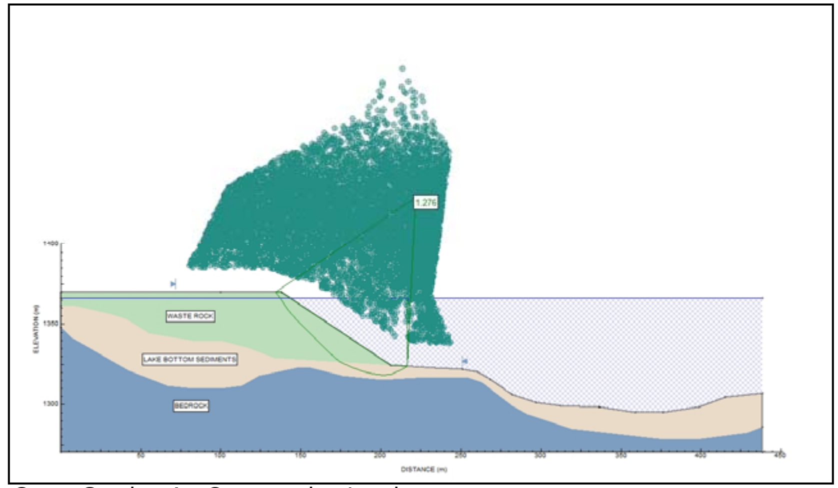


Cross Section A - Construction Laydown

Slope: 1.5H:1V

Lake Bottom Sediment Condition: Drained, $\phi' = 22^0$

Factor of Safety: 1.12

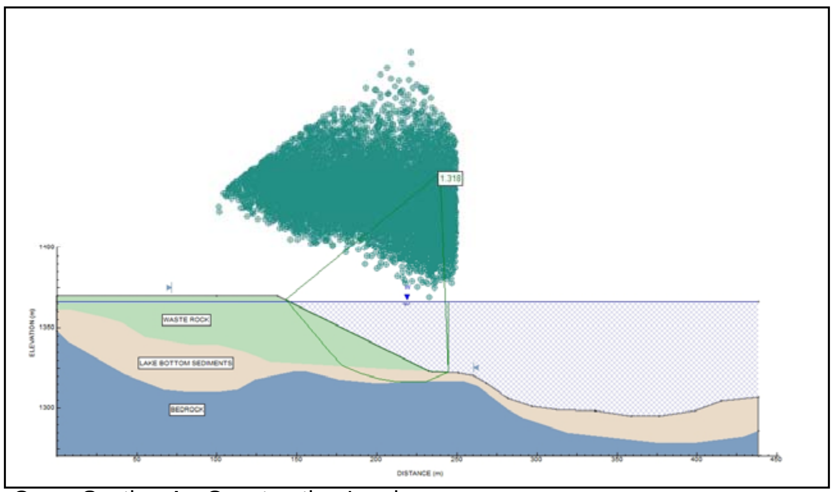


Cross Section A - Construction Laydown

Slope: 1.5H:1V

Lake Bottom Sediment Condition: Drained, $\phi' = 27^0$

Factor of Safety: 1.28

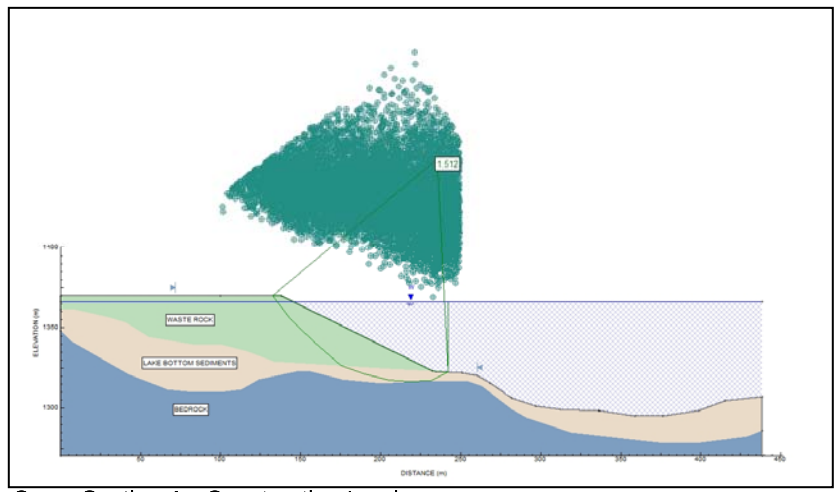


Cross Section A - Construction Laydown

Slope: 2H:1V

Lake Bottom Sediment Condition: Drained, $\phi' = 22^0$

Factor of Safety: 1.32



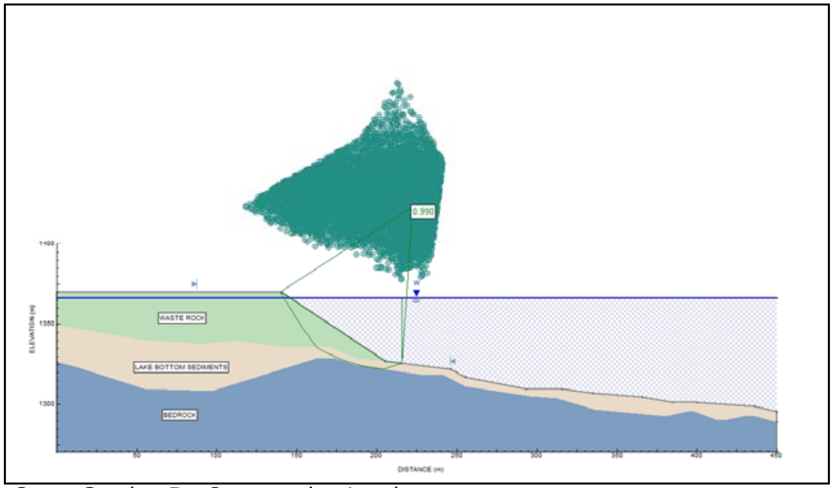
Cross Section A - Construction Laydown

Slope: 2H:1V

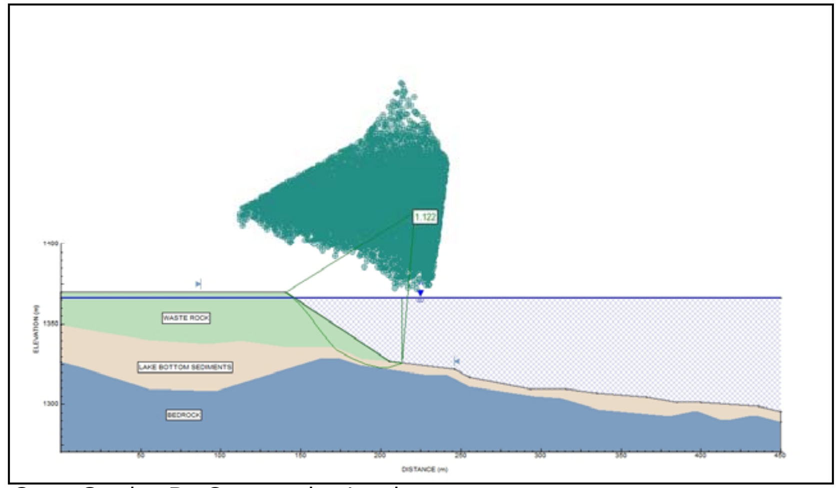
Lake Bottom Sediment Condition: Drained, $\phi' = 27^0$

Factor of Safety: 1.51

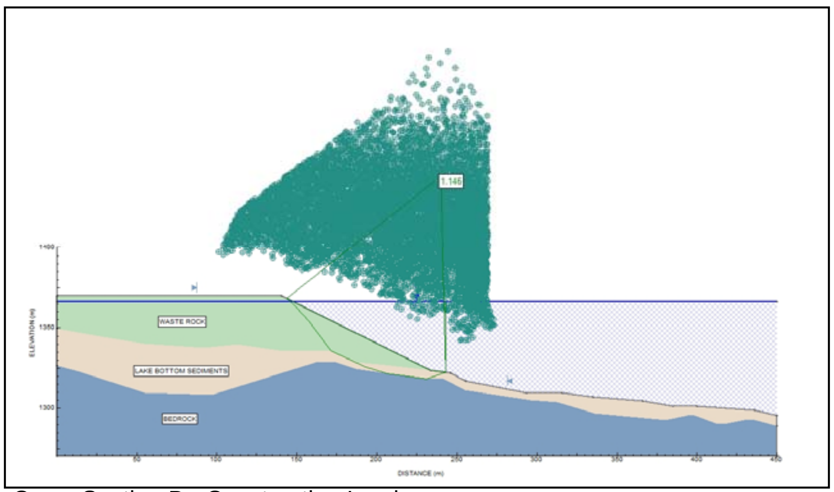
Brucejack Project - Geotechnical Stability Assessment of Waste Rock Deposition in Brucejack Lake



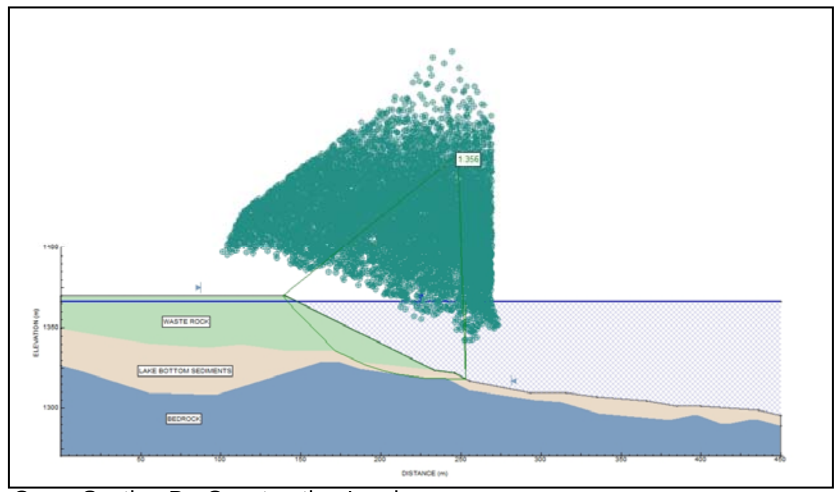
Cross Section B - Construction Laydown
Slope: 1.5H:1V
Lake Bottom Sediment Condition: Drained, $\phi' = 22^0$
Factor of Safety: 0.99



Cross Section B - Construction Laydown
Slope: 1.5H:1V
Lake Bottom Sediment Condition: Drained, $\phi' = 27^0$
Factor of Safety: 1.12

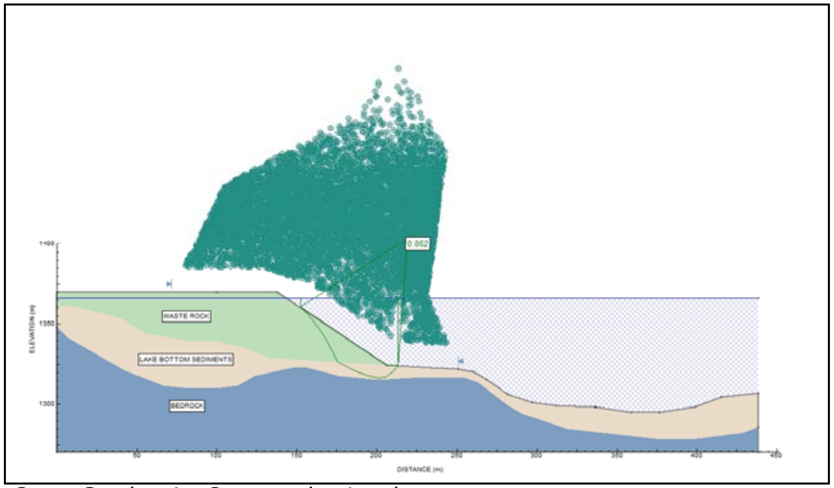


Cross Section B - Construction Laydown
Slope: 2H:1V
Lake Bottom Sediment Condition: Drained, $\phi' = 22^0$
Factor of Safety: 1.15

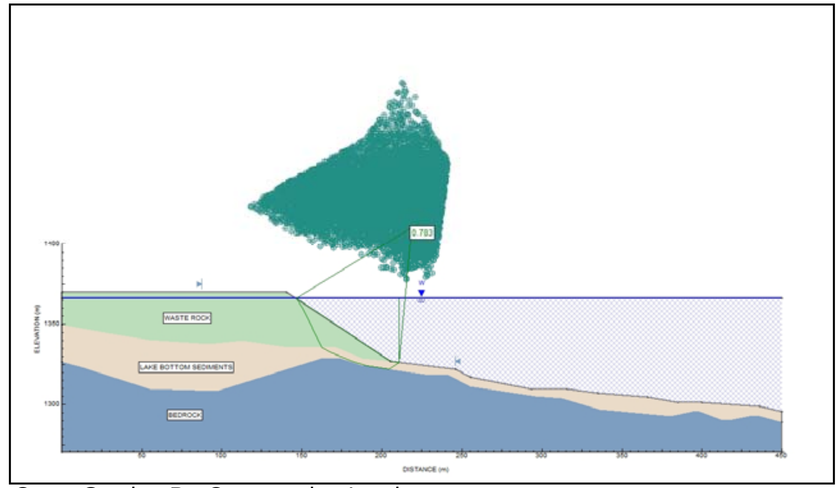


Cross Section B - Construction Laydown
Slope: 2H:1V
Lake Bottom Sediment Condition: Drained, $\phi' = 27^0$
Factor of Safety: 1.36

