

ALEXCO RESOURCE CORP

DETAILED DESIGN DRY-STACKED TAILINGS FACILITY KENO HILL DISTRICT MILL SITE, YUKON



REPORT

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1.0 INTRODUCTION

Alexco Resource Corp. (Alexco) is operating a silver, lead, zinc concentrating mill in the Keno Hill Silver District, Yukon. Alexco retained EBA, a Tetra Tech Company (EBA), to provide a detailed design for the Dry-Stacked Tailings Facility (DSTF) at the Keno Hill District Mill Site.

2.0 BACKGROUND

Alexco began preparatory earthworks and foundation work for the Keno Hill District Mill in the summer of 2009. EBA conducted a preliminary geotechnical investigation, consisting of thirty-one testpits excavated to varying depths, and a detailed geotechnical investigation consisting of drilling eleven boreholes with a mini-sonic drill rig. The preliminary investigation is summarized in the letter “Geotechnical Evaluation – Proposed Mill (Option 3) and DSTF” dated August 7, 2009. The detailed investigation is summarized in the report “Preliminary Engineering Design and Management Plan, Dry-Stacked Tailings Facility” issued by EBA in January 2010. A detailed design subject to additional confirmatory drilling in the vicinity of the proposed DSTF was completed by EBA in the summer of 2010.

Confirmatory drilling in August 2010 led to the discovery of massive ice not previously encountered and the requirement for EBA to revisit the detailed design of the DSTF. The details of the confirmatory drilling findings were summarized in a letter submitted on September 24, 2010 entitled “DSTF Detailed Drilling Findings and Revised DSTF Location”. To prevent disruption to production timelines, EBA issued “Quarter 1 Tailings Placement Provisions” on September 7, 2010 which detailed the construction of a tailings containment facility to accommodate three months worth of tailings production during the finalizing of the detailed design for the DSTF.

This report summarizes the findings of the confirmatory drill investigation conducted in August 2010 and presents the detailed design for the DSTF.

3.0 DRY-STACKED TAILINGS FACILITY DESIGN ASSUMPTIONS

The design of the DSTF at the Keno Hill District Mill Site is based on the following information, provided by Alexco:

- Tailings discharge rate of 7.75 dmt/h (dry-metric tonnes per hour) for Years 1 and 2 and 13.95 dmt/h for Years 3 and 4.
- Tailings specific gravity of 3.95.
- 60% of tailings stored on surface.
- The remaining 40% of tailings will be placed as backfill underground.
- An evapo-transpirative cover consisting of 0.5 m of vegetated soil will be used for closure of the DSTF.

The following assumptions were used by EBA in the design of the facility:

- 10% of the porewater in the DSTF will drain out of the pile in the long term.

- The design seismic event was selected to be 1:500 year return period, as recommended in “Mined Rock and Overburden Piles Investigation and Design Manual” (Piteau 1991).

The anticipated rate of tailings generation is 187 dmt (dry metric tonnes)/day for the first two years and 335 dmt/day for the next year and nine months. This information was provided to EBA by Alexco. The anticipated in place tailings volumes are summarized in Table 1.

Table 1 – Anticipated Yearly Tailings Volumes

Months of Operation	Tailings Produced (dmt)	Tailings Produced (m ³)	Tailings Stored Underground (m ³)	Tailings Stored on Surface (m ³)	Cumulative Tailings Stored on Surface (m ³)
0 – 12	67,890	39,940	15,970	23,970	23,970
12 – 24	67,890	39,940	15,970	23,970	47,940
24 – 36	122,200	71,890	28,750	43,140	91,080
36 – 45	91,070	53,570	21,430	32,140	123,220

4.0 GEOTECHNICAL INVESTIGATIONS

The preliminary geotechnical investigation was summarized in a letter “Geotechnical Evaluation – Proposed Mill (Option 3) and DSTF” dated August 7, 2009.

The detailed geotechnical investigation was summarized in a report “Preliminary Engineering Design and Management Plan, Dry-Stacked Tailings Facility” dated January 2010.

The confirmatory drilling geotechnical investigation was conducted between August 18 and September 11, 2010. EBA’s representative on site was Mr. Justin Pigage, EIT. Ten boreholes were drilled using a track mounted air-rotary drill rig provided by Geotech Drilling of Prince George, BC. Approximate UTM (NAD83 datum) coordinates, noted on the attached borehole logs, were determined using a hand-held GPS unit. Elevations shown on the logs were determined using the approximate coordinates and 1 m contour information generated from topographic survey information provided by Alexco.

4.1 Surface Conditions

The site in the vicinity of the DSTF slopes generally west at approximately 15% to 20%. There is disturbance in the area from previous surface earthwork and historic mining. A trail runs roughly north with a ditch that follows it to convey runoff around the former Flame and Moth Mine. Vegetation in the area consists of mosses and small spruce trees. A ridge crosses the site in a north-south direction. The ridge slopes approximately 5% to 10% towards the south.

4.2 Subsurface Conditions

The subsurface conditions encountered during the confirmatory drill investigation consist of four distinct zones. A brief summary of each zone is included below and the assumed extent of each zone is shown in Figure 2. The detailed borehole logs are included in Appendix B.

- **Shallow Bedrock** – Unfrozen sand and gravel (till) underlain by bedrock within the top 4.5 m was encountered in BH26 and BH27.

- **Ice Rich Silt** – Varying depths of ice rich silt till were encountered in BH32 through BH35.
- **Massive Ice** – Varying thicknesses of massive ice were encountered in BH28, BH30, BH31 and BH35.
- **Gravel** – Unfrozen gravel underlain by bedrock was encountered in BH29.

4.3 Groundwater

No groundwater was encountered during the confirmatory drill investigation.

4.4 Permafrost

Permafrost was encountered throughout the proposed DSTF. The permafrost encountered ranged from non-visible, non-excess ice to massive ice. Ice volumes estimated as a percentage of the total soil volume vary between less than 5% and nearly 100%. The type and amount of ice inclusions within the permafrost generally follows the soil stratigraphy.

The permafrost in the ice rich silt area contains a combination of horizontally stratified ice lenses, randomly oriented ice inclusions, and non-visible excess ice. The top 3.5 m of the permafrost here is considered to be ice-rich, containing 10% to 35% randomly orientated ice crystals and non-visible excess ice by volume. Below this, the permafrost is considered to be ice-poor (moisture contents in the soil are below the 100% saturation moisture content).

The permafrost in the overall massive ice area contains a combination of horizontally stratified ice lenses, massive ice, and non-visible excess ice. The ice lenses are typically about 5 mm thick. The thickness of massive ice varies in this region between roughly 10 and 15 m. Massive ice was identified within the footprint of the proposed DSTF footprint in one borehole (BH35); 4 m of massive ice was encountered in BH35 at a depth below 11.5 m within this region.

Ground temperature instrumentation was installed in two locations: BH31, and BH32. Data collected from these instruments shows that the permafrost on site is very warm, between -0.2°C and -0.4°C. Ground temperature information for all instrumentation in the vicinity of the DSTF is shown in Appendix C.

4.5 Bedrock

Bedrock was encountered in all holes advanced during the confirmatory drill investigation. The bedrock was classified as a competent quartzite. The drilling method (air rotary) provides fragments of rock sufficient for classification only -- no additional information can be provided on the bedrock.

4.6 Earthquake Parameters

The DSTF has been designed based on PGA from 2005 NBC for Keno Hill area: 0.138 g for 1/476 years.

5.0 LABORATORY TESTING

EBA conducted laboratory tests on recovered samples from the drill program and tailings samples provided by Alexco. The following tests were conducted and are explained in more detailed below:

- Moisture Content

- Particle Size Distribution
- Moisture-Density
- Direct Shear

5.1 Moisture Content

Moisture content determination was conducted on all samples returned to EBA's Whitehorse laboratory. Results of the tests are reported on the borehole logs. The moisture content reported is defined as mass of water divided by mass of dry solids.

5.2 Particle Size Distribution

Particle size distribution determination was conducted by sieve hydrometer method on tailings samples returned to EBA's Whitehorse laboratory. Results for the tailings samples tested are in Appendix D.

5.3 Moisture-Density Relationship

Moisture-density testing was conducted on the tailings samples provided by Alexco to establish density values for use in slope stability modelling. The results are provided in Appendix D.

5.4 Direct Shear

Direct shear testing was conducted on the tailings samples provided by Alexco. The resulting strength values were used in slope stability modelling. The strengths are summarized in Table 2 and included in Appendix D.

Table 2 – Tailings Strength Parameters

Description	Peak Strength		Residual Strength	
	Cohesion (kPa)	Friction (Φ)	Cohesion (kPa)	Friction (Φ)
Tailings	33.5	32.6	10.5	31.6

6.0 DRY-STACKED TAILINGS FACILITY DESIGN

Much of the design was summarized in the report "Preliminary Engineering Design and Management Plan, Dry-Stacked Tailings Facility" issued by EBA in January 2010. The following sections contain additional design work completed since January 2010, as part of the detailed design of the DSTF.

The design configuration of the dry stack facility has been modified since the preliminary design was developed. The revised configurations are shown in Figures 1, 2, 3, and 4. The modifications were put forth to avoid most of the identified massive ice areas, and to create a relatively flat pile profile over the ice rich areas.

6.1 Geothermal Analysis

A geothermal analysis was carried out to investigate the long-term impact of dry-stacked tailings placement on the thermal regime of the underlying original ground in the DSTF area under climatic

conditions including a climate change scenario (global warming). The analysis is presented in Appendix E. The following summarizes the analysis and results.

Analyses were carried out using EBA's proprietary two-dimensional finite element computer model, GEOTHERM. The model simulates transient, two-dimensional heat conduction with change of phase for a variety of boundary conditions. The heat exchange at the ground surface is modelled with an energy balance equation considering air temperatures, wind velocity, snow depth, and solar radiation.

Climate data for the analysis was synthesized from long term climate data from the Mayo station and the Galena Hill weather station near the site. Estimates of climate change magnitudes were obtained from a recent report prepared for CSA and The Adaptation and Impacts Research Section (AIRS) of Environment Canada (CSA 2010). The estimated mean annual temperature 100 years from present is 3.1°C.

The geothermal model was calibrated to the measured ground temperatures at the site. Good agreement was obtained between the measured and modelled temperatures.

The soil profile from BH35 was used in the DSTF thermal analysis. The model simulated dry stack tailings placed over the drainage blanket over the original ground. The initial ground temperature was assumed to be -0.35°C.

The analysis predicted that the frozen overburden and ice thawed in approximately 50 years. The rate of thaw varied slightly for different sensitivity parameters as presented in Table 8 in Appendix E.

6.2 Thaw Consolidation

Construction of the DSTF will involve placing and compacting relatively warm tailings on relatively cold ground. This will change the thermal equilibrium that exists on the site and eventually thaw the existing permafrost in the area.

EBA conducted thaw-consolidation testing on samples of undisturbed ice-rich permafrost recovered from BH23. An average C_v value of 0.0014 cm²/s was determined using standard consolidation theory. The C_v value is low and accounts for volume changes due to melting ice within the soil profile. An assumption in thaw-consolidation theory is that drainage is not impeded from the top of the consolidating layer. EBA has assumed that a 0.5 m thick gravel drainage blanket sufficiently fulfills this. The potential for differential settlement under the DSTF exists. This may create localized pockets of elevated porewater pressure. EBA's opinion is that this will not affect overall stability of the pile. Furthermore, the entire site slopes to free draining gravel at the toe of the pile.

Using a C_v of 0.0014 cm²/s and a rate of thaw of 1.2 m, in four months, the anticipated excess porewater pressure generated is $R_u=0.35$. This value was used in slope stability calculations, where appropriate.

6.3 Slope Inclinator Data

Slope inclinometers (SI) were installed in August 2010 in two boreholes adjacent to the proposed DSTF, BH28 and BH30. Both boreholes are located in an area with ice rich soil on a slope.

The measured SI data is presented in Appendix F. Data is available for BH30 up to February 2011. Limited data is available for BH28 as the SI has been covered with snow and debris over the winter.

BH30 SI has no significant differential movement from the bedrock at the base of the SI to the overburden at the top of SI. This indicates that the slope is not currently creeping.

The data indicates some perpendicular and parallel movement in the pipe. The movement reverses direction within the ice rich zone. The pipe movement is not believed to be slope movement, as the top of the slope is not moving. It is speculated that the grout used to install the SI liberated heat of hydration during curing and melted ice around the SI pipe creating a void. The SI pipe is likely moving within this void.

6.4 Liquefaction Assessment

A liquefaction assessment was carried out to determine if the DSTF is susceptible to liquefaction under earthquake loading. The dry stack tailings themselves are not considered to be highly liquefiable since they are expected to be drained and unsaturated. The assessment was carried out on the foundation soils. The assessment was carried out using the NCEER SPT-based method (Youd et al. 2001).

Foundation soils beneath the proposed DSTF area are silty sand, gravel and sand, silt (ice-rich) or silt (till). The liquefaction assessment is a function the soil density as measured by the Standard Penetration Test (SPT) N-value of the soils. The SPTs conducted at the mine site in the area in or close to the proposed DSTF area in the unfrozen overburden soils are summarized in Table 3. SPTs in the frozen (permafrost) soil zones are not included in the table. SPTs ranged from 12 to 36 with an average of 21. The lowest SPT measured was 12; this was carried through the liquefaction assessment.

The ice-rich silt or silt till soils in the existing permafrost would thaw gradually during the mine operation and after closure based on the thermal analysis results. It is expected that the silt or silt till soils will consolidate with time after thawed. A summary of the assessment is presented in Table 4.

Table 3 Standard Penetration and Soil Property Summary

Borehole No.	Depth from the Ground Surface (m)	Soil Description in Borehole Logs	SPT N Value
BH17	3.3	Silt (till), gravelly, some sand, trace clay, firm, non-plastic, damp	19
BH24	3.2	Silt (till), gravelly, some/sandy, trace clay, very stiff, low to non-plastic, damp to moist, gravel particles, subangular	36
BH25	3.2	Sand and gravel, glaciofluvial, trace silt, compact, medium grained, well graded, damp, rounded to sub-rounded	21
BH26	1.7	Sand, silty, some gravel, damp, loose	12
BH27	1.8	Silt, sandy, trace gravel, moist, firm, non-plastic	18

Table 4 Liquefaction Assessment

Soil Profile and Properties Assumed	SPT N Value Assumed	Moment Magnitude of Earthquake, M_w	Peak Horizontal Acceleration at the Ground Surface, a_{max} , (g)	Calculated Factor of Safety against Cyclic Liquefaction
9 m dry-stacked tailings, 0.5 m gravel drainage layer; water table at 0.5 m below the original ground;	12	7.0	0.138	1.45
	12	7.5	0.138	1.22
	12	8.1	0.138	1.00
0.5 m gravel drainage layer; ground water table at 0.5 m below the original ground surface;	12	7.0	0.138	1.54
	12	7.5	0.138	1.29
	12	8.3	0.138	1.00

Under the design Peak Horizontal Acceleration of 0.138 g, the calculated factor of safety against cyclic liquefaction is ranges from 1.2 to 1.5 for high earthquake magnitudes (7.0 and 7.5). The FS is greater than or equal to 1.0 when the magnitude of earthquake is below 8.0 for the silty sand foundation soils. This is considered an extreme event with a low risk of occurring nearby to the mine. The consequence of liquefaction is expected to be limited movement and cracking of the dry stack facility as opposed to a catastrophic collapse. Given the extreme event and consequence of failure it judged that there is low risk of a significant failure event due to liquefaction.

6.5 Stability of the DSTF

The stability of the DSTF was determined using Geostudio 2007 – Slope/W module, which is a computer program that uses limit equilibrium theory to compute the factor of safety (FS) of slopes. The DSTF slopes were analyzed in several different conditions, including during construction (Years 1 through 4) and after closure activities in both static and pseudo-static scenarios.

Minimum FSs are suggested by the BC Mine Waste Rock Pile Research Committee (Piteau 1991). The suggested FS are provided for two cases: Case A and Case B. Case A is typically used when less rigorous analyses are conducted or when material properties and actual failure mechanisms are not well understood. Case B is typically used when more rigorous analyses are conducted or when material properties and failure mechanisms are well understood. EBA has chosen to compare the calculated FS against Case A except when the long-term strength of ice-rich frozen silt is considered in the analysis. The method used to determine the long-term strength of ice-rich silt is considered to be very conservative, and thus these scenarios should be compared against Case B.

The stability of the DSTF was analyzed along two sections in three scenarios:

- Permafrost
- Permafrost thawed to 1.0 m depth
- Permafrost fully thawed

Analyses were run for static and pseudo static conditions. The parameters used for and the results of each analysis are summarized in the subsequent sections.

6.5.1 Soil Strength Parameters

Six material types were used in the slope stability model:

- Bedrock
- Frozen ice-rich silt
- Thawed silt
- Tailings
- Gravel
- Loose Gravel

The material parameters are summarized in Table 5.

Table 5 – Slope Stability Model - Material Properties

Material Description	Unit Weight (kN/m ³)	Frictional Strength		Non-Frictional Strength
		Cohesion (kPa)	Friction (Φ)	c _u (kPa)
Bedrock	Bedrock is considered impenetrable in this model			
Frozen ice-rich silt	11.8	0	30°	50
Thawed silt	19.1	0	30°	N/A
Tailings	22.5	0	32°	N/A
Gravel	24.0	0	35°	N/A
Loose gravel	21.1	0	30°	N/A

All soils are expected to behave as frictional materials for any short-term loading conditions; these are modelled in the drained state. Short-term loading is considered to be during construction of the pile or during any pseudo-static analysis.

All soils, except for the frozen ice-rich silt, are also expected to behave as frictional materials during long-term loading conditions.

The properties of each soil type are discussed in more detail below.

6.5.1.1 Bedrock

The bedrock in the area is a competent quartzite. The strength of the bedrock is much greater than that of the overburden and therefore the bedrock will not control the stability. For modelling purposes, the Bedrock was assumed to be impenetrable.

6.5.1.2 Frozen Ice-Rich Silt

A conservative approach to determining the strength of a frozen soil is to assume that the internal angle of friction (Φ) of the soil is equal to 0, thus relying solely on the cohesive properties of the frozen soil. A relationship between shear strength and temperature is (Johnston 1981):

$$C_u = 35 + 28T$$

Where: T is in degrees °C below freezing (with a positive sign) and

C_u is lower limit of undrained shear strength.

Assuming that the temperature of the frozen ice-rich silt is -0.4°C, the long term shear strength would be 46 kPa. This value is considered to be the lower limit. Based on experience and engineering judgement a value of 50 kPa has been assumed in the stability analysis. The bulk density of the ice-rich silt was estimated assuming a moisture content of 90%. In short-term loading, it is expected that the ice-rich silt will behave as a frictional material with properties similar to those determined for the thawed state.

6.5.1.3 Thawed Silt

The thawed silt will behave as a frictional material in both short-term and long-term loading conditions. The strength was determined using direct shear test results.

6.5.1.4 Tailings

Tailings will behave as a frictional material in both short-term and long-term loading conditions. The strength of the tailings was determined using direct shear test results. The bulk density was determined by first determining the maximum dry density of the tailings (2080 kg/m³) and then adding the mass of water (assuming moisture content of 15%).

6.5.1.5 Gravels

Gravel will behave as a frictional material in both short-term and long-term loading conditions. The friction angle of the gravel was conservatively assumed as 35° based on EBA's experience with gravels in the Keno City area. This was reduced to 30° for gravel placed in a loose state. The bulk density was based on a maximum dry density of 2,385 kg/m³. It is assumed that the gravel would be placed at 95% density and 8% moisture for the drain area and 87% density and 4% moisture for the cover material.

6.5.2 Analysis Results

6.5.2.1 Permafrost Condition

This scenario is intended to model the condition where the tailings have been placed and the underlying soils have remained frozen. The factor of safety against long-term slope instability was determined using the long-term strength of ice-rich silt. This is considered a conservative lower bound strength assumption. A summary of the factors of safety for several conditions within this scenario are provided in Table 6. Slope stability analyses results are presented in Appendix G.

Table 6 – DSTF Slope Stability Factor of Safety – Fully Frozen Case

Stability Conditions	Factor of Safety - Suggested Minimum (Piteau 1991)		Calculated FS for DSTF	
	Case A	Case B	Alignment A	Alignment B
Stability of Surface				
Short-term (during construction – static)	1.0	<i>1.0</i>	1.8	2.0
Long-term (after closure – static)	<i>1.2</i>	1.1	1.9	2.0
Deep Seated Stability				
Short-term (during construction – static)	1.3-1.5	<i>1.1-1.3</i>	2.0	1.8
Short-term (during construction – pseudo-static)	1.1-1.3	<i>1.0</i>	1.3	1.2
Long-term (after closure – static)	<i>1.5</i>	1.3	1.4	1.3
Long-term (after closure – pseudo-static)	1.1-1.3	<i>1.0</i>	1.3	1.2

Bold values are recommended minimum for each condition.

Italic values are provided for information only.

6.5.2.2 Permafrost Thawed to 1.0 m Depth

This scenario is intended to model the condition where the tailings are placed and the underlying soils have thawed 1.0 m in four months. This rate of thaw is relatively quick. It was determined assuming that the tailings would remain at +20°C for four consecutive months. The porewater pressures developed due to this rate of thaw is $R_u=0.35$. This is considered an upper bound for thawing of the ice-rich silt. Any thaw beyond this initial 1.0 m will occur at a much slower rate. The slower rate of thaw will allow porewater to dissipate prior to developing excess porewater pressures. A summary of the factors of safety for several conditions within this scenario are provided in Table 7. Slope stability plots are found in Appendix H.

Table 7 – DSTF Slope Stability Factor of Safety – 1.0 m Thawed Case

Stability Conditions	Factor of Safety - Suggested Minimum (Piteau 1991)		Calculated FS for DSTF	
	Case A	Case B	Alignment A	Alignment B
Stability of Surface				
Short-term (during construction – static)	1.0	<i>1.0</i>	1.6	2.0
Long-term (after closure – static)	<i>1.2</i>	1.1	1.6	1.7
Deep Seated Stability				
Short-term (during construction – static)	1.3-1.5	<i>1.1-1.3</i>	1.9	1.6

Table 7 – DSTF Slope Stability Factor of Safety – 1.0 m Thawed Case Cont'd

Stability Conditions	Factor of Safety - Suggested Minimum (Piteau 1991)		Calculated FS for DSTF	
	Case A	Case B	Alignment A	Alignment B
Stability of Surface				
Short-term (during construction – pseudo-static)	1.1-1.3	<i>1.0</i>	1.3	1.1
Long-term (after closure – static)	<i>1.5</i>	1.3	1.4	1.3
Long-term (after closure – pseudo-static)	1.1-1.3	<i>1.0</i>	1.2	1.2

Bold values are recommended minimum for each condition.

Italic values are provided for information only.

6.5.2.3 Permafrost Fully Thawed

This scenario is intended to model the anticipated long-term condition where the tailings are placed and the underlying soils have fully thawed and consolidated. Due to the rate of thaw and the lack of excess ice below the ice-rich silt layer, no excess porewater pressure is anticipated. This should be considered a reasonable approximation of the DSTF's long-term state. A summary of the factors of safety for several conditions within this scenario are provided in Table 8. Slope stability plots are found in Appendix I.

Table 8 – DSTF Slope Stability Factor of Safety – Fully Thawed Case

Stability Conditions	Factor of Safety Suggested - Minimum (Piteau 1991)		Calculated FS for DSTF	
	Case A	Case B	Alignment A	Alignment B
Stability of Surface				
Short-term (during construction – static)	1.0	<i>1.0</i>	N/A ¹	
Long-term (after closure – static)	<i>1.2</i>	1.1	1.6	2.0
Deep Seated Stability				
Short-term (during construction – static)	1.3-1.5	<i>1.1-1.3</i>	N/A ¹	
Short-term (during construction – pseudo-static)	1.1-1.3	<i>1.0</i>	N/A ¹	
Long-term (after closure – static)	<i>1.5</i>	1.3	2.0	1.9
Long-term (after closure – pseudo-static)	1.1-1.3	<i>1.0</i>	1.4	1.4

Bold values are recommended minimum for each condition.

Italic values are provided for information only.

¹Foundation will not be fully thawed during construction of the pile.

6.5.3 Creep

Ice and ice rich soils can creep over time. The magnitude of creep movement is a function of the shear stresses in the slopes.

Slope inclinometers installed at site indicate that there is no significant movement in ice rich soils in existing slopes. The DSTF is configured such that there are flat areas over the ice rich areas; therefore the shear stresses in the foundation soils should be similar or less than they are presently. This is expected to limit the creep deformation in the DSTF foundation soils.

Continued monitoring of the pile is recommended to confirm that movements are limited.

6.6 DSTF Foundation

The foundation for the DSTF consists of the drainage blanket, geosynthetic clay liner (GCL), and geocomposite drain. Proper construction and material specifications for the DSTF foundation are described in detail in the "Runoff Diversion Structure Specs" issued by EBA in September 2010. A summary of each component of the DSTF foundation is included in the following sections.

6.6.1 Drainage Blanket

The drainage blanket is a 0.6 m layer of gravel constructed over the existing organic cover without disturbing the surface, to limit the degradation of permafrost. The drainage blanket is designed to allow any water generated from thawing permafrost to drain from the DSTF. It also provides an acceptable surface for the placement of the GCL.

6.6.2 Geosynthetic Clay Liner

A properly bedded geosynthetic clay liner is to be placed above the drainage blanket to collect any seepage leaving the tailings stack. The liner will help prevent tailings and tailings porewater from infiltrating the coarser gravel material of the drainage blanket below. The GCL consists of a layer of bentonite clay sandwiched between a layer of woven geotextile and a layer of nonwoven geotextile. The nonwoven layer of geotextile shall be oriented upward to maximize friction between the GCL and the geocomposite drain.

6.6.3 Geocomposite Drain

A geocomposite drain is required above the GCL to help alleviate any potential porewater pressure buildup in the tailings stack. The geocomposite drain is a sheet of geo-net placed directly on the GCL and a layer of nonwoven geotextile above the geo-net. The tailings are to be placed and compacted directly over the nonwoven geotextile.

6.6.4 Stability of the DSTF Foundation

The stability of the DSTF foundation was determined using Geostudio 2007 – Slope/W module. The DSTF foundation was analyzed in both static and pseudo-static scenarios.

The minimum factors of safety suggested by the BC Mine Waste Rock Pile Research Committee used in the stability analysis of the DSTF were also used in the DSTF foundation analysis.

6.6.4.1 Material Strength Parameters

Soil and tailings strength parameters assumed in the DSTF foundation stability analysis were equal to the DSTF stability analysis (Section 6.5.1).

The strength of the geocomposite liner and drain was modeled as an interface frictional material. The interface friction value was based on review of relevant literature (State of California, 2006), (Lydic and Zagorski, 1991), and (Koerner, 2005). The properties of the manufactured materials are summarized in Table 9.

Table 9 – DSTF Foundation Stability Model – Material Properties

Material Description	Unit Weight (kN/m ³)	Frictional Strength		Non-Frictional Strength
		Cohesion (kPa)	Friction (Φ)	C _u (kPa)
Geocomposite liner and drain	24.0	0	16°	N/A

6.6.4.2 Analysis Results

The factor of safety along the geocomposite liner and drain was determined by forcing the failure plane through the material. A summary of the factors of safety for the DSTF foundation is provided in Table 10. The stability plots are presented in Appendix J.

Table 10 – DSTF Foundation Stability Factor of Safety

Stability Conditions	Factor of Safety – Suggested Minimum (Piteau 1991)		Calculated Factor of Safety for DSTF Foundation	
	Case A	Case B	Alignment A	Alignment B
Short-term (during construction – static)	1.3-1.5	<i>1.1-1.3</i>	1.4	1.4
Short-term (during construction – pseudo-static)	1.1-1.3	<i>1.0</i>	1.1	1.1
Long-term (after closure – static)	<i>1.5</i>	1.3	1.4	1.4
Long-term (after closure – pseudo-static)	1.1-1.3	<i>1.0</i>	1.1	1.2

Bold values are recommended minimum for each condition.

Italic values are provided for information only.

7.0 OPERATION, MAINTENANCE, AND SURVEILLANCE MANUAL

Construction and operation of the DSTF will be carried out in accordance with the Operation, Maintenance, and Surveillance (OMS Manual) submitted to Alexco by EBA in September 2010.

8.0 DSTF CLOSURE PLAN

Since the DSTF will be constructed as a sidehill fill, progressive reclamation is feasible and will be conducted. Once tailings placement for a portion of the DSTF is complete, an evapo-transpirative cover (0.5 m of loosely placed gravel soil) will be placed over the surface of the compacted tailings to temporarily store runoff and allow it evaporate or to be used by plants. The surface water collection pond and diversion berms and ditches will be left in place. The water collection pond will be able to act as a bio-reactor if necessary, and the berms will continue to divert runoff water away from the DSTF area. The entire affected footprint will be re-vegetated with plants that promote soil evapo-transpiration, similar to those used at Brewery Creek Mine. This procedure has been successfully used at the Brewery Creek Mine, which was reclaimed by Alexco (Tremblay et al. 2001).

The DSTF will require an annual geotechnical inspection for at least five years after closure. This requirement should be reviewed after five years.

9.0 CLOSURE

We trust this report meets your present requirements. Should you have any questions or comments, please contact the undersigned.

EBA, A Tetra Tech Company



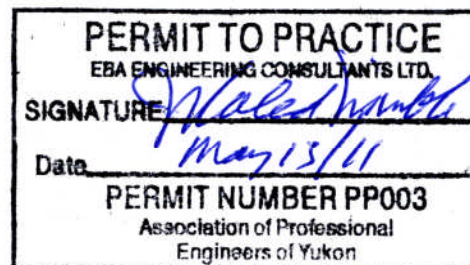
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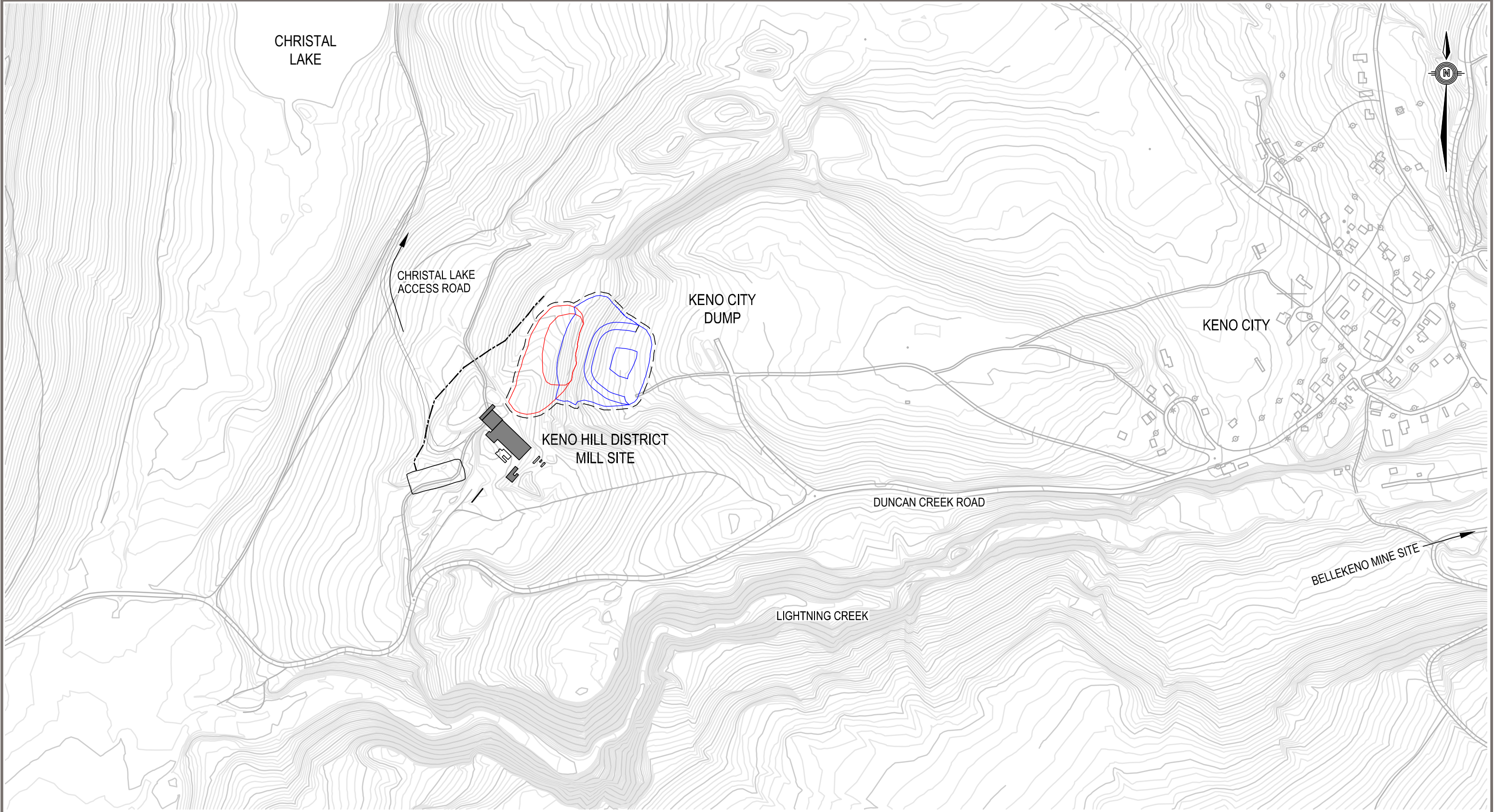


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FIGURES

Figure 1	Site Location Plan
Figure 2	Site Plan Showing Borehole Locations and Assumed Subsurface Conditions
Figure 3	DSTF Plan View
Figure 4	DSTF Sections



LEGEND

Scale: 1: 5 000 (metres)