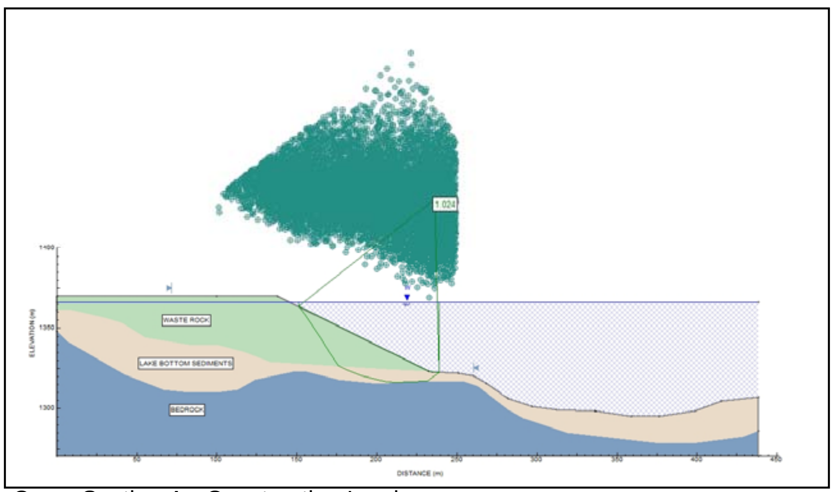
Brucejack Project - Geotechnical Stability Assessment of Waste Rock Deposition in Brucejack Lake



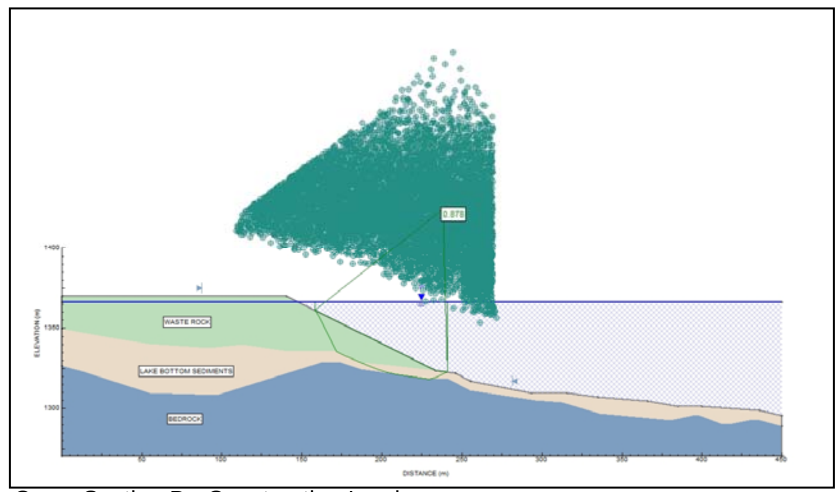
Cross Section A - Construction Laydown
Slope: 1.5H:1V
Lake Bottom Sediment Condition: Undrained, Su = 0.27 σ'_{vc}
Factor of Safety: 0.86



Cross Section B - Construction Laydown
Slope: 1.5H:1V
Lake Bottom Sediment Condition: Undrained, Su = 0.27 σ'_{vc}
Factor of Safety: 0.78



Cross Section A - Construction Laydown
Slope: 2H:1V
Lake Bottom Sediment Condition: Undrained, Su = 0.27 σ'_{vc}
Factor of Safety: 1.02



Cross Section B - Construction Laydown
Slope: 2H:1V
Lake Bottom Sediment Condition: Undrained, Su = 0.27 σ'_{vc}
Factor of Safety: 0.88

APPENDIX C
FRONTIER GEOPHYSICAL SURVEY REPORT

PRETIVM

REPORT ON

SEISMIC REFRACTION, BATHYMETRIC, AND

SUB-BOTTOM ACOUSTIC PROFILING SURVEYS

BRUCEJACK LAKE

BELL II AREA, B.C.

by

Beth Friesen, B.Sc.

Cliff Candy, P.Geo.

August, 2013 **PROJECT FGI-1319**

Frontier Geosciences Inc. 237 St. Georges Avenue, North Vancouver, B.C., Canada V7L 4T4
Tel: 604.987.3037   Fax: 604.984.3074

CONTENTS

ILLUSTRATIONS

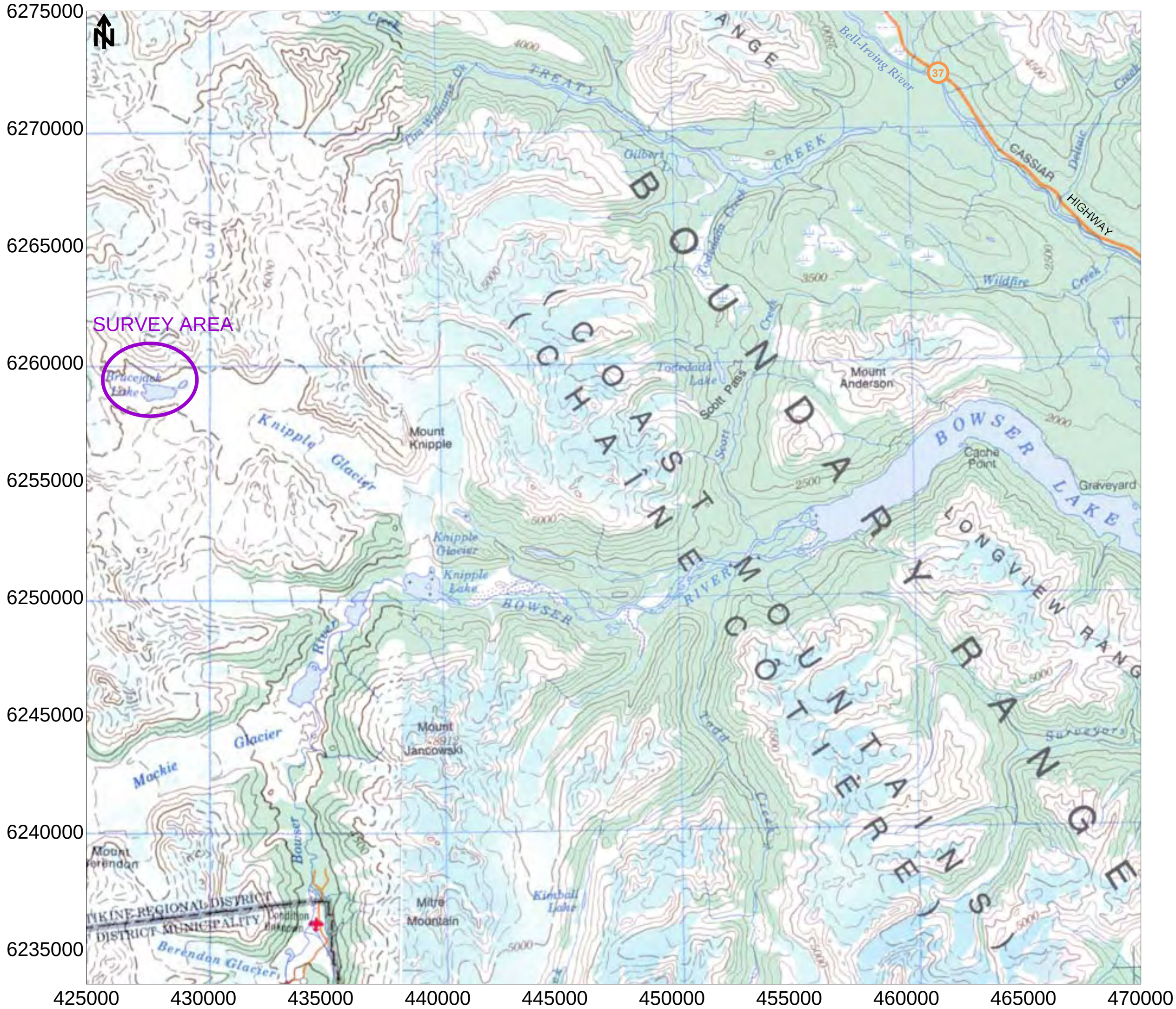
1. INTRODUCTION

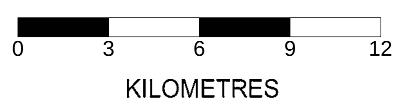
In the period August 11 to August 15, 2013, Frontier Geosciences Inc. carried out a seismic refraction and overwater geophysical survey for Pretivm at the Brucejack Lake property. The site area is located approximately 36 km southwest of Bell II, British Columbia. A Survey Location Plan of the area is shown at a scale of 1:300,000 in Figure 1.

The purpose of the land-based seismic refraction surveying and the overwater acoustic profiling was to determine bedrock topography and overlying sediment thickness in both the waste rock and outlet control structure areas.

In total, approximately 985 metres of seismic refraction data were recorded along nine separate seismic lines in the outlet control structure area. A Site Plan illustrating the locations of the seismic refraction transects is presented at a scale of 1:750 in Figure 2 of the Appendix.

The overwater survey consisted of bathymetric and sub-bottom acoustic profiling of Brucejack Lake. In total, approximately 27.5 km of data was collected over the lake. Survey coverage was carried out with a series of north-south trending traverses approximately 20 to 40 metres apart with some east-west trending traverses tying in the survey grid.





RESCAN BRUCEJACK LAKE PROJECT		
BATHYMETRY SURVEY		
SURVEY LOCATION PLAN		
FRONTIER GEOSCIENCES INC.		
DATE: AUG. 2013	SCALE 1:300,000	FIG. 1

2. THE SEISMIC REFRACTION SURVEY METHOD

2.1 Equipment

The seismic refraction survey was carried out with a Geometrics, Geode, 24 channel, signal enhancement seismograph and Oyo Geo Space, 10 Hz geophones and hydrophones. Geophone (or hydrophone) intervals along the multicored seismic cables were maintained at 5 metres in order to produce high resolution data on subsurface layering. Energy input was provided by a seismic shotgun, firing blank, black powder, 8 gauge, industrial shells into hand-excavated shotholes. Shot initiation or zero time was established by metal to metal contact of a striking hammer contacting the firing pin of the shotgun.

2.2 Survey Procedure

For each spread, the 115 metre seismic cable was stretched out in a straight line and the geophones/hydrophones implanted. Six separate ‘shots’ were then initiated: one at either end of the geophone array, two at intermediate locations along the seismic cable, and one off each end of the line to ensure adequate coverage of the basal layer. The shots were detonated individually and arrival times for each geophone were recorded digitally in the seismograph. Data recorded during field surveying operations was generally of good to excellent quality.

Throughout the survey, notes were recorded regarding seismic line positions in relation to topographic and geological features. Relative elevations on the seismic lines were recorded by chain and inclinometer with absolute elevations taken from mapping of the area provided by Pretivm.

2.3 Interpretive Method

The method of differences technique was used to arrive at the final interpretation of the seismic data. This method utilises the time taken for the seismic wave to travel to a geophone from shotpoints located to either side of the geophone. Using the total time, a small vertical time is computed which represents the time taken to travel from the refractor up to the ground surface. This time is then multiplied by the velocity of each overburden layer to obtain the thickness of each layer at that point.

3. THE OVERWATER SURVEY

3.1 Bathymetric Survey

3.1.1 Equipment

The overwater bathymetry survey was completed with a Marinetek, PCS-200 Sounder, with separate transducers to transmit and receive the sonar pulses. The system was calibrated with respect to water temperature and salinity, and used a broadband output with a 200 KHz centre frequency. Power for the field computer and Marinetek Sounder was provided by a 1000W generator. A small 20 ft aluminium boat was used for the survey. It was powered by a small outboard engine.

3.1.2 Survey Procedure and Positioning

The bathymetric transducer was placed in the water at a depth of 0.32 metres at the rear of the boat. The transducer location was carefully determined to facilitate the best operating environment for the transmission and reception of sound pulses. In operation, the source transducer pulsed twice every second with a sounding frequency of 200 KHz. The pulses emitted from the transducer were reflected by the lake bottom, then digitally recorded and visually reviewed in real time on the high resolution display of a notebook computer. The digital record of the reflected signal was stored in the notebook hard drive and played back to interpret the water depth and bottom quality.

Data collected on the Marinetek PCS-200 Sounder was correlated with a Ray Marine Navigation Inc. DGPS-220 12 channel receiver, so that each pulse position could be contoured for final data presentation and interpretation. The positioning accuracy of the GPS was 3 to 5 metres. The positioning datum of NAD83 in UTM grid coordinates was used on all plans. Data recorded during field surveying operations was generally of good to excellent quality.

3.2 Sub-bottom Acoustic Profiling Survey

3.2.1 Equipment

The overwater acoustic profiling survey was completed using a sub-bottom seismic system with an electric pulser source for detecting deeper, sub-bottom horizons. The pulser system (precision double coil, vertical boomer) was used with a multi-element hydrophone receiver array. The system was calibrated in milliseconds and has a broad band output with a 250 Hz centre frequency. Reflected signals were amplified for viewing and recorded on a field computer. The field computer recorded a seismogram of 200 milliseconds two-way time duration approximately twice per second. Power for the seismic system was also provided from the 1000W generating set.

The pulser source was placed in the water, 10 metres astern of the vessel with the midpoint of the receiver hydrophone 'eel', 10 metres behind the source. In operation, pulses from the source were reflected from the bottom and sub-bottom horizons and were summed in the eel hydrophone elements and transferred to the recording amplifiers.