STATUS

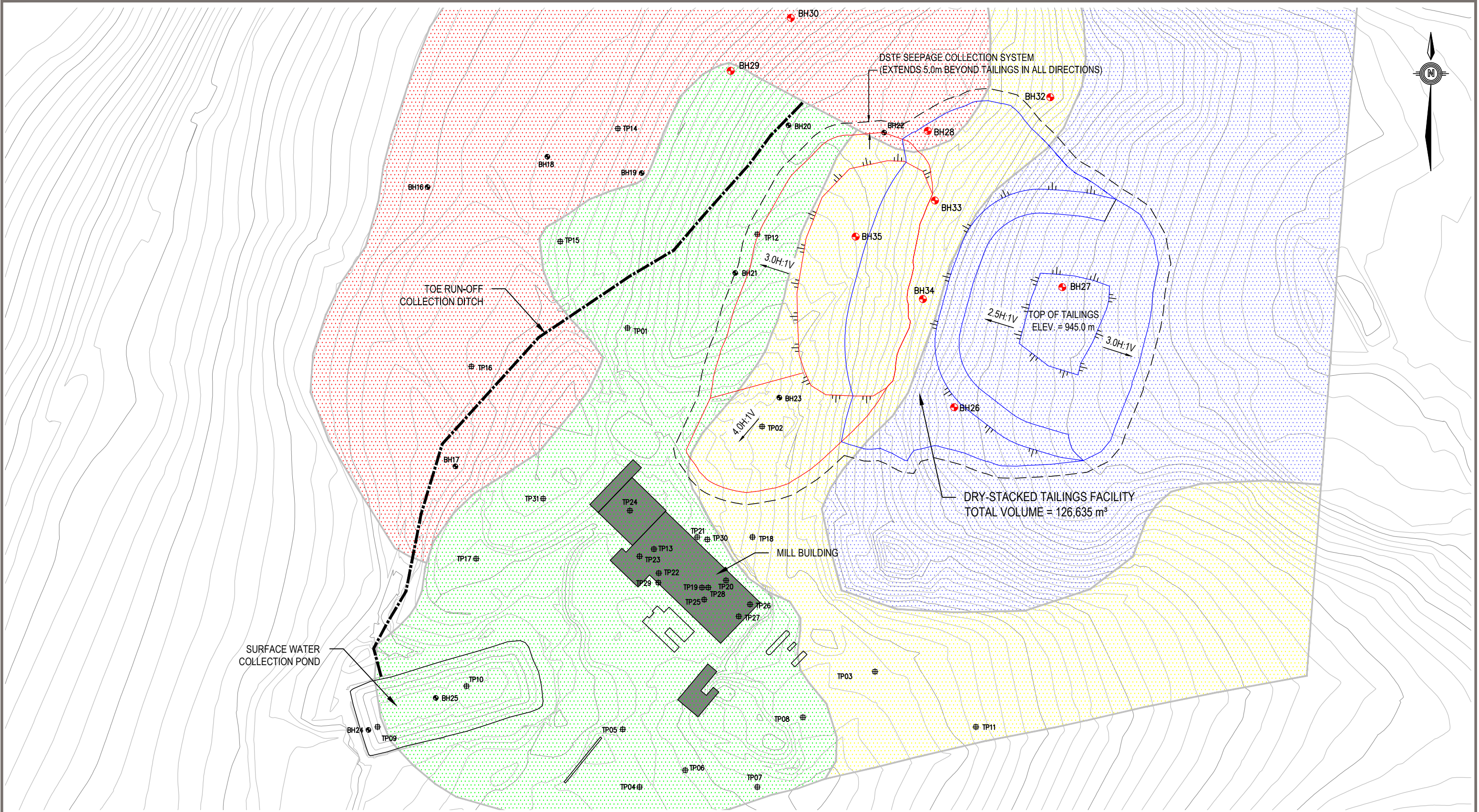
ISSUED FOR USE

CLIENT

DRY STACKED TAILINGS FACILITY
KENO HILL DISTRICT MILL SITE, YUKON

SITE LOCATION PLAN

PROJECT NO. W14101178.011	DWN CB	CKD JTP	REV 0	Figure 1
OFFICE EBA-WHSE	DATE May 13, 2011			

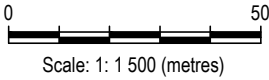


LEGEND

- - BOREHOLE LOCATION (CONFIRMATORY DRILLING)
- - BOREHOLE LOCATION (PREVIOUSLY ADVANCED)
- ⊕ - TESTPIT LOCATION

- GRAVEL
- MASSIVE ICE
- ICE RICH SILT TILL
- SHALLOW BEDROCK

STATUS
ISSUED FOR USE



CLIENT

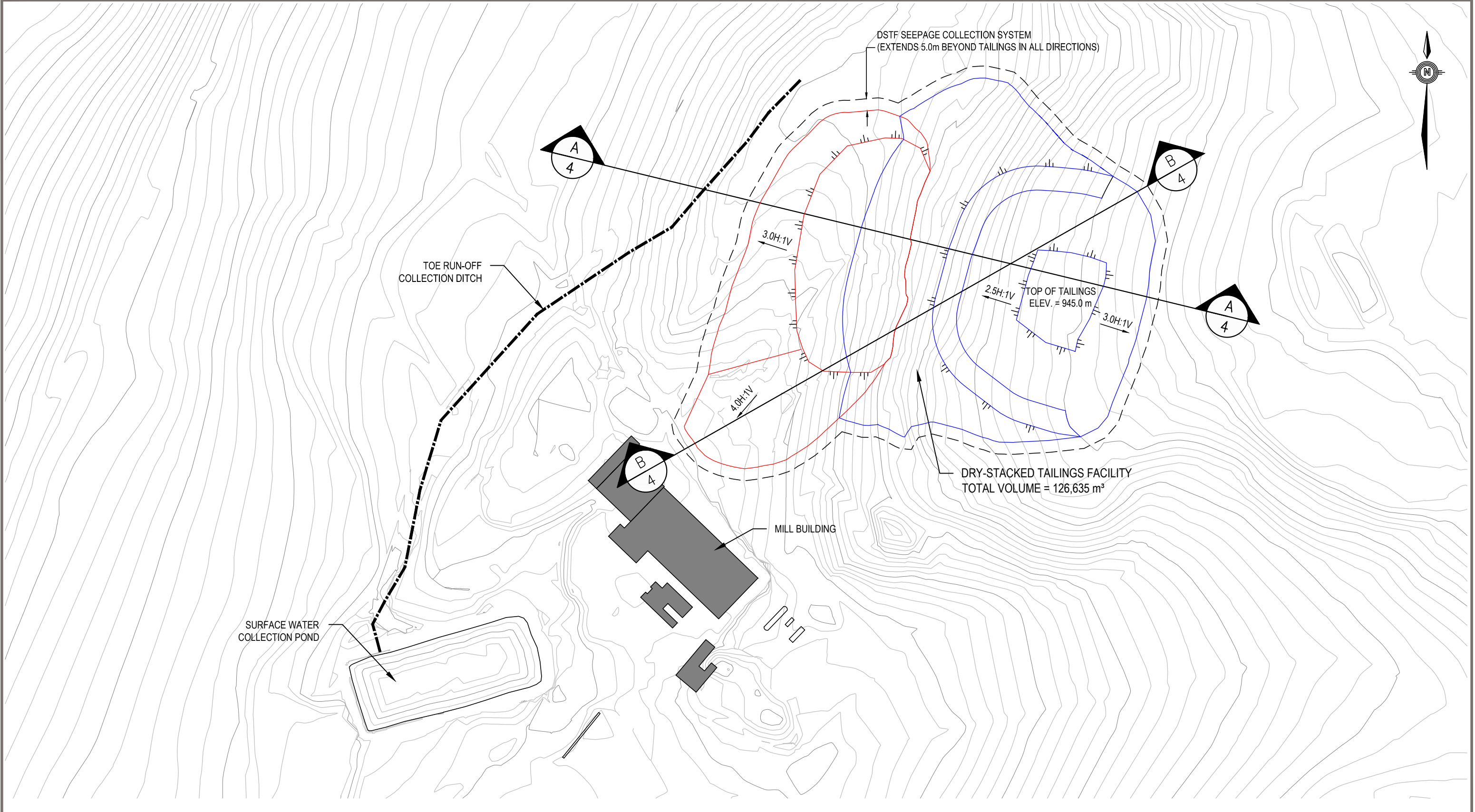


DRY STACKED TAILINGS FACILITY
KENO HILL DISTRICT MILL SITE, YUKON

SITE PLAN SHOWING BOREHOLE LOCATIONS
AND ASSUMED SUBSURFACE CONDITIONS

PROJECT NO. W14101178.011	DWN CB	CKD JTP	REV 0
OFFICE EBA-WHSE	DATE May 13, 2011		

Figure 2



LEGEND

STATUS
ISSUED FOR USE

CLIENT

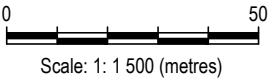


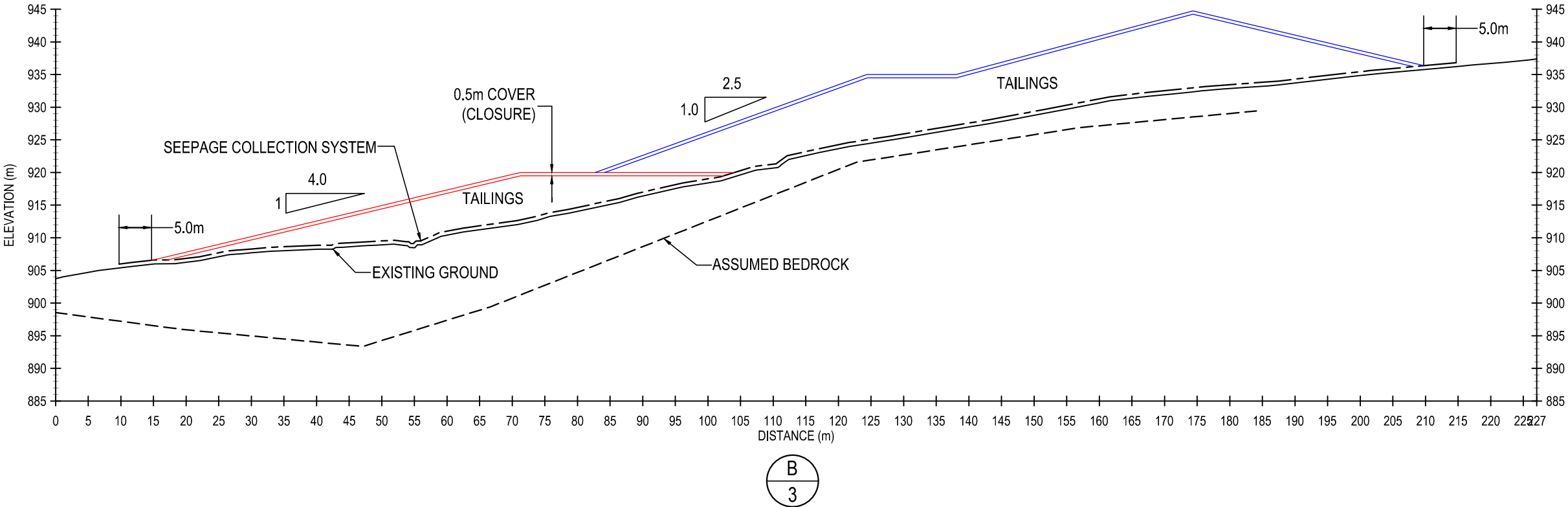
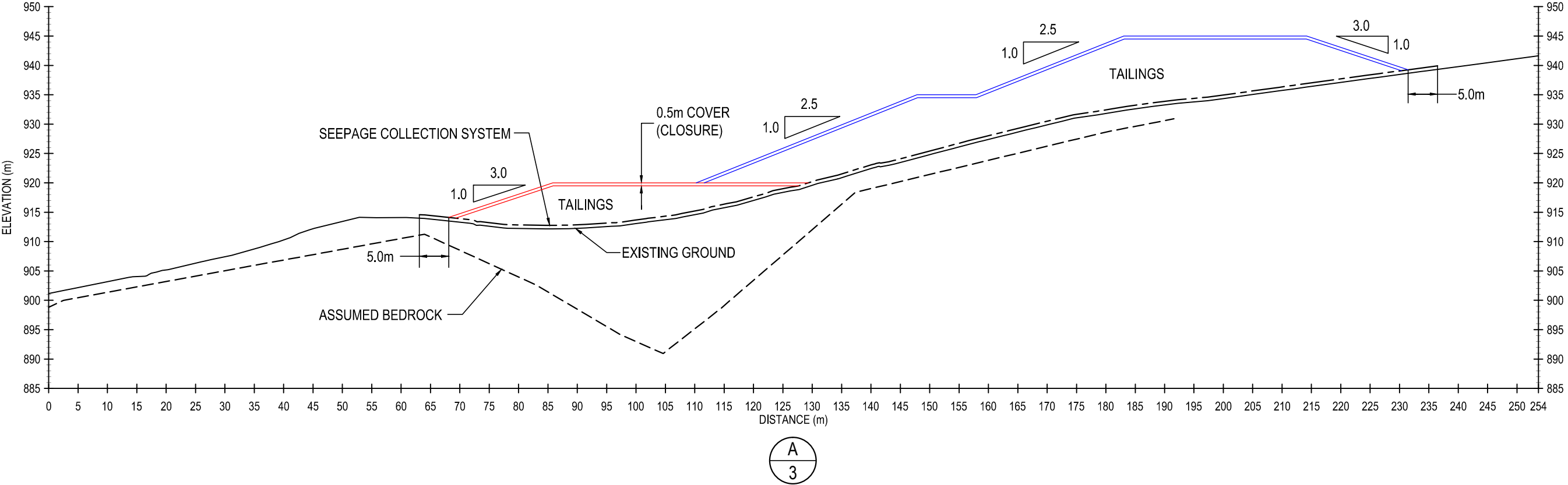
DRY STACKED TAILINGS FACILITY
KENO HILL DISTRICT MILL SITE, YUKON

DSTF PLAN VIEW

PROJECT NO. W14101178.011	DWN CB	CKD JTP	REV 0
OFFICE EBA-WHSE	DATE May 13, 2011		

Figure 3





LEGEND

STATUS
ISSUED FOR USE

CLIENT

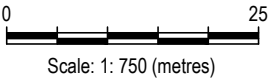


DRY STACKED TAILINGS FACILITY
KENO HILL DISTRICT MILL SITE, YUKON

DSTF SECTIONS

PROJECT NO. W14101178.011	DWN CB	CKD JTP	REV 0
OFFICE EBA-WHSE	DATE May 13, 2011		

Figure 4



APPENDIX A

APPENDIX A EBA'S GENERAL CONDITIONS

GENERAL CONDITIONS

GEOTECHNICAL REPORT

This report incorporates and is subject to these "General Conditions".

1.0 USE OF REPORT AND OWNERSHIP

This geotechnical report pertains to a specific site, a specific development and a specific scope of work. It is not applicable to any other sites nor should it be relied upon for types of development other than that to which it refers. Any variation from the site or development would necessitate a supplementary geotechnical assessment.

This report and the recommendations contained in it are intended for the sole use of EBA's Client. EBA does not accept any responsibility for the accuracy of any of the data, the analyses or the recommendations contained or referenced in the report when the report is used or relied upon by any party other than EBA's Client unless otherwise authorized in writing by EBA. Any unauthorized use of the report is at the sole risk of the user.

This report is subject to copyright and shall not be reproduced either wholly or in part without the prior, written permission of EBA. Additional copies of the report, if required, may be obtained upon request.

2.0 ALTERNATE REPORT FORMAT

Where EBA submits both electronic file and hard copy versions of reports, drawings and other project-related documents and deliverables (collectively termed EBA's instruments of professional service), only the signed and/or sealed versions shall be considered final and legally binding. The original signed and/or sealed version archived by EBA shall be deemed to be the original for the Project.

Both electronic file and hard copy versions of EBA's instruments of professional service shall not, under any circumstances, no matter who owns or uses them, be altered by any party except EBA. EBA's instruments of professional service will be used only and exactly as submitted by EBA.

Electronic files submitted by EBA have been prepared and submitted using specific software and hardware systems. EBA makes no representation about the compatibility of these files with the Client's current or future software and hardware systems.

3.0 ENVIRONMENTAL AND REGULATORY ISSUES

Unless stipulated in the report, EBA has not been retained to investigate, address or consider and has not investigated, addressed or considered any environmental or regulatory issues associated with development on the subject site.

4.0 NATURE AND EXACTNESS OF SOIL AND ROCK DESCRIPTIONS

Classification and identification of soils and rocks are based upon commonly accepted systems and methods employed in professional geotechnical practice. This report contains descriptions of the systems and methods used. Where deviations from the system or method prevail, they are specifically mentioned.

Classification and identification of geological units are judgmental in nature as to both type and condition. EBA does not warrant conditions represented herein as exact, but infers accuracy only to the extent that is common in practice.

Where subsurface conditions encountered during development are different from those described in this report, qualified geotechnical personnel should revisit the site and review recommendations in light of the actual conditions encountered.

5.0 LOGS OF TEST HOLES

The testhole logs are a compilation of conditions and classification of soils and rocks as obtained from field observations and laboratory testing of selected samples. Soil and rock zones have been interpreted. Change from one geological zone to the other, indicated on the logs as a distinct line, can be, in fact, transitional. The extent of transition is interpretive. Any circumstance which requires precise definition of soil or rock zone transition elevations may require further investigation and review.

6.0 STRATIGRAPHIC AND GEOLOGICAL INFORMATION

The stratigraphic and geological information indicated on drawings contained in this report are inferred from logs of test holes and/or soil/rock exposures. Stratigraphy is known only at the locations of the test hole or exposure. Actual geology and stratigraphy between test holes and/or exposures may vary from that shown on these drawings. Natural variations in geological conditions are inherent and are a function of the historic environment. EBA does not represent the conditions illustrated as exact but recognizes that variations will exist. Where knowledge of more precise locations of geological units is necessary, additional investigation and review may be necessary.

7.0 PROTECTION OF EXPOSED GROUND

Excavation and construction operations expose geological materials to climatic elements (freeze/thaw, wet/dry) and/or mechanical disturbance which can cause severe deterioration. Unless otherwise specifically indicated in this report, the walls and floors of excavations must be protected from the elements, particularly moisture, desiccation, frost action and construction traffic.

8.0 SUPPORT OF ADJACENT GROUND AND STRUCTURES

Unless otherwise specifically advised, support of ground and structures adjacent to the anticipated construction and preservation of adjacent ground and structures from the adverse impact of construction activity is required.

9.0 INFLUENCE OF CONSTRUCTION ACTIVITY

There is a direct correlation between construction activity and structural performance of adjacent buildings and other installations. The influence of all anticipated construction activities should be considered by the contractor, owner, architect and prime engineer in consultation with a geotechnical engineer when the final design and construction techniques are known.

10.0 OBSERVATIONS DURING CONSTRUCTION

Because of the nature of geological deposits, the judgmental nature of geotechnical engineering, as well as the potential of adverse circumstances arising from construction activity, observations during site preparation, excavation and construction should be carried out by a geotechnical engineer. These observations may then serve as the basis for confirmation and/or alteration of geotechnical recommendations or design guidelines presented herein.

11.0 DRAINAGE SYSTEMS

Where temporary or permanent drainage systems are installed within or around a structure, the systems which will be installed must protect the structure from loss of ground due to internal erosion and must be designed so as to assure continued performance of the drains. Specific design detail of such systems should be developed or reviewed by the geotechnical engineer. Unless otherwise specified, it is a condition of this report that effective temporary and permanent drainage systems are required and that they must be considered in relation to project purpose and function.

12.0 BEARING CAPACITY

Design bearing capacities, loads and allowable stresses quoted in this report relate to a specific soil or rock type and condition. Construction activity and environmental circumstances can materially change the condition of soil or rock. The elevation at which a soil or rock type occurs is variable. It is a requirement of this report that structural elements be founded in and/or upon geological materials of the type and in the condition assumed. Sufficient observations should be made by qualified geotechnical personnel during construction to assure that the soil and/or rock conditions assumed in this report in fact exist at the site.

13.0 SAMPLES

EBA will retain all soil and rock samples for 30 days after this report is issued. Further storage or transfer of samples can be made at the Client's expense upon written request, otherwise samples will be discarded.

14.0 INFORMATION PROVIDED TO EBA BY OTHERS

During the performance of the work and the preparation of the report, EBA may rely on information provided by persons other than the Client. While EBA endeavours to verify the accuracy of such information when instructed to do so by the Client, EBA accepts no responsibility for the accuracy or the reliability of such information which may affect the report.

APPENDIX B

APPENDIX B BOREHOLE LOGS

Detailed DSTF Drilling		CLIENT: Alexco Resource Corporation		PROJECT NO. - BOREHOLE NO.	
Keno Hill District Mill Site		DRILL: M5 Air Rotary		W14101178.011-BH26	
Keno City, YT		7086870N; 484037E; Zone 8		ELEVATION: 928.5m	
SAMPLE TYPE		☒ DISTURBED	☐ NO RECOVERY	☒ SPT	☐ A-CASING
BACKFILL TYPE		☒ BENTONITE	☐ PEA GRAVEL	☐ SLOUGH	☐ GROUT
		☐ DRILL CUTTINGS	☐ SAND	☐ CORE	

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SPT (N)	MOISTURE CONTENT	STANDARD PENETRATION (N)				Elevation (m)
0	SAND - silty, some gravel, damp, loose, dark grey, organics near surface									928.0
1		☒	SA01		7.6					
2		☒	SA02	12	9.7					
3	GRAVEL and SAND (TILL) - some silt, damp, compact, grey									
4		☒	SA03		2.8					
5		☒	SA04		4.6					
6	BEDROCK - weathered, grey with quartz and staining - soft rock seems 0.2 m thick, easy drilling	☒	SA05		2.4					
7	BEDROCK - hard drilling									
8		☒	SA06		0.1					
9	END OF BOREHOLE @ 6.0 m (Target Depth)									
10	NOTE: Hole grouted to surface; Bentonite plug installed on surface.									



EBA Engineering Consultants Ltd.

LOGGED BY: JTP
REVIEWED BY: JRT
DRAWING NO:

COMPLETION DEPTH: 6m
COMPLETE: 8/18/2010
Page 1 of 1

Detailed DSTF Drilling		CLIENT: Alexco Resource Corporation		PROJECT NO. - BOREHOLE NO.				
Keno Hill District Mill Site		DRILL: M5 Air Rotary		W14101178.011-BH27				
Keno City, YT		7086920N; 484082E; Zone 8		ELEVATION: 933.75m				
SAMPLE TYPE ☒ DISTURBED ☐ NO RECOVERY ☒ SPT ☐ A-CASING ☐ SHELBY TUBE ☐ CORE BACKFILL TYPE ☒ BENTONITE ☒ PEA GRAVEL ☐ SLOUGH ☐ GROUT ☐ DRILL CUTTINGS ☐ SAND								
Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SPT (N)	MOISTURE CONTENT	PLASTIC M.C. LIQUID 20 40 60 80	STANDARD PENETRATION (N)	Elevation (m)
							20 40 60 80 ◆ UNCONFINED (kPa) ◆ 50 100 150 200 ▲ POCKET PEN. (kPa) ▲ 100 200 300 400	



EBA Engineering Consultants Ltd.

LOGGED BY: JTP
REVIEWED BY: JRT
DRAWING NO:

COMPLETION DEPTH: 3m
COMPLETE: 8/18/2010
Page 1 of 1

Detailed DSTF Drilling		CLIENT: Alexco Resource Corporation		PROJECT NO. - BOREHOLE NO.						
Keno Hill District Mill Site		DRILL: M5 Air Rotary		W14101178.011-BH28						
Keno City, YT		7086985N; 484026E; Zone 8		ELEVATION: 917.8m						
SAMPLE TYPE ☒ DISTURBED ☐ NO RECOVERY ☒ SPT ☐ A-CASING ☐ SHELBY TUBE ☐ CORE BACKFILL TYPE ☒ BENTONITE ☒ PEA GRAVEL ☐ SLOUGH ☐ GROUT ☐ DRILL CUTTINGS ☐ SAND										
Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SPT (N)	MOISTURE CONTENT	PLASTIC M.C. LIQUID 20 40 60 80	STANDARD PENETRATION (N) 20 40 60 80	UNCONFINED (kPa) 50 100 150 200	POCKET PEN. (kPa) 100 200 300 400	Elevation (m)
0	ORGANIC MOSS COVER									917.0
1	SILT - some sand, uniform, moist, soft, dark brown, some organics	☒	SA10	59						
2	SILT (TILL) - gravelly, trace sand, frozen (Vx), firm, grey	☒	SA11	42	45.3					916.0
3	- ICE and SILT	☒	SA12		43.2					915.0
4		☒	SA13	57	25.7					914.0
5	- attempted SPT - spoon refusal	☒	SA14		13.5					913.0
6	SAND and GRAVEL (TILL) - gravelly, moist, firm, grey									912.0
7	MASSIVE ICE									911.0
8	- attempted SPT - spoon refusal	☒	SA15		22.6					910.0
9	SILT (TILL) - gravelly, moist, firm, grey									909.0
10										908.0
11	MASSIVE ICE									907.0
12										906.0
13										905.0
14	GRAVEL (TILL) - some silt, frozen (Vx), compact, grey with other minerals									904.0
15	MASSIVE ICE - occasional gravel									903.0



Detailed DSTF Drilling		CLIENT: Alexco Resource Corporation		PROJECT NO. - BOREHOLE NO.				
Keno Hill District Mill Site		DRILL: M5 Air Rotary		W14101178.011-BH28				
Keno City, YT		7086985N; 484026E; Zone 8		ELEVATION: 917.8m				
SAMPLE TYPE ☐ DISTURBED ☐ NO RECOVERY ☒ SPT ☐ A-CASING ☐ SHELBY TUBE ☐ CORE BACKFILL TYPE ☐ BENTONITE ☒ PEA GRAVEL ☐ SLOUGH ☐ GROUT ☐ DRILL CUTTINGS ☐ SAND								
Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SPT (N)	MOISTURE CONTENT	STANDARD PENETRATION (N)		Elevation (m)
						20 40 60 80	50 100 150 200	
					PLASTIC M.C. LIQUID 20 40 60 80	◆ UNCONFINED (kPa) ◆ 50 100 150 200 ▲ POCKET PEN. (kPa) ▲ 100 200 300 400		
15								902.0
16								901.0
17								900.0
18								899.0
19								898.0
20								897.0
21	GRAVEL (TILL) - silty, some sand, dry, dense, grey SILT (TILL) - gravelly, dry, stiff, grey with staining							896.0
22								895.0
23								894.0
24	SAND and GRAVEL (TILL) - trace silt, dry, dense, grey - grey rock seem 0.3 m thick - sand seem 0.2 m thick, tan - sand seem 0.2 m thick, tan							893.0
25	- becomes damp - becomes some silt							892.0
26								891.0
27	BEDROCK - hard drilling, light grey							890.0
28	END OF BOREHOLE @ 27.5 m (Target Depth) NOTES: Installed SI casing to 89' (27.13 m). Grouted hole to surface with tremie line (approx. 60 gal.)							889.0
29								888.0
30								



EBA Engineering Consultants Ltd.

LOGGED BY: JTP
REVIEWED BY: JRT
DRAWING NO:

COMPLETION DEPTH: 27.5m
COMPLETE: 8/20/2010
Page 2 of 2

Detailed DSTF Drilling		CLIENT: Alexco Resource Corporation		PROJECT NO. - BOREHOLE NO.					
Keno Hill District Mill Site		DRILL: M5 Air Rotary		W14101178.011-BH29					
Keno City, YT		7087010N; 483944E; Zone 8		ELEVATION: 906.5m					
SAMPLE TYPE ☒ DISTURBED ☐ NO RECOVERY ☒ SPT ☐ A-CASING ☐ SHELBY TUBE ☐ CORE BACKFILL TYPE ☒ BENTONITE ☒ PEA GRAVEL ☐ SLOUGH ☐ GROUT ☐ DRILL CUTTINGS ☐ SAND									
Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT	PLASTIC M.C. LIQUID		STANDARD PENETRATION (N)		Elevation (m)
					20 40 60 80	50 100 150 200	20 40 60 80	100 200 300 400	
0	MOSS COVER								
	SAND and GRAVEL - some silt, medium grained, well graded, sub-rounded, moist, compact (est.), dark brown, trace organics	☒	SA16	12.6	●				906.0
1	ROCK - fractured angular cuttings returned, various colours, some staining								905.0
	SILT - some sand, trace gravel, damp, firm (est.), non-plastic, olive grey hint of green	☒	SA17	16.5	●				904.0
2	BEDROCK - hard drilling								903.0
		☒	SA18	1.7	●				902.0
3	END OF BOREHOLE @ 3.0 m (Target Depth)								901.0
4									900.0
5									899.0
6									898.0
7									897.0
8									
9									
10									

Detailed DSTF Drilling		CLIENT: Alexco Resource Corporation		PROJECT NO. - BOREHOLE NO.						
Keno Hill District Mill Site		DRILL: M5 Air Rotary		W14101178.011-BH30						
Keno City, YT		7087032N; 483969E; Zone 8		ELEVATION: 907.25m						
SAMPLE TYPE ☒ DISTURBED ☒ NO RECOVERY ☒ SPT ☒ A-CASING ☒ SHELBY TUBE ☒ CORE BACKFILL TYPE ☒ BENTONITE ☒ PEA GRAVEL ☒ SLOUGH ☒ GROUT ☒ DRILL CUTTINGS ☒ SAND										
Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SPT (N)	MOISTURE CONTENT	PLASTIC M.C. LIQUID		STANDARD PENETRATION (N)		Elevation (m)
						20 40 60 80	50 100 150 200	20 40 60 80	50 100 150 200	
0	SAND and GRAVEL (FILL) - trace silt, well graded, damp, brown PEAT and ORGANICS - frozen, dark brown	☒	SA19		73.4					907.0
1	SILT (TILL) - some gravel, frozen (Nbn), brown - becomes Vx - attempted SPT - spoon refusal	☒	SA20		36.8					906.0
2	SAND and GRAVEL - trace silt, well graded, medium grained, sub-angular, frozen (Vx), grey	☒	SA21		36.3					905.0
3		☒	SA22		16.3					904.0
4	- less silt, sub-rounded									903.0
5	ROCK - fractured, angular, multi coloured	☒	SA23		6.9					902.0
	SILT (TILL) - some gravel, frozen (Vx)	☒	SA24							901.0
6	ICE - massive ice with little or no soil	☒	SA25	43	313.5			314		901.0
7										900.0
8										899.0
9		☒	SA26	48	2421.1			2421		898.0
10										897.0
11										896.0
12										895.0
13										894.0
14	- contains some gravel for 0.3 m									893.0
15										



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DRAWING NO:

COMPLETION DEPTH: 26m
COMPLETE: 9/8/2010
Page 1 of 2

Detailed DSTF Drilling		CLIENT: Alexco Resource Corporation		PROJECT NO. - BOREHOLE NO.	
Keno Hill District Mill Site		DRILL: M5 Air Rotary		W14101178.011-BH30	
Keno City, YT		7087032N; 483969E; Zone 8		ELEVATION: 907.25m	
SAMPLE TYPE ☒ DISTURBED ☐ NO RECOVERY ☒ SPT ☐ A-CASING ☐ SHELBY TUBE ☐ CORE					
BACKFILL TYPE ☒ BENTONITE ☒ PEA GRAVEL ☐ SLOUGH ☐ GROUT ☐ DRILL CUTTINGS ☐ SAND					

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SPT (N)	MOISTURE CONTENT	STANDARD PENETRATION (N)				Elevation (m)
15										892.0
16										891.0
17										890.0
18	- contains some silt for 0.3 m									889.0
19										888.0
20										887.0
21										886.0
22	GRAVEL - some sand, some silt, frozen (Nbn), grey									885.0
23	- becomes Vx		SA27		10.4					884.0
24	- becomes damp		SA28		6.9					883.0
25	ROCK - easy drilling, dry, shiny black/grey									882.0
26	BEDROCK - hard drilling, grey									881.0
27	END OF BOREHOLE @ 26.0 m (Target Depth)									880.0
28										879.0
29										878.0
30										

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	REVIEWED BY: JRT	COMPLETE: 9/8/2010
	DRAWING NO:	Page 2 of 2

Detailed DSTF Drilling		CLIENT: Alexco Resource Corporation		PROJECT NO. - BOREHOLE NO.	
Keno Hill District Mill Site		DRILL: M5 Air Rotary		W14101178.011-BH31	
Keno City, YT		7078058N; 484016E; Zone 8		ELEVATION: 907.8m	
SAMPLE TYPE		☒ DISTURBED	☐ NO RECOVERY	☒ SPT	☐ A-CASING
BACKFILL TYPE		☒ BENTONITE	☐ PEA GRAVEL	☐ SLOUGH	☐ GROUT
		☐ SHELBY TUBE	☐ CORE	☐ DRILL CUTTINGS	☐ SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SPT (N)	MOISTURE CONTENT	STANDARD PENETRATION (N)				Elevation (m)
0	PEAT - frozen, black/dark brown									907.0
1		☒	SA29		666.2					
2	SILT - trace gravel, frozen (Vx), brown	☒	SA30	50	130.1					906.0
3	- organics (wood) for 1.5 m	☒	SA31	45	177.6					905.0
4										904.0
5	SILT (TILL) - gravelly, trace sand, frozen (Vx), grey	☒	SA32		10.4					903.0
		☒	SA33		15.8					
6										902.0
7	- becomes some gravel	☒	SA34	72	14.5					901.0
8	SAND and GRAVEL - trace silt, well graded, medium grained, sub-angular, frozen (Vx), multi-coloured	☒	SA35		8.8					900.0
	SILT (TILL) - some gravel, frozen, grey									899.0
9										898.0
10										897.0
11	MASSIVE ICE - trace silt									896.0
12										895.0
13										894.0
14	SAND and GRAVEL - some silt, frozen (Vx), grey									893.0
15										

 EBA Engineering Consultants Ltd.	LOGGED BY: JTP	COMPLETION DEPTH: 24.4m
	REVIEWED BY: JRT	COMPLETE: 9/10/2010
	DRAWING NO:	Page 1 of 2

Detailed DSTF Drilling		CLIENT: Alexco Resource Corporation		PROJECT NO. - BOREHOLE NO.						
Keno Hill District Mill Site		DRILL: M5 Air Rotary		W14101178.011-BH31						
Keno City, YT		7078058N; 484016E; Zone 8		ELEVATION: 907.8m						
SAMPLE TYPE ☒ DISTURBED ☐ NO RECOVERY ☒ SPT ☐ A-CASING ☐ SHELBY TUBE ☐ CORE BACKFILL TYPE ☒ BENTONITE ☒ PEA GRAVEL ☐ SLOUGH ☐ GROUT ☐ DRILL CUTTINGS ☐ SAND										
Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SPT (N)	MOISTURE CONTENT	PLASTIC M.C. LIQUID 20 40 60 80	STANDARD PENETRATION (N) 20 40 60 80	UNCONFINED (kPa) 50 100 150 200	POCKET PEN. (kPa) 100 200 300 400	Elevation (m)
15	MASSIVE ICE - trace silt									892.0
16										891.0
17										890.0
18			SA36		977.9			978		889.0
19										888.0
20										887.0
21	SILT (TILL) - some gravel, frozen (Vx), grey		SA37		10.3					886.0
22										885.0
23	ROCK - fractured, angular, damp, multi-coloured									884.0
24	BEDROCK - hard drilling, grey									883.0
25	END OF BOREHOLE @ 24.4 m (Target Depth)									882.0
26										881.0
27										880.0
28										879.0
29										878.0
30										


EBA Engineering Consultants Ltd.

LOGGED BY: JTP
REVIEWED BY: JRT
DRAWING NO:

COMPLETION DEPTH: 24.4m
COMPLETE: 9/10/2010
Page 2 of 2

Detailed DSTF Drilling		CLIENT: Alexco Resource Corporation		PROJECT NO. - BOREHOLE NO.	
Keno Hill District Mill Site		DRILL: M5 Air Rotary		W14101178.011-BH32	
Keno City, YT		7086999N; 484077E; Zone 8		ELEVATION: 923.75m	
SAMPLE TYPE		☒ DISTURBED	☐ NO RECOVERY	☒ SPT	☐ A-CASING
BACKFILL TYPE		☐ BENTONITE	☐ PEA GRAVEL	☐ SLOUGH	☐ GROUT
		☐ DRILL CUTTINGS	☐ SAND	☐ CORE	

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT	STANDARD PENETRATION (N)		Elevation (m)
					UNCONFINED (kPa)	POCKET PEN. (kPa)	
					20 40 60 80	50 100 150 200	
0	SAND and GRAVEL (FILL) - some silt, medium grained, well graded, sub-round, damp, loose, brown						923.0
1	PEAT - frozen, black/dark brown						922.0
2	SILT - some sand, frozen (Vx), grey						921.0
3			SA38	109	109		920.0
4							919.0
5	- hard drilling for 0.3 m - attempted SPT - spoon refusal	☒	SA39				918.0
6		☒	SA40	12.8			917.0
7							916.0
8	- gravel content increases	☒	SA41	8.6			915.0
9		☒	SA42	7.8			914.0
10	BEDROCK - hard drilling, grey						
			SA43	1.2			
	END OF BOREHOLE @ 9.0 m (Target Depth)						



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DRAWING NO:

COMPLETION DEPTH: 9m
COMPLETE: 9/10/2010
Page 1 of 1

Detailed DSTF Drilling		CLIENT: Alexco Resource Corporation		PROJECT NO. - BOREHOLE NO.			
Keno Hill District Mill Site		DRILL: M5 Air Rotary		W14101178.011-BH33			
Keno City, YT		7086956N; 484029E; Zone 8		ELEVATION: 920.5m			
SAMPLE TYPE ☒ DISTURBED ☐ NO RECOVERY ☒ SPT ☐ A-CASING ☐ SHELBY TUBE ☐ CORE BACKFILL TYPE ☒ BENTONITE ☒ PEA GRAVEL ☐ SLOUGH ☐ GROUT ☐ DRILL CUTTINGS ☐ SAND							
Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE SAMPLE NUMBER	SPT (N)	MOISTURE CONTENT			Elevation (m)
					STANDARD PENETRATION (N) ■ 20 40 60 80 ◆ UNCONFINED (kPa) ◆ 50 100 150 200 ▲ POCKET PEN. (kPa) ▲ 100 200 300 400		
0	SAND and GRAVEL (FILL) - some silt, medium grained, well graded, sub-round, damp, loose, brown PEAT - frozen, dark brown						920.0
1							
2	SILT (TILL) - gravelly, frozen (Vx), grey - becomes trace gravel	SA44	73	18.5	●	■	919.0
3		SA45	71	41.3	●	■	917.0
4							
5	- becomes some gravel with visible staining - becomes damp	SA46		13.8	●		916.0
6	SAND and GRAVEL - silty, fine grained, dense, dry, tan	SA47		12.2	●		915.0
7	BEDROCK - hard drilling, grey	SA48 SA49		1.9	●		914.0
8	END OF BOREHOLE @ 7.5 m (Target Depth)						913.0
9							912.0
10							911.0



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LOGGED BY: JTP
REVIEWED BY: JRT
DRAWING NO:

COMPLETION DEPTH: 7.5m
COMPLETE: 9/10/2010
Page 1 of 1

Detailed DSTF Drilling		CLIENT: Alexco Resource Corporation		PROJECT NO. - BOREHOLE NO.			
Keno Hill District Mill Site		DRILL: M5 Air Rotary		W14101178.011-BH34			
Keno City, YT		7086915N; 484024E; Zone 8		ELEVATION: 922m			
SAMPLE TYPE ☒ DISTURBED ☐ NO RECOVERY ☒ SPT ☐ A-CASING ☐ SHELBY TUBE ☐ CORE BACKFILL TYPE ☐ BENTONITE ☒ PEA GRAVEL ☐ SLOUGH ☐ GROUT ☐ DRILL CUTTINGS ☒ SAND							
Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	MOISTURE CONTENT	STANDARD PENETRATION (N)		Elevation (m)
					UNCONFINED (kPa)	POCKET PEN. (kPa)	
					PLASTIC M.C. LIQUID		
					20 40 60 80	20 40 60 80	
0	SAND and GRAVEL (FILL) - trace silt, medium grained, well graded, sub-rounded, damp, loose, brown PEAT - frozen, dark brown						922.0
1	SILT (TILL) - gravelly, frozen (Vx), grey - attempted SPT - spoon refusal	☒	SA50	16.4			921.0
2	BEDROCK - hard drilling, light grey	☒	SA51	4.1			920.0
3	END OF BOREHOLE @ 3.0 m (Target Depth)						919.0
4							918.0
5							917.0
6							916.0
7							915.0
8							914.0
9							913.0
10							912.0



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REVIEWED BY: JRT
DRAWING NO:

COMPLETION DEPTH: 3m
COMPLETE: 9/11/2010
Page 1 of 1

Detailed DSTF Drilling		CLIENT: Alexco Resource Corporation		PROJECT NO. - BOREHOLE NO.				
Keno Hill District Mill Site		DRILL: M5 Air Rotary		W14101178.011-BH35				
Keno City, YT		7086941N; 483996E; Zone 8		ELEVATION: 914.25m				
SAMPLE TYPE ☒ DISTURBED ☒ NO RECOVERY ☒ SPT ☒ A-CASING ☒ SHELBY TUBE ☒ CORE BACKFILL TYPE ☒ BENTONITE ☒ PEA GRAVEL ☒ SLOUGH ☒ GROUT ☒ DRILL CUTTINGS ☒ SAND								
Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SPT (N)	MOISTURE CONTENT	STANDARD PENETRATION (N)		Elevation (m)
						20 40 60 80	50 100 150 200	
					PLASTIC M.C. LIQUID 20 40 60 80	◆ UNCONFINED (kPa) ◆ 50 100 150 200	▲ POCKET PEN. (kPa) ▲ 100 200 300 400	
0	SAND and GRAVEL (FILL) - trace silt, medium grained, well graded, sub-rounded, damp, loose, brown							914.0
1	PEAT - frozen, dark brown							913.0
2		⊗	SA52	30	199.6		200	912.0
3	SILT (TILL) - some gravel, frozen (Vx), grey							911.0
4		⊗	SA53		37.5			910.0
5		⊗	SA54	78	52.4			909.0
6	- becomes gravelly	⊗	SA55					908.0
7		■	SA56		13.4			907.0
8	- becomes some gravel							906.0
9								905.0
10	- becomes trace							904.0
11								903.0
12	- becomes SILT and GRAVEL							902.0
13	MASSIVE ICE - trace silt							901.0
14	SILT and GRAVEL (TILL) - frozen (Vx), grey	■	SA57		9.3			900.0
15								
15	MASSIVE ICE - some gravel							



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DRAWING NO:

COMPLETION DEPTH: 26m
COMPLETE: 9/11/2010
Page 1 of 2

Detailed DSTF Drilling		CLIENT: Alexco Resource Corporation		PROJECT NO. - BOREHOLE NO.				
Keno Hill District Mill Site		DRILL: M5 Air Rotary		W14101178.011-BH35				
Keno City, YT		7086941N; 483996E; Zone 8		ELEVATION: 914.25m				
SAMPLE TYPE ☒ DISTURBED ☐ NO RECOVERY ☒ SPT ☐ A-CASING ☐ SHELBY TUBE ☐ CORE								
BACKFILL TYPE ☒ BENTONITE ☒ PEA GRAVEL ☐ SLOUGH ☐ GROUT ☐ DRILL CUTTINGS ☐ SAND								
Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SPT (N)	MOISTURE CONTENT	STANDARD PENETRATION (N)		Elevation (m)
						20 40 60 80	100 150 200	
						PLASTIC M.C. LIQUID	50 100 150 200	
						20 40 60 80	100 200 300 400	
15	- becomes trace silt							899.0
16								898.0
17	GRAVEL seem - frozen (Vx), hard drilling							897.0
18								896.0
19								895.0
20	SILT and GRAVEL (TILL) - frozen (Vx), grey		SA58		15.2			894.0
21	- hard drilling for 1.0 m, possible rock							893.0
22								892.0
23	SAND - some silt, trace gravel, fine grained, compact (est.), dry, dark tan							891.0
24	BEDROCK - hard drilling - soft black rock seem, 0.3 m		SA59		4.5			890.0
25								889.0
26	END OF BOREHOLE @ 26.0 m (Target Depth)							888.0
27								887.0
28								886.0
29								885.0
30								