3.2.2 Data Processing and Interpretation Procedure

The sub-bottom acoustic profiling data was processed into SEG-2 format and imported into the Kansas Geological Survey (KGS) WinSeis reflection processing package. The positioning information was processed to account for the 15 metre lay-back distance of the source and receiver from the GPS transducer. The data was then converted to SEG-Y format and together with the GPS position information, was imported into the Seismic Micro Technologies (SMT) 2D/3D seismic interpretation package. This software is a comprehensive 2D/3D seismic interpretation program that provides interpretive and horizon picking tools integrated into a map and section database, data management and display system. As well, the bathymetry data was converted to time and then imported as a horizon into the SMT package for interpretation and to allow full handling of the time to depth conversion.

The first stage in the analysis was the use of the horizon picking tools to identify the main subsurface reflector in the data. The software shows time markers at the intersection of lines and tie-lines, facilitating the picking of a consistent event throughout the map area. The time-depths of the interpreted subsurface layer data were then converted to depths using an average velocity of 1475 m/s. The surface was then plotted in colour contour format.

4. GEOPHYSICAL RESULTS

4.1 General

The results of the seismic refraction interpretations are illustrated at 1:250 scale in Figures 3 to 11 of the Appendix. The interpreted bathymetric water depth contour plan, illustrated at a scale of 1:5,000 in Figure 12 of the Appendix, shows the interpreted lake bottom contours. The interpreted bedrock surface depth contour plan of the lake is illustrated at 1:5,000 scale in Figure 13 of the Appendix. Sediment thickness overlying the basal bedrock surface is shown as an isopach at a 1:5,000 scale in Figure 14 of the Appendix. Two typical example plots of the overwater acoustic profiling data illustrating the lake bottom and interpreted bedrock reflection are shown in both grey scale and colour scale at a horizontal scale of 1:1,000 in Figures 15 to 17 of the Appendix. The locations of these cross sections are illustrated in Figure 12.

4.2 Seismic Refraction

Seismic lines SL-1 though SL-9 are located in the outlet control structure area across the shallow, extreme west arm of Brucejack Lake. Analysis of the seismic data indicates the site area is underlain by three distinct velocity layers.

The surficial layer with compressional (P) wave velocities ranging from 380 m/s to 550 m/s is consistent with surficial exposures of unsaturated loose sand, gravel, and thin soils. This layer is generally thin, averaging approximately 0.8 metres over most of the site area. On seismic line SL-2, the layer thickens to approximately 3 metres.

Underlying the surficial layer is a slightly thicker intermediate layer exhibiting compressional wave velocities ranging from 1420 m/s to 1500 m/s. These velocities are indicative of saturated sand and gravels, and the water column within the channel. This intermediate layer varies in thickness from a minimum of 1 metre on line SL-6 station 100NW, to a maximum of 6 metres on seismic line SL-2 station 30NW, and averages approximately 3 metres over the survey area.

The basal layer with velocities varying from 4080 m/s to 4790 m/s is the interpreted competent bedrock surface. The average interpreted depth to bedrock throughout the site area is approximately 4 metres, with shallow sections of approximately 1 metre on seismic lines SL-6, at its northwestern end, and SL-8 at its northern end. These shallow areas generally occur in close proximity to bedrock outcrops along the lake edge.

4.3 Bathymetry and Sub-Bottom Acoustic Profiling Results

In Figure 12, the results of the bathymetry survey shows the general lake bottom configuration with a relatively deep area in the central eastern area of the lake. This area reaches a maximum depth of approximately 89.8 metres at 427890E, 6259090N. An average depth of 88 metres extends from approximately 427800E to 427900E, where the lake bottom shows little variation in depth. The northern and southern extents of this area show a rapid change in bathymetry indicating a steeply dipping lake bottom.

A relatively deep section of the lake also extends westwards from the central deep area. This extent is slightly shallower, with depths of approximately 70 metres and has a much narrower north-south width of roughly 40 metres. The western arms of the lake remain shallow, with a maximum depth of approximately 30 metres at 427150E, 6259290N. Contours in these arms appear at a low gradient, indicating a gently dipping lake bottom. The extreme western arm was not surveyed to its full extent as shallow lake conditions and channel narrowing made surveying unfeasible due to risk of boat and equipment damage.

Figure 13 shows the interpreted bedrock depths in colour contour format. The general configuration of bedrock generally follows the bathymetry for most of the lake, with the central eastern area of the lake reaching maximum interpreted bedrock depths of approximately 120 metres. Interpreted sediment thickness is displayed as an isopach in Figure 14. The isopach indicates a thick zone of sediment accumulation near the southwestern lake edge within the area of the proposed waste rock disposal area. This zone, extending north to approximately 6258850N has an interpreted sediment thickness of up to 30 metres. For most of the remaining area within the waste rock disposal area the sediment is approximately 10 metres. Sediment thicknesses thin around the lake shore, particularly along the north edge to less than a metre, in close proximity to exposed bedrock.

5. LIMITATIONS

The depths to subsurface boundaries derived from seismic refraction surveys are generally accepted as accurate to within fifteen percent of the true depths to the boundaries. In some cases, unusual geological conditions may produce false or misleading data points with the result that computed depths to subsurface boundaries may be less accurate. In seismic refraction surveying difficulties with a 'hidden layer' or a velocity inversion may produce erroneous depths. The first condition is caused by the inability of the seismic refraction method to detect the existence of a layer because of insufficient velocity contrasts or layer thicknesses. A velocity inversion exists when an underlying layer has a lower velocity than the layer directly above it. The interpreted depths shown on drawings are to the closest interface location, which may not be vertically below the measurement point if the refractor dip direction departs significantly from the survey line location.

The depths to subsurface boundaries derived from overwater seismic acoustic profiling surveys are generally accepted as accurate to within ten percent of the true depths to the boundaries. In practice, the seismic velocity of sub-bottom materials are not determined in the course of an overwater acoustic profiling investigation. Errors may arise from application of an assumed velocity for saturated materials to determine the depths to sub-surface horizons when only the travel time to the horizon is known. An underestimate of the velocity function would produce depths that are too shallow, with the reverse occurring using an overestimate of velocity. Small errors may also occur in data gridding.

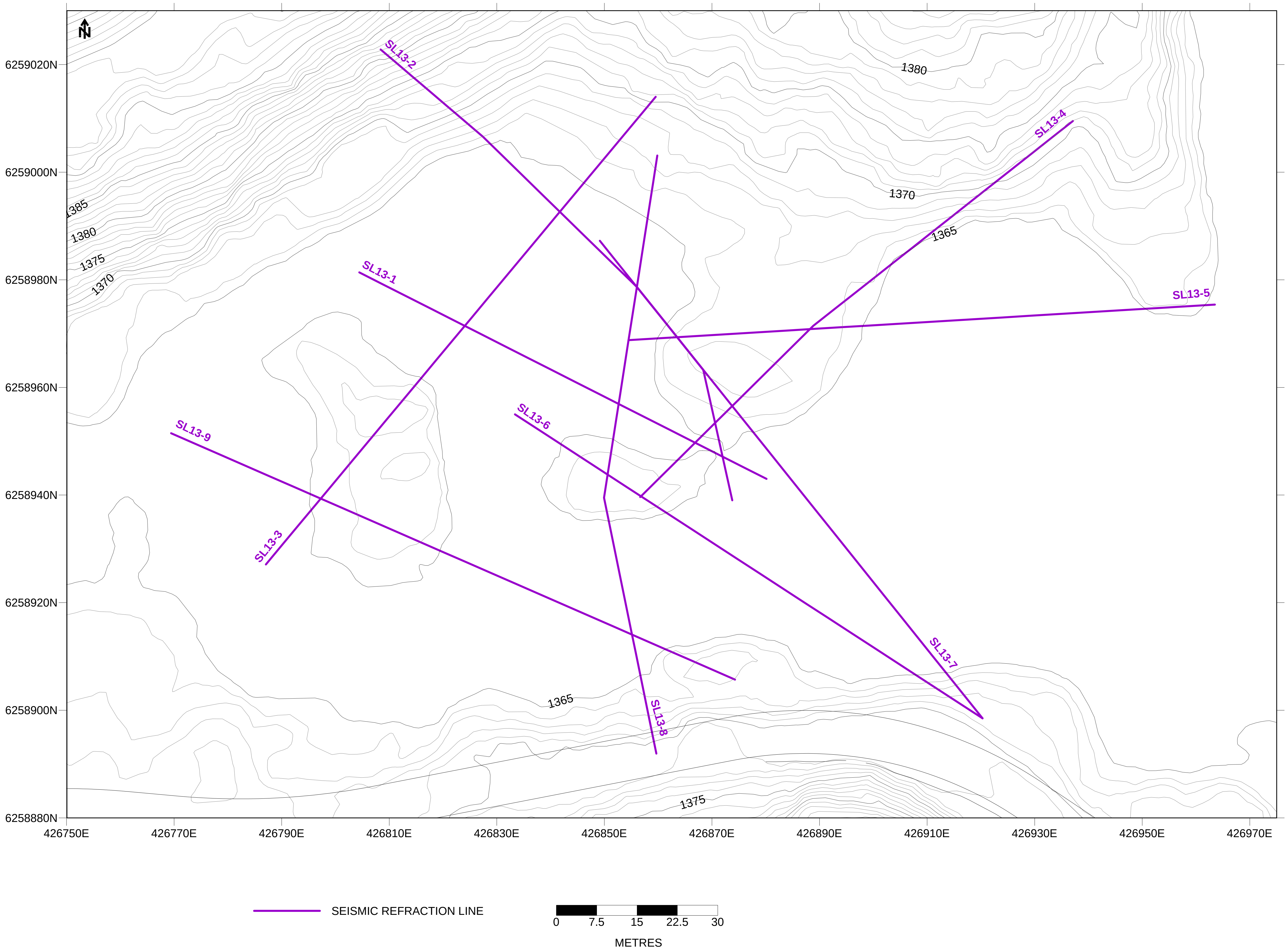
In addition, the nature and composition of sub-bottom layers identified in acoustic profiling surveys cannot be determined by inspection of the data. Several indicators such as reflector strength, diffraction patterns, lack of internal reflectors, multiple thin-bed reflectors, depth position, smoothness of reflectors, and reflector relief may provide insight into sub-surface features. The geology of horizons identified in overwater acoustic profiling and seismic refraction investigations would have to be established by borehole intersections.

The information in this report is based upon geophysical measurements and field procedures and our interpretation of the data. The geological information is based upon our estimate of the subsurface conditions considering the seismic refraction data, acoustic profiling data and all other information available to us. The consistency of interpretations of interfaces between the seismic refraction and overwater acoustic profiling surveys is excellent with good agreement in interpretation between the methods. The results are interpretive in nature and are considered to be a reasonably accurate presentation of existing bottom and subsurface conditions within the limitations of the seismic refraction and acoustic profiling methods.

For: Frontier Geosciences Inc.

Beth Friesen, B.Sc.

Cliff Candy, P.Geo.



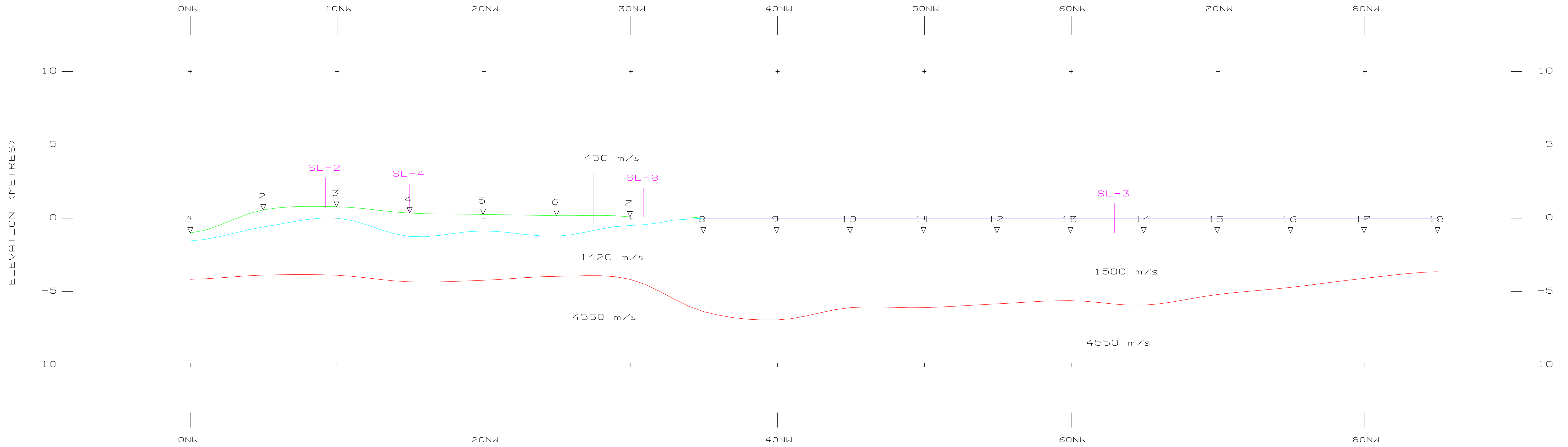
PRETIVM
BRUCEJACK PROJECT

SEISMIC REFRACTION SURVEY

OUTLET CONTROL STRUCTURE
SITE PLAN

FRONTIER GEOSCIENCES INC.

DATE: AUG. 2013	SCALE 1:750	FIG. 2



SEISMIC LINE SL13-1

INSTRUMENT: GEOMETRICS GEODE

PRETIVM

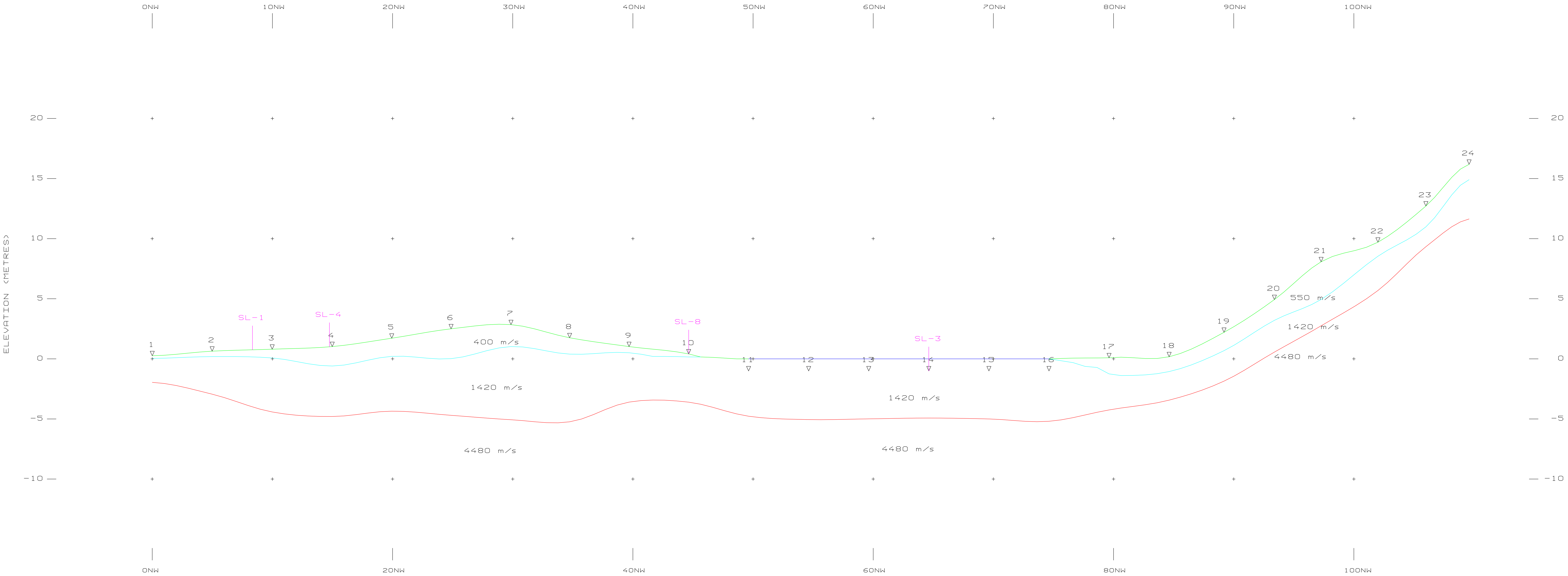
BRUCEJACK LAKE OUTLET CONTROL STRUCTURE

SEISMIC REFRACTION SURVEY

INTERPRETED DEPTH SECTION SL13-1

FRONTIER GEOSCIENCES INC.

DATE: AUG 2013	SCALE 1:250	FIG. 3

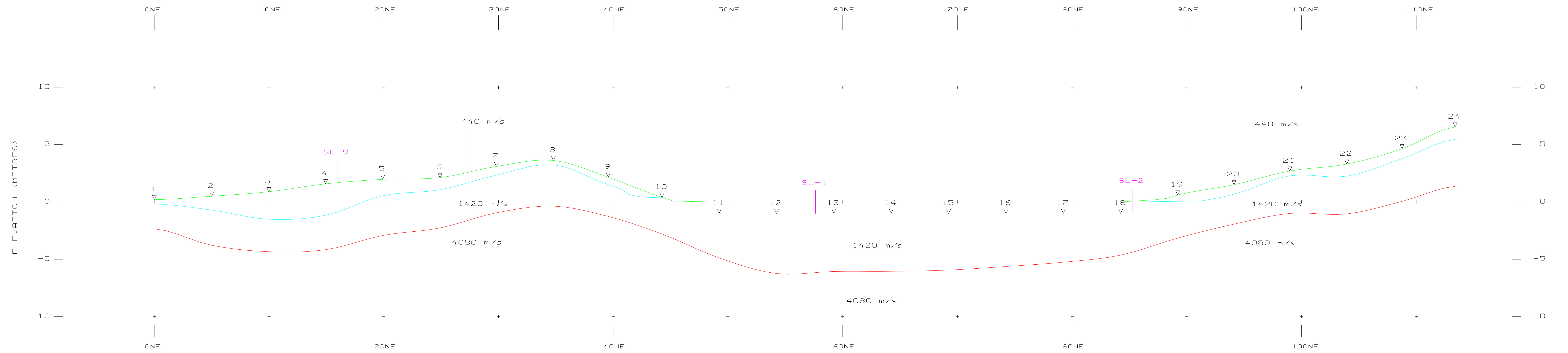


SEISMIC LINE SL13-2

INSTRUMENT: GEOMETRICS GEODE

PRETIVM
BRUCEJACK LAKE OUTLET CONTROL STRUCTURE
SEISMIC REFRACTION SURVEY
INTERPRETED DEPTH SECTION SL13-2
FRONTIER GEOSCIENCES INC.

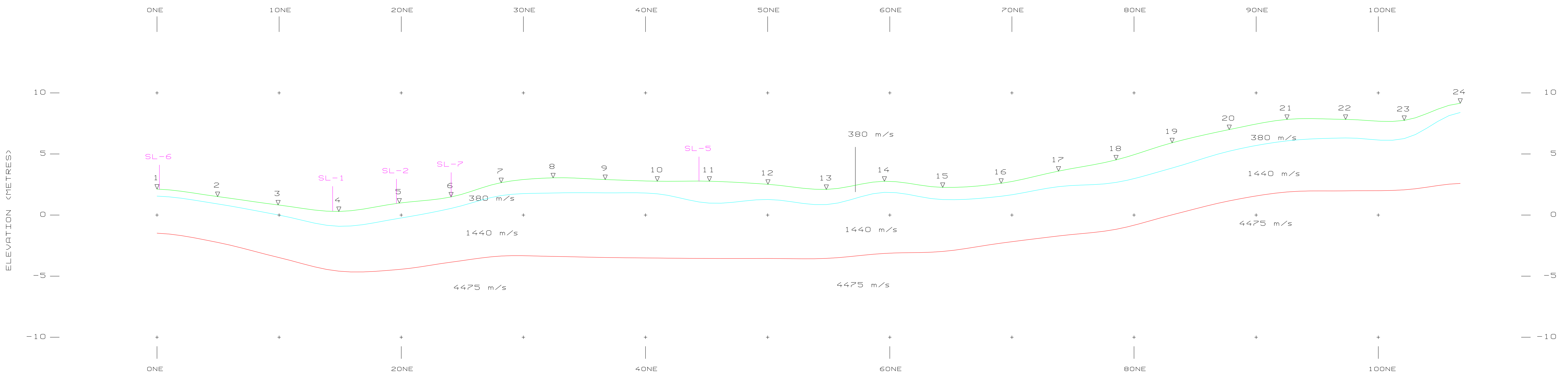
DATE: AUG 2013	SCALE 1:250	FIG. 4



SEISMIC LINE SL13-3

INSTRUMENT: GEOMETRICS GEODE

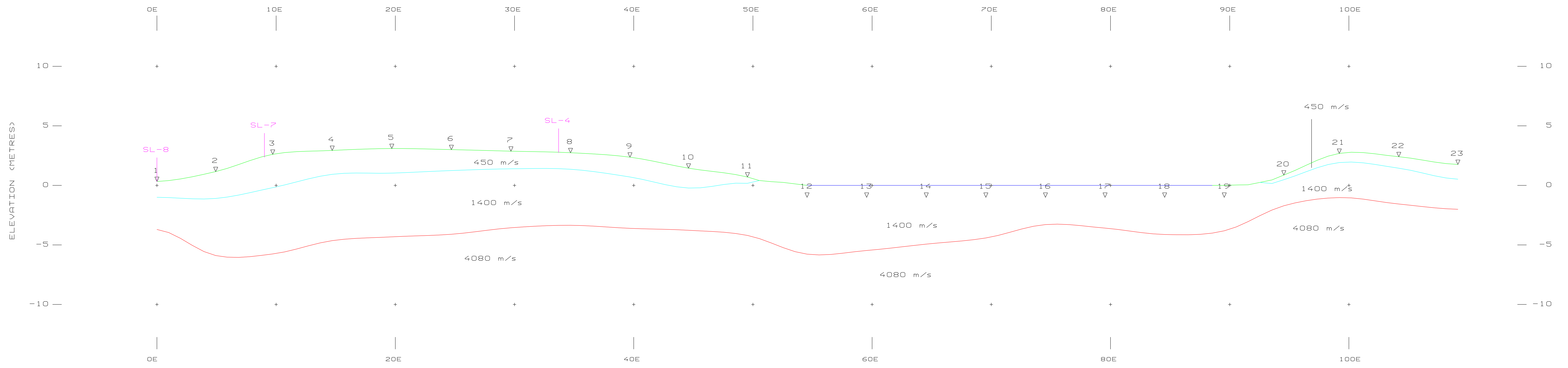
PRETIVM		
BRUCEJACK LAKE OUTLET CONTROL STRUCTURE		
SEISMIC REFRACTION SURVEY		
INTERPRETED DEPTH SECTION SL13-3		
FRONTIER GEOSCIENCES INC.		
DATE: AUG 2013	SCALE 1:250	FIG. 5



SEISMIC LINE SL13-4

INSTRUMENT: GEOMETRICS GEODE

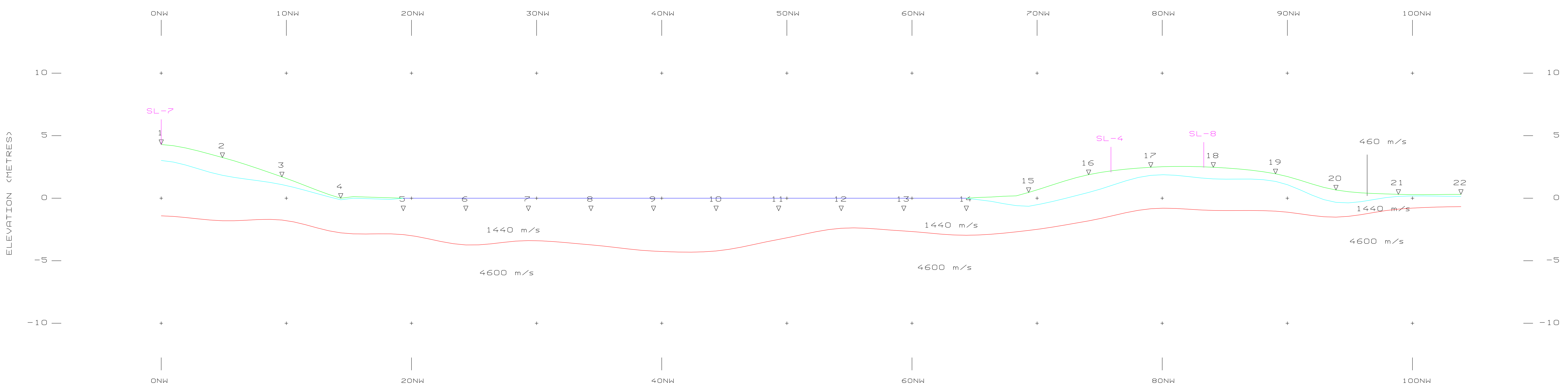
PRETIVM BRUCEJACK LAKE OUTLET CONTROL STRUCTURE		
SEISMIC REFRACTION SURVEY		
INTERPRETED DEPTH SECTION SL13-4		
FRONTIER GEOSCIENCES INC.		
DATE: AUG 2013	SCALE 1:250	FIG. 6



SEISMIC LINE SL13-5

INSTRUMENT: GEOMETRICS GEODE

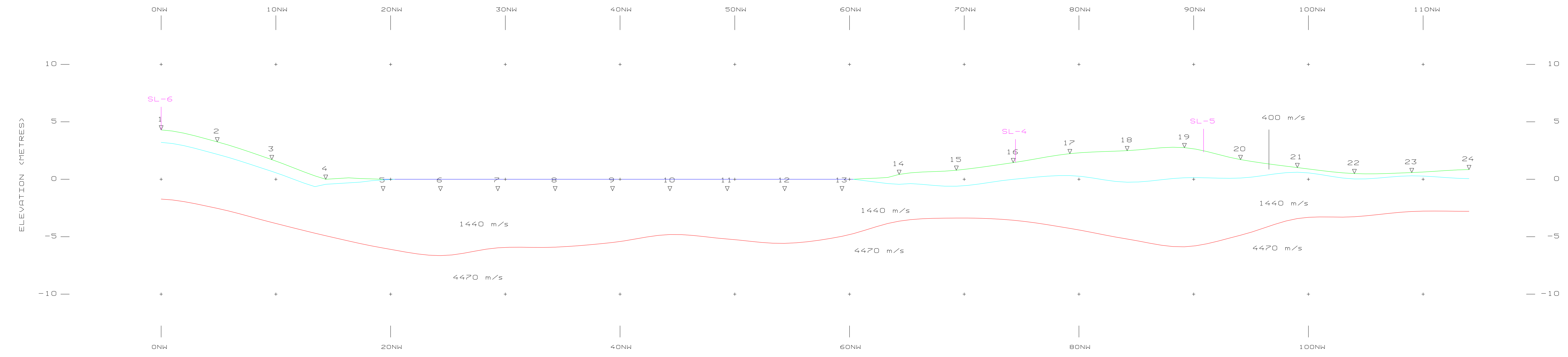
PRETIVM BRUCEJACK LAKE OUTLET CONTROL STRUCTURE		
SEISMIC REFRACTION SURVEY		
INTERPRETED DEPTH SECTION SL13-5		
FRONTIER GEOSCIENCES INC.		
DATE: AUG 2013	SCALE 1:250	FIG. 7