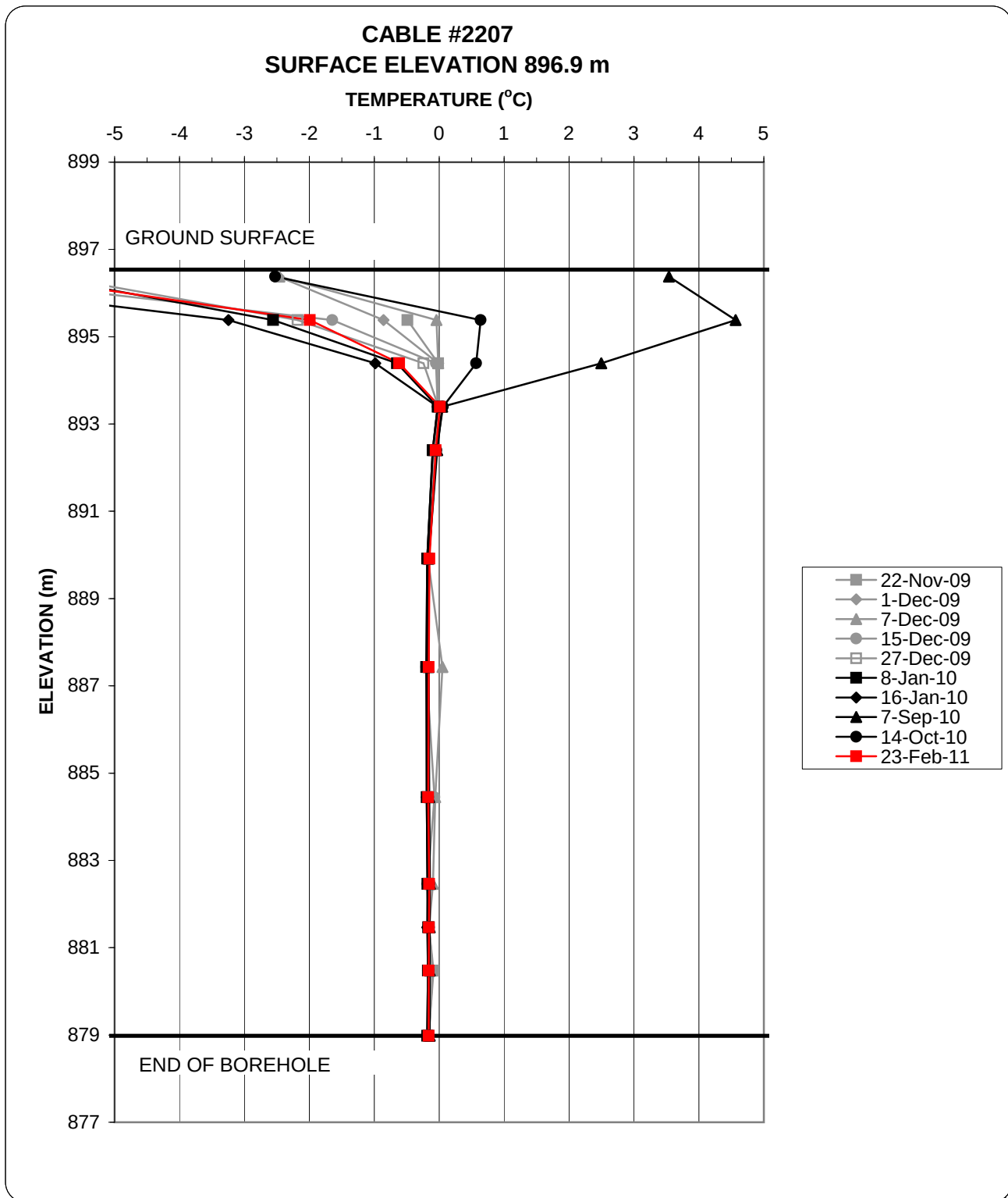
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REVIEWED BY: JRT
DRAWING NO:

COMPLETION DEPTH: 26m
COMPLETE: 9/11/2010
Page 2 of 2

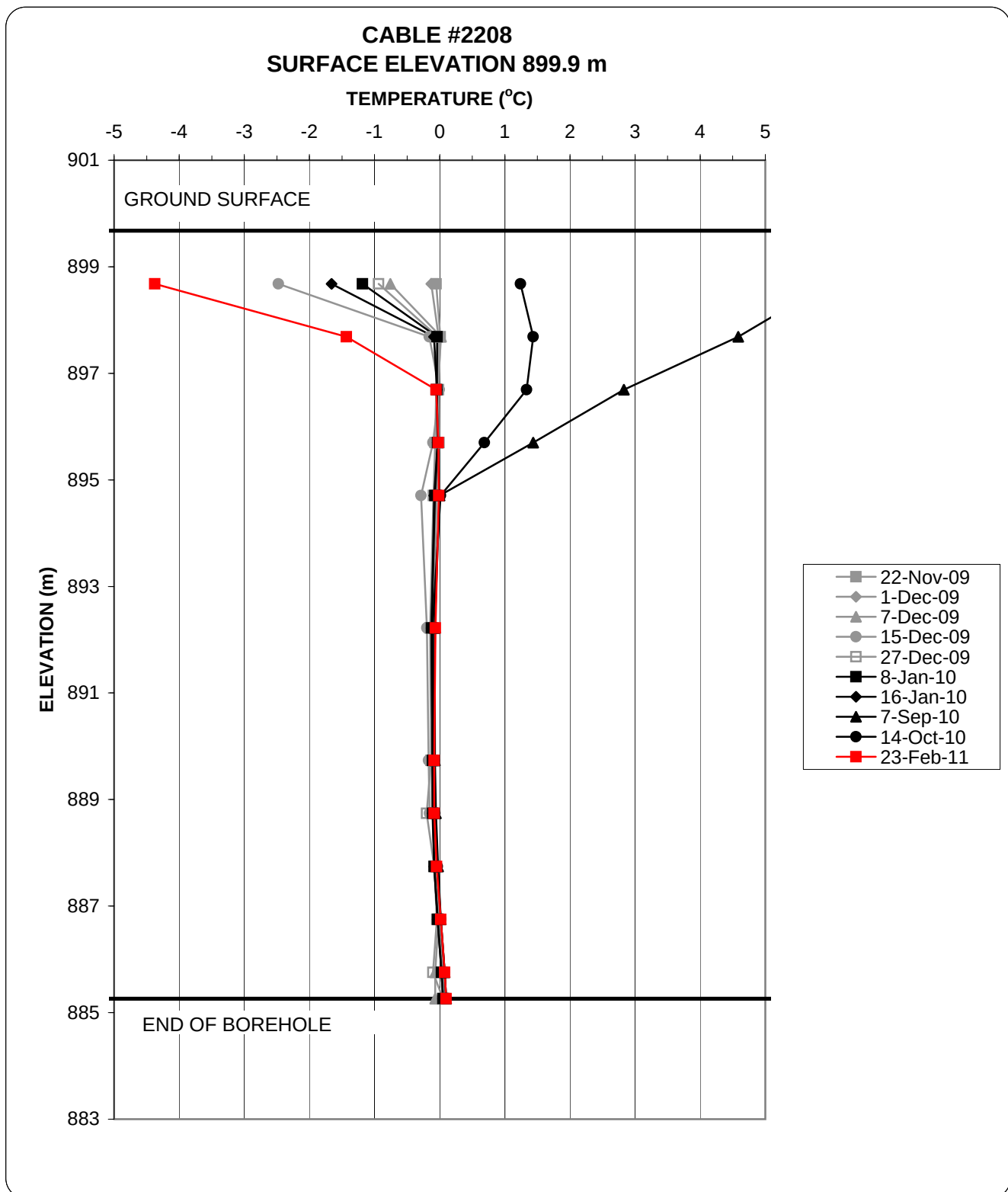
APPENDIX C

APPENDIX C GROUND TEMPERATURE PROFILES



Drilled August 30, 2009

Ground Temperature Profile
Mill Site
Borehole #15 - Flame and Moth

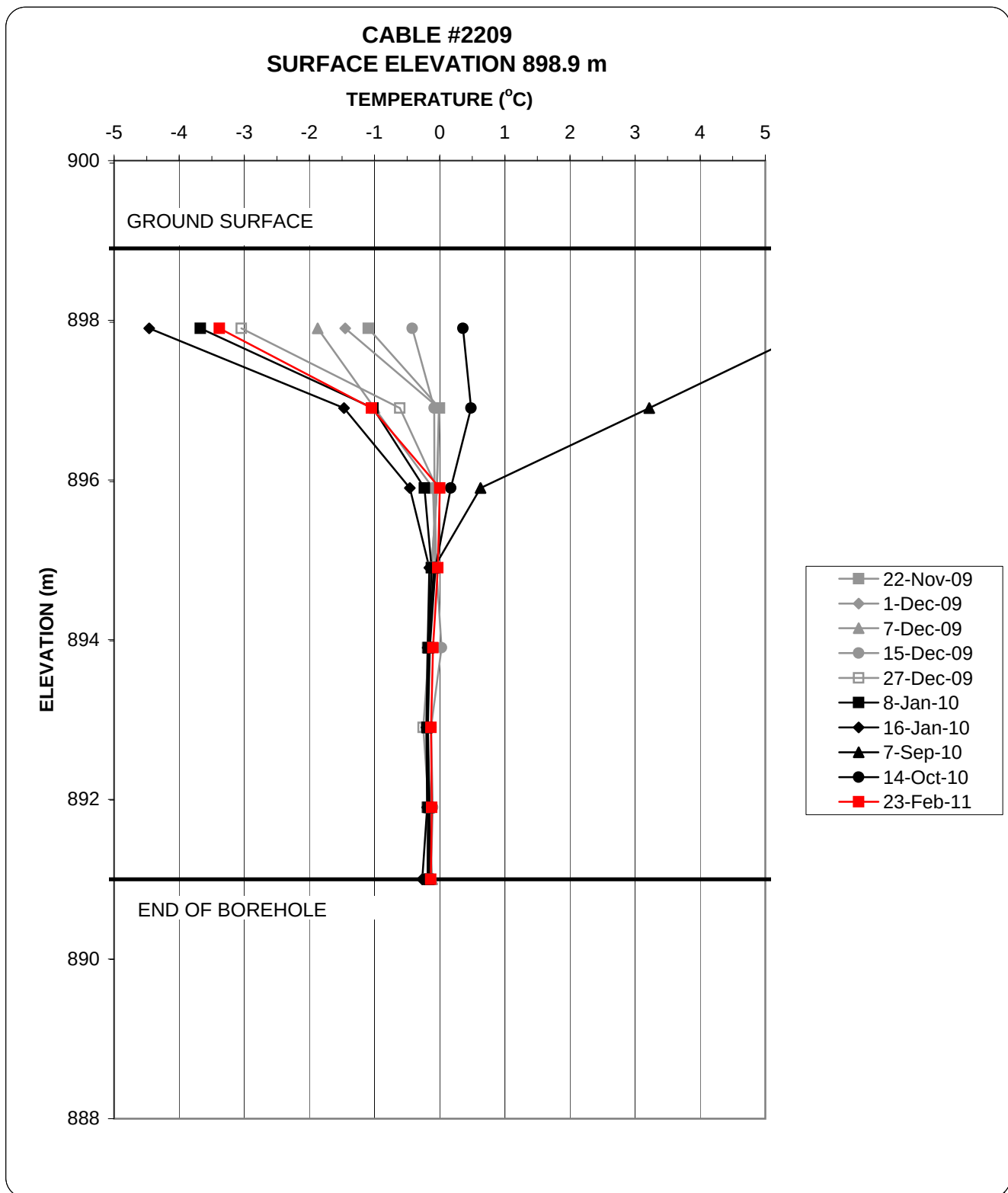


Drilled August 30, 2009

Ground Temperature Profile

Mill Site

Borehole #17 - Flame and Moth

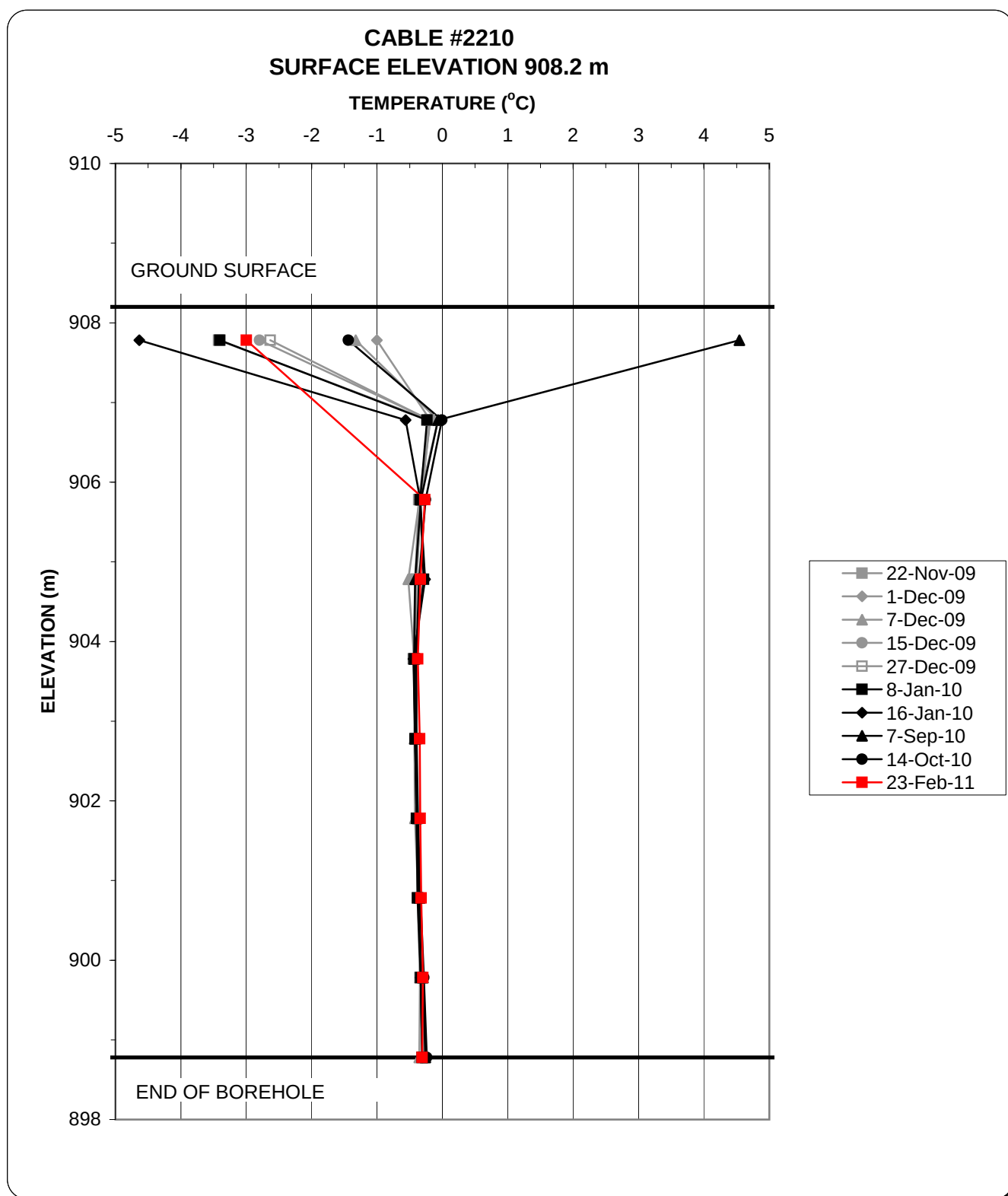


Drilled September 2, 2009

Ground Temperature Profile

Mill Site

Borehole #18 - Flame and Moth

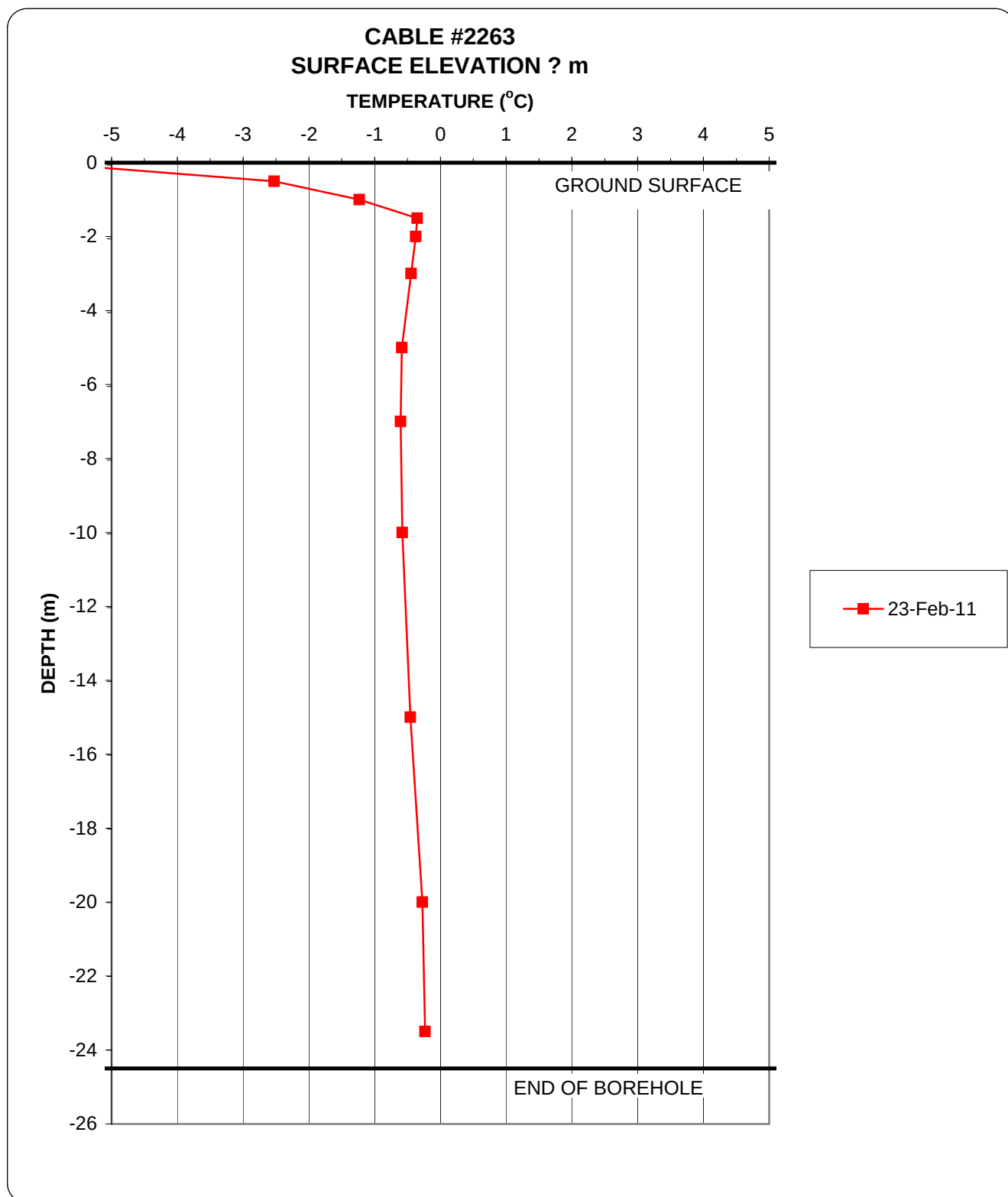


Drilled August 29, 2009

Ground Temperature Profile

Mill Site

Borehole #23 - Flame and Moth

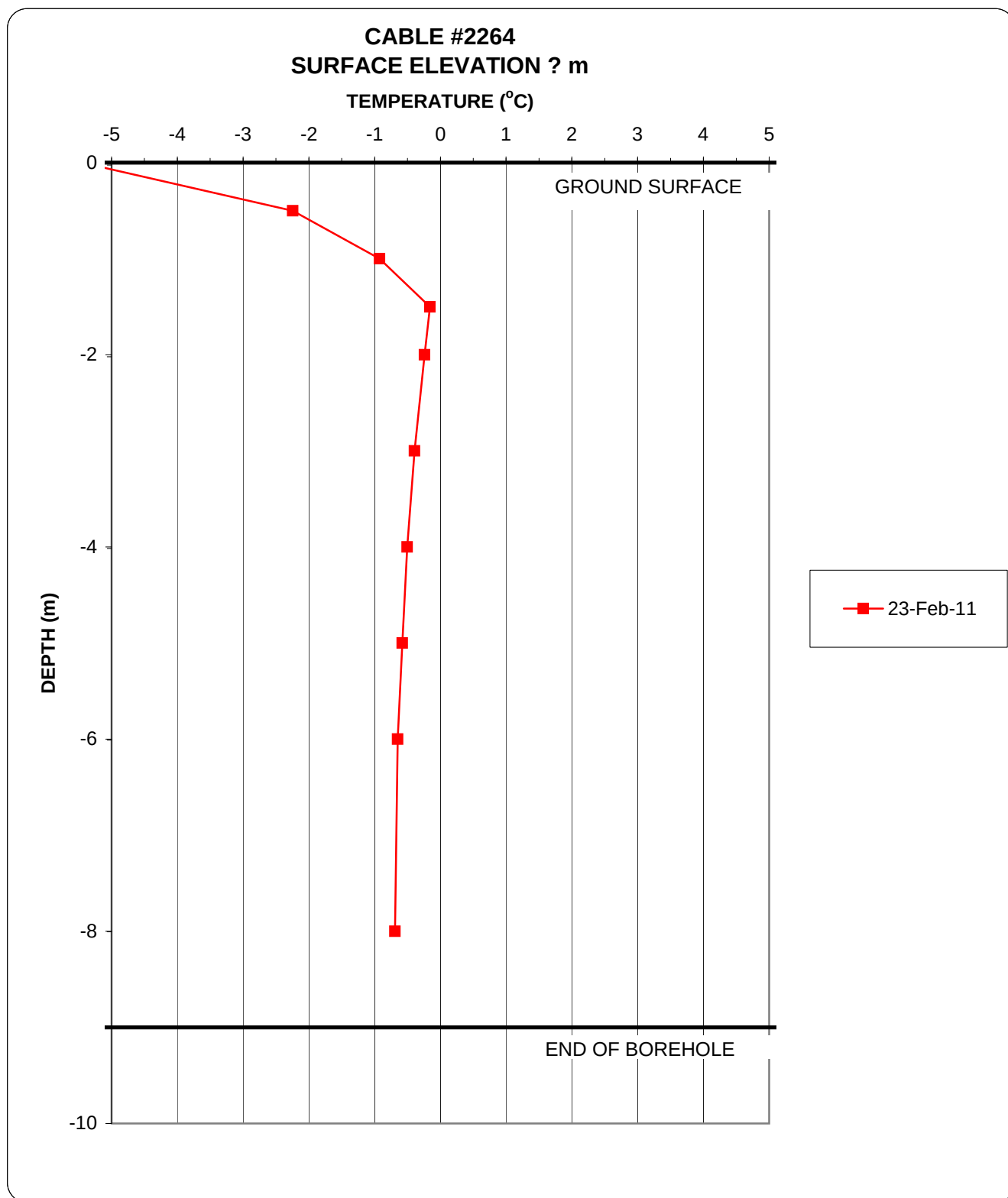


Drilled September 10, 2010

Ground Temperature Profile

DSTF

Borehole #31 - DSTF



Drilled September 10, 2010

Ground Temperature Profile

DSTF

Borehole #32 - DSTF

APPENDIX D

APPENDIX D LABORATORY TEST RESULTS - TAILINGS

MOISTURE-DENSITY RELATIONSHIP (Proctor) REPORT

ASTM D698 (Standard Proctor)

Project: Keno Hill District Mill - DSTF

Sample No.: combined tailings

Project No.: W14101178.011

Sampled By: Alexco

Client: Alexco Resource Corp.

Date Received: 3-Feb-11

Attention: Scott Davidson

Test Date: 4-Feb-11

E-mail:

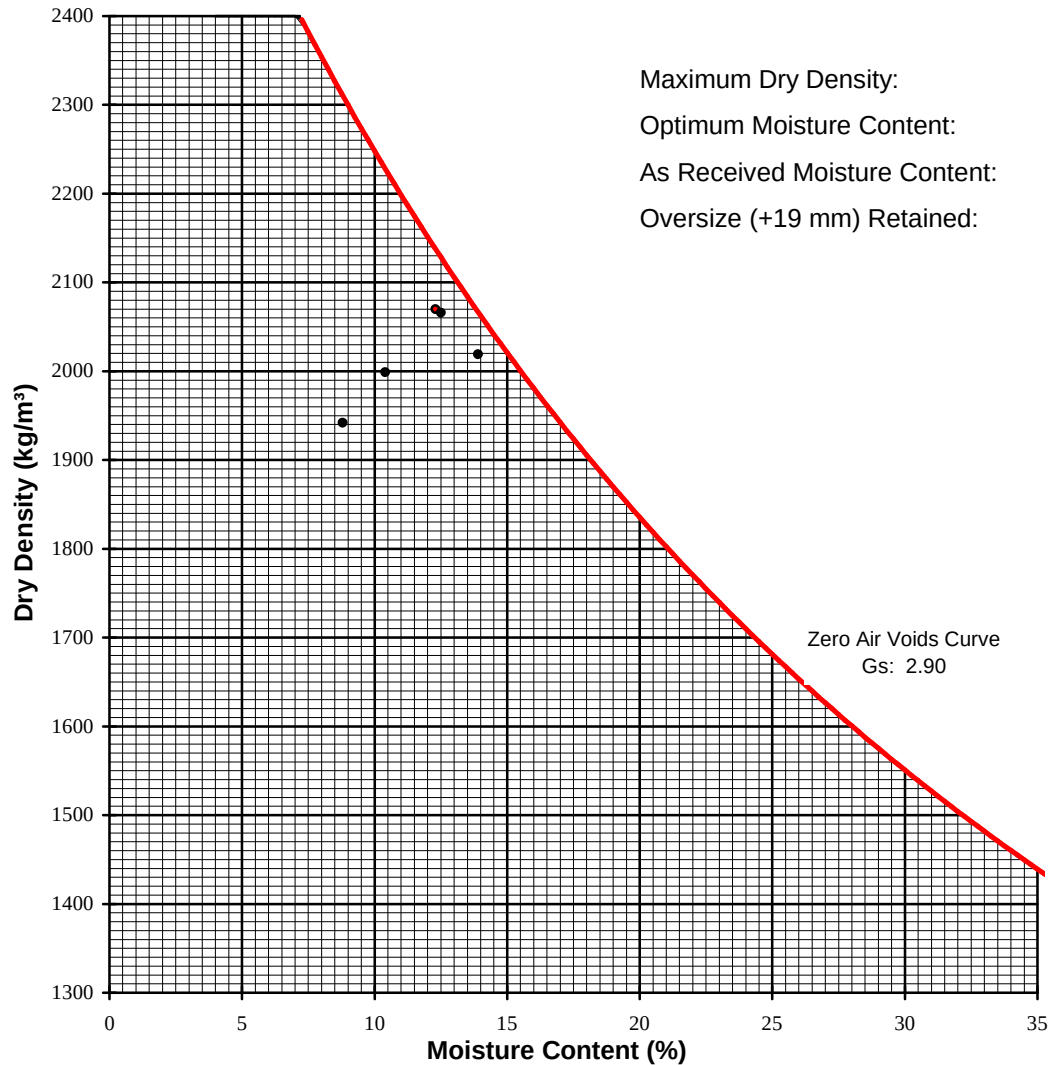
Test Method: Method A

Source: Combined Tailings

Compaction: Manual

Sample Location: Tailings Stockpile

Sample Description: SAND, silty, trace clay - grey



Maximum Dry Density: **2070** kg/m³

Optimum Moisture Content: **12.3** %

As Received Moisture Content: 3.0 %

Oversize (+19 mm) Retained: 0.0 %

Remarks: _____

Reviewed By: _____

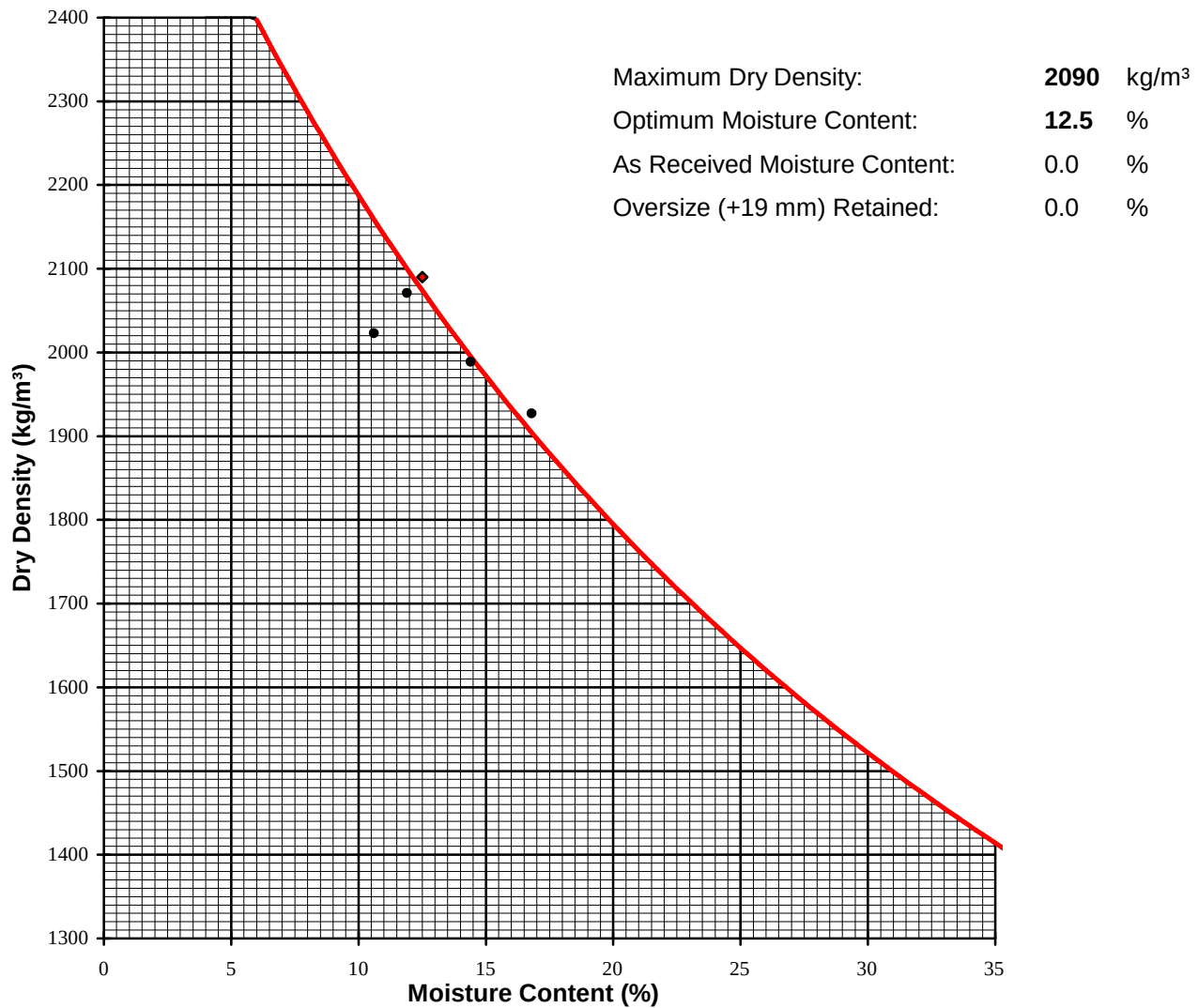
Data presented herein is for the sole use of the stipulated client. EBA is not responsible, nor can be held liable, for use made of this report by any other party, with or without the knowledge of EBA. The testing services reported herein have been performed by an EBA technician to recognized industry standards, unless otherwise noted. No other warranty is made. These data do not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, EBA will provide it upon written request.

MOISTURE-DENSITY RELATIONSHIP (Proctor) REPORT

ASTM D698 (Standard Proctor)

Project: Keno Hill District Mill - DSTF
Project No.: W14101178.011
Client: Alexco Resource Corp
Attention:
E-mail:
Source: Tailings
Sample Location: Tailings Stockpile
Sample Description: SILT and SAND - trace clay

Sample No.: composite
Sampled By: Alexco
Date Received: 21-Jan-11
Test Date: 25-Jan-11
Test Method: Method A
Compaction: Manual



Remarks: _____

Reviewed By: _____

Data presented hereon is for the sole use of the stipulated client. EBA is not responsible, nor can be held liable, for use made of this report by any other party, with or without the knowledge of EBA. The testing services reported herein have been performed by an EBA technician to recognized industry standards, unless otherwise noted. No other warranty is made. These data do not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, EBA will provide it upon written request.

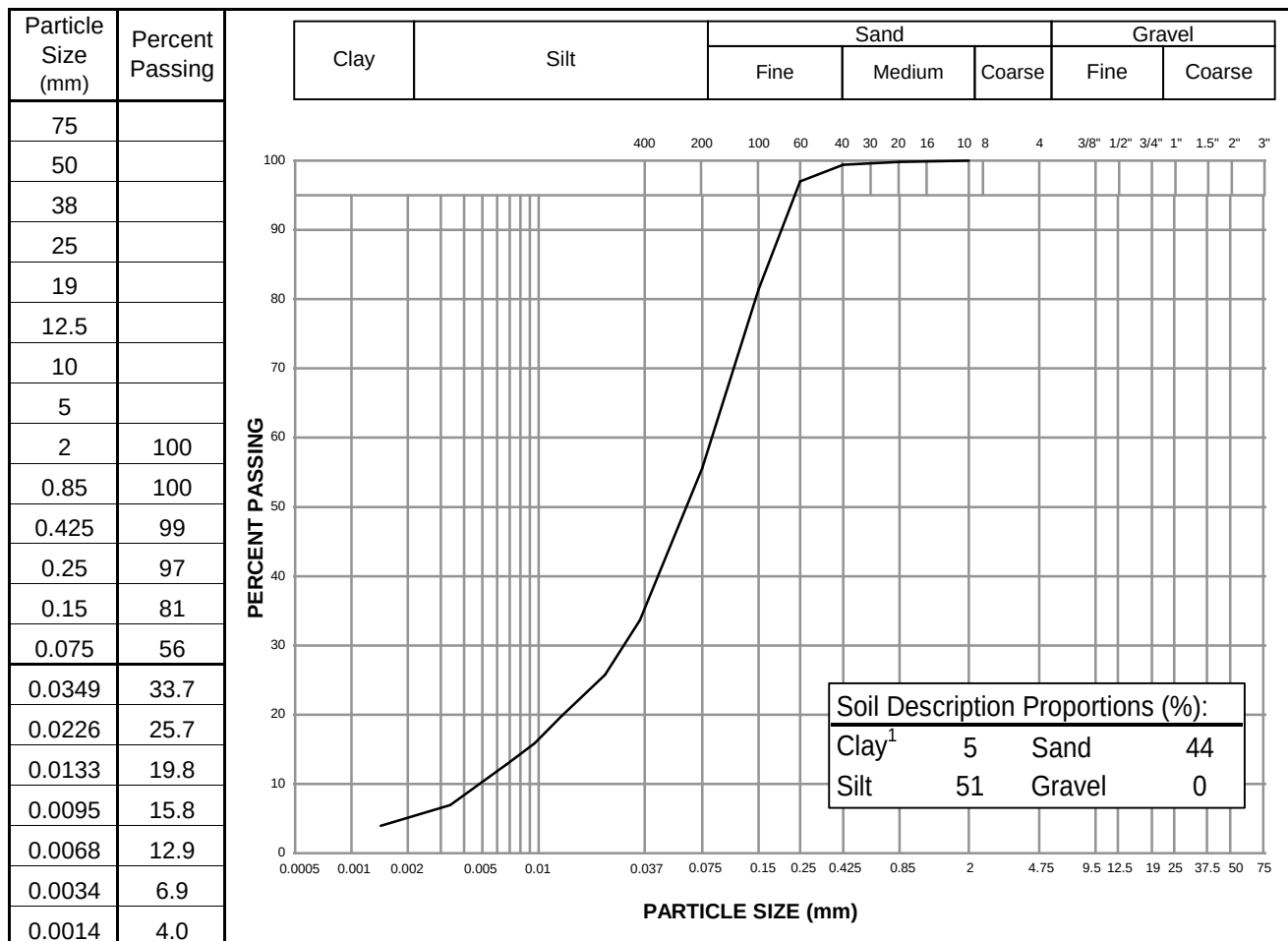
PARTICLE SIZE ANALYSIS TEST REPORT

ASTM D422, C136 & C117

Project: Keno Hill District Mill - DSTF
 Project No.: W14101178.011
 Site: Keno City, YT
 Client: Alexco Resource Corp
 Client Rep.:
 Date Tested: January 24, 2011 By: SMS
 Soil Description²: SILT and SAND - trace clay

Sample No.: SA01
 Material Type: Tailings
 Sample Loc.:
 Sample Depth:
 Sampling Method: Grab
 Date sampled: January, 2011
 Sampled By: Alexco
 USC Classification: Cu: 17.1
 Cc: 1.9

Moisture Content: 18.7%



Notes: ¹ The upper clay size of 2 um, per the Canadian Foundation Engineering Manual

² The description is visually based & subject to EBA description protocols

Specification: _____

Remarks: _____

Reviewed By: _____

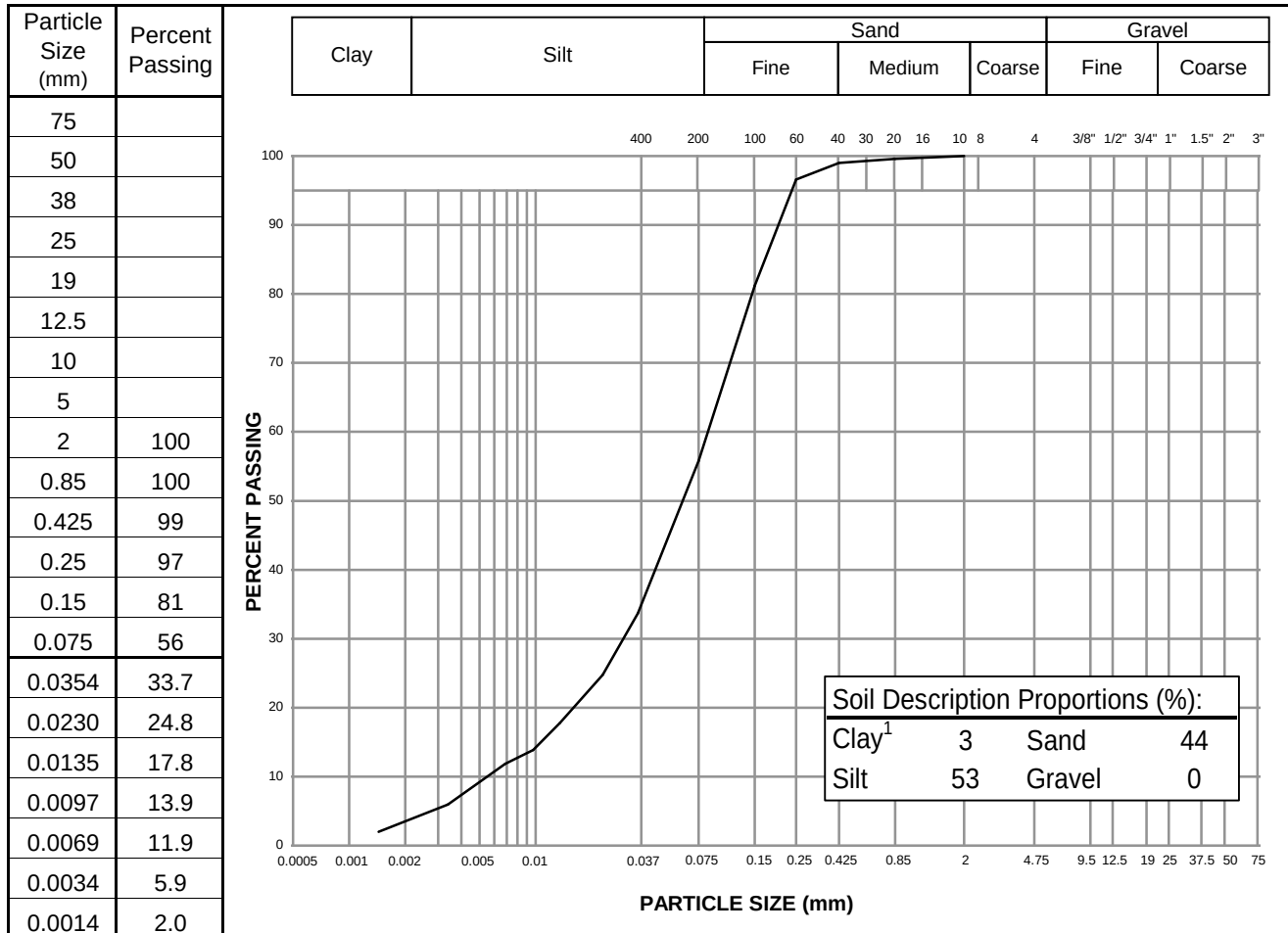
PARTICLE SIZE ANALYSIS TEST REPORT

ASTM D422, C136 & C117

Project: Keno Hill District Mill - DSTF
 Project No.: W14101178.011
 Site: Keno City, YT
 Client: Alexco Resource Corp
 Client Rep.:
 Date Tested: January 24, 2011 By: SMS
 Soil Description²: SILT and SAND - trace clay