SEISMIC LINE SL13-6

INSTRUMENT: GEOMETRICS GEODE

PRETIVM BRUCEJACK LAKE OUTLET CONTROL STRUCTURE
SEISMIC REFRACTION SURVEY
INTERPRETED DEPTH SECTION SL13-6
FRONTIER GEOSCIENCES INC.
DATE: AUG 2013 | SCALE 1:250 | FIG. 8



PRETIVM

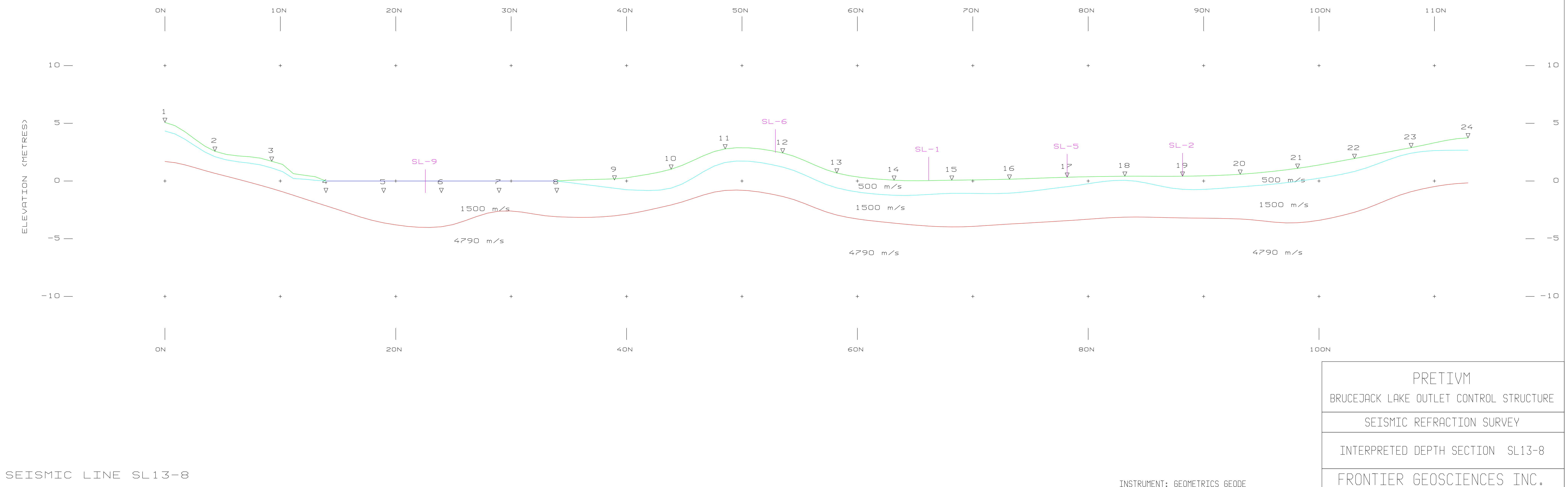
BRUCEJACK LAKE OUTLET CONTROL STRUCTURE

SEISMIC REFRACTION SURVEY

INTERPRETED DEPTH SECTION SL13-7

FRONTIER GEOSCIENCES INC.

DATE: AUG 2013	SCALE 1:250	FIG. 9



INSTRUMENT: GEOMETRICS GEODE

PRETIVM

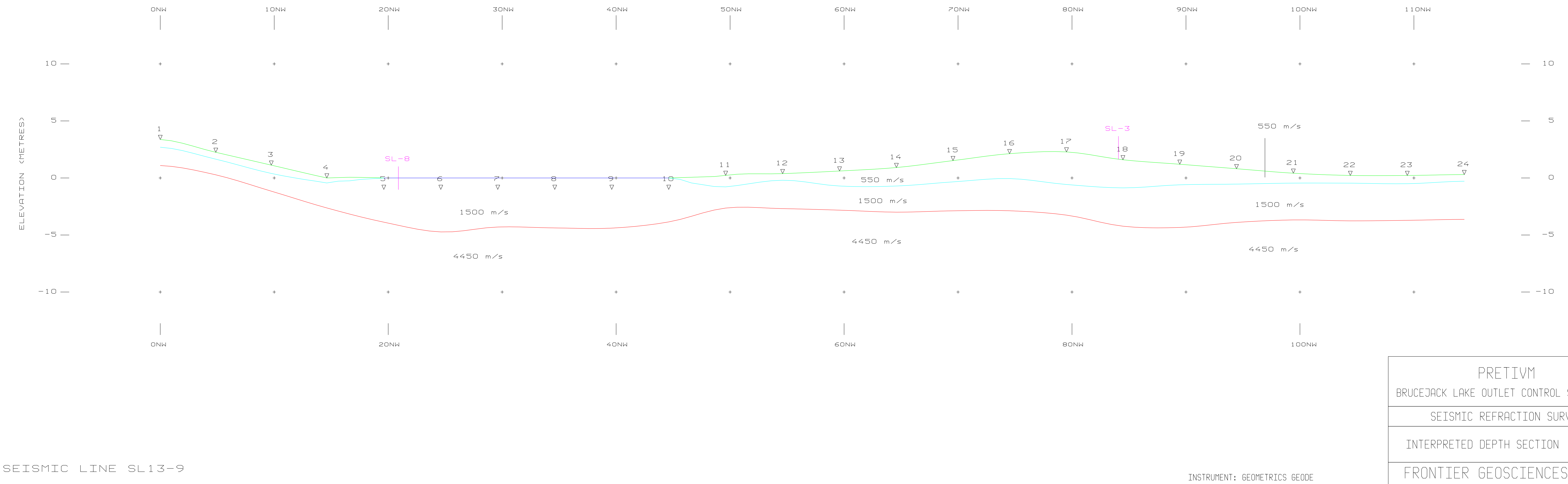
BRUCEJACK LAKE OUTLET CONTROL STRUCTURE

SEISMIC REFRACTION SURVEY

INTERPRETED DEPTH SECTION SL13-8

FRONTIER GEOSCIENCES INC.

DATE: AUG 2013	SCALE 1:250	FIG. 10



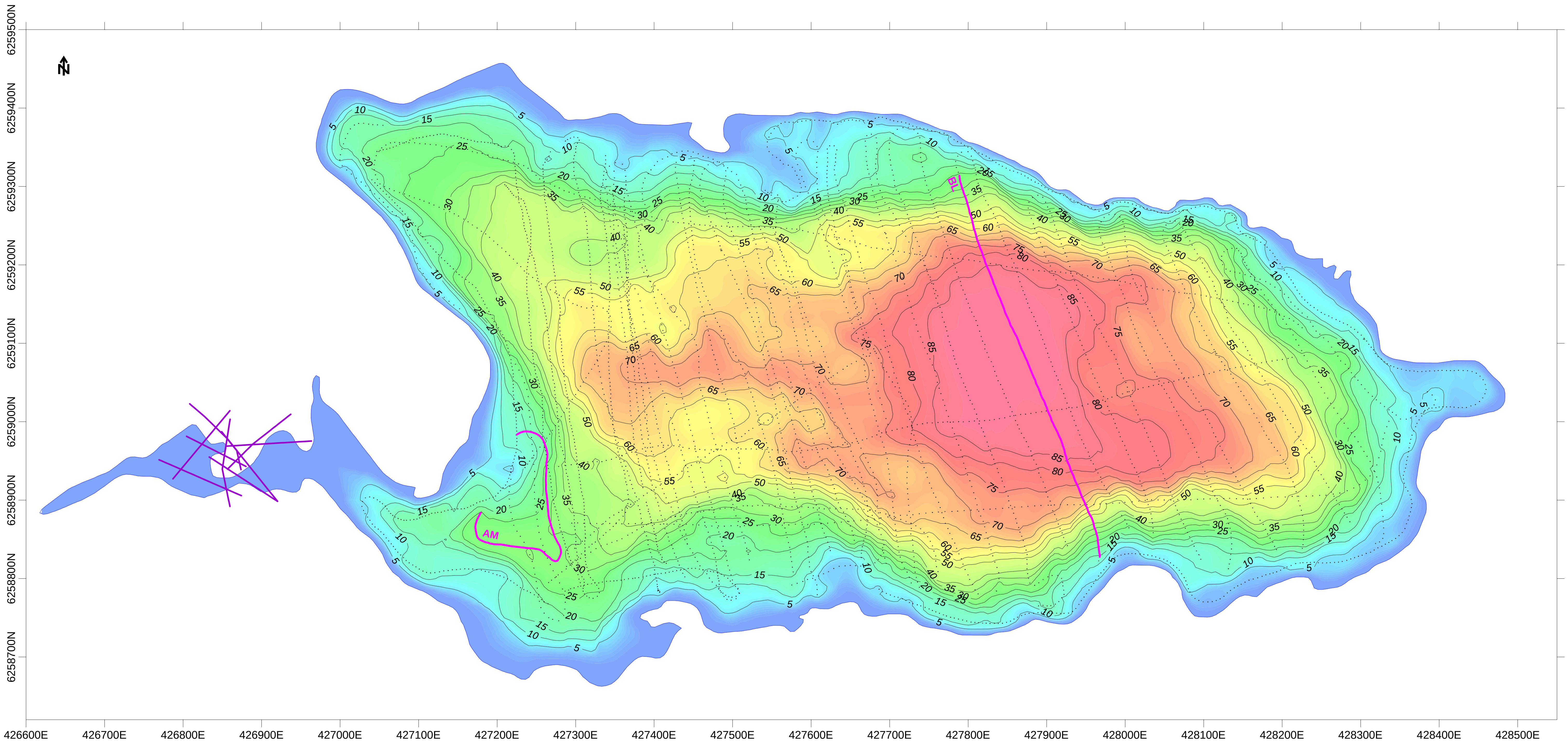
PRETIVM
BRUCEJACK LAKE OUTLET CONTROL STRUCTURE

SEISMIC REFRACTION SURVEY

INTERPRETED DEPTH SECTION SL13-9

FRONTIER GEOSCIENCES INC.

DATE: AUG 2013 | SCALE 1:250 | FIG. 11



SUB-BOTTOM EXAMPLE LINES
SEISMIC REFRACTION LINES
BOAT TRACK

0.0	4.3	9.3	16.3	25.0	34.9	44.9	55.6	65.0	72.1	83.1

DEPTH (m)

0 50 100 150 200

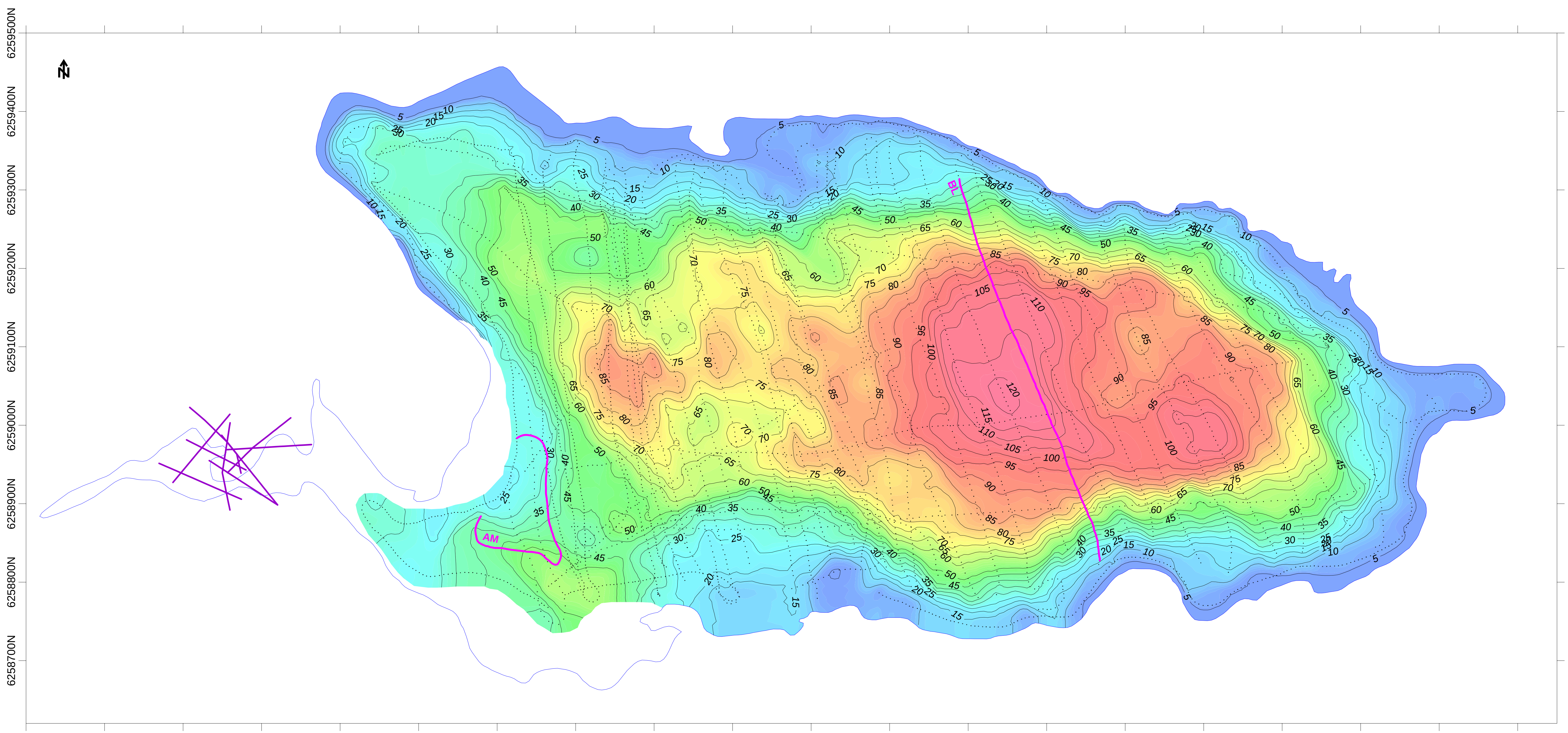
METRES

PRETIVM
BRUCEJACK LAKE PROJECT
OVERWATER SURVEY

BATHYMETRIC
DEPTH CONTOUR PLAN

FRONTIER GEOSCIENCES INC.

DATE: AUG. 2013	SCALE 1:5,000	FIG. 12



SUB-BOTTOM EXAMPLE LINES
SEISMIC REFRACTION LINES
BOAT TRACK

0.0 4.3 9.3 16.3 25.0 34.9 44.9 55.6 65.0 72.1 83.1

DEPTH (m)

0 50 100 150 200

METRES

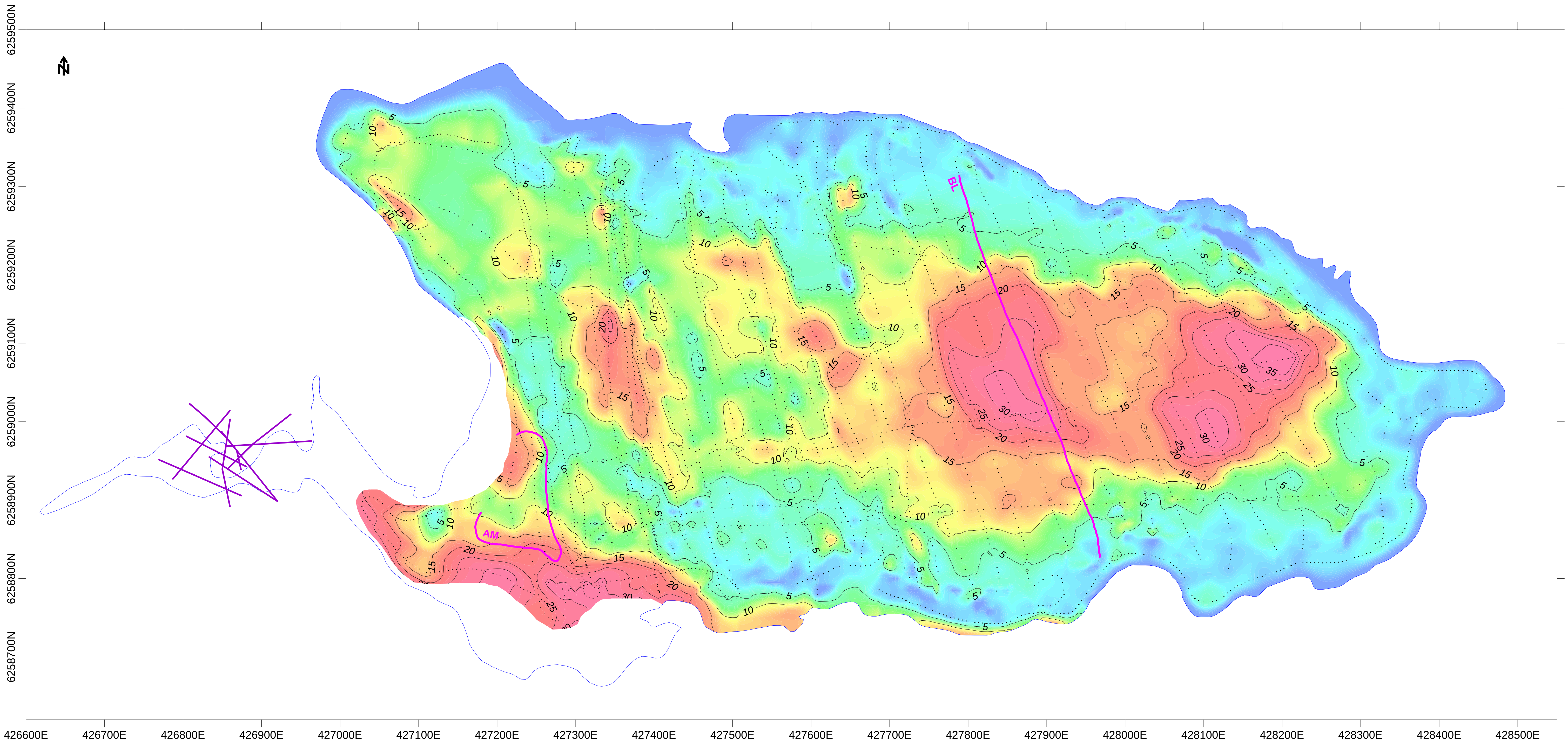
PRETIVM
BRUCEJACK LAKE PROJECT

OVERWATER SURVEY

INTERPRETED BEDROCK
DEPTH CONTOUR PLAN

FRONTIER GEOSCIENCES INC.

DATE: AUG. 2013	SCALE 1:5,000	FIG. 13



SUB-BOTTOM EXAMPLE LINES
SEISMIC REFRACTION LINES
BOAT TRACK

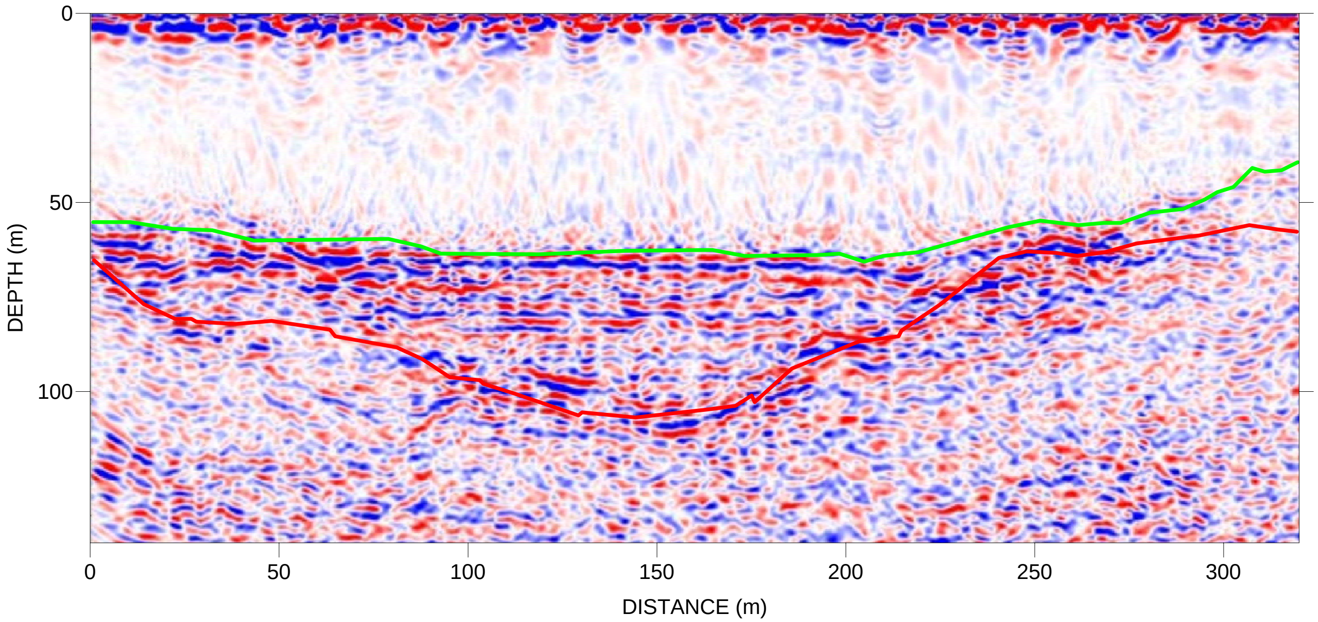
0.0 4.3 9.3 16.3 25.0 34.9 44.9 55.6 65.0 72.1 83.1

DEPTH (m)

0 50 100 150 200

METRES

PRETIVM BRUCEJACK LAKE PROJECT		
OVERWATER SURVEY		
INTERPRETED SEDIMENT THICKNESS ISOPACH CONTOUR PLAN		
FRONTIER GEOSCIENCES INC.		
DATE: AUG. 2013	SCALE 1:5,000	FIG. 14