Sample No.: SA02
 Material Type: Tailings
 Sample Loc.:
 Sample Depth:
 Sampling Method: Grab
 Date sampled: January, 2011
 Sampled By: Alexco
 USC Classification: Cu: 15.2
 Cc: 1.8

Moisture Content: 21.3%



Notes: ¹ The upper clay size of 2 um, per the Canadian Foundation Engineering Manual

² The description is visually based & subject to EBA description protocols

Specification: _____

Remarks: _____

Reviewed By: _____

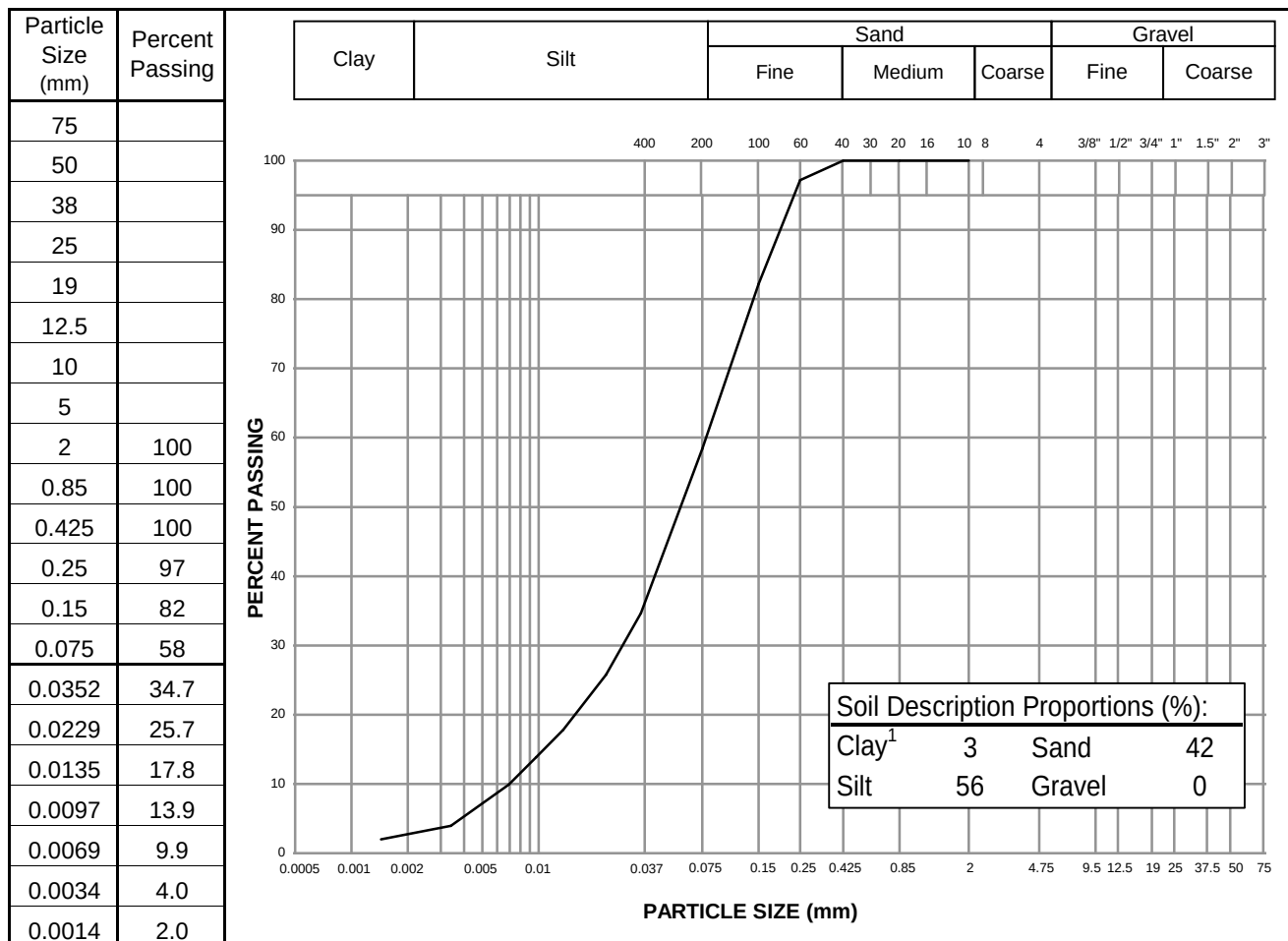
PARTICLE SIZE ANALYSIS TEST REPORT

ASTM D422, C136 & C117

Project: Keno Hill District Mill - DSTF
 Project No.: W14101178.011
 Site: Keno City, YT
 Client: Alexco Resource Corp
 Client Rep.:
 Date Tested: January 24, 2011 By: SMS
 Soil Description²: SILT and SAND - trace clay

Sample No.: SA03
 Material Type: Tailings
 Sample Loc.:
 Sample Depth:
 Sampling Method: Grab
 Date sampled: January, 2011
 Sampled By: Alexco
 USC Classification: Cu: 11.5
 Cc: 1.5

Moisture Content: 11.0%



Notes: ¹ The upper clay size of 2 μ m, per the Canadian Foundation Engineering Manual

² The description is visually based & subject to EBA description protocols

Specification: _____

Remarks: _____

Reviewed By: _____

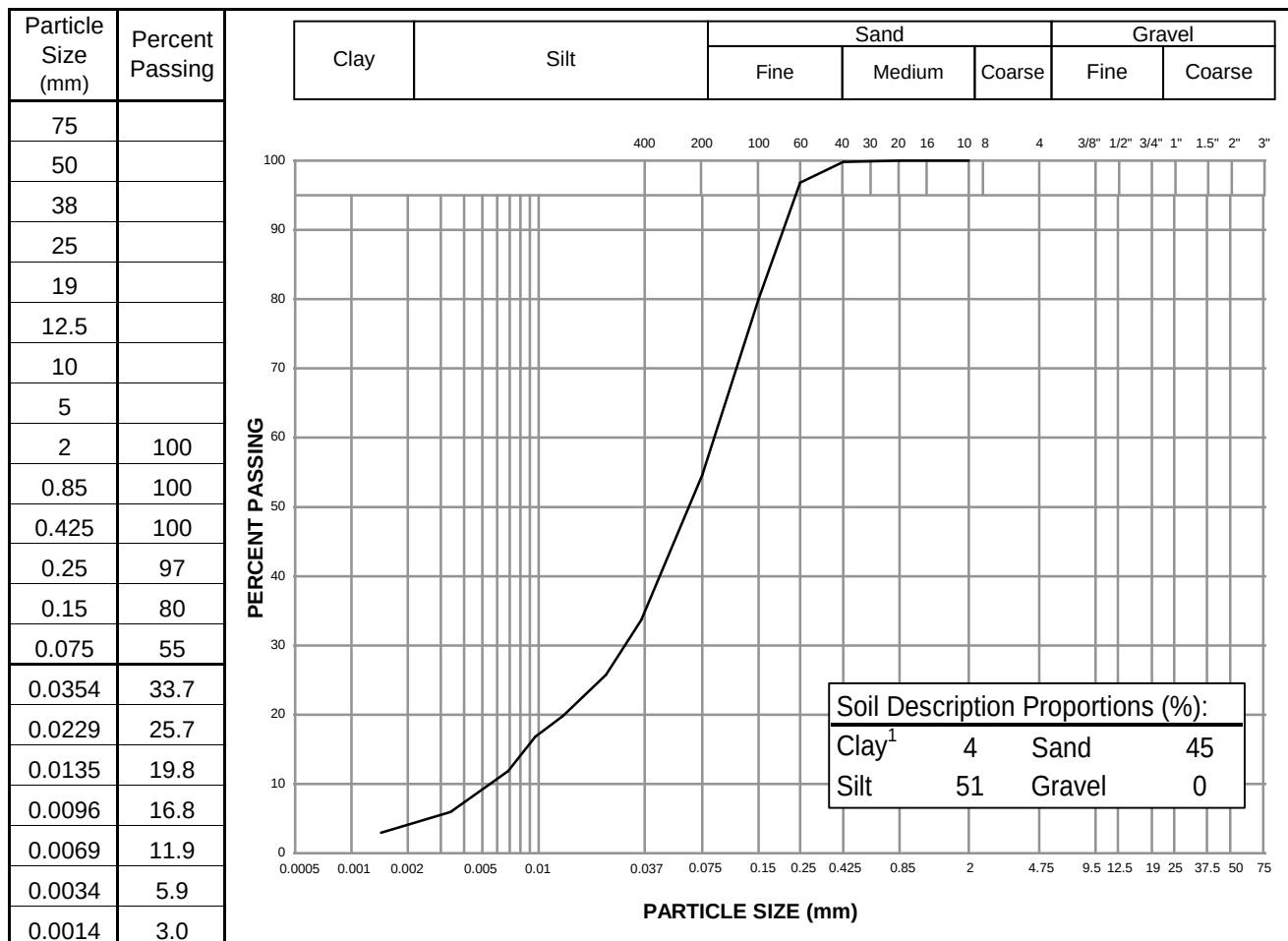
PARTICLE SIZE ANALYSIS TEST REPORT

ASTM D422, C136 & C117

Project: Keno Hill District Mill - DSTF
 Project No.: W14101178.011
 Site: Keno City, YT
 Client: Alexco Resource Corp
 Client Rep.:
 Date Tested: January 24, 2011 By: SMS
 Soil Description²: SILT and SAND - trace clay

Sample No.: SA04
 Material Type: Tailings
 Sample Loc.:
 Sample Depth:
 Sampling Method: Grab
 Date sampled: January, 2011
 Sampled By: Alexco
 USC Classification: Cu: 15.8
 Cc: 1.7

Moisture Content: 12.9%



Notes: ¹ The upper clay size of 2 um, per the Canadian Foundation Engineering Manual

² The description is visually based & subject to EBA description protocols

Specification: _____

Remarks: _____

Reviewed By: _____

PARTICLE SIZE ANALYSIS TEST REPORT

ASTM D422, C136 & C117

Project: Keno Hill District Mill - DSTF

Sample No.: SA05

Project No.: W14101178.011

Material Type: Tailings

Site: Keno City, YT

Sample Loc.:

Client: Alexco Resource Corp

Sample Depth:

Client Rep.:

Sampling Method: Grab

Date Tested: January 24, 2011 By: SMS

Date sampled: January, 2011

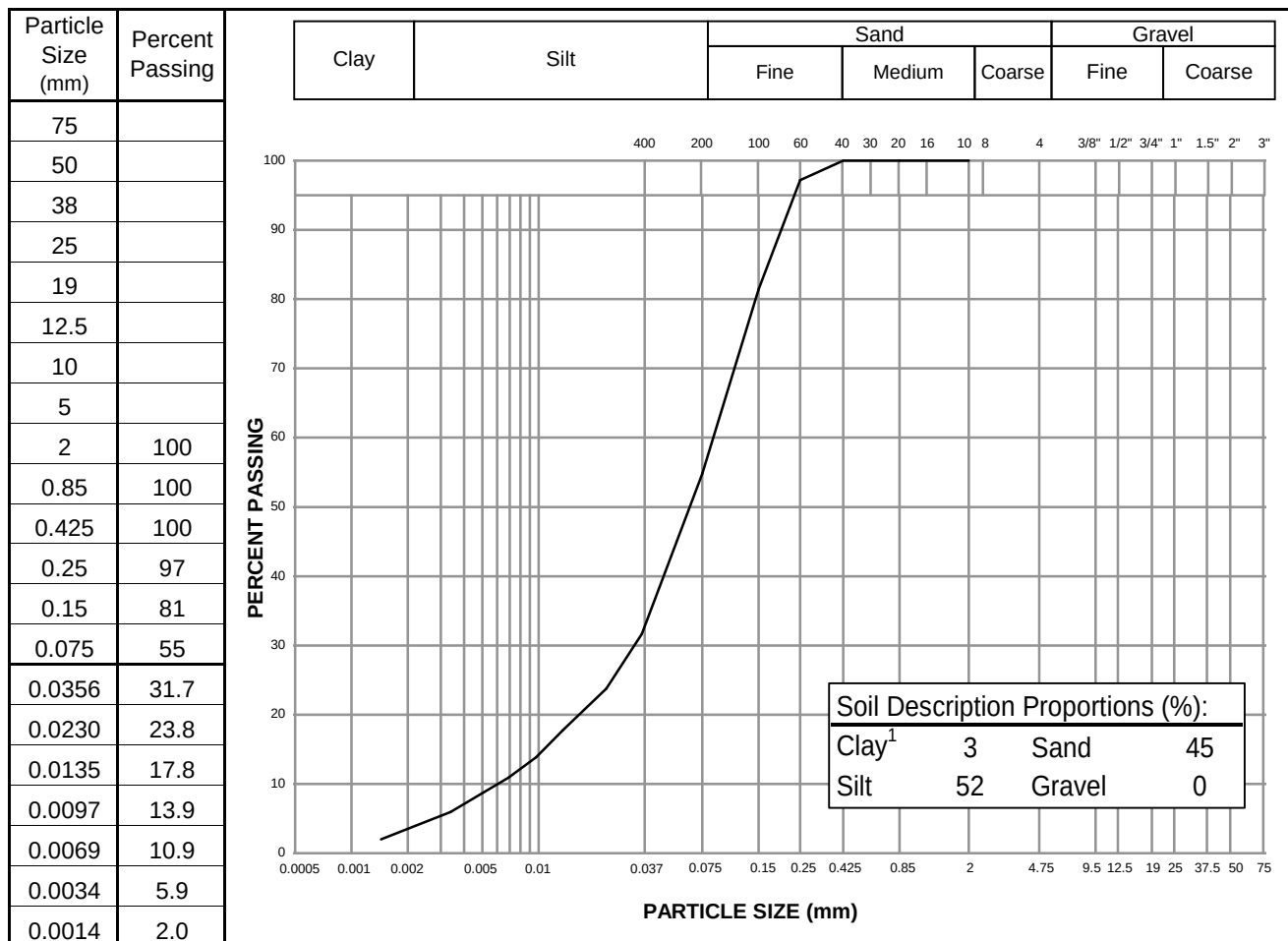
Soil Description²: SILT and SAND - trace clay

Sampled By: Alexco

USC Classification: Cu: 14.3

Moisture Content: 9.4%

Cc: 1.9



Notes: ¹ The upper clay size of 2 um, per the Canadian Foundation Engineering Manual

² The description is visually based & subject to EBA description protocols

Specification: _____

Remarks: _____

Reviewed By: _____

PARTICLE SIZE ANALYSIS TEST REPORT

ASTM D422, C136 & C117

Project: Keno Hill District Mill - DSTF

Sample No.: SA06

Project No.: W14101178.011

Material Type: Tailings

Site: Keno City, YT

Sample Loc.:

Client: Alexco Resource Corp

Sample Depth:

Client Rep.:

Sampling Method: Grab

Date Tested: January 24, 2011 By: SMS

Date sampled: January, 2011

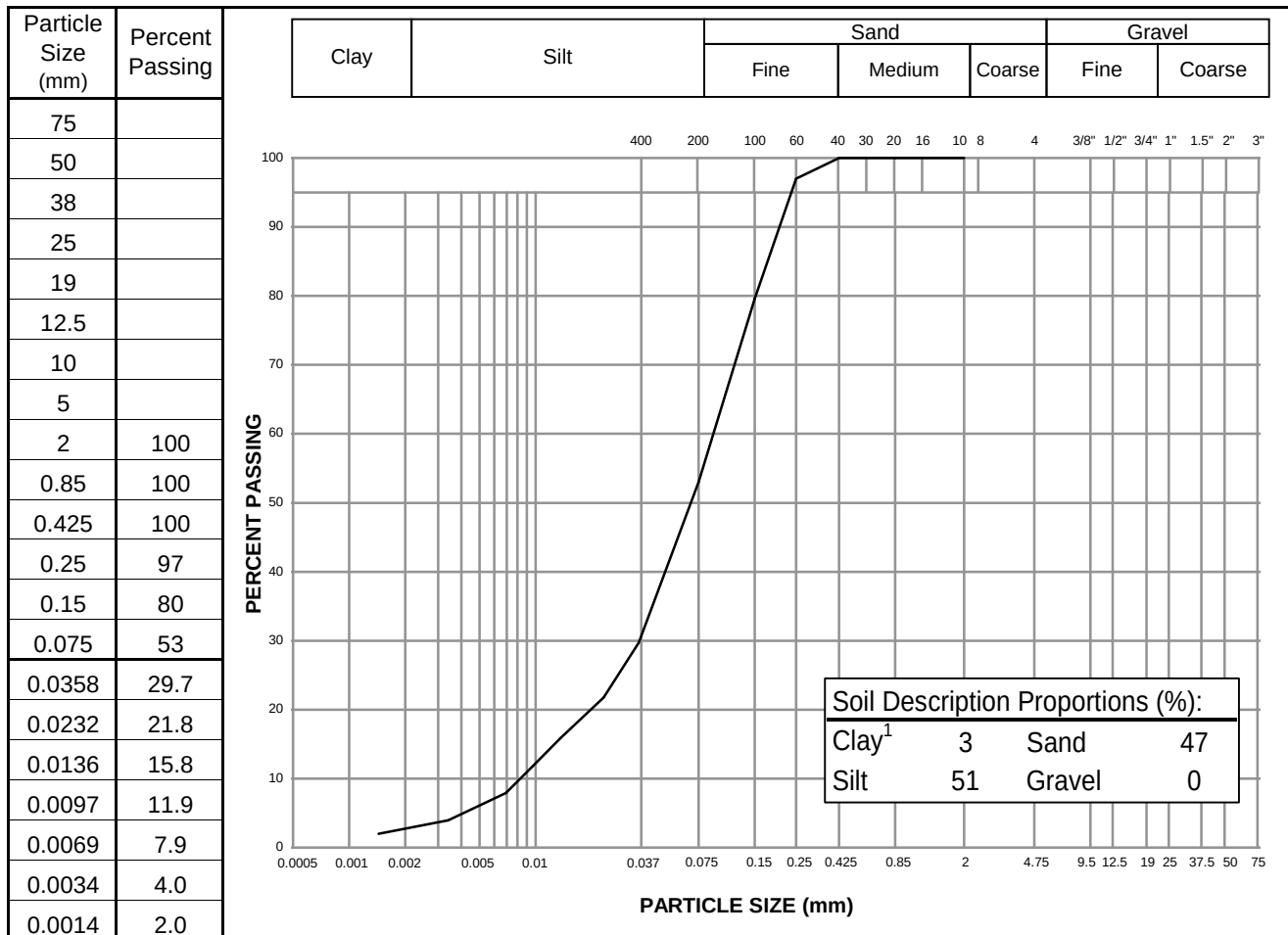
Soil Description²: SILT and SAND - trace clay

Sampled By: Alexco

USC Classification: Cu: 11.3

Moisture Content: 8.6%

Cc: 1.7



Notes: ¹ The upper clay size of 2 um, per the Canadian Foundation Engineering Manual

² The description is visually based & subject to EBA description protocols

Specification: _____

Remarks: _____

Reviewed By: _____

SUMMARY of DIRECT SHEAR TEST RESULTS

ASTM D3080

Project : Keno Hill District Mill - DSTF

Test Hole : Combined Tailings

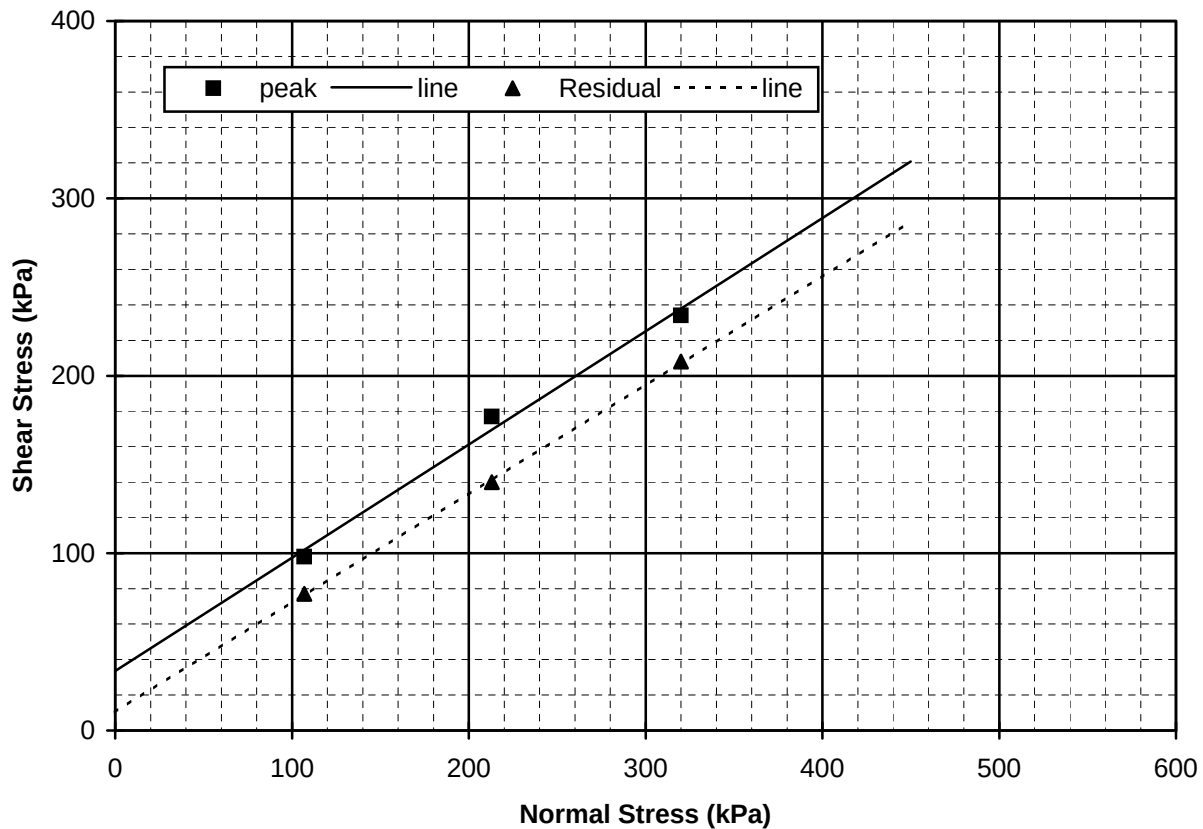
Project No. : W14101178.011

Depth: _____

Client: Alexco Resource Corp

Date : 11-02-10

Tested By: SK



Inferred Shear Strength Parameters :-

	Cohesion Intercept (kPa)	Inferred Angle of Shearing Resistance (Degrees)
Peak Strength:	33.5	32.6
Residual Strength:	10.5	31.6

Reviewed By: _____ P.Eng.

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DIRECT SHEAR TEST

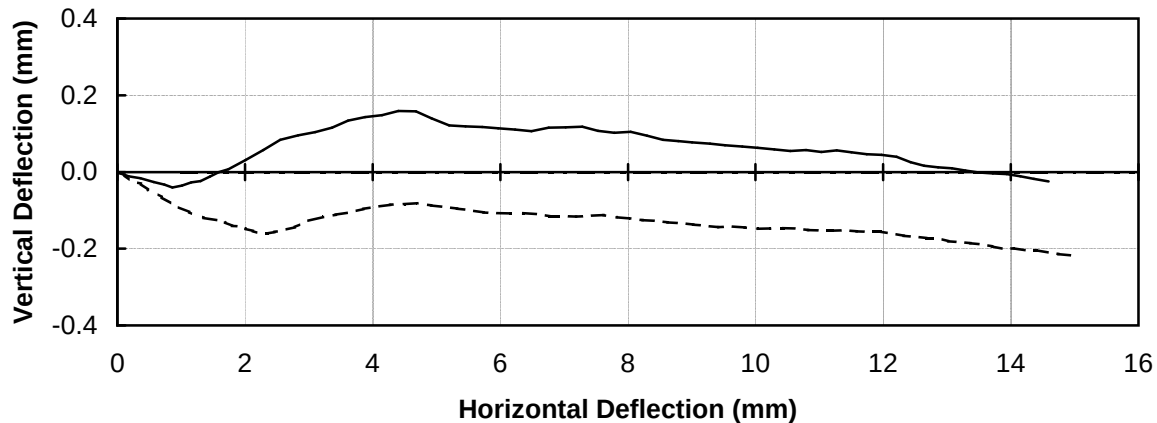
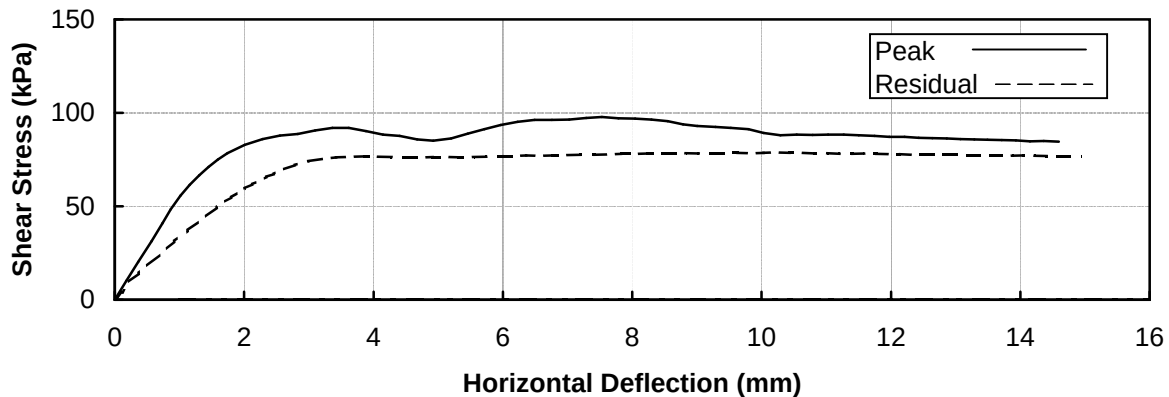
ASTM D3080

Project: Keno Hill District Mill - DSTF
Project No.: W14101178.011
Client: Alexco Resource Corp
Date Tested: 11-02-07
Description: SAND, silty, trace clay

Test Hole No.: Combined Tailings
Depth: _____
Test No.: DS-1
Machine: 1
Preparation: Remolded

Peak Stress (kPa) = 98
Residual Stress (kPa) = 77
Shear Displacement (mm) = 14.6

Normal Stress (kPa) = 107
Displacement Rate (mm/min.) = 0.012



Remarks: _____

Reviewed By: _____ P.Eng.

DIRECT SHEAR TEST

ASTM D3080

Project: Keno Hill District Mill - DSTF

Test Hole No.: Combined Tailings

Project No.: W14101178.011

Depth (m):

Client: Alexco Resource Corp

Test No.: DS-1

Date Tested: 11-02-07

	Initial	Final
Moisture Content (%)	12.8	16.3
Wet Density (Mg/m ³)	2.231	2.301
Dry Density (Mg/m ³)	1.978	1.978

Horizontal Displacement (mm)	Vertical Displacement (mm)	Shear Stress (kPa)	Horizontal Displacement (mm)	Vertical Displacement (mm)	Shear Stress (kPa)
0.00	0.000	0.0	7.53	0.107	97.7
0.18	-0.011	10.1	7.79	0.102	97.0
0.36	-0.016	20.2	8.04	0.105	97.0
0.57	-0.026	31.4	8.30	0.094	96.4
0.74	-0.033	40.9	8.55	0.084	95.5
0.86	-0.040	48.4	8.79	0.081	93.8
1.01	-0.036	55.6	9.00	0.077	92.9
1.16	-0.027	61.5	9.29	0.073	92.5
1.30	-0.024	66.7	9.52	0.070	91.9
1.45	-0.012	71.0	9.79	0.066	91.2
1.59	0.000	75.1	10.03	0.063	89.2
1.74	0.007	78.3	10.29	0.059	88.0
2.01	0.032	82.9	10.54	0.054	88.3
2.29	0.057	85.9	10.79	0.057	88.2
2.55	0.084	87.9	11.03	0.052	88.4
2.83	0.096	88.8	11.27	0.056	88.3
3.10	0.104	90.6	11.50	0.051	88.0
3.37	0.115	92.0	11.74	0.046	87.7
3.61	0.134	92.0	11.97	0.045	87.1
3.88	0.143	90.3	12.21	0.040	87.2
4.15	0.148	88.4	12.43	0.025	86.7
4.40	0.159	87.7	12.64	0.016	86.5
4.68	0.158	85.8	12.86	0.012	86.2
4.92	0.140	85.1	13.08	0.010	86.0
5.20	0.122	86.2	13.29	0.003	85.9
5.46	0.119	88.8	13.49	-0.002	85.7
5.71	0.117	91.3	13.72	-0.004	85.5
5.97	0.114	93.4	13.93	-0.005	85.3
6.23	0.110	95.2	14.15	-0.011	84.8
6.49	0.106	96.3	14.36	-0.018	84.9
6.76	0.116	96.3	14.59	-0.025	84.6
7.02	0.116	96.5			
7.29	0.118	97.2			

RESIDUAL STRENGTH TEST

ASTM D3080

Project: Keno Hill District Mill - DSTF

Sample No.: Combined Tailings

Horizontal Displacement (mm)	Vertical Displacement (mm)	Shear Stress (kPa)	Horizontal Displacement (mm)	Vertical Displacement (mm)	Shear Stress (kPa)
0.00	0.000	0.0	7.62	-0.113	77.7
0.11	-0.008	3.9	7.83	-0.118	78.0
0.22	-0.024	9.6	8.04	-0.121	78.1
0.37	-0.030	14.3	8.23	-0.125	78.2
0.48	-0.046	17.6	8.43	-0.127	78.3
0.70	-0.066	24.3	8.62	-0.131	78.3
0.92	-0.089	31.3	8.83	-0.133	78.4
1.13	-0.105	37.1	9.03	-0.137	78.3
1.35	-0.119	43.3	9.22	-0.141	78.4
1.58	-0.127	49.4	9.42	-0.144	78.4
1.69	-0.131	52.3	9.63	-0.142	78.5
1.80	-0.140	54.9	9.83	-0.145	78.4
1.91	-0.141	57.3	10.03	-0.148	78.6
2.01	-0.148	59.6	10.23	-0.148	78.7
2.13	-0.154	61.8	10.43	-0.146	78.7
2.24	-0.161	63.8	10.64	-0.147	78.5
2.35	-0.161	65.8	10.83	-0.152	78.3
2.46	-0.157	67.4	11.02	-0.152	78.3
2.56	-0.153	69.2	11.20	-0.153	78.1
2.78	-0.144	72.1	11.41	-0.152	78.1
2.99	-0.127	74.2	11.59	-0.154	78.2
3.22	-0.118	75.6	11.78	-0.156	78.1
3.43	-0.111	76.2	11.96	-0.155	77.9
3.63	-0.105	76.5	12.14	-0.161	77.9
3.85	-0.096	76.7	12.33	-0.166	77.6
4.07	-0.091	76.6	12.50	-0.169	77.6
4.28	-0.086	76.4	12.68	-0.172	77.5
4.49	-0.084	76.2	12.85	-0.172	77.5
4.71	-0.081	76.2	13.02	-0.180	77.6
4.92	-0.087	76.3	13.19	-0.183	77.4
5.13	-0.091	76.3	13.37	-0.185	77.5
5.32	-0.095	76.2	13.54	-0.189	77.3
5.54	-0.100	76.4	13.71	-0.194	77.3
5.74	-0.105	76.6	13.87	-0.200	77.1
5.95	-0.107	76.9	14.05	-0.199	77.1
6.16	-0.108	76.9	14.22	-0.204	77.0
6.36	-0.107	77.1	14.40	-0.204	76.8
6.57	-0.110	77.1	14.57	-0.210	76.7
6.77	-0.116	77.2	14.75	-0.214	76.7
6.98	-0.116	77.4	14.92	-0.218	76.5
7.19	-0.117	77.5			
7.42	-0.114	77.5			

DIRECT SHEAR TEST

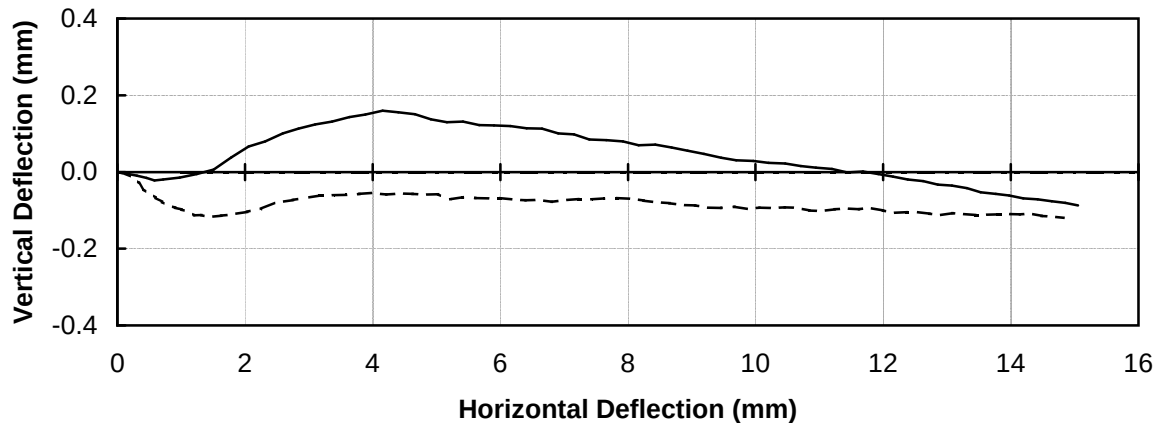
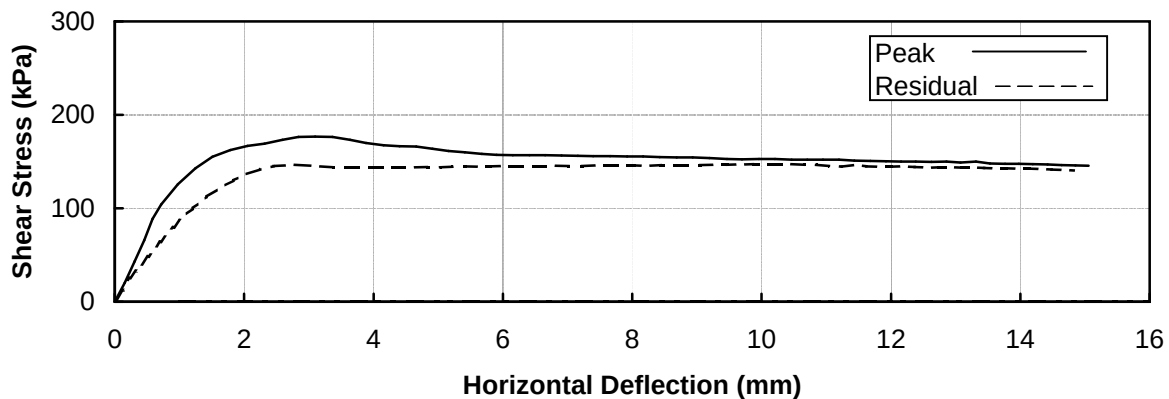
ASTM D3080

Project: Keno Hill District Mill - DSTF
Project No.: W14101178.011
Client: Alexco Resource Corp
Date Tested: 11-02-07
Description: SAND, silty, trace clay

Test Hole No.: Combined Tailings
Depth: _____
Test No.: DS-2
Machine: 2
Preparation: Remolded

Peak Stress (kPa) = 177
Residual Stress (kPa) = 140
Shear Displacement (mm) = 15.1

Normal Stress (kPa) = 213
Displacement Rate (mm/min.) = 0.012



Remarks: _____

Reviewed By: _____ P.Eng.