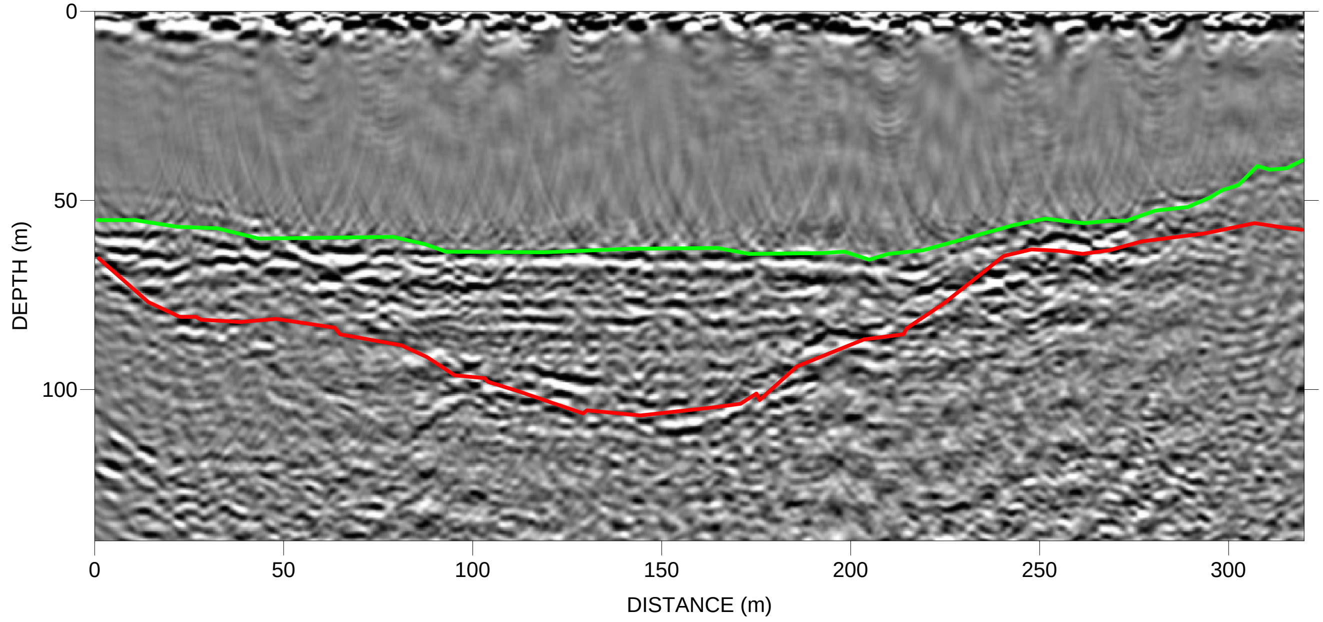
BATHYMETRY

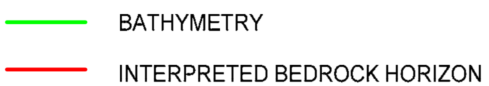
INTERPRETED BEDROCK HORIZON

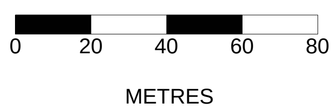
0 20 40 60 80

METRES

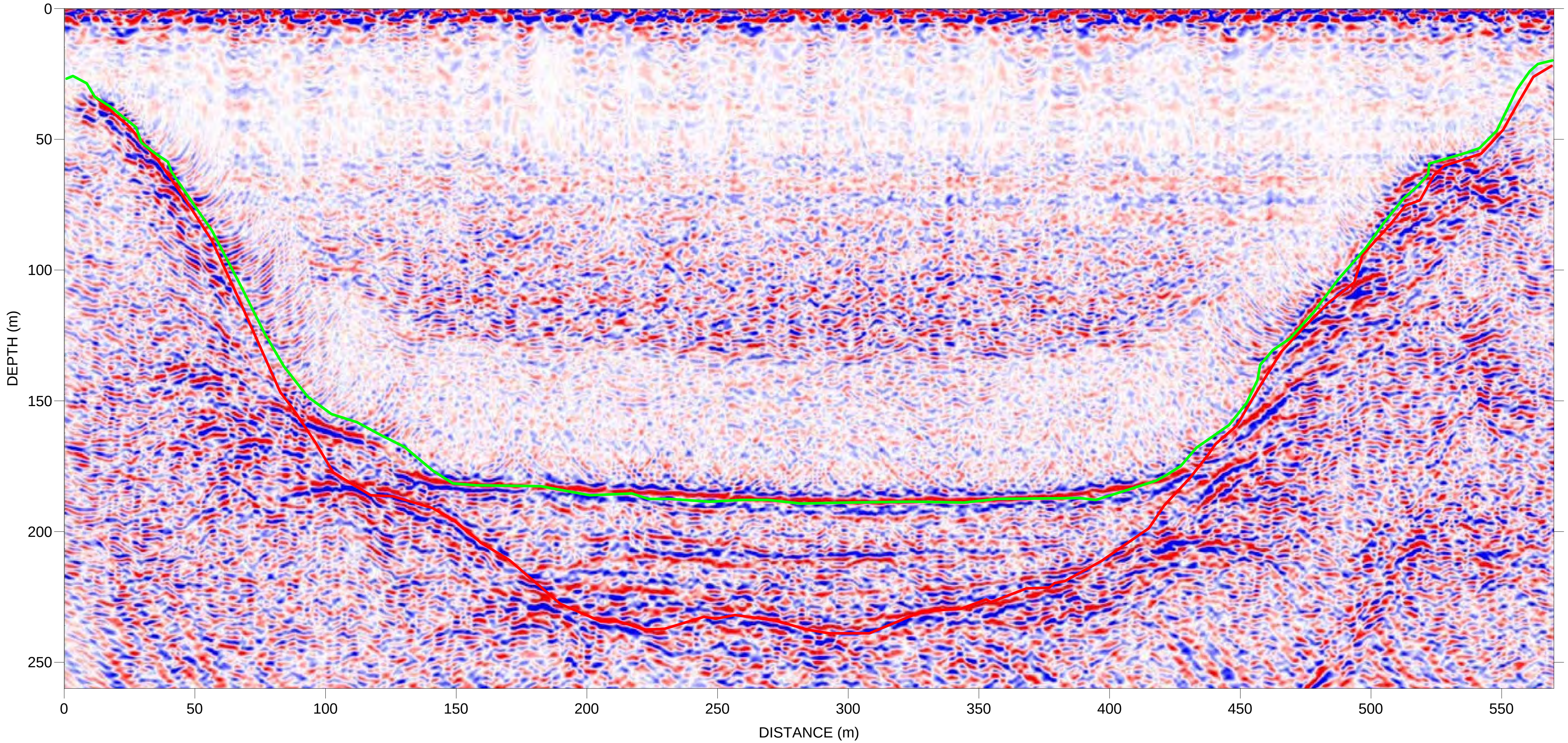
PRETIVM BRUCEJACK LAKE PROJECT		
OVERWATER SURVEY		
ACOUSTIC PROFILE LINE AM COLOUR SCALE		
FRONTIER GEOSCIENCES INC.		
DATE: AUG. 2013	SCALE 1:2,000	FIG. 15







PRETIVM BRUCEJACK LAKE PROJECT		
OVERWATER SURVEY		
ACOUSTIC PROFILE LINE AM GREYSCALE		
FRONTIER GEOSCIENCES INC.		
DATE: AUG. 2013	SCALE 1:2,000	FIG. 16



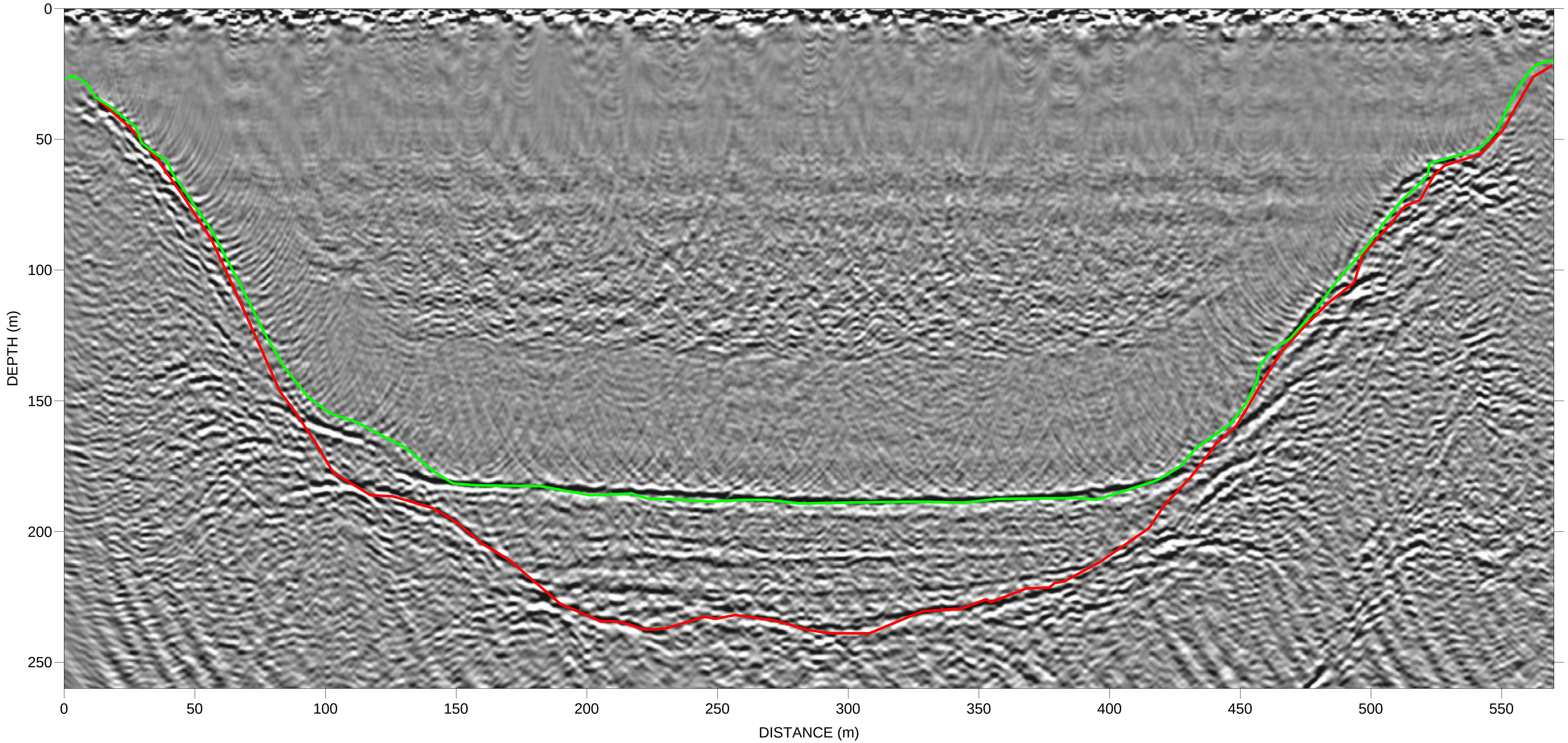
BATHYMETRY

INTERPRETED BEDROCK HORIZON

0 20 40 60 80

METRES

PRETIVM BRUCEJACK LAKE PROJECT		
OVERWATER SURVEY		
ACOUSTIC PROFILE LINE BL COLOUR SCALE		
FRONTIER GEOSCIENCES INC.		
DATE: AUG. 2013	SCALE 1:2,000	FIG. 17



BATHYMETRY

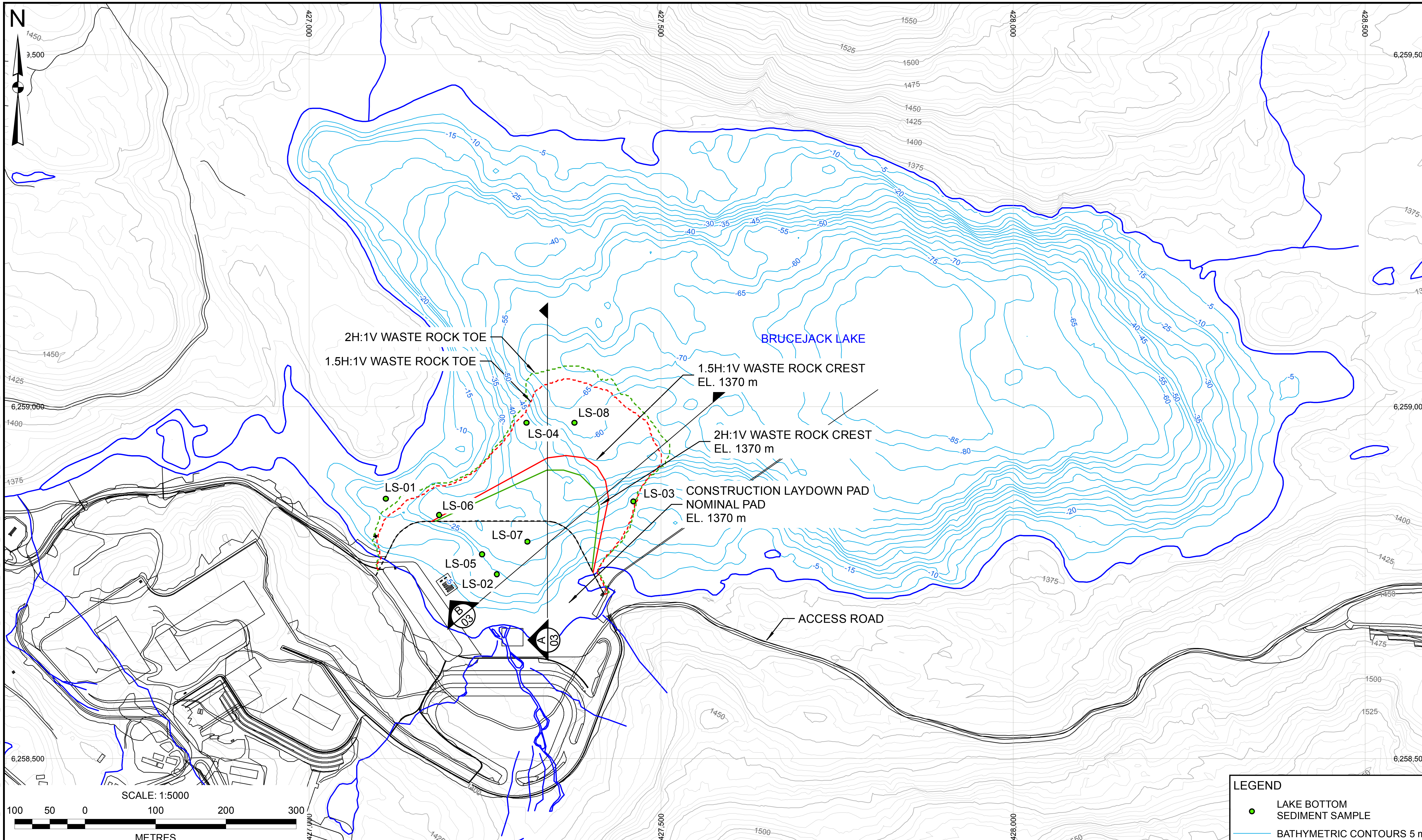
INTERPRETED BEDROCK HORIZON

0 20 40 60 80

METRES

PRETIVM BRUCEJACK LAKE PROJECT		
OVERWATER SURVEY		
ACOUSTIC PROFILE LINE BL GREYSCALE		
FRONTIER GEOSCIENCES INC.		
DATE: AUG. 2013	SCALE 1:2,000	FIG. 18

DRAWINGS



NOTES:
1. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE NOTED.
2. THIS DRAWING MUST BE READ IN CONJUNCTION WITH BGC'S REPORT TITLED "BRUCEJACK PROJECT GEOTECHNICAL STABILITY ASSESSMENT OF WASTE ROCK DEPOSITION IN BRUCEJACK LAKE" AND DATED APRIL 2014.
3. BASE TOPOGRAPHIC DATA BASED ON PHOTOGRAMETRIC TOPO PROVIDED BY SILVER STANDARD, DATED FEBRUARY, 2011. CONTOUR INTERVAL IS 5 m.
4. PROJECTION IS NAD 1983 UTM ZONE 9N.
5. BATHYMETRY CONTOURS OF BRUCEJACK LAKE RECEIVED FROM FRONTIER, NOVEMBER 13, 2013.
6. GENERAL ARRANGEMENT OF THE SITE RECEIVED FROM TETRA TECH, NOVEMBER 27, 2013 (DRAWING 100000-10-005 REV. C).
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SCALE:	1:5,000
DATE:	APR 2014
DRAWN:	MIB
CHECKED:	VKG
APPROVED:	BMM

BGC ENGINEERING INC.
AN APPLIED EARTH SCIENCES COMPANY

CLIENT: PRETIUM RESOURCES INC.