DIRECT SHEAR TEST

ASTM D3080

Project: Keno Hill District Mill - DSTF

Test Hole No.: Combined Tailings

Project No.: W14101178.011

Depth (m):

Client: Alexco Resource Corp

Test No.: DS-2

Date Tested: 11-02-07

	Initial	Final
Moisture Content (%)	12.7	16.1
Wet Density (Mg/m ³)	2.242	2.309
Dry Density (Mg/m ³)	1.989	1.989

Horizontal Displacement (mm)	Vertical Displacement (mm)	Shear Stress (kPa)	Horizontal Displacement (mm)	Vertical Displacement (mm)	Shear Stress (kPa)
0.00	0.000	0.0	7.92	0.079	155.6
0.15	-0.005	20.1	8.17	0.069	155.3
0.30	-0.009	43.1	8.43	0.071	154.8
0.46	-0.016	65.8	8.69	0.064	154.6
0.58	-0.022	88.7	8.94	0.055	154.3
0.72	-0.020	104.1	9.19	0.047	153.7
0.98	-0.015	125.6	9.46	0.037	152.9
1.24	-0.005	142.9	9.70	0.031	152.5
1.51	0.007	155.2	9.96	0.029	152.6
1.78	0.038	162.4	10.21	0.024	152.6
2.05	0.067	166.7	10.47	0.022	152.2
2.32	0.079	169.3	10.71	0.015	152.0
2.59	0.101	173.1	10.95	0.011	152.2
2.84	0.113	176.4	11.20	0.008	151.9
3.10	0.124	176.8	11.44	-0.001	151.1
3.36	0.131	176.4	11.68	0.001	150.8
3.63	0.143	173.2	11.92	-0.005	150.2
3.88	0.150	170.0	12.16	-0.012	150.0
4.16	0.160	167.5	12.39	-0.020	150.0
4.40	0.156	166.4	12.63	-0.024	149.8
4.66	0.151	166.0	12.86	-0.033	149.9
4.91	0.137	163.8	13.07	-0.036	149.0
5.16	0.130	161.4	13.31	-0.043	149.8
5.41	0.131	159.8	13.53	-0.053	147.9
5.67	0.122	158.3	13.77	-0.057	147.5
5.90	0.121	157.2	13.97	-0.062	147.5
6.15	0.120	156.7	14.20	-0.069	147.3
6.41	0.114	157.0	14.42	-0.071	146.9
6.65	0.113	156.9	14.64	-0.077	146.4
6.91	0.100	156.6	14.85	-0.081	145.8
7.16	0.098	156.3	15.05	-0.087	145.4
7.40	0.085	155.8			
7.66	0.083	155.7			

RESIDUAL STRENGTH TEST

ASTM D3080

Project: Keno Hill District Mill - DSTF

Sample No.: Combined Tailings

Horizontal Displacement (mm)	Vertical Displacement (mm)	Shear Stress (kPa)	Horizontal Displacement (mm)	Vertical Displacement (mm)	Shear Stress (kPa)
0.00	0.000	0.0	7.43	-0.072	145.8
0.13	-0.004	12.2	7.63	-0.069	145.8
0.23	-0.014	25.3	7.83	-0.068	146.0
0.33	-0.028	32.7	8.04	-0.070	146.0
0.41	-0.045	40.0	8.25	-0.075	145.7
0.51	-0.057	48.1	8.45	-0.079	146.2
0.60	-0.067	55.8	8.65	-0.081	146.2
0.70	-0.078	64.1	8.85	-0.086	146.2
0.80	-0.088	72.1	9.05	-0.087	146.4
0.91	-0.093	79.6	9.26	-0.093	146.5
1.01	-0.098	87.0	9.47	-0.094	146.6
1.11	-0.104	93.7	9.67	-0.091	146.9
1.20	-0.113	100.1	9.87	-0.096	147.2
1.32	-0.112	106.8	10.07	-0.093	147.4
1.42	-0.118	112.3	10.26	-0.094	147.4
1.63	-0.114	122.0	10.46	-0.092	147.3
1.83	-0.109	129.7	10.66	-0.093	146.6
2.04	-0.104	136.6	10.84	-0.100	146.7
2.25	-0.096	141.8	11.04	-0.102	145.2
2.46	-0.080	145.2	11.24	-0.097	144.6
2.75	-0.073	146.5	11.43	-0.096	146.2
3.17	-0.062	144.7	11.62	-0.097	144.8
3.38	-0.061	143.9	11.81	-0.094	144.6
3.59	-0.060	143.4	12.00	-0.101	144.4
3.80	-0.057	143.4	12.18	-0.106	144.8
4.01	-0.054	143.7	12.37	-0.105	144.2
4.22	-0.058	143.9	12.55	-0.105	143.5
4.42	-0.056	143.8	12.72	-0.109	143.7
4.63	-0.057	144.0	12.90	-0.112	143.7
4.83	-0.059	144.1	13.09	-0.108	143.6
5.03	-0.058	144.0	13.26	-0.110	143.5
5.22	-0.071	144.4	13.44	-0.112	143.3
5.42	-0.066	144.8	13.62	-0.111	142.9
5.61	-0.068	144.6	13.79	-0.111	142.8
5.81	-0.069	144.8	13.97	-0.109	142.6
6.00	-0.068	145.0	14.14	-0.111	142.3
6.20	-0.071	145.3	14.32	-0.109	142.0
6.40	-0.074	145.1	14.49	-0.115	141.4
6.60	-0.073	145.3	14.66	-0.116	141.1
6.81	-0.078	145.5	14.83	-0.119	140.3
7.02	-0.074	145.3			
7.23	-0.071	145.3			

DIRECT SHEAR TEST

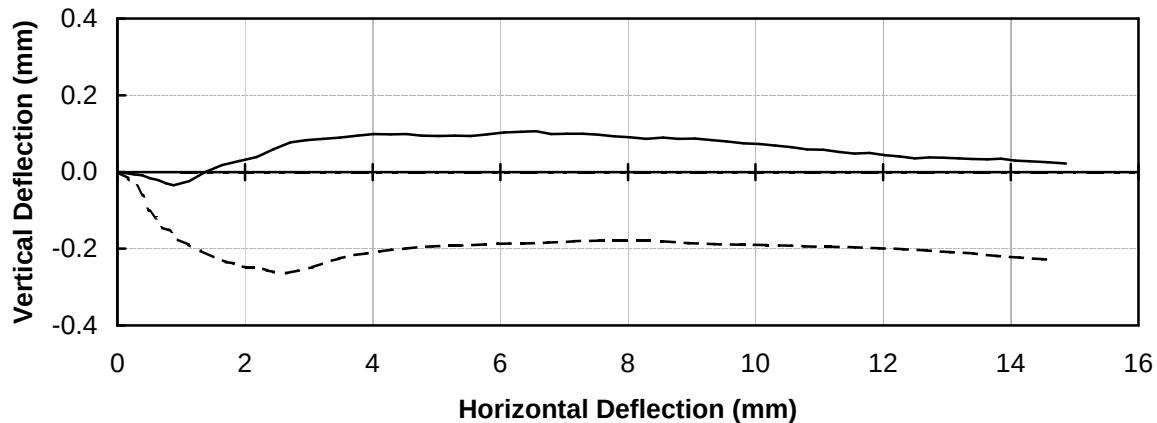
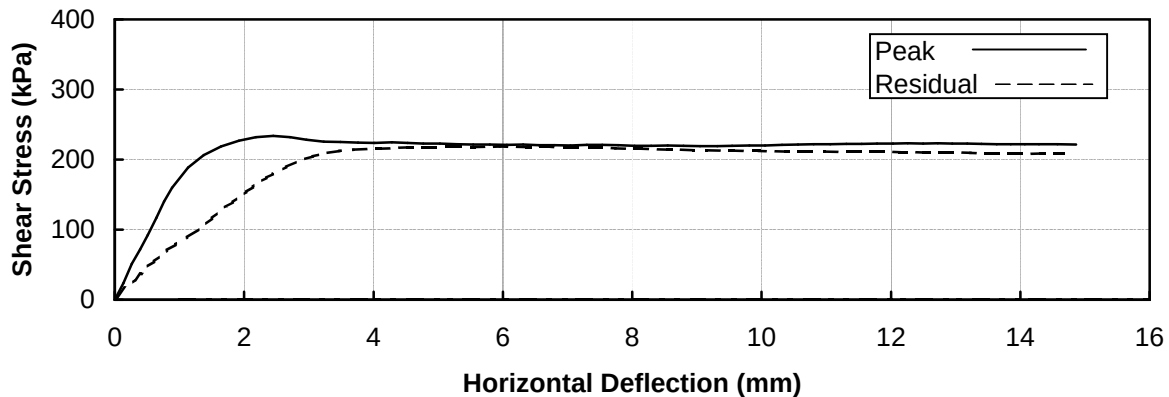
ASTM D3080

Project: Keno Hill District Mill - DSTF
Project No.: W14101178.011
Client: Alexco Resource Corp
Date Tested: 11-02-07
Description: SAND, silty, trace clay

Test Hole No.: Combined Tailings
Depth: _____
Test No.: DS-3
Machine: 3
Preparation: Remolded

Peak Stress (kPa) = 234
Residual Stress (kPa) = 208
Shear Displacement (mm) = 14.9

Normal Stress (kPa) = 320
Displacement Rate (mm/min.) = 0.012



Remarks: _____

Reviewed By: _____ P.Eng.

DIRECT SHEAR TEST

ASTM D3080

Project: Keno Hill District Mill - DSTF

Test Hole No.: Combined Tailings

Project No.: W14101178.011

Depth (m):

Client: Alexco Resource Corp

Test No.: DS-3

Date Tested: 11-02-07

	Initial	Final
Moisture Content (%)	12.7	15.9
Wet Density (Mg/m ³)	2.236	2.300
Dry Density (Mg/m ³)	1.985	1.985

Horizontal Displacement (mm)	Vertical Displacement (mm)	Shear Stress (kPa)	Horizontal Displacement (mm)	Vertical Displacement (mm)	Shear Stress (kPa)
0.00	0.000	0.0	7.53	0.097	220.9
0.13	-0.003	23.9	7.78	0.093	220.4
0.26	-0.006	51.3	8.03	0.090	219.7
0.39	-0.009	71.9	8.29	0.086	219.8
0.51	-0.016	92.3	8.55	0.089	220.0
0.64	-0.021	117.0	8.79	0.087	219.5
0.76	-0.030	140.0	9.05	0.087	219.0
0.88	-0.035	160.0	9.32	0.083	219.3
1.13	-0.024	188.5	9.55	0.079	219.7
1.37	0.000	206.5	9.81	0.075	220.1
1.64	0.018	218.8	10.05	0.073	220.2
1.92	0.029	227.1	10.31	0.069	220.8
2.18	0.038	231.9	10.56	0.064	221.7
2.45	0.059	233.6	10.81	0.058	221.8
2.71	0.077	232.2	11.06	0.058	222.1
2.96	0.083	228.5	11.31	0.052	222.2
3.23	0.086	225.7	11.55	0.048	222.4
3.49	0.090	225.2	11.79	0.049	222.8
3.76	0.095	224.2	12.03	0.044	223.1
4.02	0.098	223.9	12.26	0.040	223.2
4.29	0.098	224.5	12.50	0.036	223.1
4.53	0.099	223.8	12.72	0.038	223.2
4.77	0.095	223.1	12.95	0.037	223.1
5.03	0.094	222.6	13.18	0.036	222.8
5.29	0.095	221.9	13.40	0.034	222.5
5.54	0.094	221.7	13.63	0.033	222.1
5.80	0.098	221.4	13.85	0.035	221.9
6.06	0.103	221.2	14.07	0.030	221.9
6.31	0.104	221.4	14.29	0.028	221.8
6.56	0.106	220.5	14.58	0.026	221.8
6.80	0.099	220.5	14.86	0.022	221.7
7.05	0.099	220.2			
7.30	0.099	221.1			

RESIDUAL STRENGTH TEST

ASTM D3080

Project: Keno Hill District Mill - DSTF

Sample No.: Combined Tailings

Horizontal Displacement (mm)	Vertical Displacement (mm)	Shear Stress (kPa)	Horizontal Displacement (mm)	Vertical Displacement (mm)	Shear Stress (kPa)
0.00	0.000	0.0	7.15	-0.181	217.4
0.17	-0.016	18.0	7.35	-0.180	216.9
0.31	-0.035	28.1	7.54	-0.179	216.7
0.40	-0.061	36.8	7.74	-0.179	216.2
0.49	-0.102	46.5	7.94	-0.179	215.8
0.61	-0.121	54.9	8.15	-0.179	215.3
0.71	-0.146	63.1	8.33	-0.179	214.9
0.81	-0.152	70.9	8.55	-0.181	214.2
0.94	-0.175	78.8	8.75	-0.183	214.3
1.12	-0.190	89.2	8.95	-0.185	213.4
1.31	-0.206	101.3	9.16	-0.187	213.1
1.50	-0.222	116.3	9.36	-0.188	212.7
1.71	-0.235	132.2	9.56	-0.189	212.9
1.82	-0.238	139.5	9.76	-0.190	212.4
1.93	-0.245	146.9	9.96	-0.190	212.2
2.03	-0.249	154.1	10.17	-0.191	212.0
2.14	-0.249	161.1	10.37	-0.191	211.4
2.24	-0.251	167.9	10.58	-0.193	211.4
2.34	-0.256	173.9	10.77	-0.194	211.4
2.45	-0.261	179.4	10.98	-0.195	211.3
2.65	-0.264	189.6	11.17	-0.195	211.1
2.84	-0.256	198.2	11.37	-0.196	211.3
3.06	-0.248	204.5	11.56	-0.197	211.4
3.26	-0.235	209.0	11.74	-0.197	210.8
3.47	-0.226	212.2	11.94	-0.199	210.8
3.69	-0.217	214.1	12.13	-0.200	210.3
3.90	-0.212	214.9	12.32	-0.202	210.3
4.11	-0.207	215.6	12.50	-0.203	210.1
4.31	-0.202	216.5	12.68	-0.204	210.1
4.52	-0.200	217.6	12.87	-0.207	210.1
4.73	-0.196	217.9	13.05	-0.209	210.1
4.94	-0.194	218.0	13.23	-0.211	209.7
5.13	-0.193	218.3	13.41	-0.213	209.2
5.35	-0.192	218.1	13.60	-0.216	209.0
5.55	-0.190	217.9	13.78	-0.219	208.4
5.75	-0.189	218.1	13.96	-0.221	208.4
5.96	-0.188	218.6	14.14	-0.223	208.3
6.16	-0.187	218.1	14.32	-0.225	208.4
6.36	-0.186	218.0	14.50	-0.227	208.3
6.56	-0.186	218.3	14.67	-0.229	208.3
6.75	-0.184	218.1			
6.95	-0.183	217.6			

APPENDIX E

APPENDIX E THERMAL ANALYSIS

TECHNICAL MEMO

EBA, A Tetra Tech Company
14940 - 123 Avenue
Edmonton, AB T5V 1B4 CANADA
p. 780.451.2121 f. 780.454.5688

TO: Bill Horne
C: Gordon Zhang
FROM: Hongwei Xia
DATE: March 28 ,2011
EBA FILE: W14101178.011
SUBJECT: Thermal Analysis of Dry Stacked Tailings Facility Area, Keno Hill Silver District, YT

1.0 INTRODUCTION

EBA, a Tetra Tech Company (EBA) was retained by Alexco Resource Corp. (Alexco) to conduct thermal analyses for the proposed dry-stacked tailings facility (DSTF) area at the Bellekeno mine site in Keno Hill Silver District, Yukon. The purpose of the analysis was to investigate the long-term impact of dry-stacked tailings placement on the thermal regime of the underlying original ground in the DSTF area under climatic conditions including a climate change scenario (global warming). This memo summarizes the methodology, input data, and results of the thermal analyses. Conclusions drawn from the results are also presented in this memo.

2.0 PROJECT DESCRIPTION

2.1 General Site Condition

The proposed DSTF area generally slopes west at approximately 15% to 20%. The overburden thickness in the area varies with locations, typically increasing along the valley bed and decreasing on the valley slope. The overburden thickness in the area approximately ranged from 2 m to 25 m based on the available borehole information. The overburden soil generally consists of a peat or moss layer overlying ice-rich silt, sand, and glaciofluvial gravel underlain by predominately igneous rocks of quartzite (EBA 2010).

2.2 Permafrost Condition

A total of twenty boreholes were drilled at the mine site including ten boreholes drilled in and near the proposed DSTF area. Permafrost was encountered throughout the proposed DSTF area during the site investigation. The permafrost encountered ranged from non-visible, non-excess ice to massive ice lenses. Ice volumes estimated as a percentage of the total soil volume vary between less than 5% and nearly 100%. In eight of the boreholes drilled at the mine site, massive ice was encountered and the thickness of massive ice ranged from 1.0 m to 15 m (EBA 2010). The DSTF was located to avoid most of the ice rich permafrost; however one borehole within the proposed DSTF had a total of 4 m of massive ice below 9.5 m.

2.3 Ground Temperature

Two ground temperature cables (GTCs) were installed at the proposed DSTF area. Ground temperature data measured from the GTCs indicated that the ground temperature near the proposed DSTF area approximately ranged from -0.2°C and -0.4°C (EBA 2010).

2.4 Porewater Salinity

Six salinity tests were performed on the selected samples. The salinity test results indicated that porewater salinity ranged from 1 ppt to 3 ppt. The porewater salinity was assumed to be 2 ppt in the thermal analysis to consider the freezing point depression due to the impact of porewater salinity.

3.0 THERMAL ANALYSES MODEL

3.1 General

Analyses were carried out using EBA's proprietary two-dimensional finite element computer model, GEOTHERM. The model simulates transient, two-dimensional heat conduction with change of phase for a variety of boundary conditions. The heat exchange at the ground surface is modelled with an energy balance equation considering air temperatures, wind velocity, snow depth, and solar radiation. The model facilitates the inclusion of temperature phase change relationships for soils, such that any freezing depression and unfrozen water content variations can be explicitly modelled. The model has been verified by comparing its results with closed-form analytical solutions and many different field observations. The model has successfully formed the basis for thermal evaluations and designs of tailings dykes, dams, foundations, pipelines, utilidor systems, landfills, and ground freezing systems in both arctic and sub-arctic regions.

3.2 Climatic Data Input for Thermal Model

Climatic data required for the thermal analyses includes monthly air temperature, wind speed, solar radiation, and snow cover. No long-term climatic data is available at the DSTF. A meteorological station on Galena Hill in Keno Hill Silver District has been operated since June 2007 at an elevation of approximately 1380 m above sea level to record wind speed, air temperature, relative humidity, barometric pressure, solar radiation, and rainfall. The weather station is close the DSTF; however the weather station is at an elevation approximately 400 m higher. The available climatic data at this station are from June 2007 to November 2010.

Mayo is the closest meteorological station that has a long-term climate record for the region. The station is located at 63° 37' N, 135° 52' W and an elevation of 504 m, which is approximately 40 km northwest of Keno Hill. The station has daily air temperature records from January 1971 to November 2010. Measured long-term air temperatures at the Mayo station were obtained from Environment Canada (<http://www.climate.weatheroffice.ec.gc.ca>).

Comparison of the measured air temperatures between the Mayo station and Galena Hill station for the past four years of the overlapped period indicates that mean air temperatures at the Galena Hill station (1380 m) are approximately 3°C to 5°C warmer than those at the Mayo station (504 m) during winter

periods, and approximately 5°C cooler than those at the Mayo station during summer periods. One possible reason for the temperature discrepancy in winter period is general winter temperature inversion in the Yukon where temperatures increase with height during winter (Wahl et al, 1987). Analysis of a 43-year period of data (1958-2000) from Whitehorse shows a long-term average lapse rate of approximately +8°C/km up to an elevation of 1500 m during the winter (Pinard, 2009). The positive sign indicates a warming with elevation, or an inversion. Long-term mean monthly air temperatures for this study were estimated based on the long-term monthly air temperatures at Mayo and then adjusted the air temperatures based on the measured monthly air temperature differences between the Mayo and Galena Hill stations during the overlapped period of 2007 to 2010.

Measured wind speed data from the Galena Hill station is available from June 2007 to September 2010. Long-term mean wind speed data is available from 1971-2000 at the Mayo station. Comparison between the measured wind speed data from the Mayo and Galena Hill stations indicated that the measured wind speed at the Mayo and Galena stations are very similar; therefore, the measured wind speed data at Galena Hill station were used in the thermal analysis.

No snow depth data is available from the Galena Hill station. The climate records from available climate stations near the Keno Hill Silver District shows a linear relationship can be established between mean annual precipitation and elevation at these available stations. The mean annual precipitation increases by an average 27 mm for every 100 m of elevation increasing (ACCESS 2009). Snow depth were predicted based on the snow depth data from Mayo station using the linear relationship.

Norman Wells and Whitehorse are the closet stations to the Keno Hill Silver District with long-term solar radiation data. The measured solar radiation data from the Galena Hill station is available between June 2007 and September 2010. Comparison of the available solar radiation data from the three stations indicated that the measured solar radiation data from the Galena Hill is close to these from Norma Wells and Whitehorse. Therefore, the average monthly solar radiation data from the three stations was used in this study.

The mean climatic data estimated for the DSTF for this study are summarized in Table 1.

Table 1: Mean Climatic Conditions at Keno Hill Used in Thermal Analyses

Month	Estimated Mean Monthly Air Temperatures at Keno Hill (1971 to 2007) ^(a) (°C)	Measured Monthly Air Temperature at Keno Hill (2007-2010) ^(b) (°C)	Measured Monthly Wind Speed at Keno Hill ^(c) (km/h)	Estimated Monthly Snow Cover at Keno Hill ^(d) (m)	Estimated Daily Solar Radiation at Keno Hill ^(e) (W/m ²)
January	-14.7	-16.7	7.7	0.57	9.1
February	-14.0	-14.3	5.4	0.57	38.3
March	-14.4	-12.2	12.4	0.53	101.4
April	-4.9	-3.8	11.8	0.41	181.8
May	3.4	4.1	8.8	0	233.5
June	9.6	9.0	7.5	0	242.9
July	10.8	10.7	8.2	0	218.4
August	8.0	8.1	8.7	0	162.0
September	1.9	2.3	8.5	0	96.4
October	-5.1	-6.2	8.0	0.34	41.5
November	-13.6	-10.5	8.9	0.48	13.2
December	-10.2	-15.2	5.5	0.56	4.5
Annual	-3.6	-3.7			

Notes:

- (a) Based on measured monthly air temperatures at Mayo for the periods of 1971 to 2010, measured air temperatures at Galena Hill station for the period of 2007 to 2010
- (b) Based on measured temperature data at Galena Hill station (2007-2010)
- (c) Based on measured data at Galena Hill station for the period of 2007 to 2010
- (d) Based on mean month-end snow data at Mayo (Climate Normals 1971-2000, Environment Canada website) and environmental conditions report (Access Consulting Group, 2009)
- (e) Based on measured data at Galena Hill station (2007-2010), Norman Wells and Whitehorse (1951-1980)

3.3 Climate Change Projection

The historical air temperature data at Mayo for the period of 1970 to 2010 indicated that the long-term climatic trend at Mayo is warming, and a similar conclusion can be made at Keno Hill DSTF. Based on the observed warming trend in the historical air temperatures and state-of-practice, the thermal evaluations for this project should consider the long-term effects of climate change (or global warming).

The Adaptation and Impacts Research Section (AIRS) of Environment Canada recently produced a report (Environment Canada 2009) summarizing findings from the most recent modelling assessment for the Arctic. AIRS adopted an ensemble approach (multi-model means/medians) to reduce the uncertainty associated with any individual model. Model validation over the historical period from 1971-2000 was first used to identify those models which best reproduced the mean annual temperature of this period against the National Centre for Environmental Prediction global gridded dataset. Subsequently, only the four best-agreement models were used to produce the final ensemble projections. The four best ranking models within each sector were then used as an ensemble to produce projections of temperature change in

the 2020s, 2050s, and 2080s for both the 'A1B' (middle of the road emission), and 'A2' (high emission) scenarios. CSA (2010) adopted the climate change projections in Environment Canada (2009).

The Keno Hill site (63° N 135° W) is located at the arctic zone W1 in Environment Canada (2009) and CSA (2010). The predicted mean temperature changes from 1970-2000 baseline under the moderate greenhouse gas emission scenario in zone W1 (CSA 2010) are presented in Table 2. These rates of the predicted temperature change were applied in the thermal evaluations. Table 3 summarizes the estimated monthly air temperatures at Keno Hill during the period of 1971 to 2000, 1981 to 2010, and in 2013 considering the rates of the projected climate changes in the period of 2011 to 2040. Comparing the estimated air temperatures in 2013 with the recent measured air temperatures at the Galena Hill station (2007 to 2010) indicates that the estimated mean annual air temperature is slightly colder than the measured at the Galena Hill station. This suggests that the projected air temperature changes for the period of 2011 to 2040 may not be conservative.

Table 2 Predicted Seasonal Air Temperature Changes in Zone W1 (CSA 2010)

Period	Predicted Seasonal Air Temperature Changes from 1971-2000 Baseline under Moderate Green-house Gas Emission Scenario (°C)			
	Winter	Spring	Summer	Autumn
2011–2040	0.9	0.9	0.6	0.6
2041–2070	2.3	2.0	1.6	2.2
2070-2100	4.3	2.8	2.5	2.9

Table 3: Estimated Monthly Air Temperatures at Keno Hill

Month	Estimated Mean Monthly Air Temperature at Keno Hill (1971-2000) (°C) ¹	Estimated Mean Monthly Air Temperature at Keno Hill (1981-2010) (°C) ²	Estimated Mean Monthly Air Temperature at Keno Hill in 2013 Based on Projected Climate Change and 1971-2000 Air Temperatures (°C) ³
January	-18.9	-15.1	-18.3
February	-15.4	-14.0	-14.8
March	-12.9	-13.7	-12.3
April	-4.7	-4.6	-4.1
May	3.1	3.6	3.7
June	8.6	9.5	9.1
July	10.8	10.7	11.2
August	7.7	7.9	8.2
September	1.7	2.0	2.1
October	-6.6	-5.3	-6.2
November	-14.4	-12.9	-14.0
December	-14.8	-11.3	-14.2
Annual	-4.6	-3.6	-4.1
1. Based on Mayo 1971 to 2000, adjusted to Keno using Galena Hill Data 2. Based on Mayo 1981 to 2010, adjusted to Keno using Galena Hill Data 3. Based on Mayo 1971 to 2000, adjusted to Keno using Galena Hill Data plus climate change estimate			

4.0 CALIBRATION THERMAL ANALYSIS

A thermistor cable was installed on August 29, 2009 to a depth of 9.4 m in Borehole BH23 within the footprint of the proposed DSTF area. One-dimensional thermal analysis was used to calibrate the thermal model with measured ground temperatures at BH23.

The soil profile at BH23 for the calibration thermal analysis consisted of a 0.5 m peat layer overlying 2.4 m ice rich sand and silt, 2.4 m sand, 2.3 m sand and silt, 0.4 m gravel, 1.3 m silt, and 7.7 m gravel over bedrock.

The material properties used in the analysis are presented in Table 4. The index soil properties were estimated from borehole logs and past experience with similar soils. The soil thermal properties were determined indirectly from well-established correlations with soil index properties (Farouki, 1986; Johnston, 1981).

Table 4: Material Properties Used in Thermal Calibration Analysis for BH23

Material	Water Content (%)	Bulk Density (Mg/m ³)	Thermal Conductivity (W/m-°C)		Specific Heat (kJ/kg°C)		Latent Heat (MJ/m ³)
			Frozen	Unfrozen	Frozen	Unfrozen	
Peat	130	0.8	0.57	0.31	1.92	3.10	152
Silt and Sand No. 1	60	1.65	2.35	0.96	1.24	2.03	206
Sand	17	2.16	2.48	1.57	0.93	1.23	105
Silt and Sand No. 2	17.1	2.17	2.48	1.57	0.93	1.24	106
Gravel No. 1	10	2.31	2.67	2.01	0.86	1.05	70
Silt	10	2.20	2.23	1.74	0.86	1.05	67
Gravel No. 2	8	2.32	2.46	2.02	0.83	0.99	57
Bedrock	1	2.63	4.00	4.00	0.75	0.77	9

Table 5 compares the predicted and measured ground temperatures on December 27, 2009 and February 23, 2011 at BH23.

Table 5: Measured and Predicted Ground Temperatures at BH23

Depth below Ground Surface (m)	Measured on Dec. 27, 2009 (°C)	Predicted on Dec. 27, 2009 (°C)	Measured on Feb. 23, 2011 (°C)	Predicted on Feb. 23, 2011 (°C)
-0.4	-2.63	-2.43	-3.0	-2.94
-1.4	-0.20	-0.30	N/A	-0.35
-2.4	-0.33	-0.33	-0.27	-0.32
-3.4	-0.39	-0.35	-0.33	-0.32
-4.4	-0.42	-0.35	-0.37	-0.33
-5.4	-0.41	-0.35	-0.35	-0.33
-6.4	-0.40	-0.35	-0.34	-0.33
-7.4	-0.37	-0.35	-0.32	-0.33
-8.4	-0.32	-0.33	-0.30	-0.32
-9.4	-0.30	-0.33	-0.31	-0.32

Good agreement was obtained between the measured and predicted ground, which suggests that the thermal model is reasonable and can be used in the thermal evaluations for other locations at the mine site.

5.0 THERMAL ANALYSIS FOR DRY-STACKED TAILINGS FACILITY AREA

5.1 General

The purposes of the thermal evaluation are to investigate the impact of tailing placement on the thermal regime of the original ground and to predict the permafrost thaw rate under climatic conditions including the climate change scenario.

The following schedules and assumptions for the dry-stacked tailings facility area were adopted in the thermal analyses:

- Removing trees in the tailings placement area;
- Placing 0.5 m sand and gravel fill as drainage blanket over the area in February 2011;
- Placing tailings overlying the sand and gravel blanket beginning in June 2011;
- The total height of placed tailings was assumed to be 10 m by 2013;
- The initial temperature for sand and gravel drainage blanket was assumed to be -5°C; and
- The initial temperature for dry stacked tailings was assumed to be +20 °C.

Several cases were run in the thermal analyses to investigate the impact of tailings placement under different climate conditions as summarized in Table 6.

Table 6: Cases Simulated in Thermal Modelling

Case	Mean Monthly Air Temperatures Used	Vegetation Layer Cover	Running Time
1	1971-2000	Yes	Long-Term (100 years)
2	1971-2000	No	Long-Term (100 years)
3	Climate Change	Yes	Long-Term (100 years)
4	Climate Change	No	Long-Term (100 years)
5	1981-2010	Yes	Long-Term (100 years)
6	1981-2010	No	Long-Term (100 years)

5.2 Thermal Analysis

One-dimensional analyses were carried out for a representative soil profile based on BH35 drilled in the proposed DSTF area. The soil profile at BH35 consisted of a 1.0 m peat layer overlying 9.5 m ice rich silt, 1.0 m massive ice, 1.8 m silt and gravel, 2.7 m massive ice, 3.0 m gravel, 2.2 m silt and gravel, and 1.0 m sand over bedrock.

The index properties for the sand and gravel drainage blanket and dry-stacked tailings have been estimated from limited available information (Jim, 2005) and past experience. Thermal properties of the

material were determined indirectly from well-established correlations with their index properties. Table 7 summarizes the material properties used in the thermal analyses.

Table 7: Material Properties Used in Thermal Analyses

Material	Water Content (%)	Bulk Density (Mg/m ³)	Thermal Conductivity (W/m-°C)		Specific Heat (kJ/kg°C)		Latent Heat (MJ/m ³)
			Frozen	Unfrozen	Frozen	Unfrozen	
Dry-stack Tailings	17	1.98	3.20	1.90	0.93	1.23	96
Sand and Gravel (Fill)	5	2.10	1.33	1.50	0.80	0.90	33
Peat before thaw consolidation	150	0.75	0.49	0.30	1.92	2.19	150
Peat after thaw consolidation	60	1.60	2.36	1.02	1.24	2.03	200
Silt (Till)	40	1.81	2.36	1.12	1.12	1.72	172
Ice		0.91	2.20	10.0	2.10	4.20	334
Silt and Gravel No 1	10	2.25	2.21	1.71	0.86	1.05	68
Gravel	10	2.31	2.67	2.00	0.86	1.05	70
Silt and Gravel No 2	15.5	2.19	2.59	1.70	0.92	1.20	98
Sand	10	2.25	2.27	1.73	0.86	1.05	68
Bedrock	1	2.63	4.00	4.00	0.75	0.77	9

5.3 Results and Discussions

One-dimensional thermal analyses were conducted for all six cases listed in Table 6. The predicted thaw rate and permafrost condition for each case are summarized in Table 8.

Table 8: Predicted Thaw Rate and Permafrost Condition in DSTF Area

Case	Mean Monthly Air Temperature Used	Vegetation Layer Cover	Thaw Rate in Soils (m/year)	Predicted Permafrost Condition
1	1971-2000	Yes	0.0 m/year (2013-2025) 0.15 m/year (2025-2038) 1.8 m/year (2038-2042)	Permafrost in soils would disappear in 29 years; the ice layer would disappear in 53 years
2	1971-2000	No	0.0 m/year (2013-2018) 0.17 m/year (2018-2036) 1.5 m/year (2036-2040)	Permafrost in soils would disappear in 27 years; the ice layer would disappear in 50 years
3	Climate Change	Yes	0.0 m/year (2013-2015) 0.13 m/year (2018-2034) 1.4 m/year (2034-2039)	Permafrost in soils would disappear in 26 years; the ice layer would disappear in 50 years
4	Climate Change	No	0.0 m/year (2013-2016) 0.17 m/year (2016-2036) 1.4 m/year (2036-2040)	Permafrost in soils would disappear in 27 years; the ice layer would disappear in 48 years
5	1981-2010	Yes	0.0 m/year (2013-2022) 0.16 m/year (2022-2039) 2.1 m/year (2037-2040)	Permafrost in soils would disappear in 27 years; the ice layer would disappear in 50 years
6	1981-2010	No	0.0 m/year (2013-2016) 0.17 m/year (2016-2032) 2.1 m/year (2032-2035)	Permafrost in soils would disappear in 22 years; the ice layer would disappear in 46 years

The following conclusions can be drawn from the thermal analysis results:

- 1) The predicted thaw depth below the original ground surface is 1.5 m by 2013 when the tailings placement in the study area is assumed to be completed.
- 2) The predicted rate of thaw into the permafrost soils is negligible during first several years after completion of the tailings placement and then starts to increase with time after that period.
- 3) The predicted rate of thaw into the permafrost interval from 1.5 m to 4.5 m below the original ground surface ranges from 0.13 m/year to 0.17 m/year, with an average of 0.15 m/year.

- 4) The predicted thaw rate dramatically increases after the top 4.5 m permafrost soils are completely thawed. The predicted rate of thaw into the depth interval from 4.5 m to 10.5 m below the original ground surface ranges from 1.4 m/year to 2.1 m/year, with an average of 1.7 m/year.
- 5) The permafrost in the soil layers is predicted thaw within 30 years but the ice layer is predicted to be thawed within 55 years under the climatic conditions evaluated.
- 6) Evapo-transpirative cover layer would slightly delay the permafrost degradation for several years.

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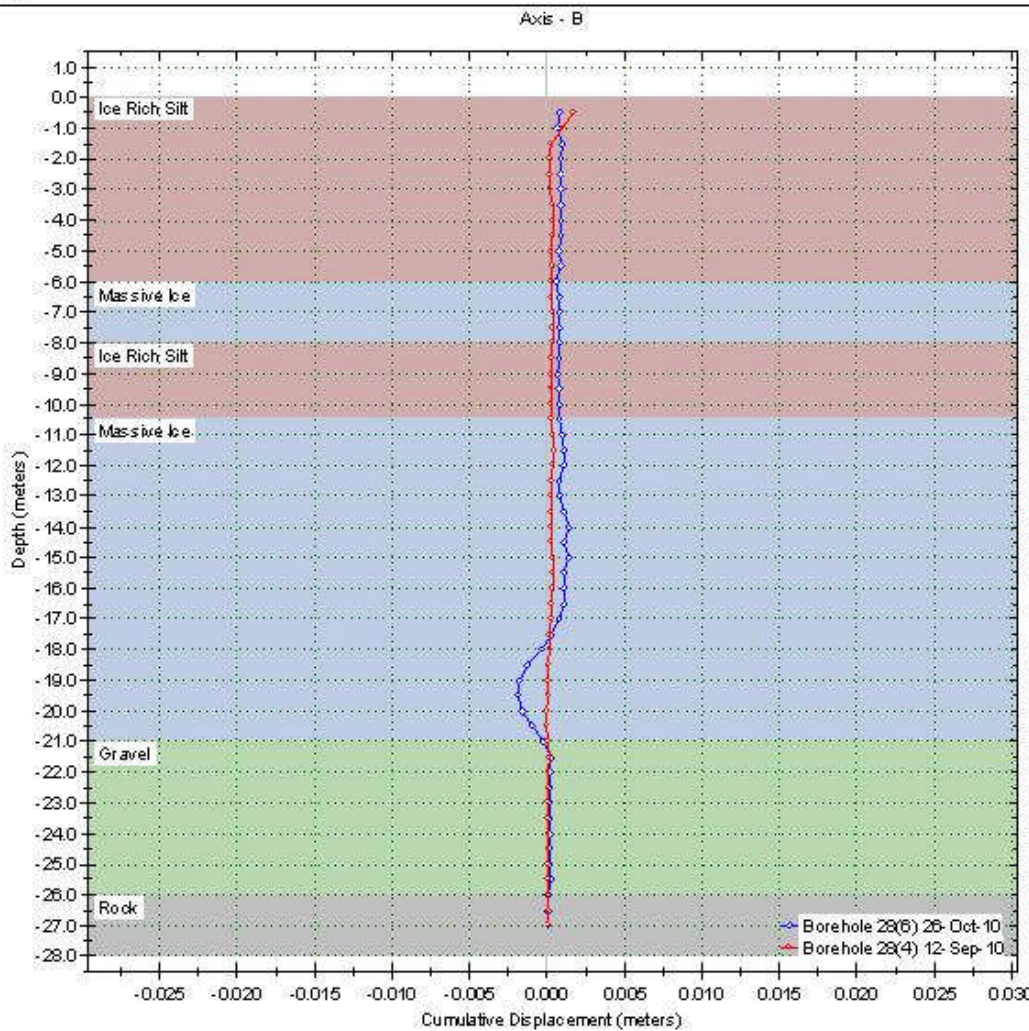
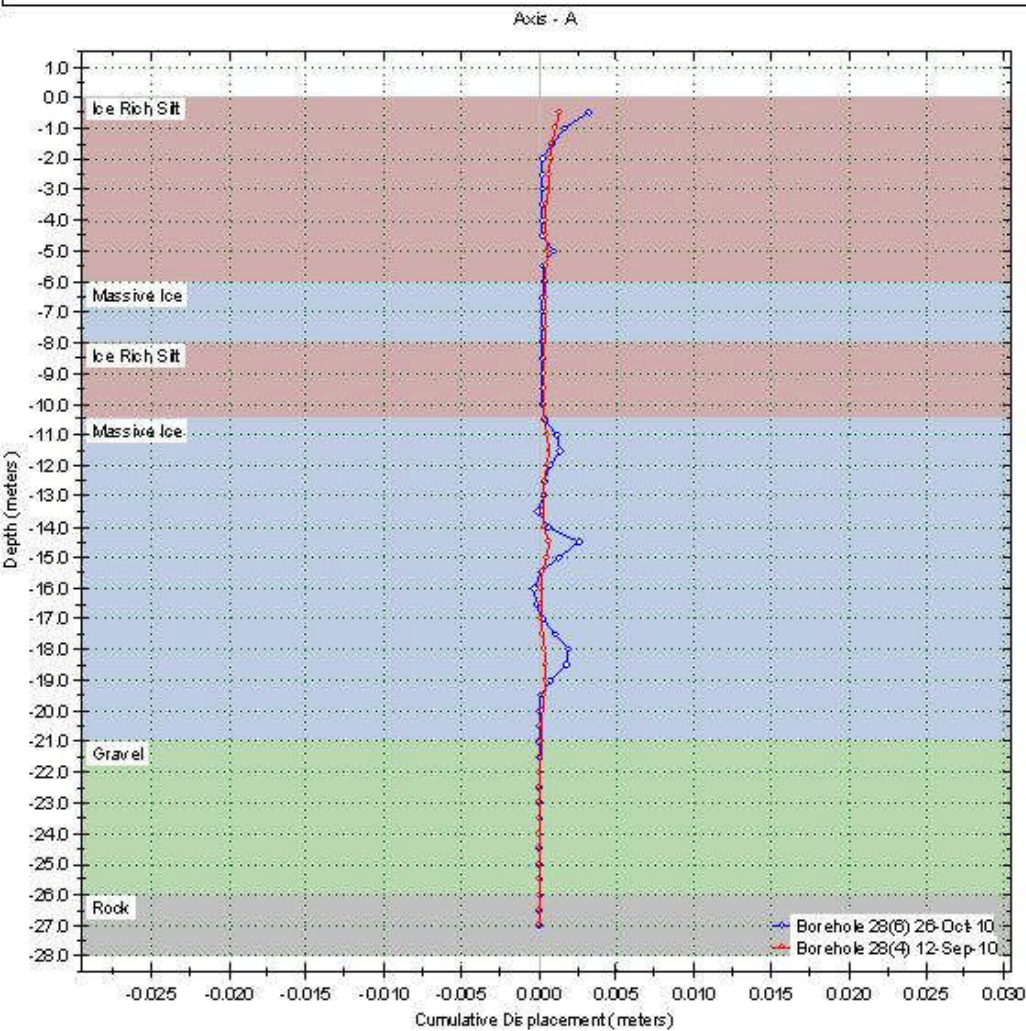
APPENDIX F