PROJECT: BRUCEJACK PROJECT GEOTECHNICAL STABILITY ASSESSMENT OF WASTE ROCK DEPOSITION IN BRUCEJACK LAKE

TITLE: WASTE ROCK PILE LAYOUT

PROJECT No.: 1008010-006
DWG No.: 01

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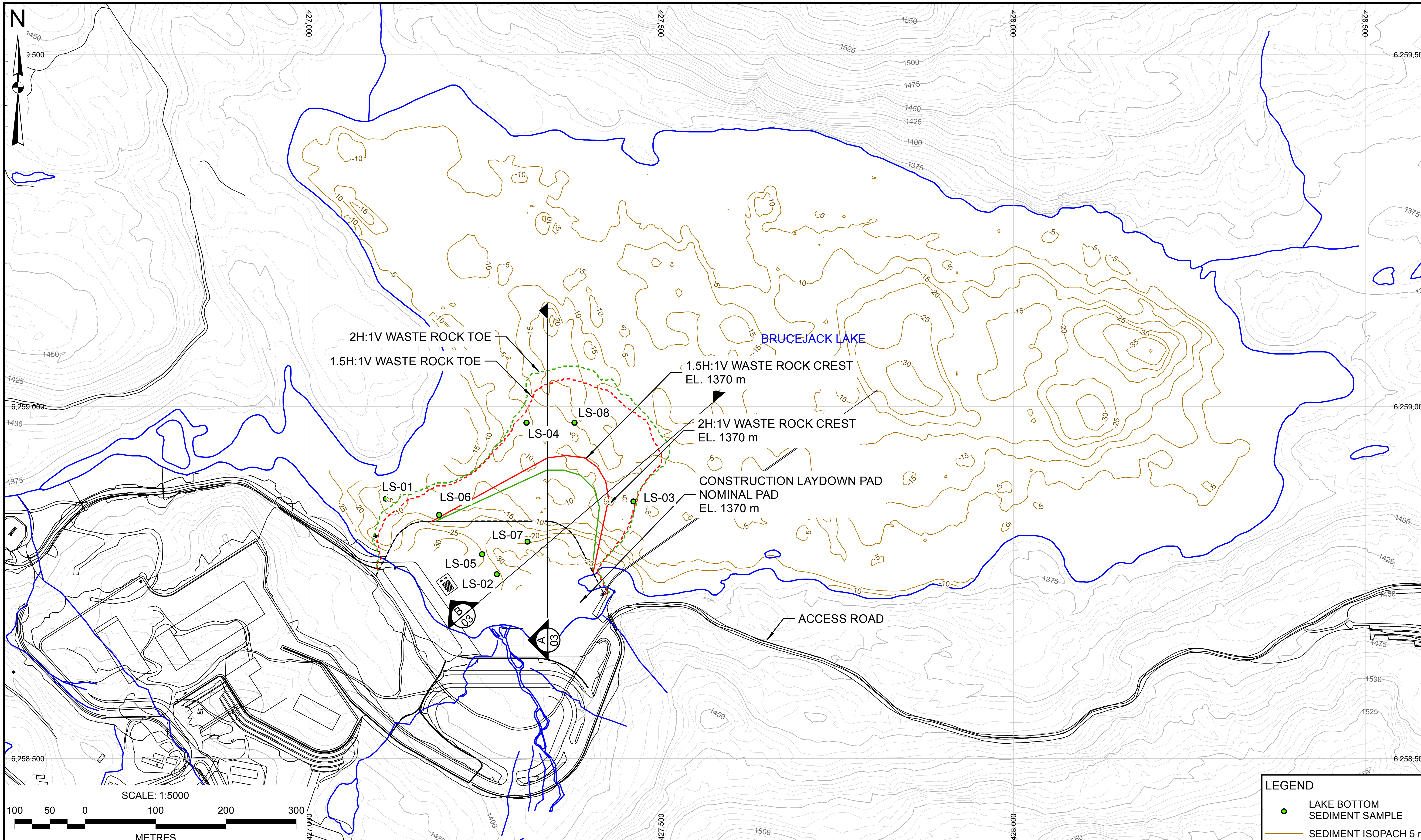

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2. THIS DRAWING MUST BE READ IN CONJUNCTION WITH BGC'S REPORT TITLED "BRUCEJACK PROJECT GEOTECHNICAL STABILITY ASSESSMENT OF WASTE ROCK DEPOSITION IN BRUCEJACK LAKE" AND DATED APRIL 2014.
3. BASE TOPOGRAPHIC DATA BASED ON PHOTOGRAMETRIC TOPO PROVIDED BY SILVER STANDARD, DATED FEBRUARY, 2011. CONTOUR INTERVAL IS 5 m.
4. PROJECTION IS NAD 1983 UTM ZONE 9N.
5. BATHYMETRY CONTOURS OF BRUCEJACK LAKE RECEIVED FROM FRONTIER, NOVEMBER 13, 2013.
6. GENERAL ARRANGEMENT OF THE SITE RECEIVED FROM TETRA TECH, NOVEMBER 27, 2013 (DRAWING 100000-10-005 REV. C).
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SCALE:	1:5,000
DATE:	APR 2014
DRAWN:	MIB
CHECKED:	VKG
APPROVED:	BMM

BGC ENGINEERING INC.
AN APPLIED EARTH SCIENCES COMPANY

CLIENT: PRETIUM RESOURCES INC.

PROJECT: BRUCEJACK PROJECT GEOTECHNICAL STABILITY ASSESSMENT OF WASTE ROCK DEPOSITION IN BRUCEJACK LAKE

TITLE: LAKE BOTTOM SEDIMENT THICKNESS ISOPACH

PROJECT No.: 1008010-006

DWG No.: 02

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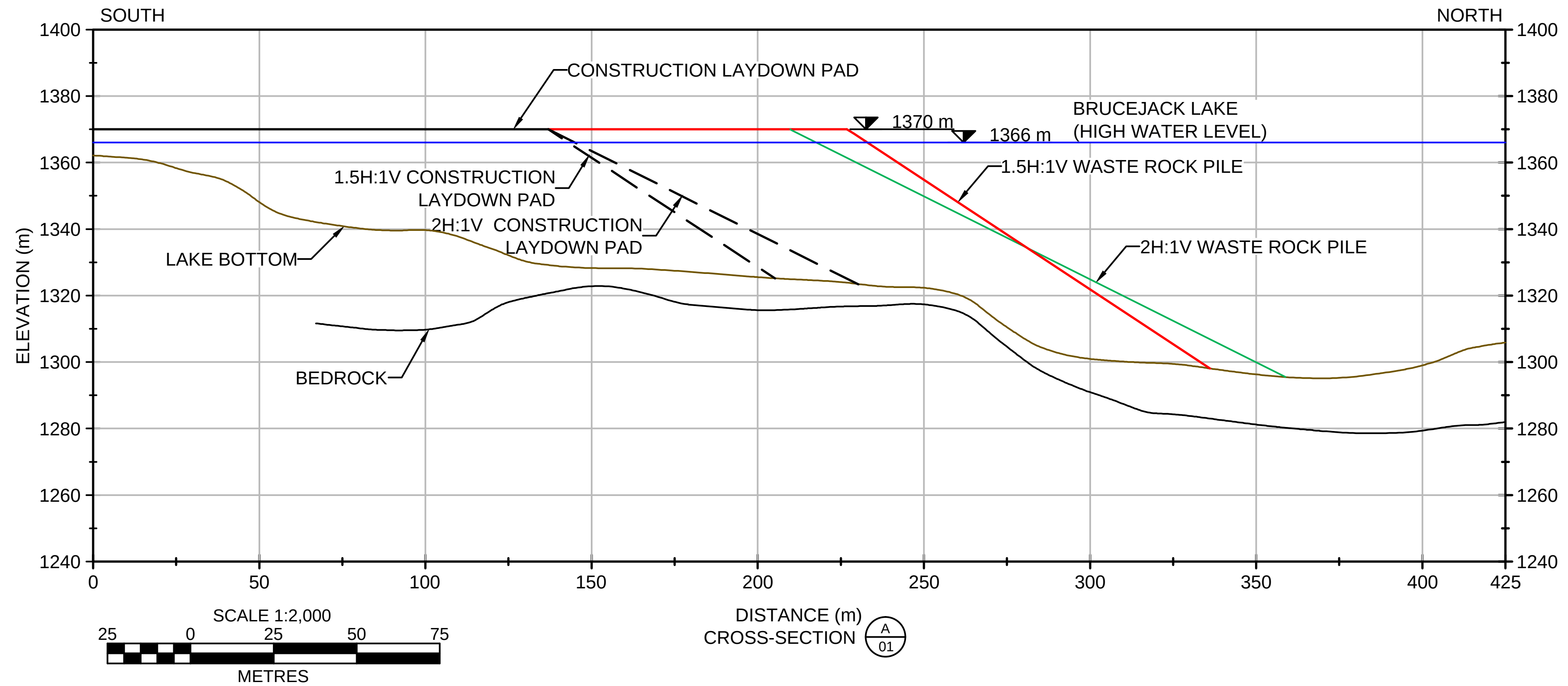

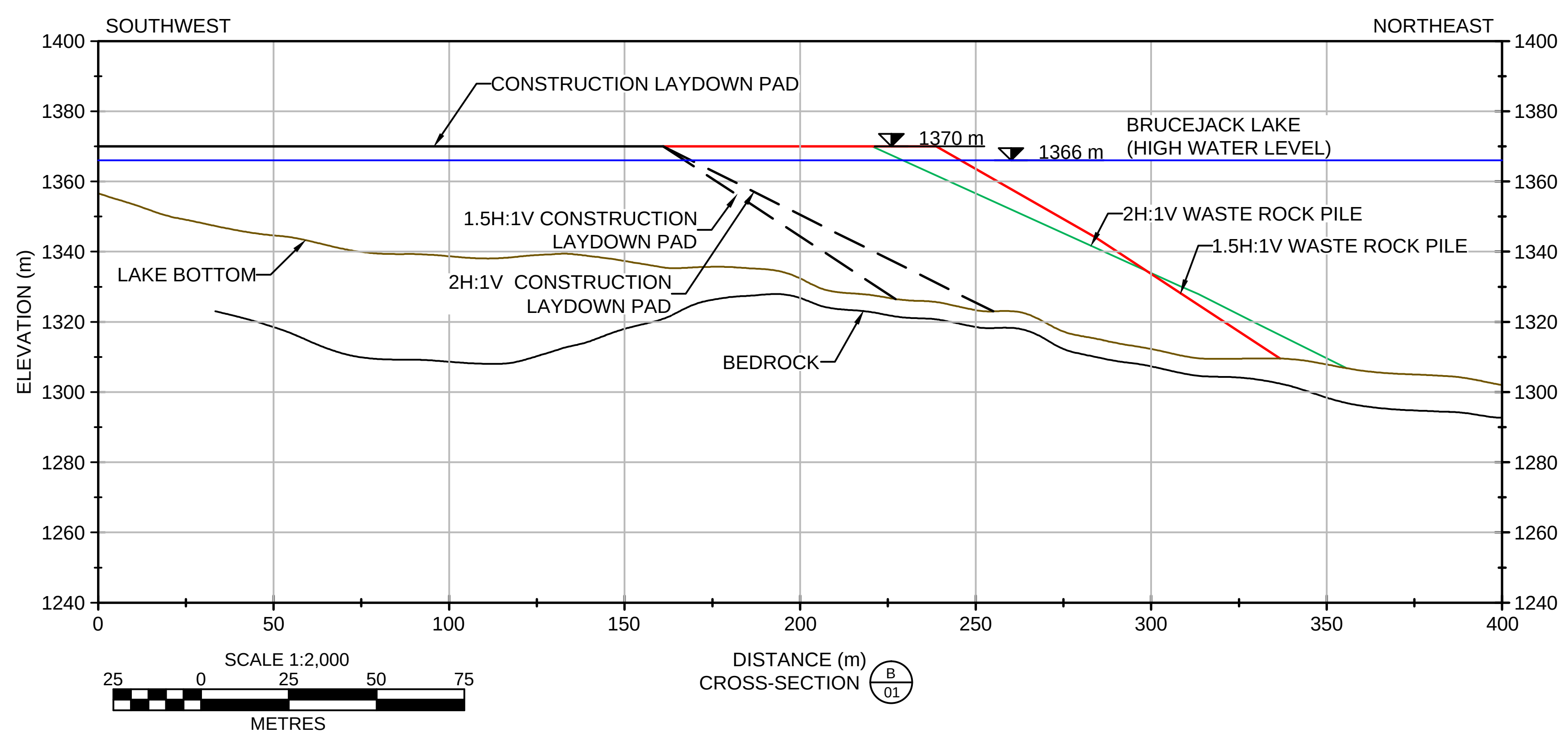

NOTES:
1. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE NOTED.
2. THIS DRAWING MUST BE READ IN CONJUNCTION WITH BGC'S REPORT TITLED "BRUCEJACK PROJECT GEOTECHNICAL STABILITY ASSESSMENT OF WASTE ROCK DEPOSITION IN BRUCEJACK LAKE" AND DATED APRIL 2014.
3. BATHYMETRIC DATA PROVIDED BY FRONTIER, 2013. CONTOUR INTERVAL IS 5 m.
4. PROJECTION IS NAD 1983 UTM ZONE 9N.
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DATE:	APR 2014
DRAWN:	SKS
CHECKED:	VKG
APPROVED:	BMM

BGC ENGINEERING INC.
AN APPLIED EARTH SCIENCES COMPANY

CLIENT: PRETIUM RESOURCES INC.

PROJECT: BRUCEJACK PROJECT GEOTECHNICAL STABILITY ASSESSMENT OF WASTE ROCK DEPOSITION IN BRUCEJACK LAKE

TITLE: CROSS-SECTION A AND B

PROJECT No.:	DWG No.
1008010-006	03