APPENDIX F SLOPE INCLINOMETER DATA

Borehole : Borehole 28
Project : Keno Hill District Mill
Location : DSTF
Northing : 7086985
Easting : 484026
Collar :

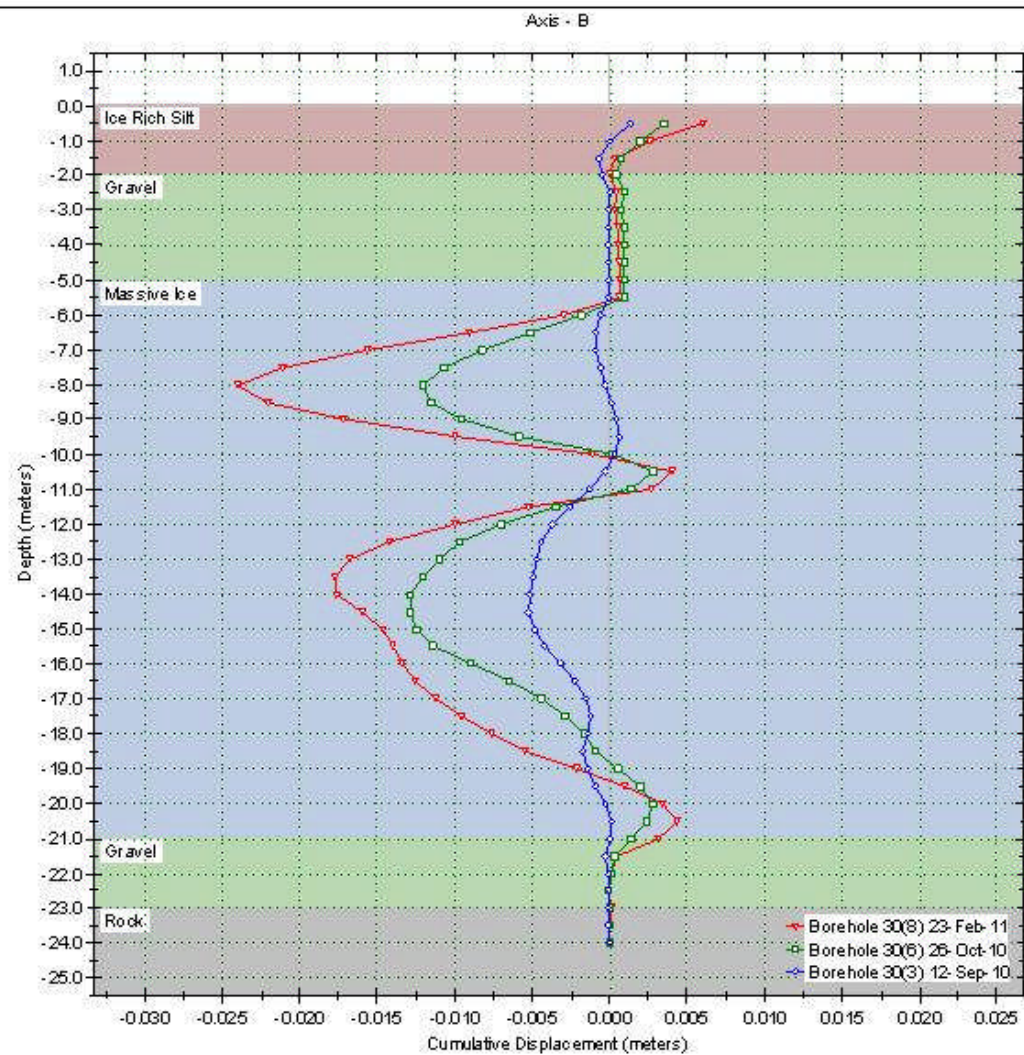
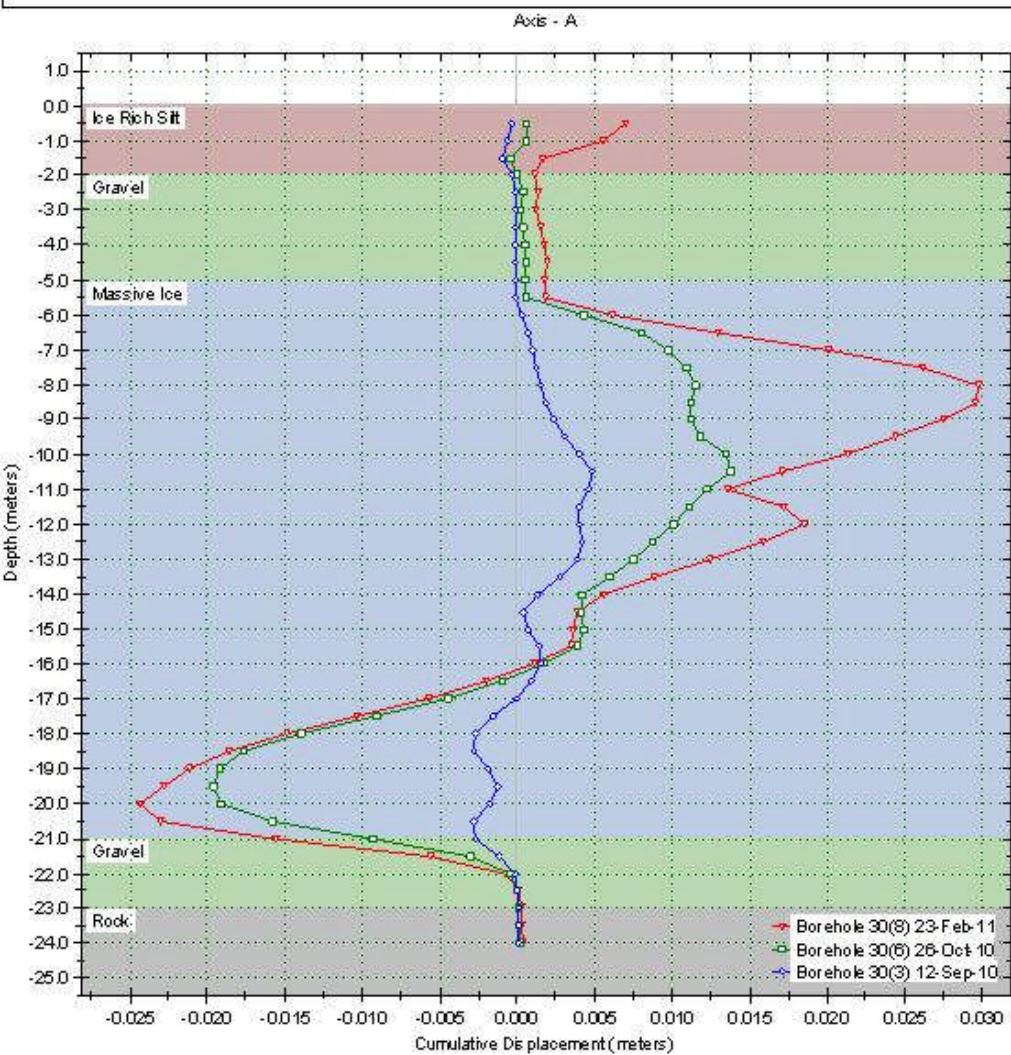
Spiral Correction : N/A
Collar Elevation : 0.0 meters
Borehole Total Depth : 27.0 meters
North Groove Azimuth :
Base Reading : 2010 Sep 07 10:08
Axis A Azimuth : 0.0 degrees

SI Installed August 22



Borehole : Borehole 30
Project : Keno Hill District Mill
Location : DSTF
Northing : 7087032
Easting : 483969
Collar :

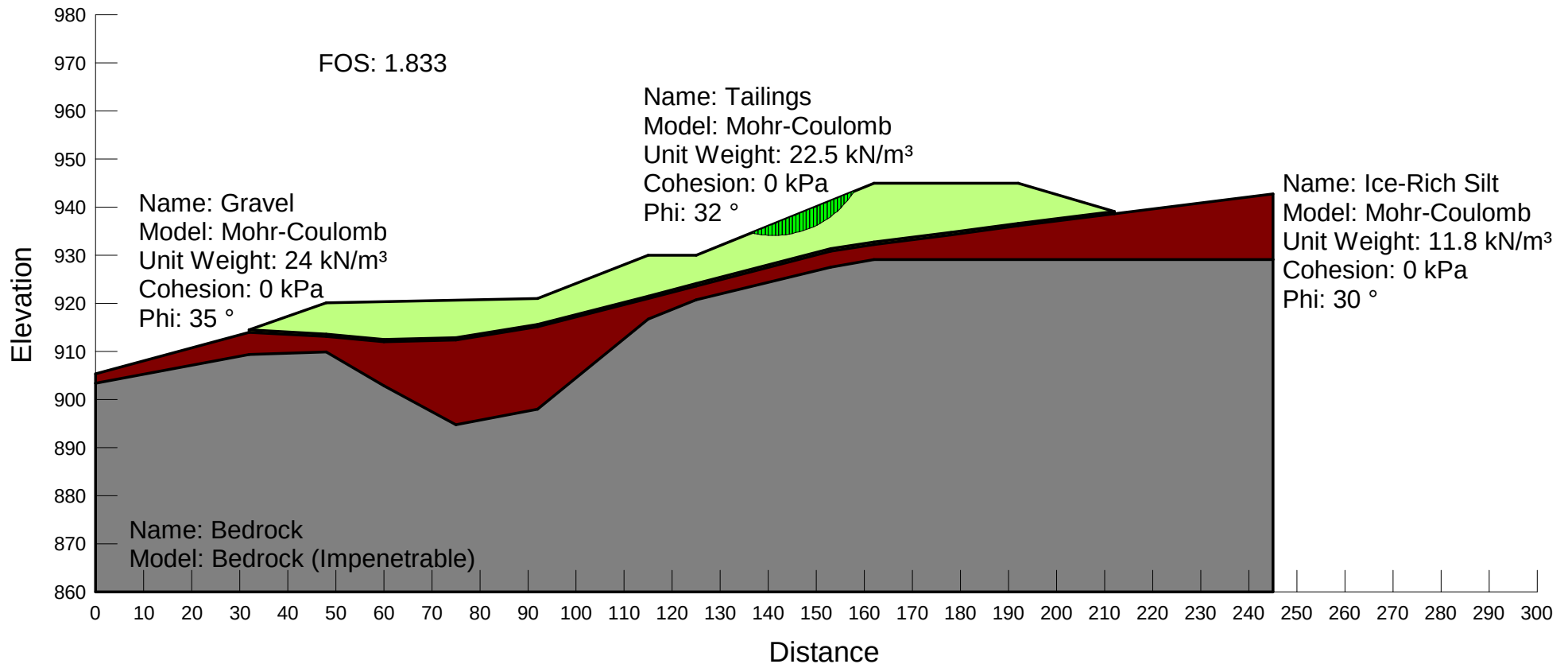
Spiral Correction : N/A
Collar Elevation : 0.0 meters
Borehole Total Depth : 24.0 meters
North Groove Azimuth :
Base Reading : 2010 Sep 09 13:32
Axis A Azimuth : 0.0 degrees



APPENDIX G

APPENDIX G SLOPE STABILITY RESULTS – PERMAFROST CONDITION

Name: Alignment A
Description: Static w/o PWP Conditions (Frozen State)
File Name: W14101178.011_AlignmentA_R04A2_Static_NoPWP.gsz
Method: Morgenstern-Price
Horz Seismic Load: 0
PWP Conditions Source: (none)
Length(L) Units: meters
Horizontal Scale: 1250
Vertical Scale: 1250
Minimum Slip Surface Depth: 1 m



Name: Alignment B

Description: Static w/o PWP Conditions (Fully Frozen)

File Name: W14101178.011_AlignmentB_R04A2_Static_NoPWP.gsz

Method: Morgenstern-Price

Horz Seismic Load: 0

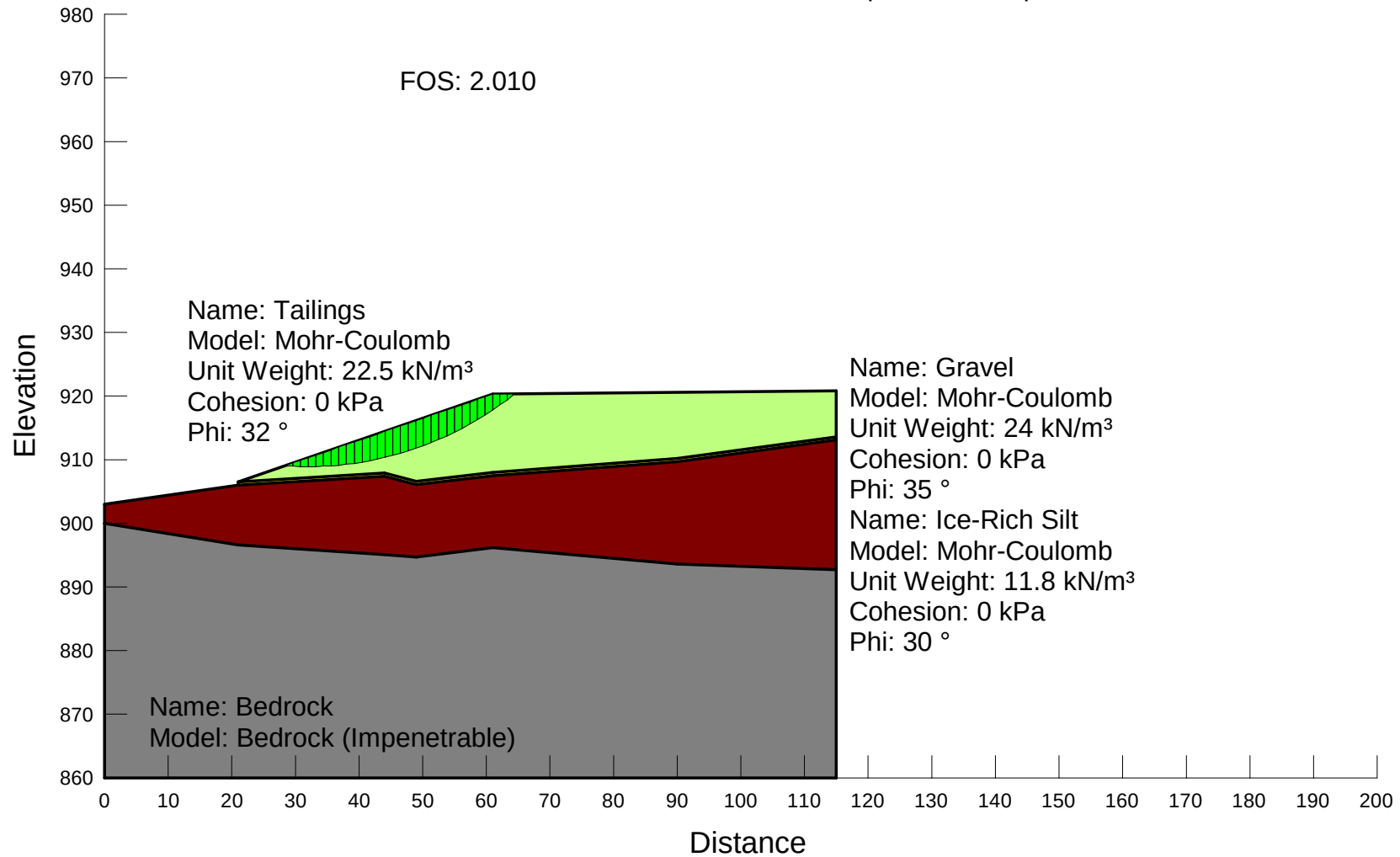
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Length(L) Units: meters

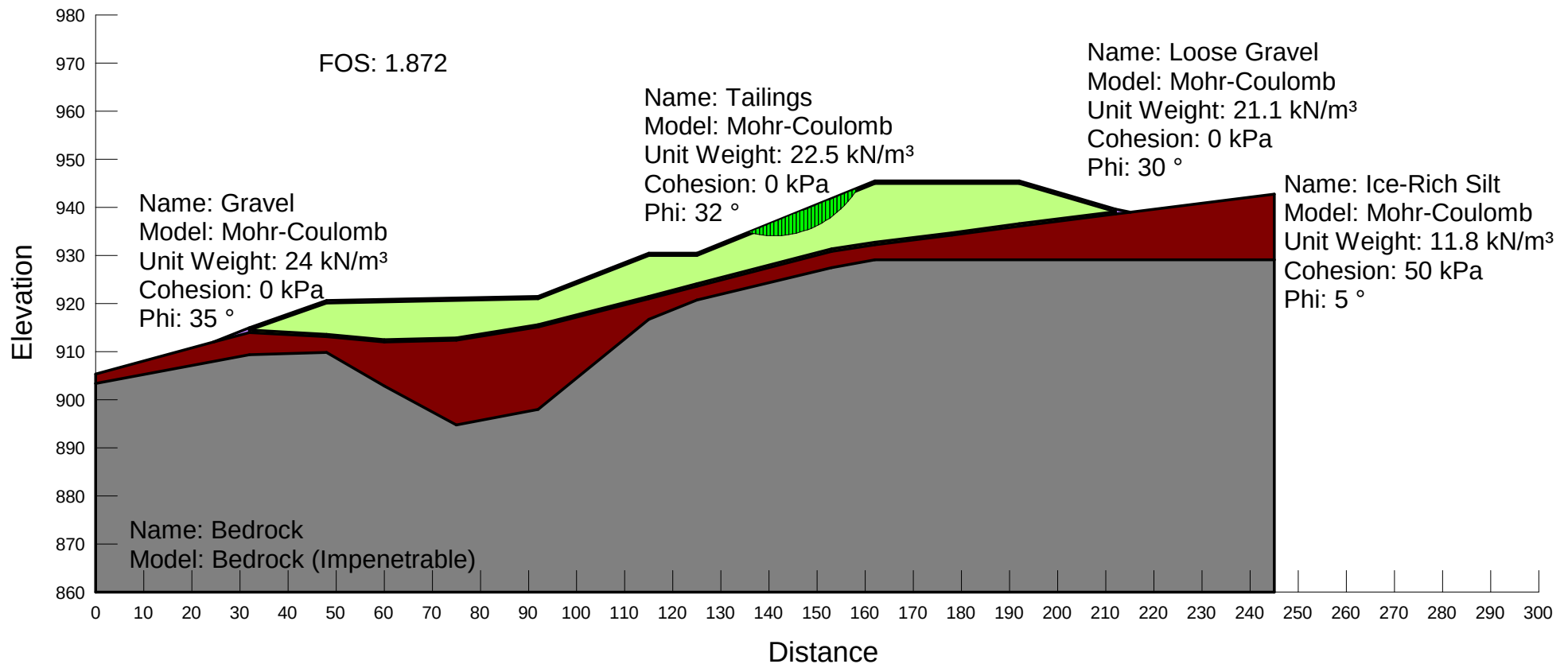
Horizontal Scale: 1000

Vertical Scale: 1000

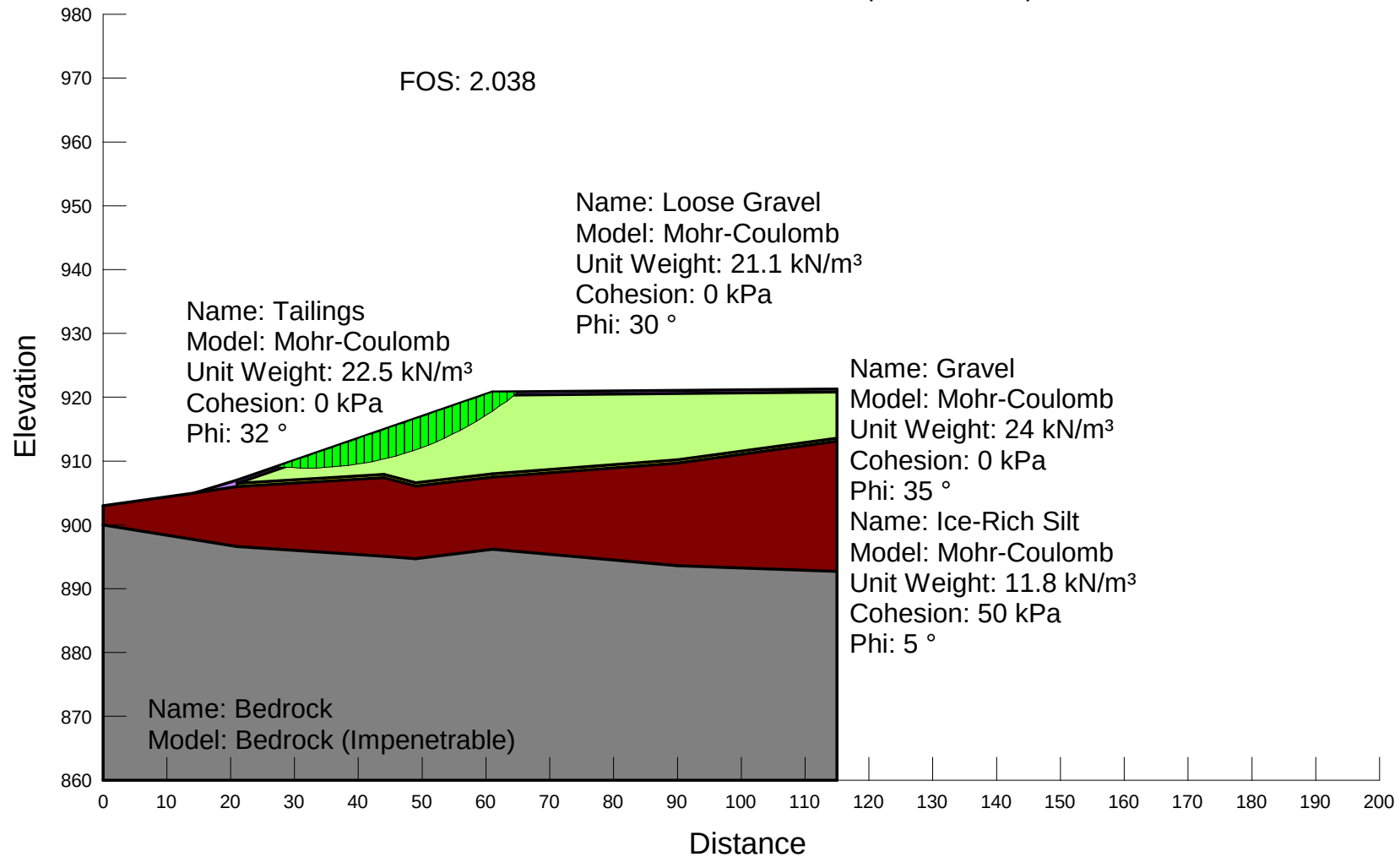
Minimum Slip Surface Depth: 1 m



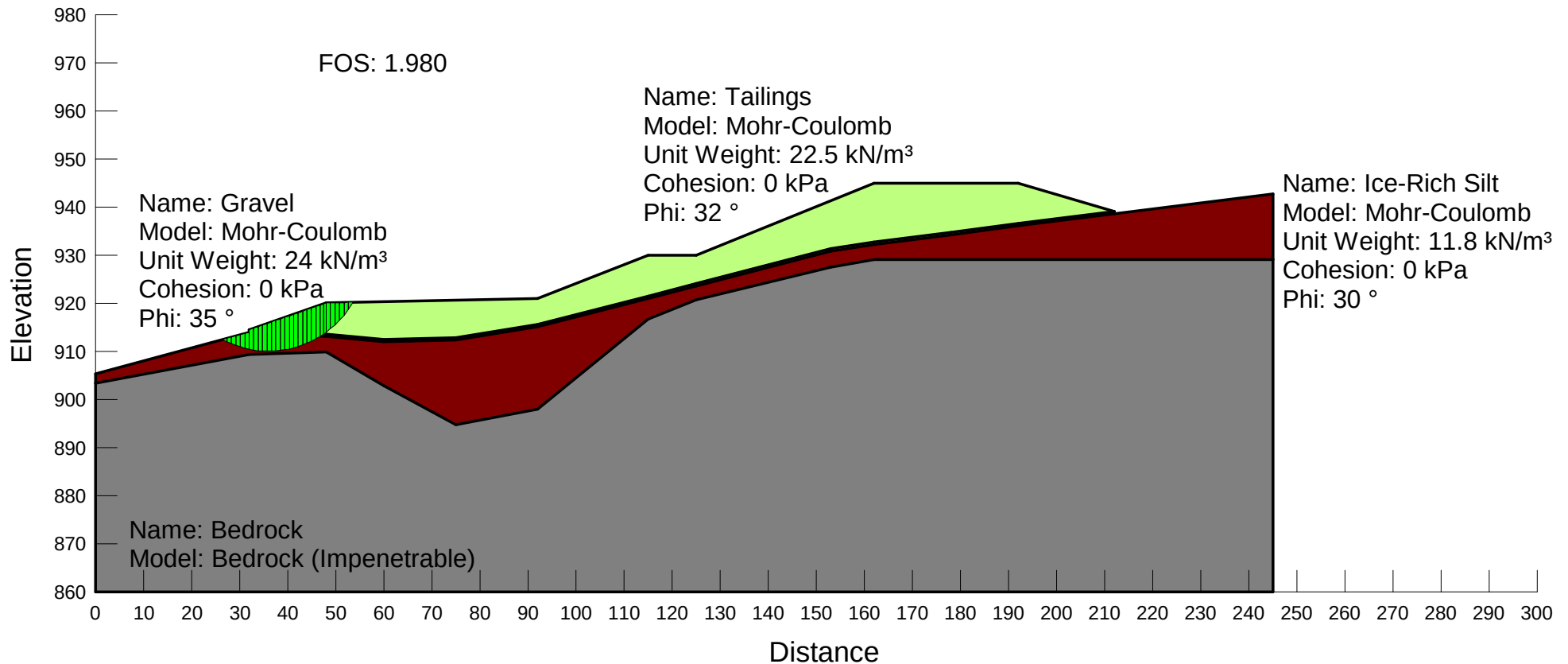
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PWP Conditions Source: (none)
Length(L) Units: meters
Horizontal Scale: 1250
Vertical Scale: 1250
Minimum Slip Surface Depth: 1 m



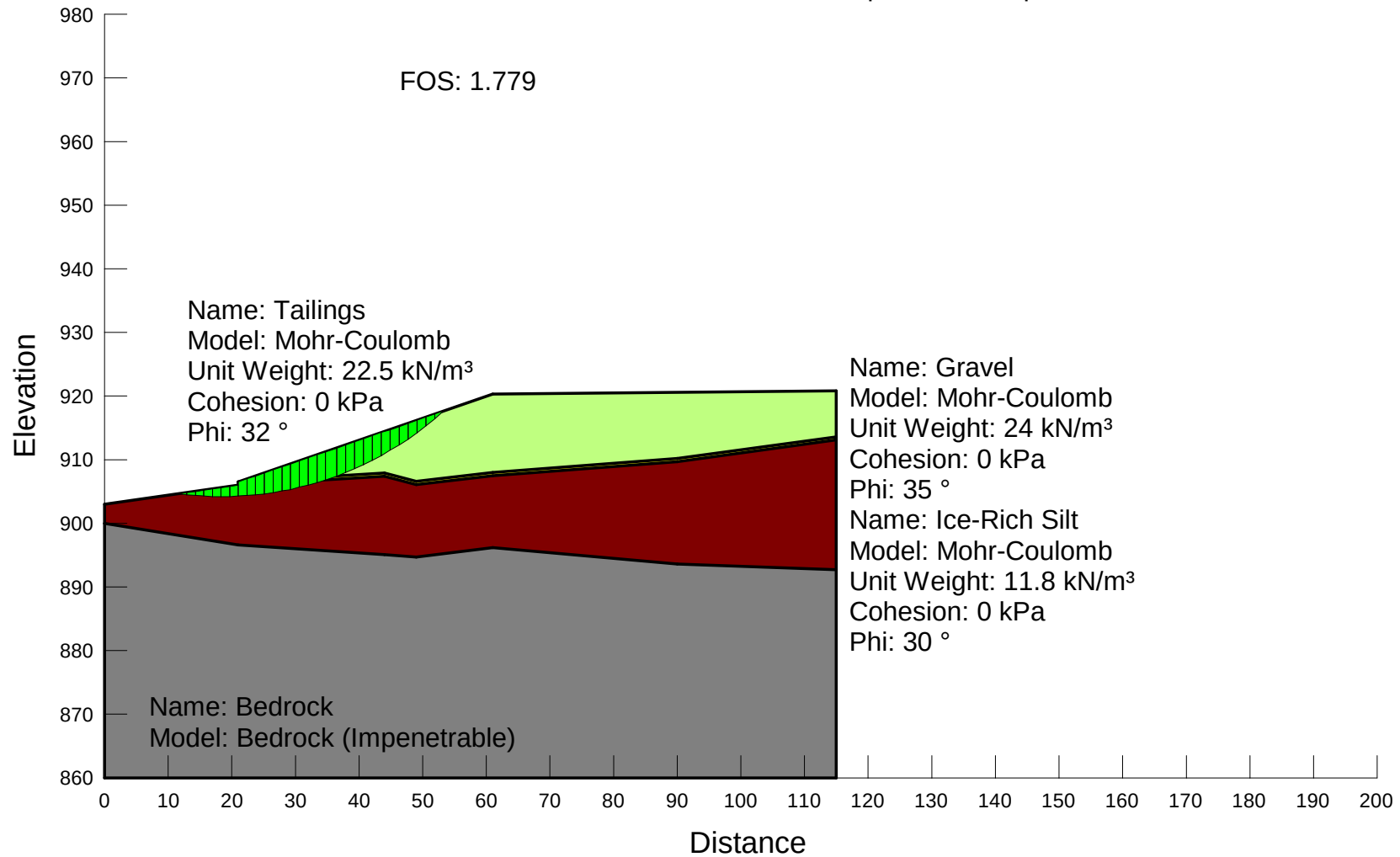
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Method: Morgenstern-Price
Horz Seismic Load: 0
PWP Conditions Source: (none)
Length(L) Units: meters
Horizontal Scale: 1000
Vertical Scale: 1000
Minimum Slip Surface Depth: 1 m



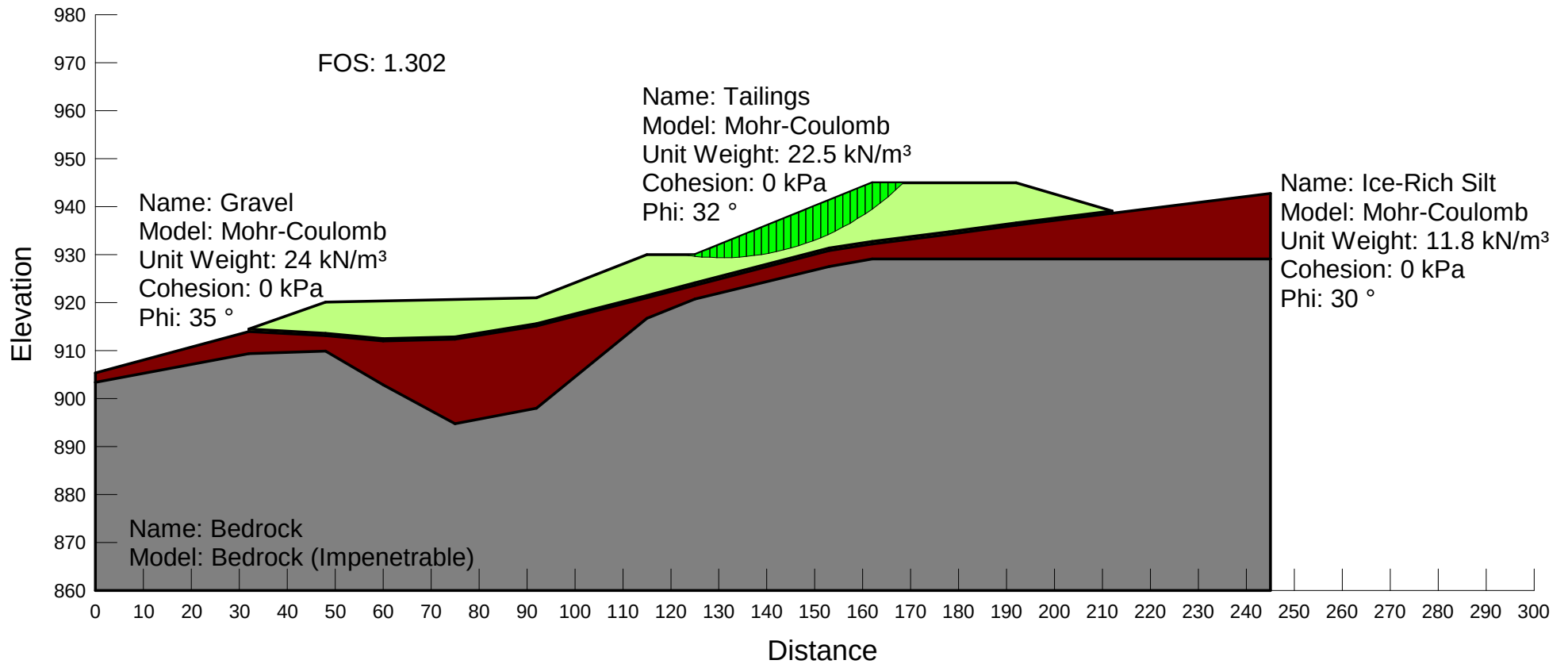
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PWP Conditions Source: (none)
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Horizontal Scale: 1250
Vertical Scale: 1250
Minimum Slip Surface Depth: 1 m



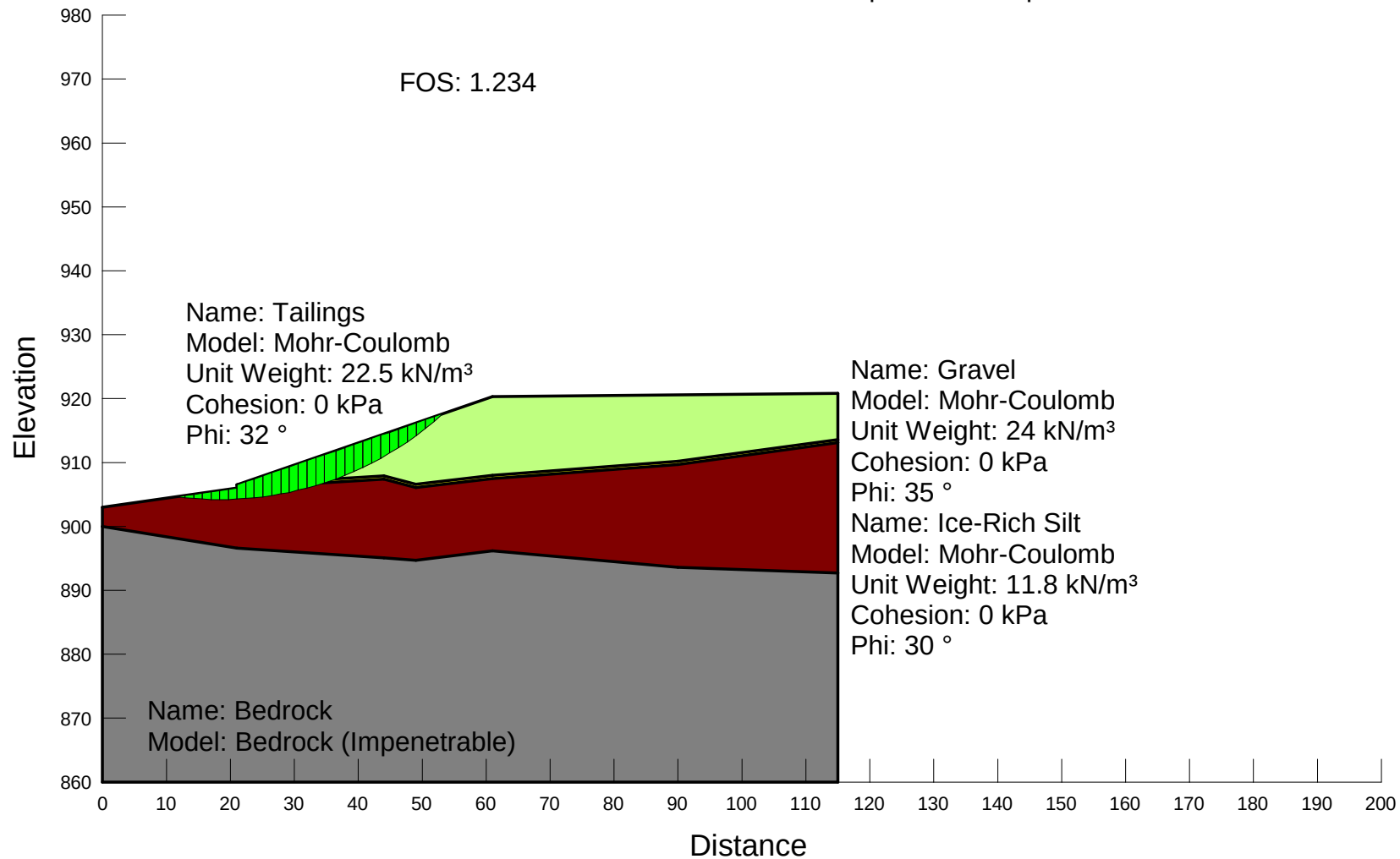
Name: Alignment B
Description: Static w/o PWP Conditions (Fully Frozen)
File Name: W14101178.011_AlignmentB_R04A1_Static_NoPWP.gsz
Method: Morgenstern-Price
Horz Seismic Load: 0
PWP Conditions Source: (none)
Length(L) Units: meters
Horizontal Scale: 1000
Vertical Scale: 1000
Minimum Slip Surface Depth: 1 m



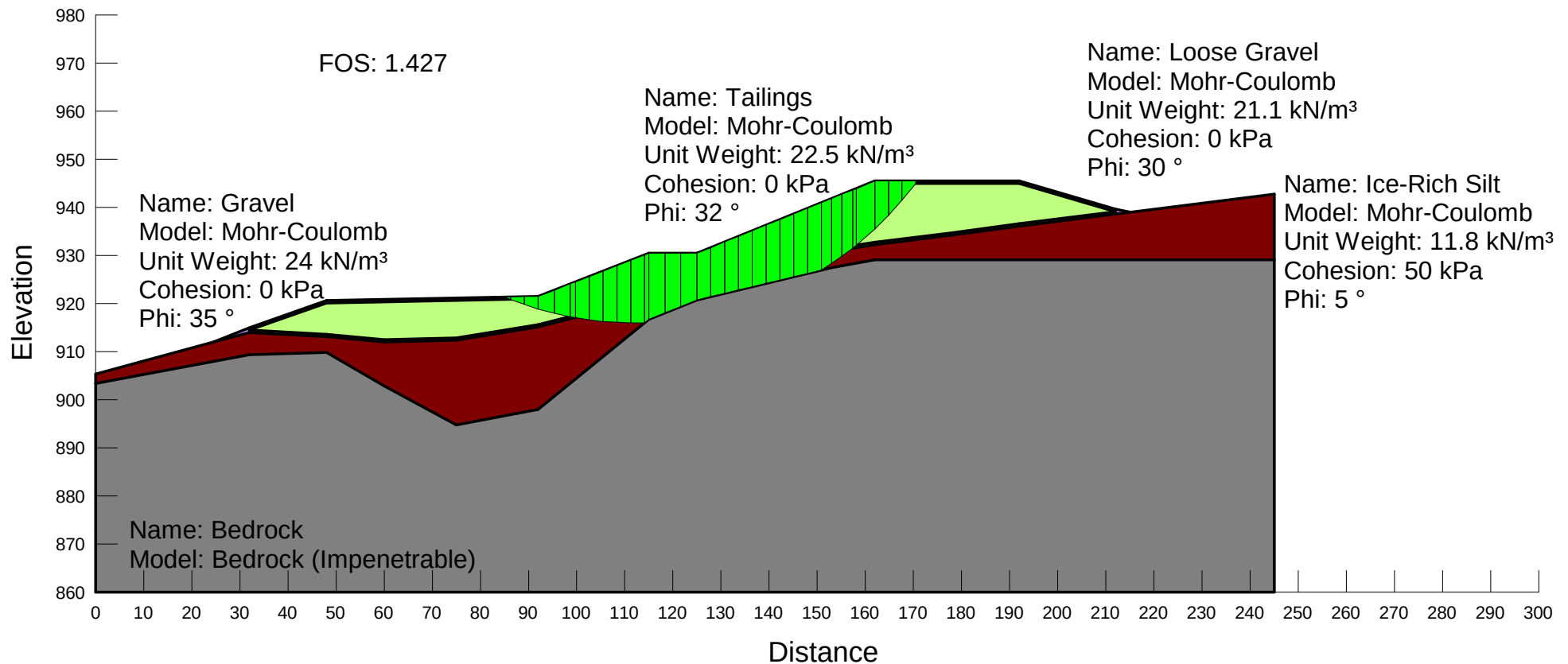
Name: Alignment A
Description: Dynamic (1:475) w/o PWP Conditions (Frozen State)
File Name: W14101178.011_AlignmentA_R04C_Dynamic475_NoPWP.gsz
Method: Morgenstern-Price
Horz Seismic Load: 0.138
PWP Conditions Source: (none)
Length(L) Units: meters
Horizontal Scale: 1250
Vertical Scale: 1250
Minimum Slip Surface Depth: 1 m



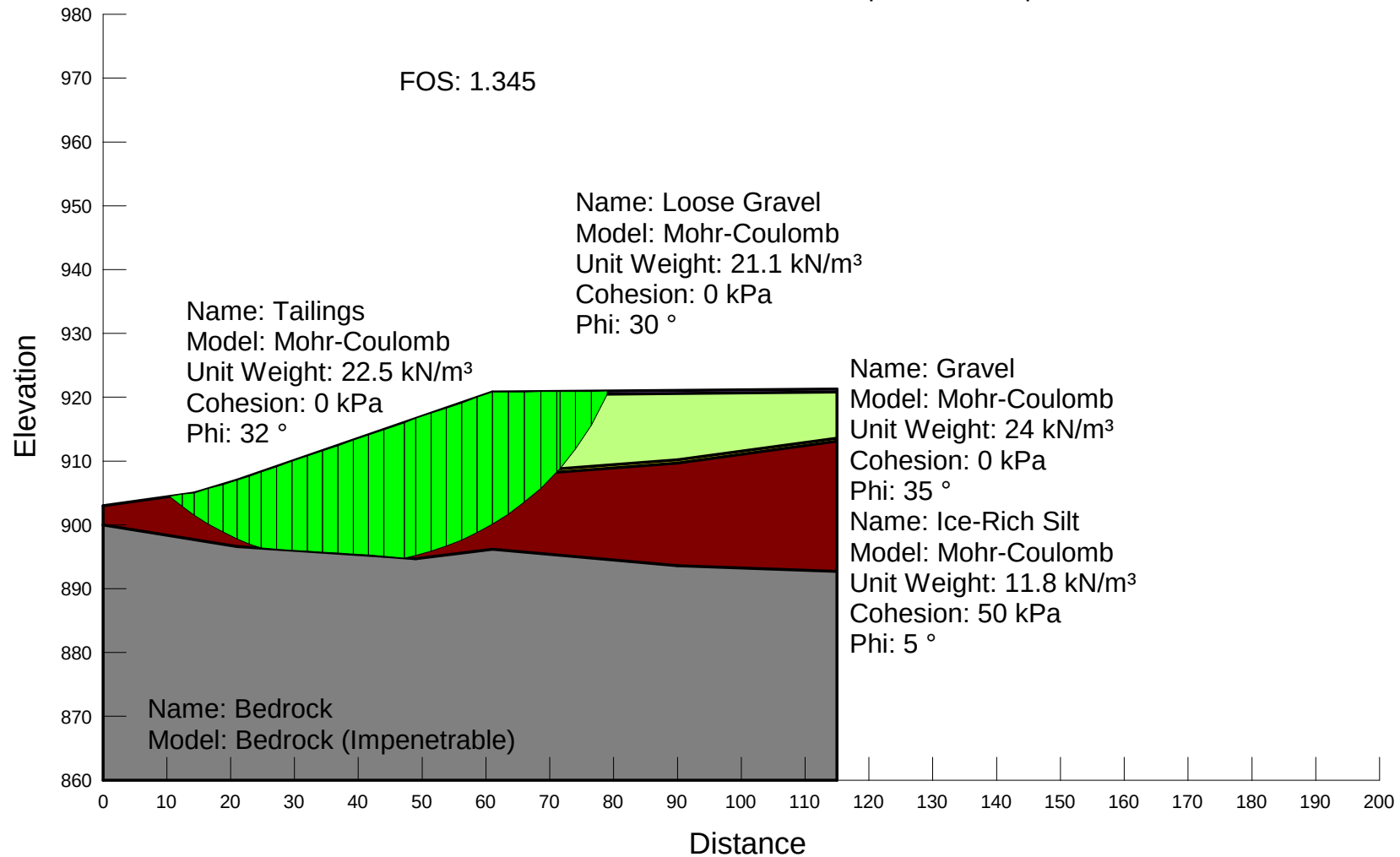
Name: Alignment B
Description: Dynamic (1:475) w/o PWP Conditions (Fully Frozen)
File Name: W14101178.011_AlignmentB_R04C_Dynamic475_NoPWP.gs
Method: Morgenstern-Price
Horz Seismic Load: 0.138
PWP Conditions Source: (none)
Length(L) Units: meters
Horizontal Scale: 1000
Vertical Scale: 1000
Minimum Slip Surface Depth: 1 m



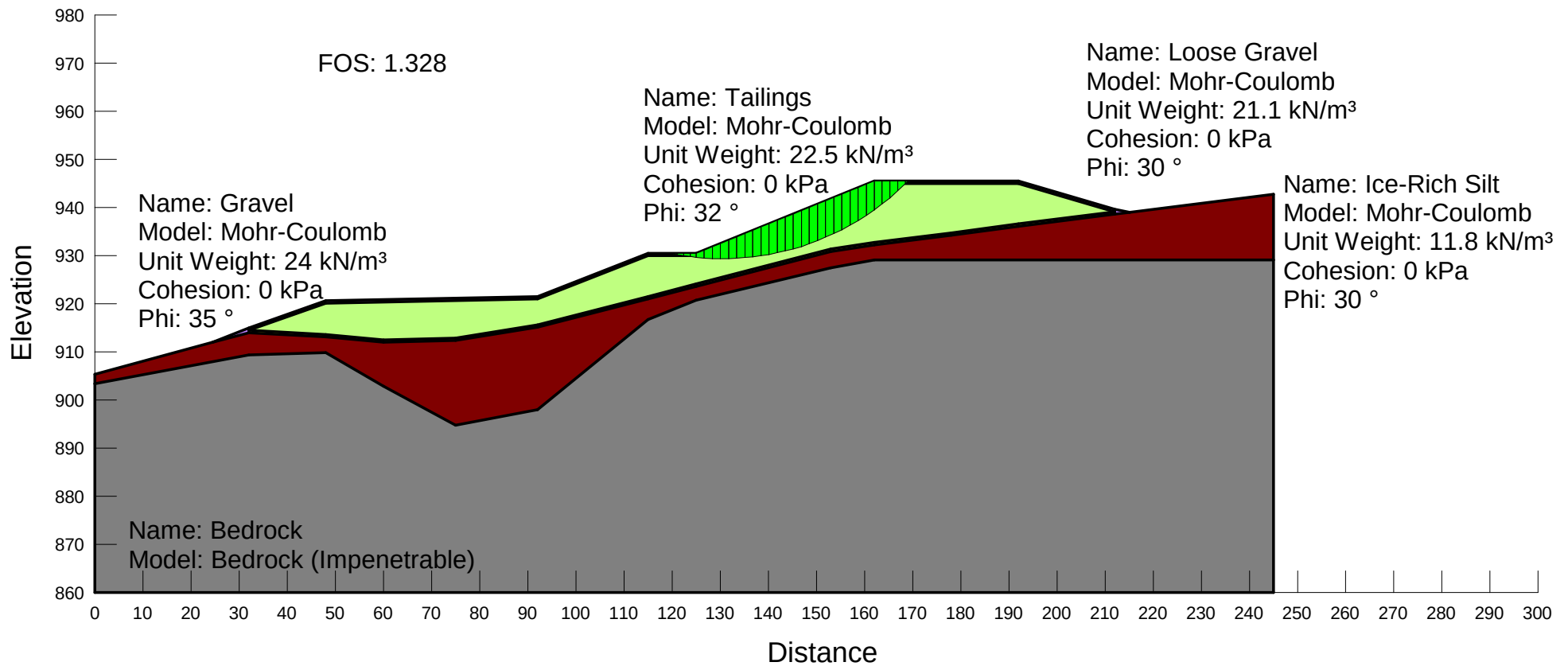
Name: Alignment A
Description: Static w/o PWP Conditions (Frozen State)
File Name: W14101178.011_AlignmentA_R10D1_Static_NoPWP.gsz
Method: Morgenstern-Price
Horz Seismic Load: 0
PWP Conditions Source: (none)
Length(L) Units: meters
Horizontal Scale: 1250
Vertical Scale: 1250
Minimum Slip Surface Depth: 1 m



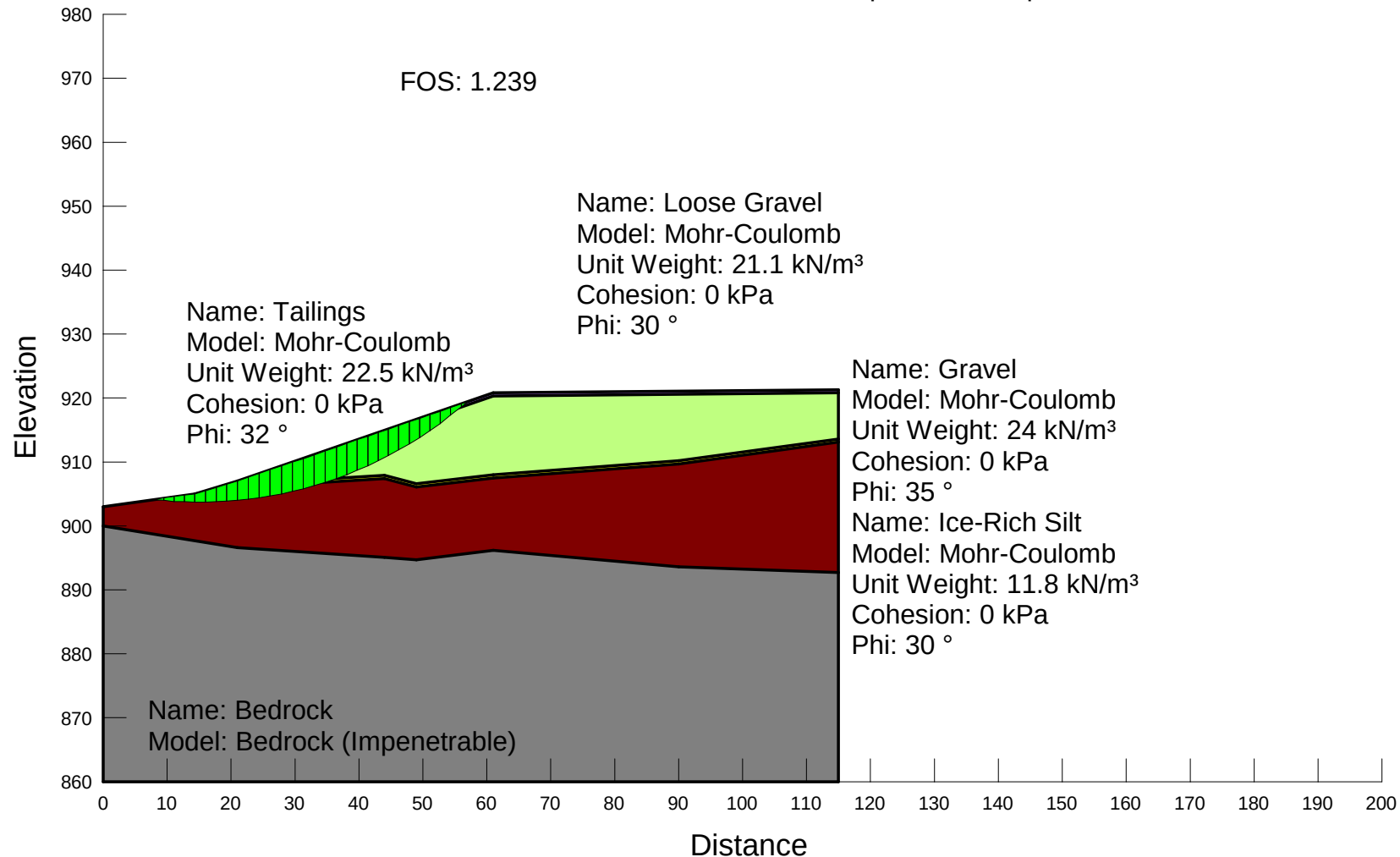
Name: Alignment B
Description: Static w/o PWP Conditions (Fully Frozen)
File Name: W14101178.011_AlignmentB_R10D1_Static_NoPWP.gs
Method: Morgenstern-Price
Horz Seismic Load: 0
PWP Conditions Source: (none)
Length(L) Units: meters
Horizontal Scale: 1000
Vertical Scale: 1000
Minimum Slip Surface Depth: 1 m



Name: Alignment A
Description: Dynamic (1:475) w/o PWP Conditions (Frozen State)
File Name: W14101178.011_AlignmentA_R04E_Dynamic475_NoPWP.gs
Method: Morgenstern-Price
Horz Seismic Load: 0.138
PWP Conditions Source: (none)
Length(L) Units: meters
Horizontal Scale: 1250
Vertical Scale: 1250
Minimum Slip Surface Depth: 1 m



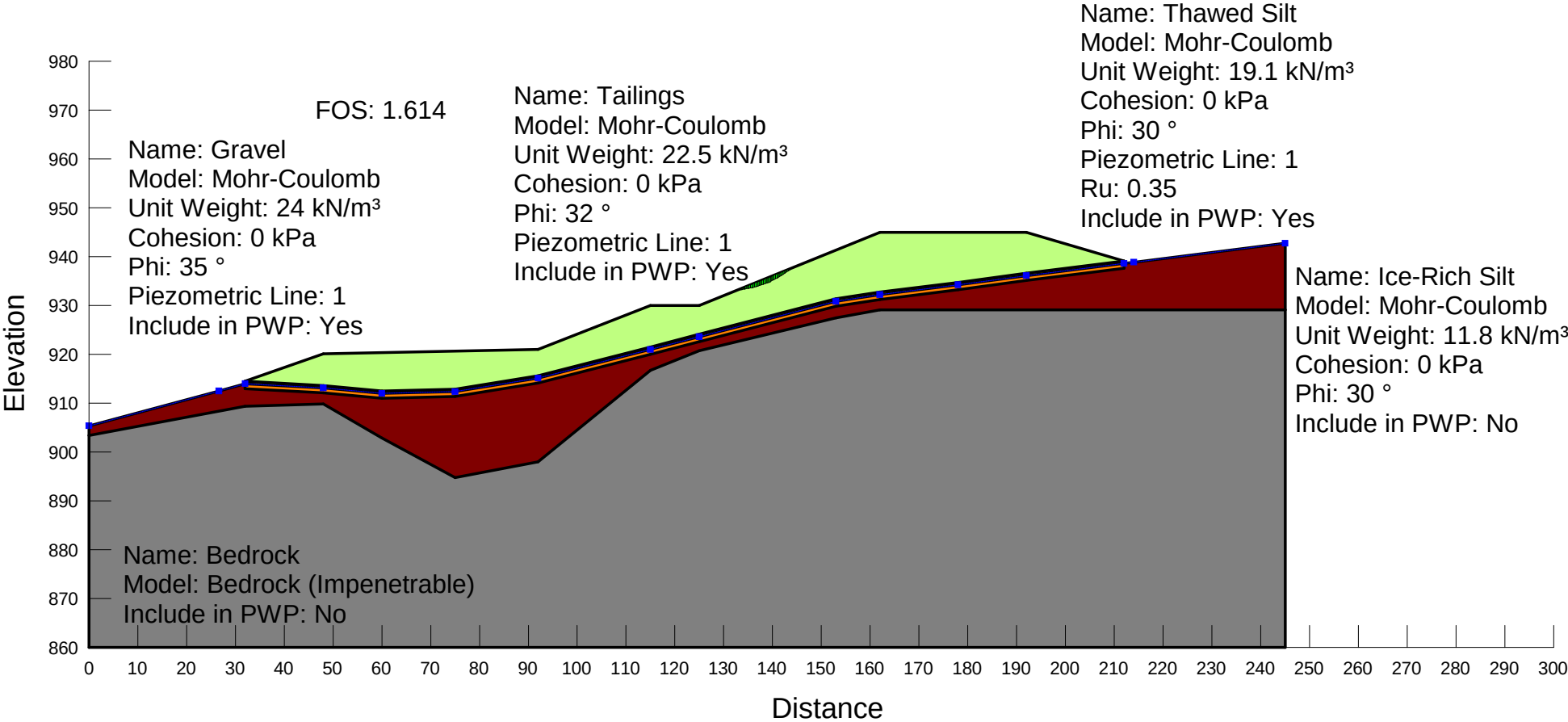
Name: Alignment B
Description: Dynamic (1:475) w/o PWP Conditions (Fully Frozen)
File Name: W14101178.011_AlignmentB_R04E_Dynamic475_NoPWP.gs
Method: Morgenstern-Price
Horz Seismic Load: 0.138
PWP Conditions Source: (none)
Length(L) Units: meters
Horizontal Scale: 1000
Vertical Scale: 1000
Minimum Slip Surface Depth: 1 m



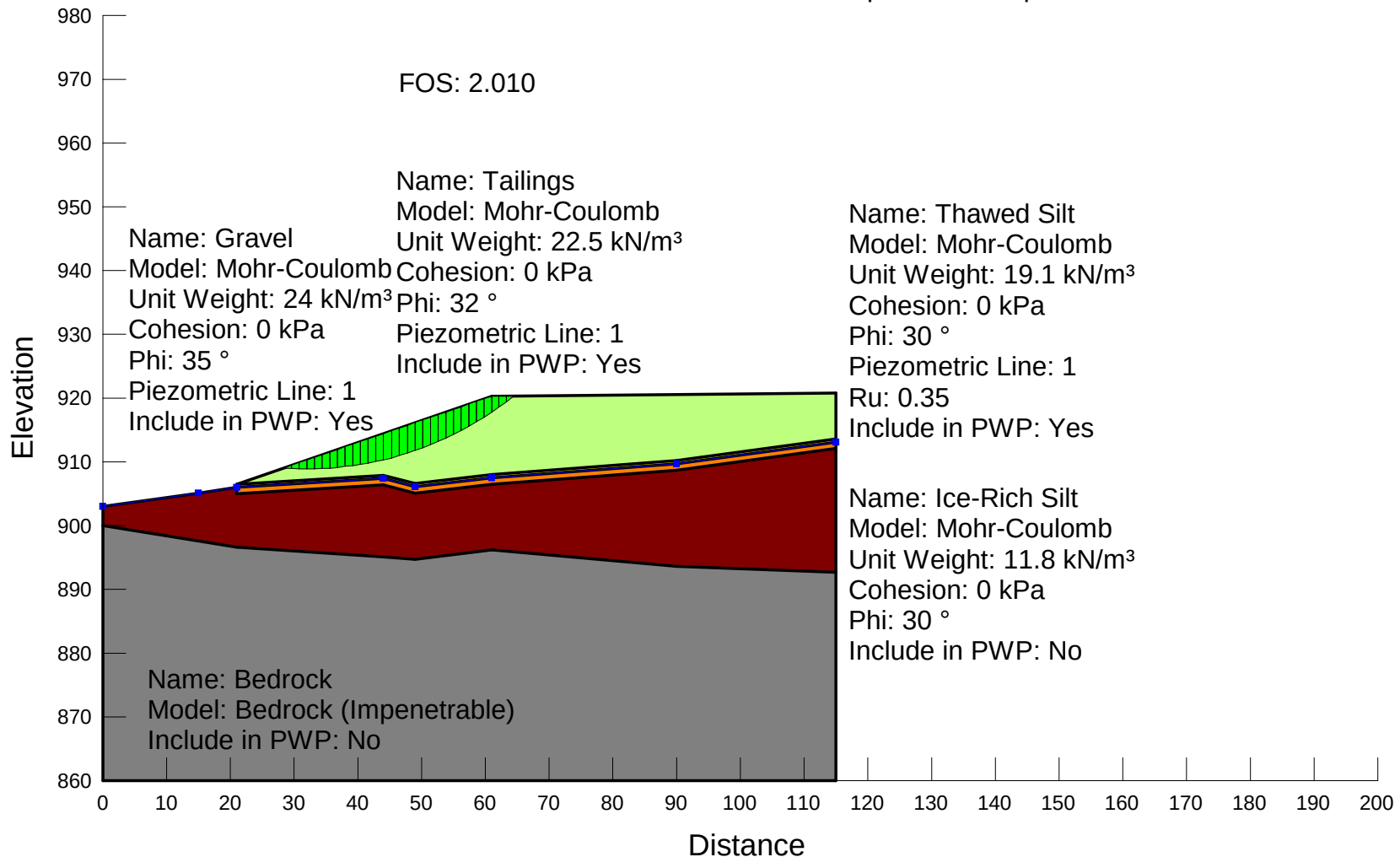
APPENDIX H

APPENDIX H SLOPE STABILITY RESULTS – PERMAFROST 1.0 M THAWED

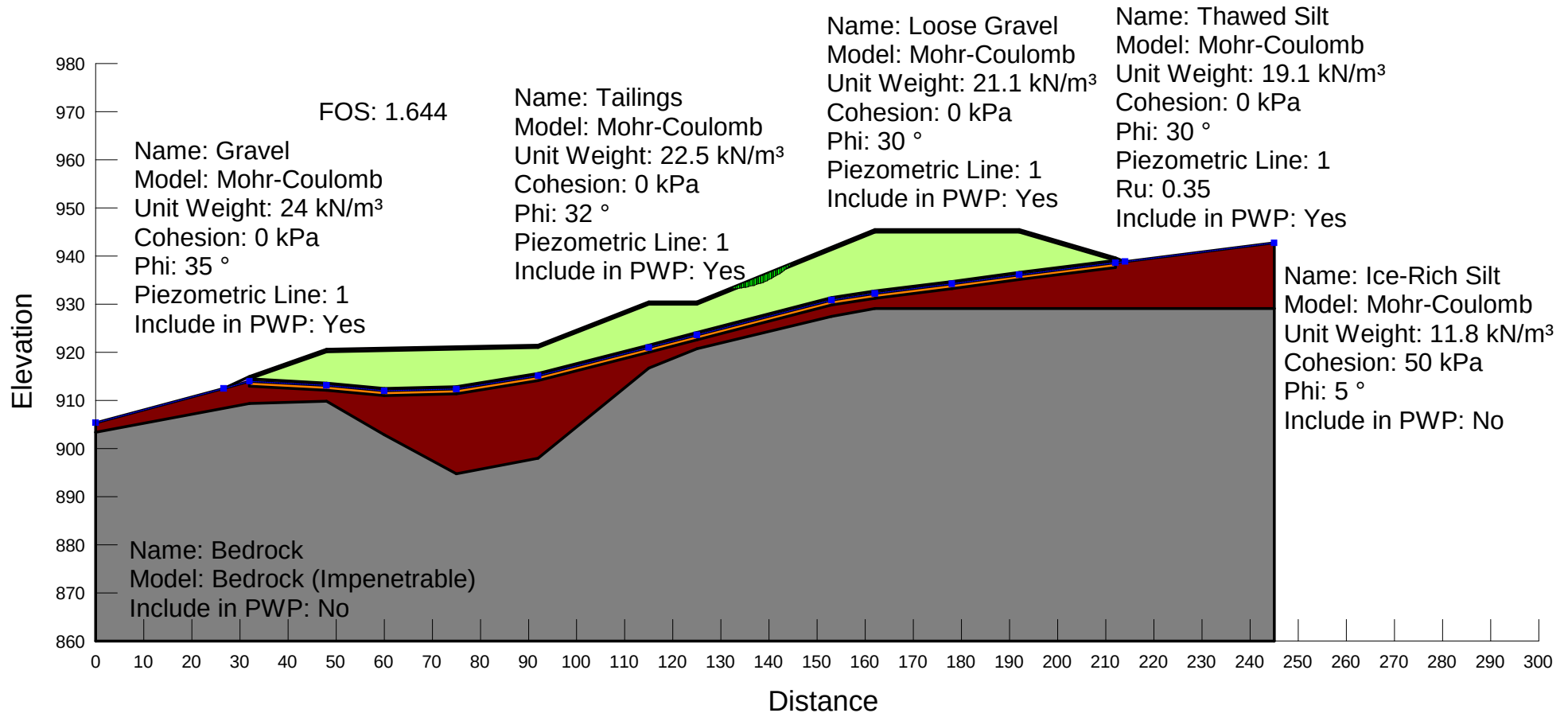
Name: Alignment A
Description: Static w/ Ru PWP Conditions (1.0 m Thaw)
File Name: W14101178.011_AlignmentA_R05A2_Static_RuPWP.gsz
Method: Morgenstern-Price
Horz Seismic Load: 0
PWP Conditions Source: Piezometric Line with Ru
Length(L) Units: meters
Horizontal Scale: 1250
Vertical Scale: 1250
Minimum Slip Surface Depth: 1 m



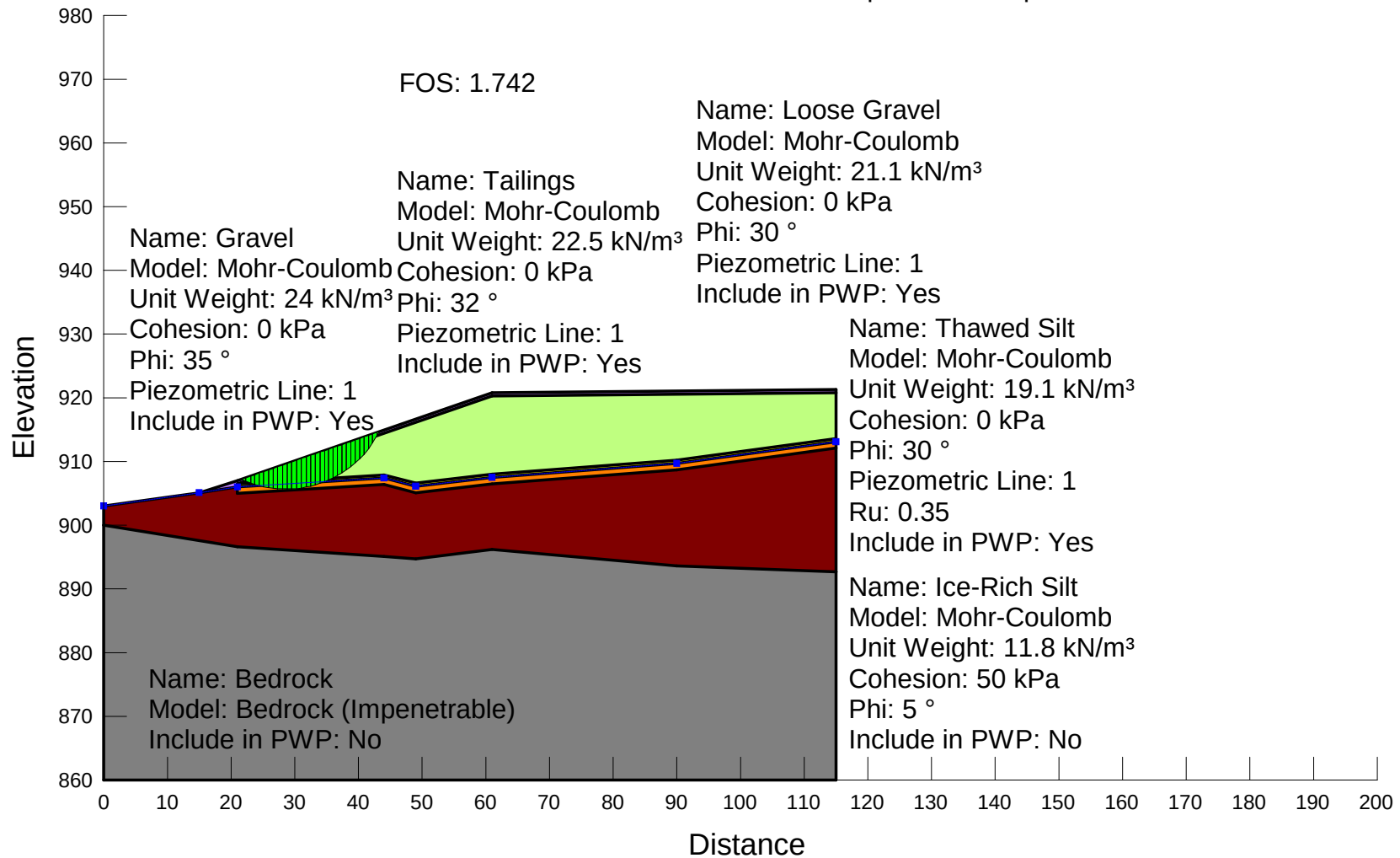
Name: Alignment B
Description: Static w/ Ru PWP Conditions (1.0 m Thaw)
File Name: W14101178.011_AlignmentB_R05A2_Static_RuPWP.gsz
Method: Morgenstern-Price
Horz Seismic Load: 0
PWP Conditions Source: Piezometric Line with Ru
Length(L) Units: meters
Horizontal Scale: 1000
Vertical Scale: 1000
Minimum Slip Surface Depth: 1 m



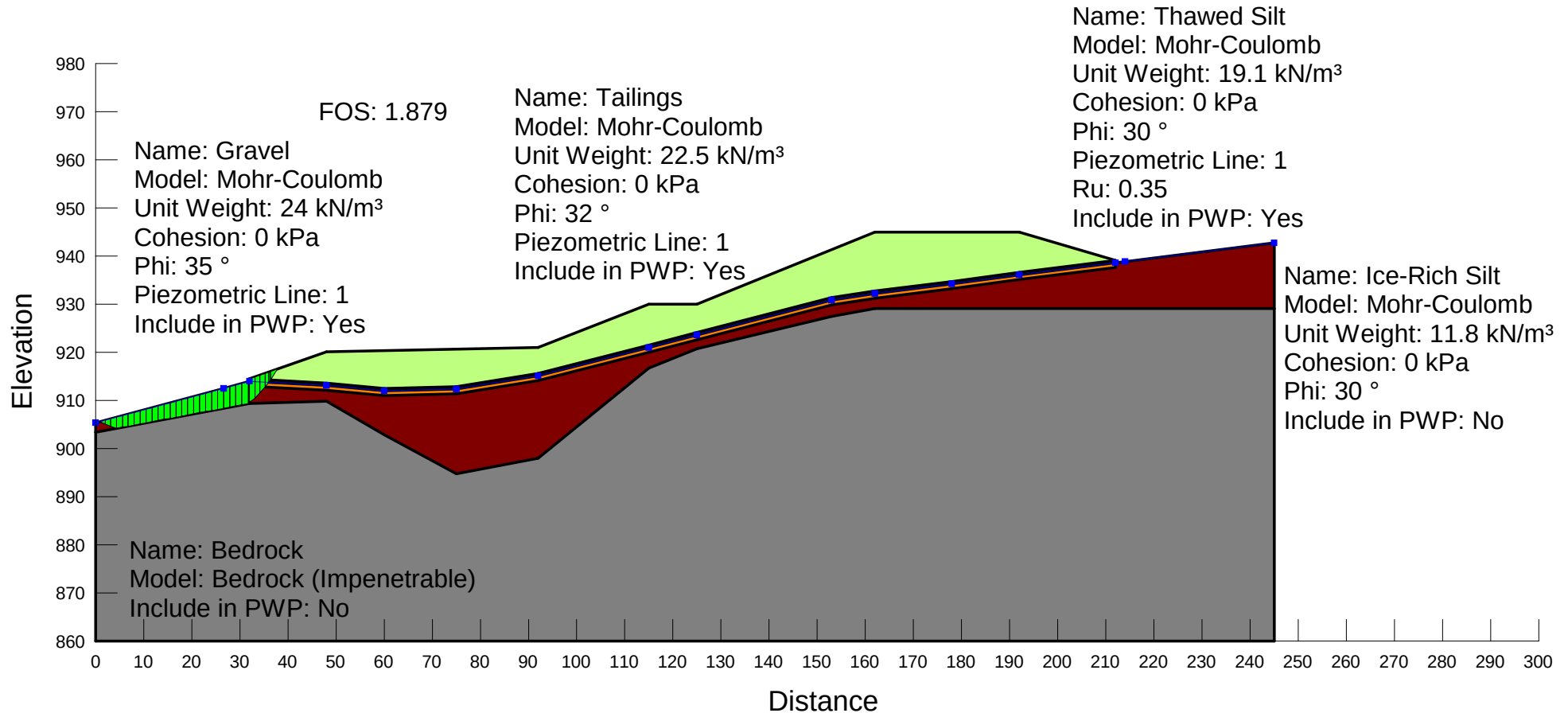
Name: Alignment A
Description: Static w/ Ru PWP Conditions (1.0 m Thaw)
File Name: W14101178.011_AlignmentA_R11D2_Static_RuPWP.gsz
Method: Morgenstern-Price
Horz Seismic Load: 0
PWP Conditions Source: Piezometric Line with Ru
Length(L) Units: meters
Horizontal Scale: 1250
Vertical Scale: 1250
Minimum Slip Surface Depth: 1 m



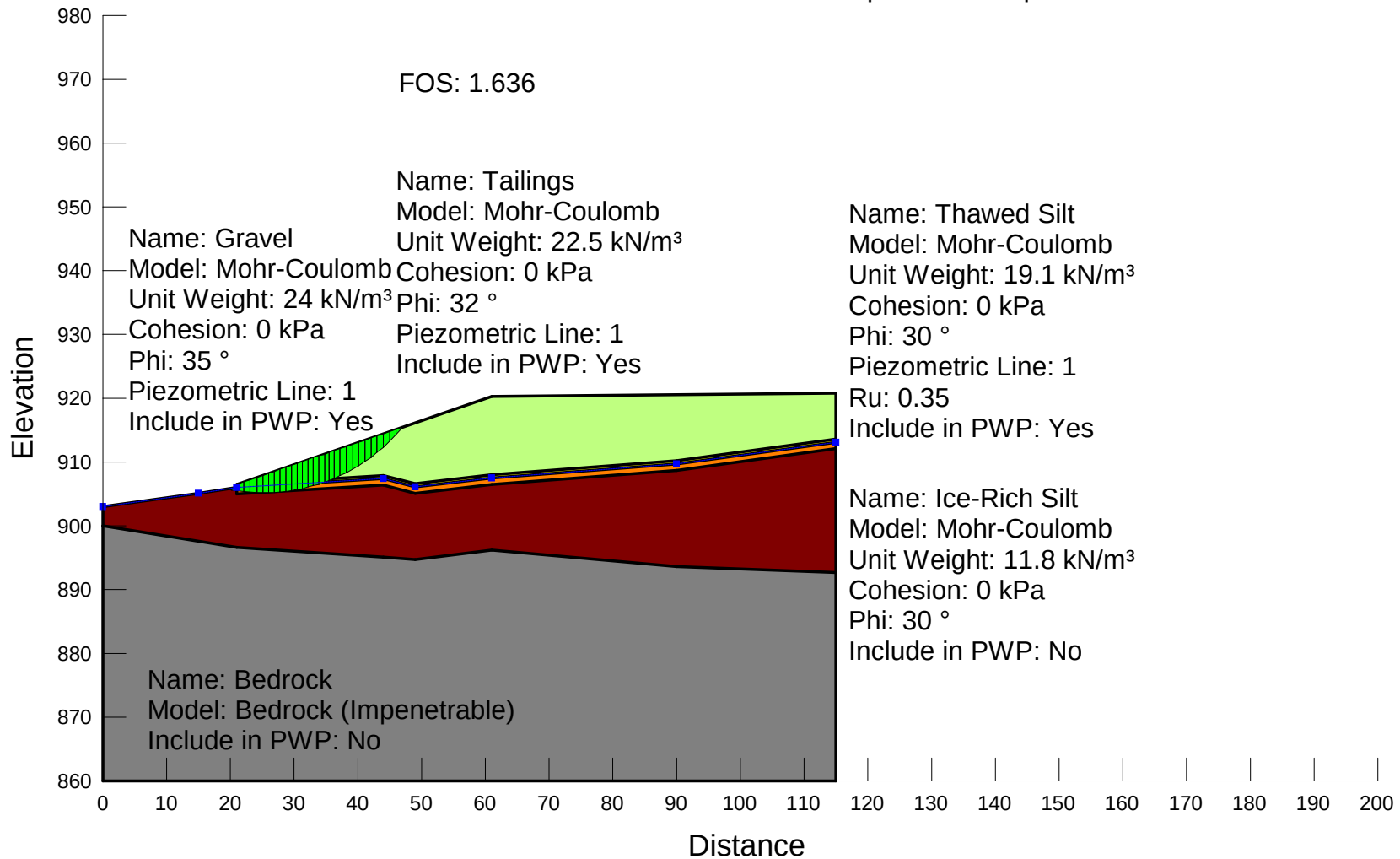
Name: Alignment B
Description: Static w/ Ru PWP Conditions (1.0 m Thaw)
File Name: W14101178.011_AlignmentB_R11D2_Static_RuPWP.gsz
Method: Morgenstern-Price
Horz Seismic Load: 0
PWP Conditions Source: Piezometric Line with Ru
Length(L) Units: meters
Horizontal Scale: 1000
Vertical Scale: 1000
Minimum Slip Surface Depth: 1 m



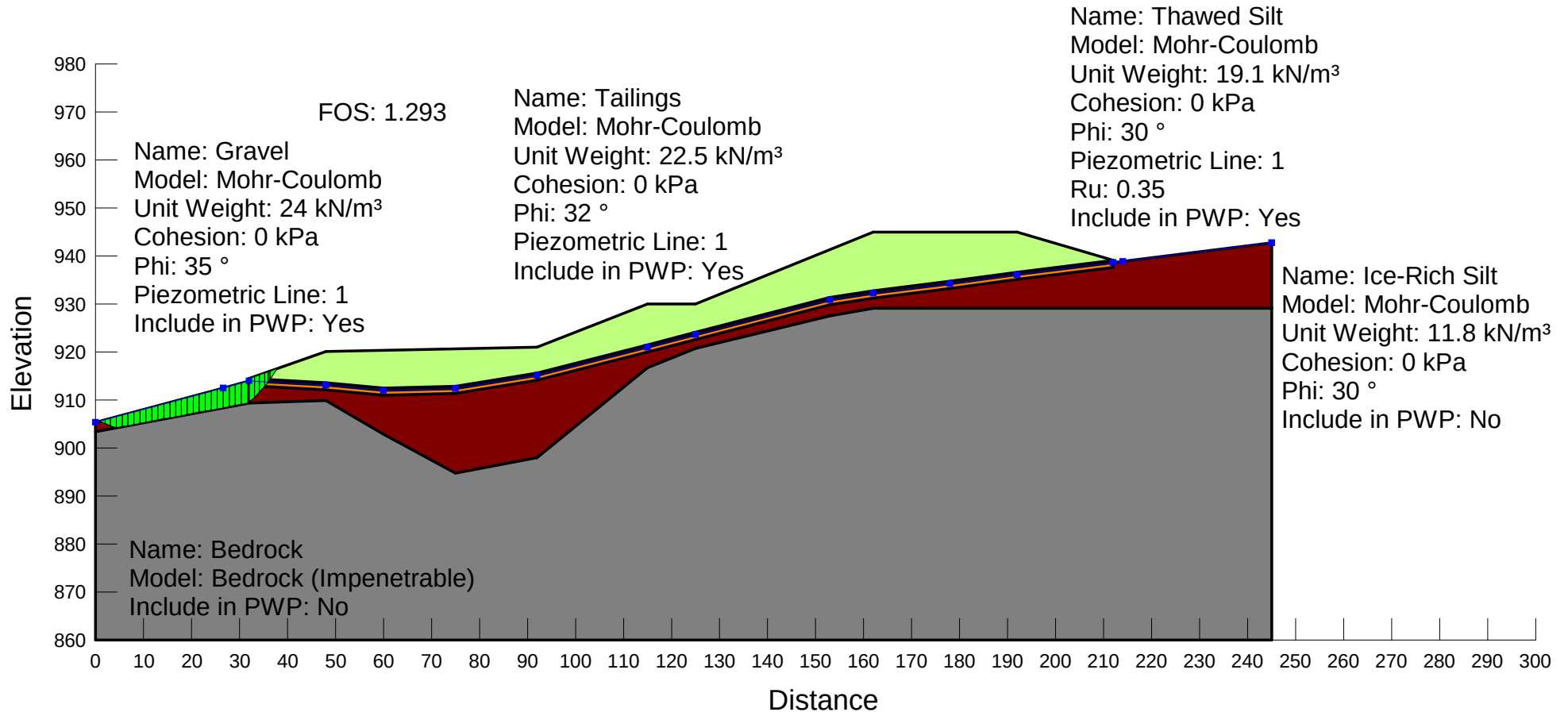
Name: Alignment A
Description: Static w/ Ru PWP Conditions (1.0 m Thaw)
File Name: W14101178.011_AlignmentA_R05A1_Static_RuPWP.gsz
Method: Morgenstern-Price
Horz Seismic Load: 0
PWP Conditions Source: Piezometric Line with Ru
Length(L) Units: meters
Horizontal Scale: 1250
Vertical Scale: 1250
Minimum Slip Surface Depth: 1 m



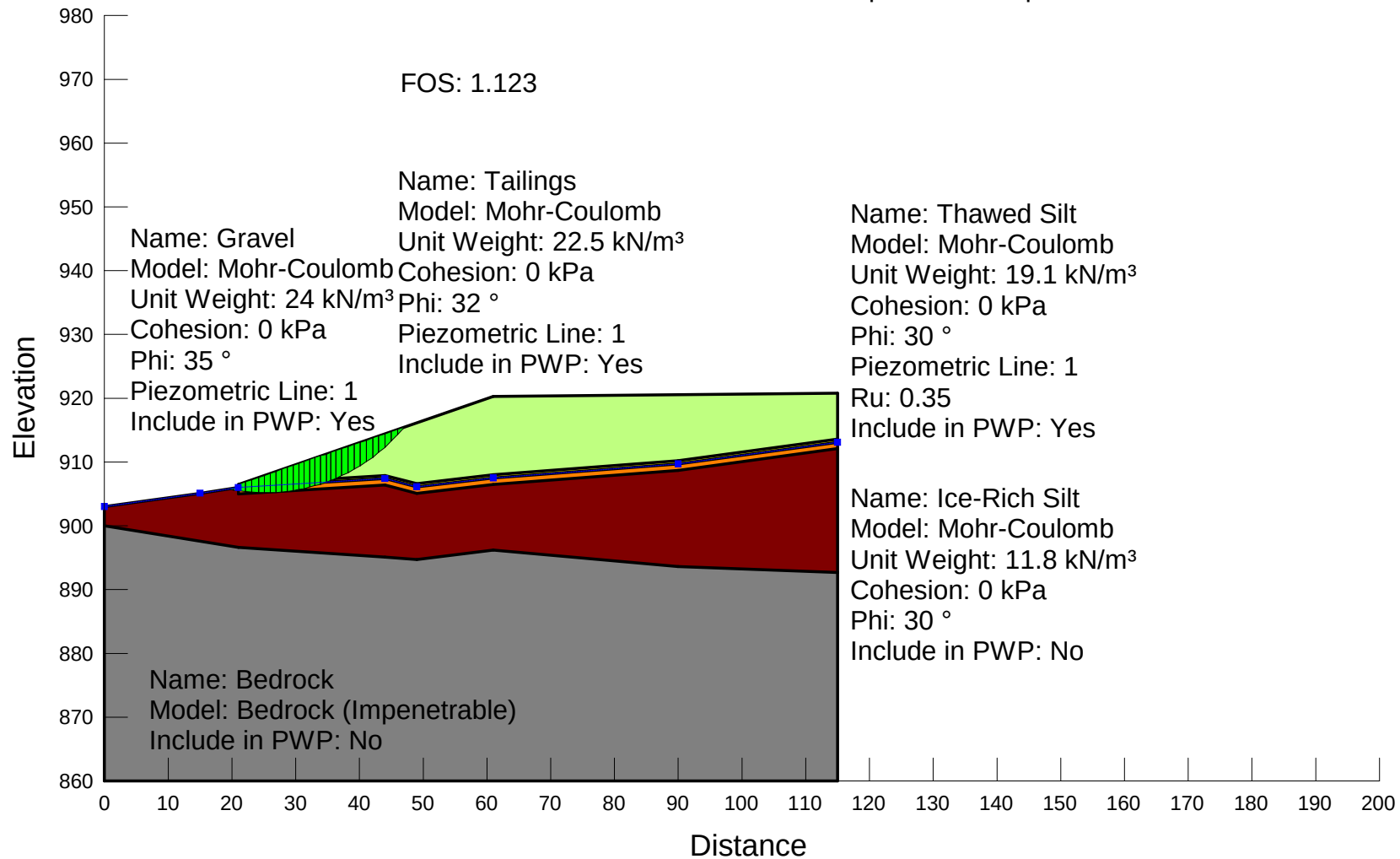
Name: Alignment B
Description: Static w/ Ru PWP Conditions (1.0 m Thaw)
File Name: W14101178.011_AlignmentB_R05A1_Static_RuPWP.gsz
Method: Morgenstern-Price
Horz Seismic Load: 0
PWP Conditions Source: Piezometric Line with Ru
Length(L) Units: meters
Horizontal Scale: 1000
Vertical Scale: 1000
Minimum Slip Surface Depth: 1 m



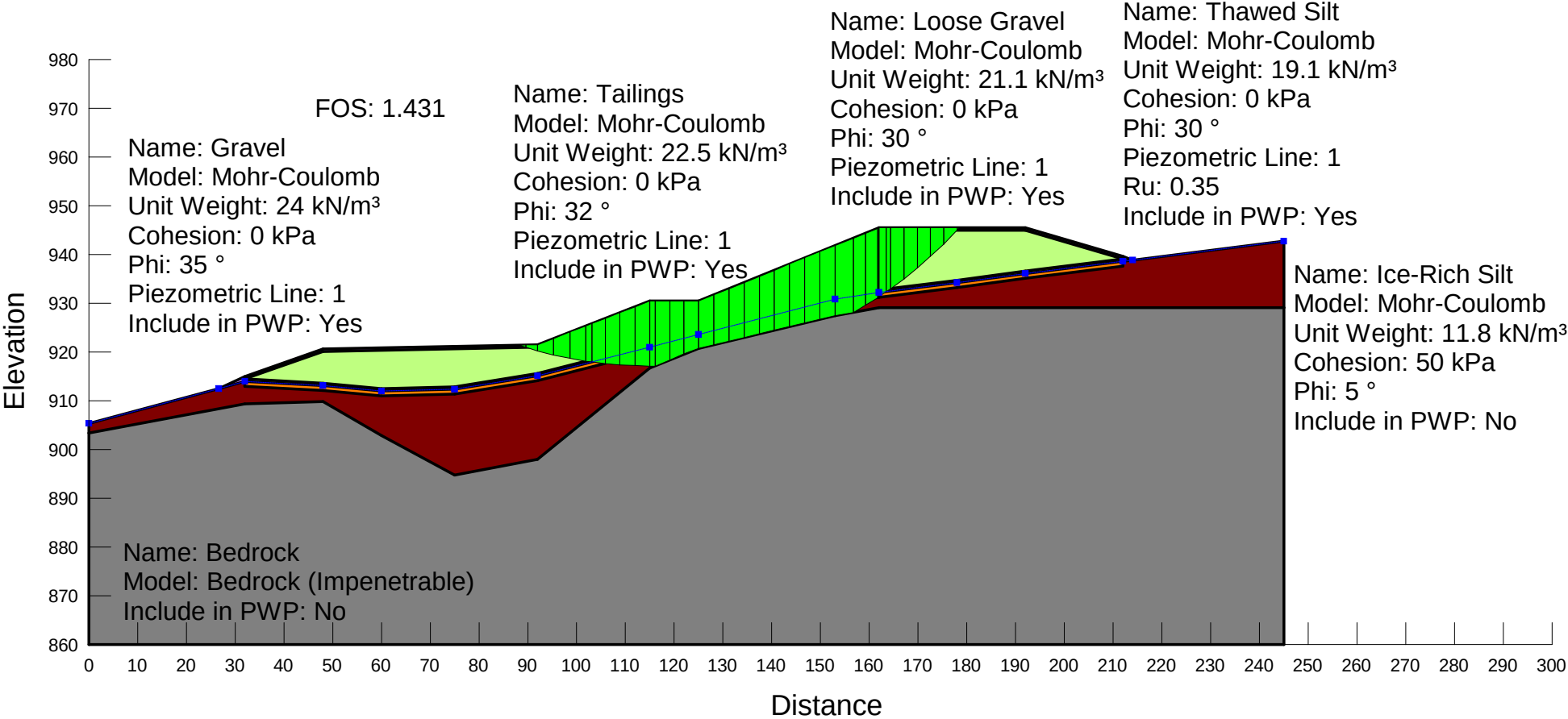
Name: Alignment A
Description: Dynamic (1:475) w/ Ru PWP Conditions (1.0 m Thaw)
File Name: W14101178.011_AlignmentA_R05C_Dynamic475_RuPWP.gsz
Method: Morgenstern-Price
Horz Seismic Load: 0.138
PWP Conditions Source: Piezometric Line with Ru
Length(L) Units: meters
Horizontal Scale: 1250
Vertical Scale: 1250
Minimum Slip Surface Depth: 1 m



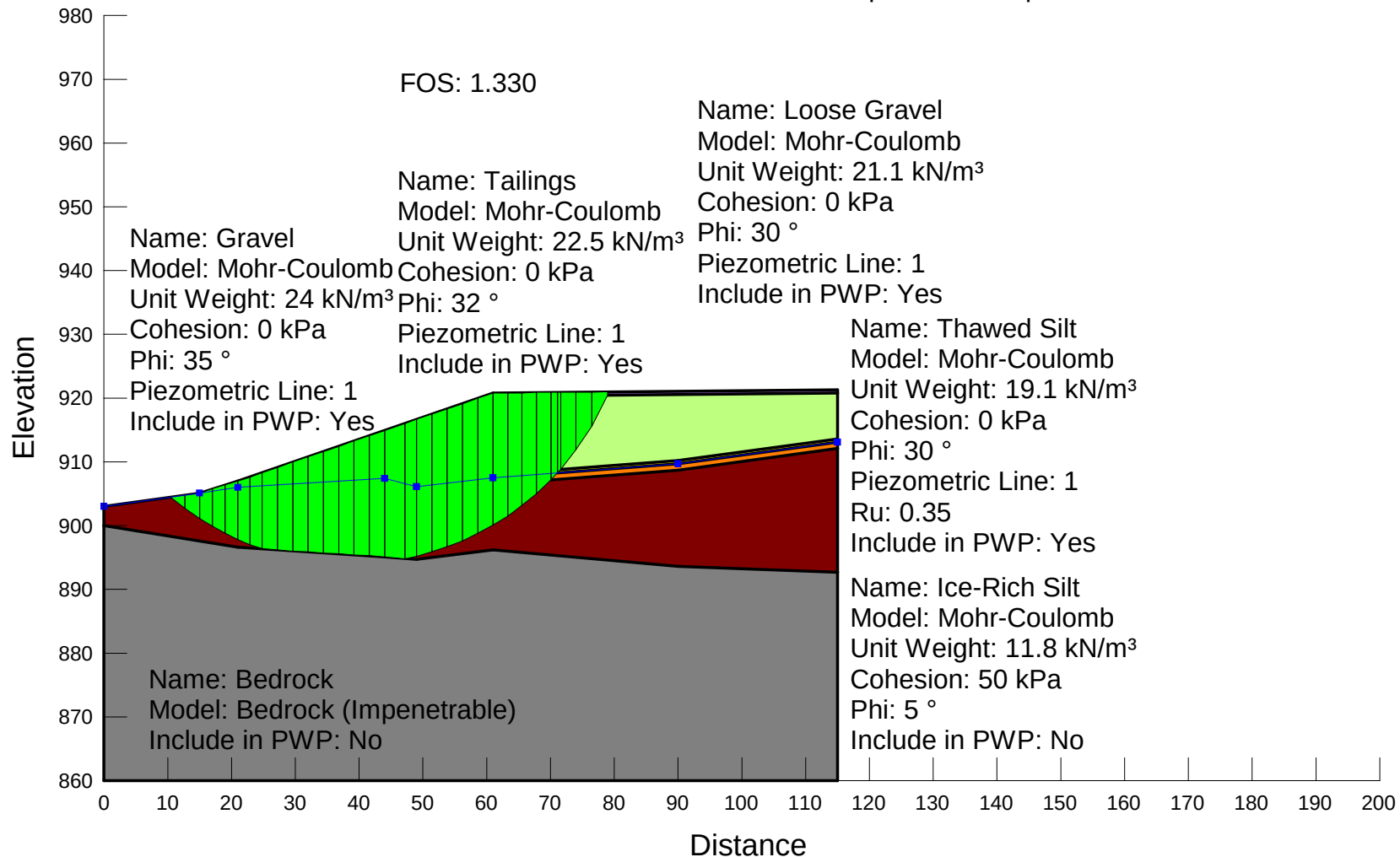
Name: Alignment B
Description: Dynamic (1:475) w/ Ru PWP Conditions (1.0 m Thaw)
File Name: W14101178.011_AlignmentB_R05C_Dynamic475_RuPWP.gsz
Method: Morgenstern-Price
Horz Seismic Load: 0.138
PWP Conditions Source: Piezometric Line with Ru
Length(L) Units: meters
Horizontal Scale: 1000
Vertical Scale: 1000
Minimum Slip Surface Depth: 1 m



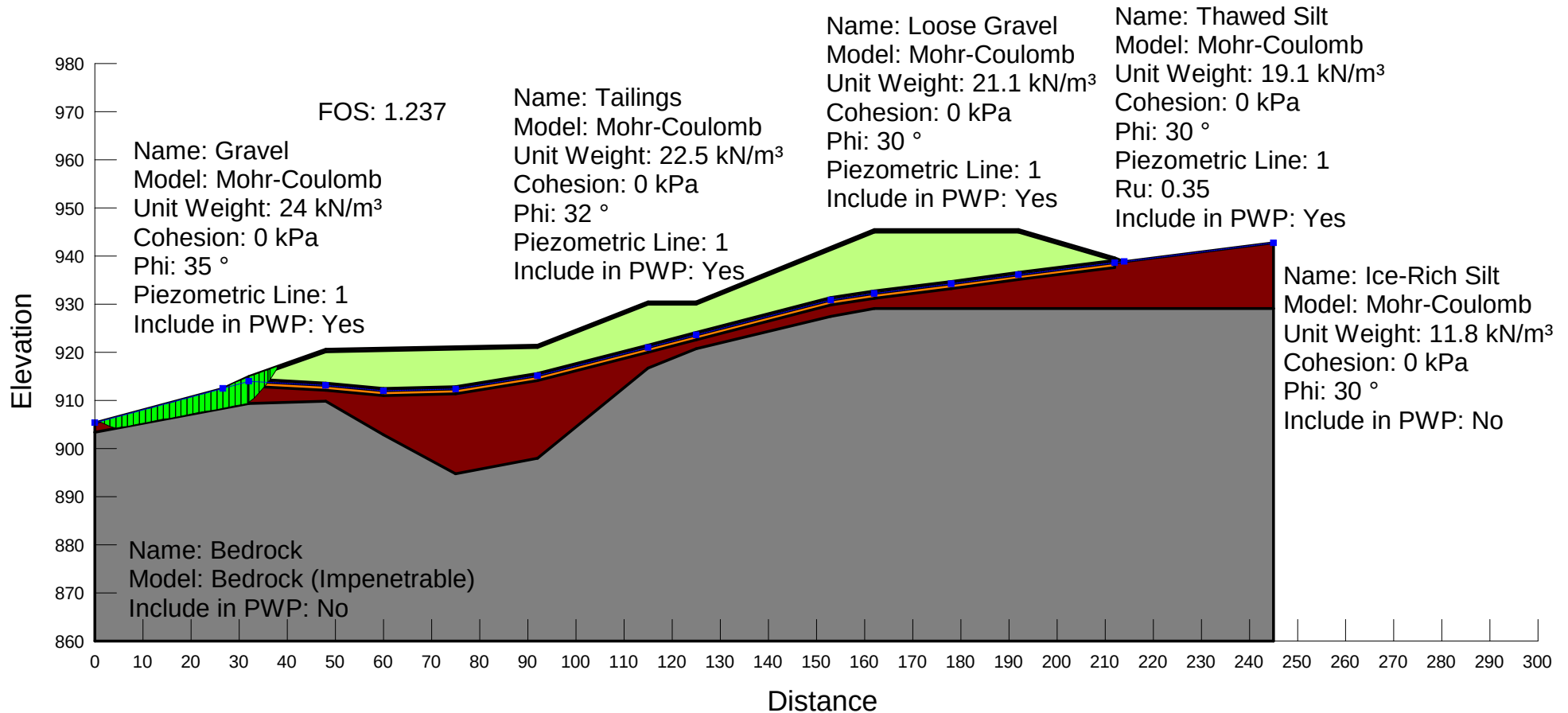
Name: Alignment A
Description: Static w/ Ru PWP Conditions (1.0 m Thaw)
File Name: W14101178.011_AlignmentA_R11D1_Static_RuPWP.gsz
Method: Morgenstern-Price
Horz Seismic Load: 0
PWP Conditions Source: Piezometric Line with Ru
Length(L) Units: meters
Horizontal Scale: 1250
Vertical Scale: 1250
Minimum Slip Surface Depth: 1 m



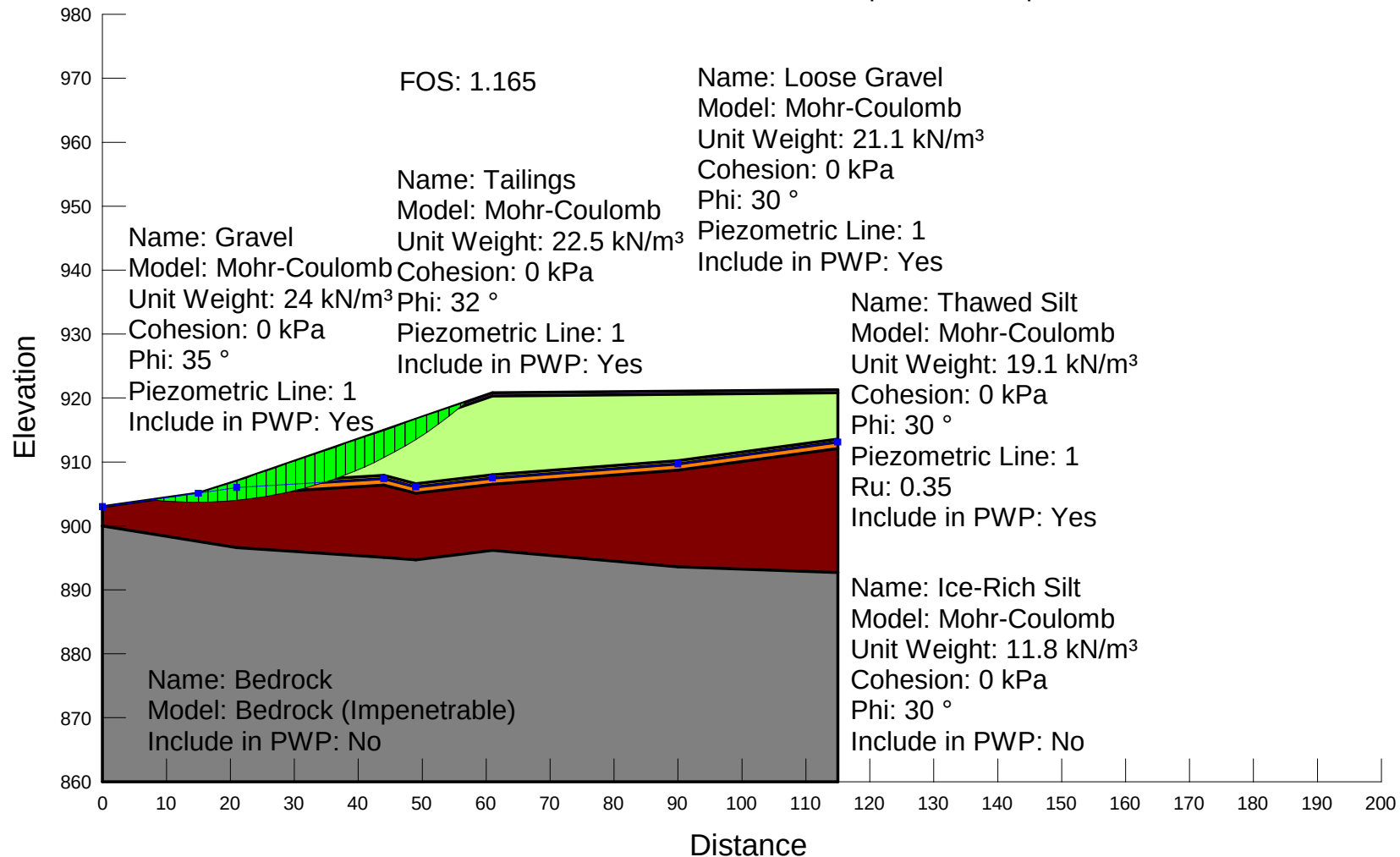
Name: Alignment B
Description: Static w/ Ru PWP Conditions (1.0 m Thaw)
File Name: W14101178.011_AlignmentB_R11D1_Static_RuPWP.gsz
Method: Morgenstern-Price
Horz Seismic Load: 0
PWP Conditions Source: Piezometric Line with Ru
Length(L) Units: meters
Horizontal Scale: 1000
Vertical Scale: 1000
Minimum Slip Surface Depth: 1 m



Name: Alignment A
Description: Dynamic (1:475) w/ Ru PWP Conditions (1.0 m Thaw)
File Name: W14101178.011_AlignmentA_R05E_Dynamic475_RuPWP.gs
Method: Morgenstern-Price
Horz Seismic Load: 0.138
PWP Conditions Source: Piezometric Line with Ru
Length(L) Units: meters
Horizontal Scale: 1250
Vertical Scale: 1250
Minimum Slip Surface Depth: 1 m



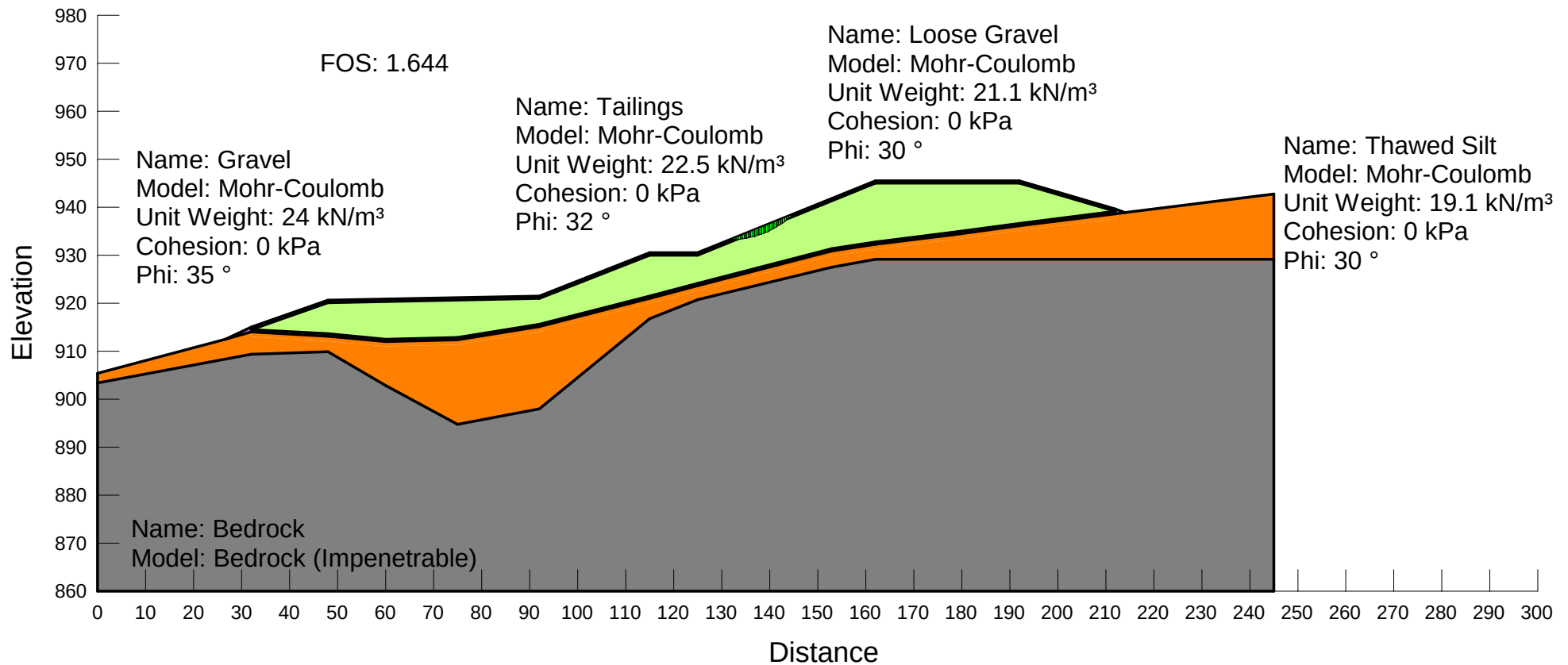
Name: Alignment B
Description: Dynamic (1:475) w/ Ru PWP Conditions (1.0 m Thaw)
File Name: W14101178.011_AlignmentB_R05E_Dynamic475_RuPWP.gs
Method: Morgenstern-Price
Horz Seismic Load: 0.138
PWP Conditions Source: Piezometric Line with Ru
Length(L) Units: meters
Horizontal Scale: 1000
Vertical Scale: 1000
Minimum Slip Surface Depth: 1 m



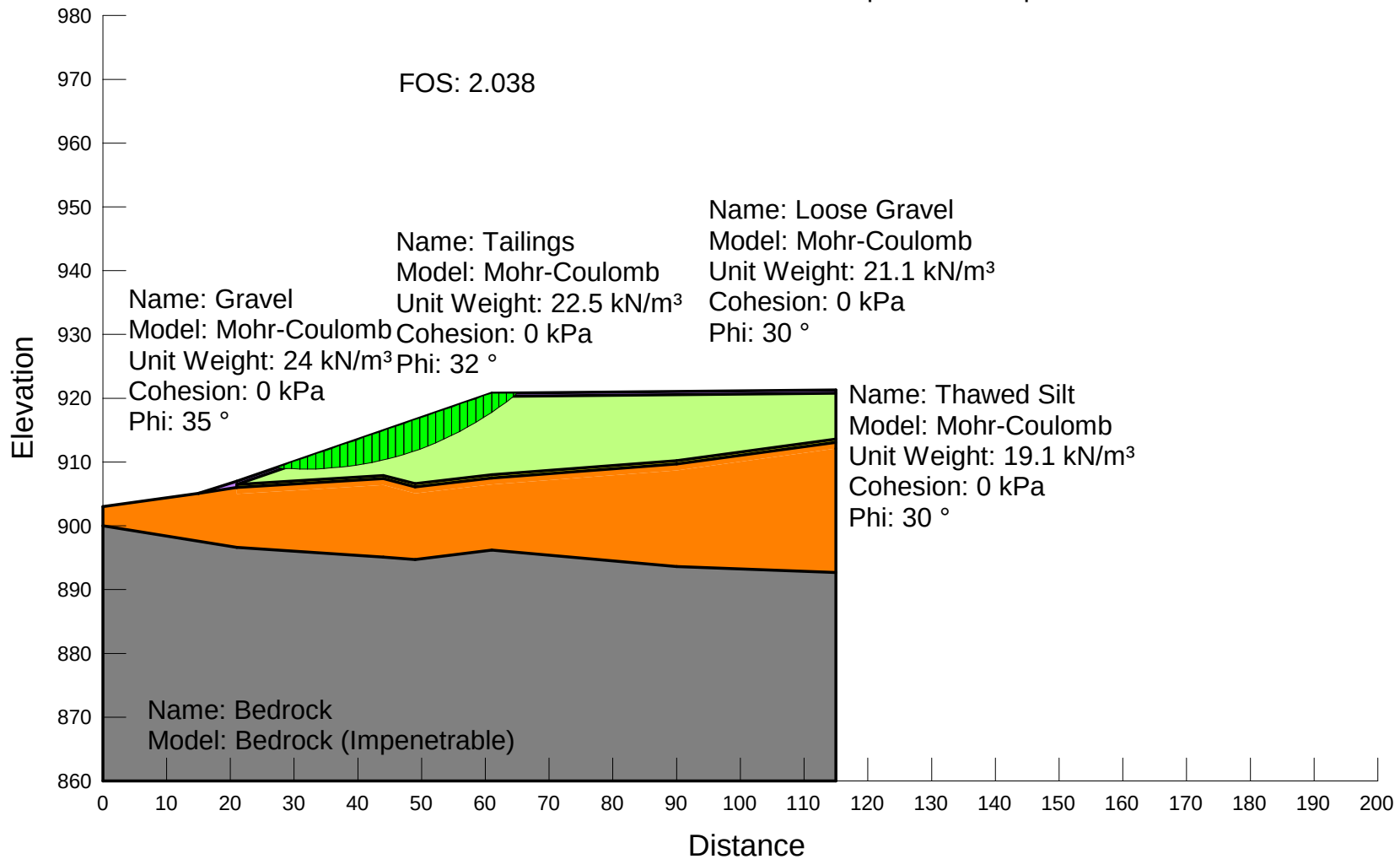
APPENDIX I

APPENDIX I SLOPE STABILITY RESULTS – FULLY THAWED PERMAFROST

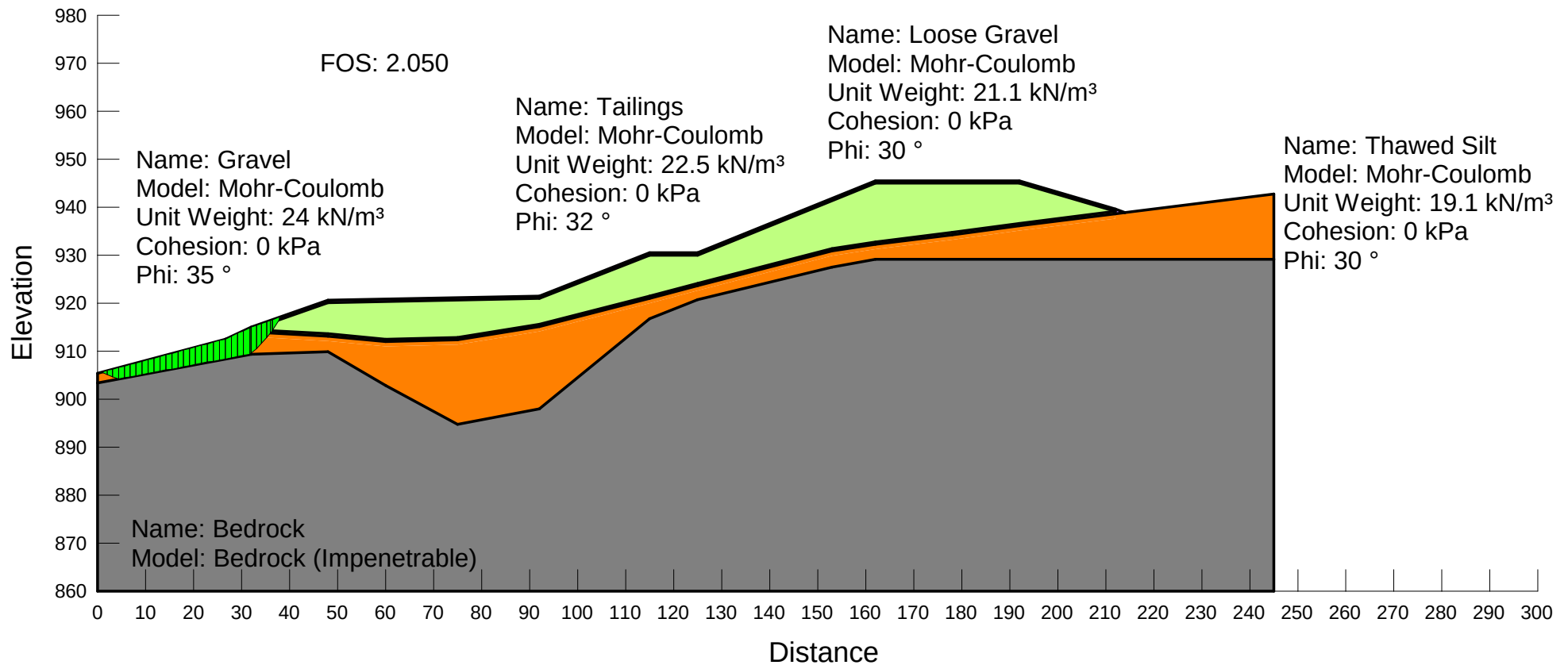
Name: Alignment A
Description: Static w/o PWP Conditions (Fully Thawed)
File Name: W14101178.011_AlignmentA_R06A2_Static_NoPWP.gsz
Method: Morgenstern-Price
Horz Seismic Load: 0
PWP Conditions Source: (none)
Length(L) Units: meters
Horizontal Scale: 1250
Vertical Scale: 1250
Minimum Slip Surface Depth: 1 m



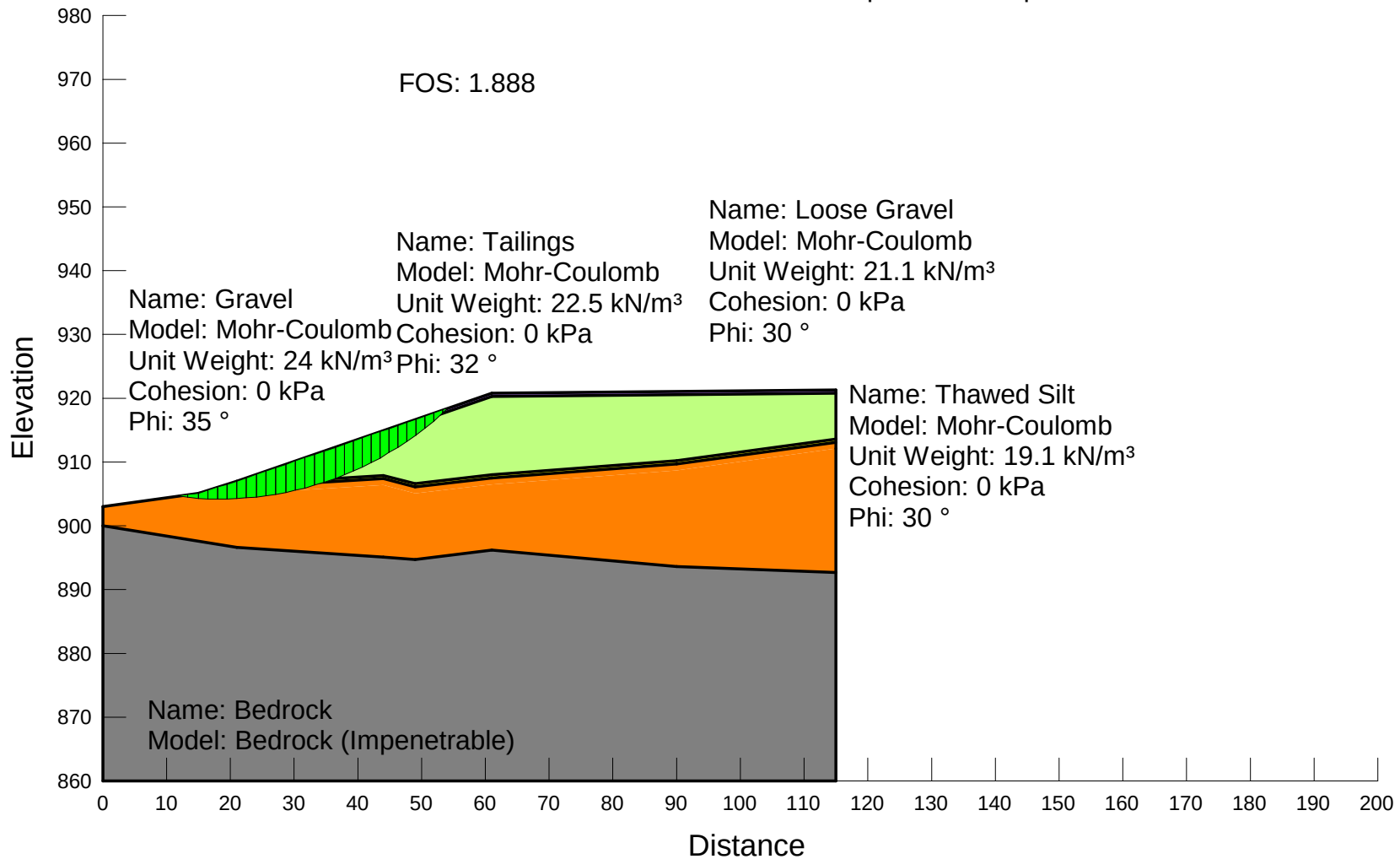
Name: Alignment B
Description: Static w/o PWP Conditions (Fully Thawed)
File Name: W14101178.011_AlignmentB_R06A2_Static_NoPWP.gsz
Method: Morgenstern-Price
Horz Seismic Load: 0
PWP Conditions Source: (none)
Length(L) Units: meters
Horizontal Scale: 1000
Vertical Scale: 1000
Minimum Slip Surface Depth: 1 m



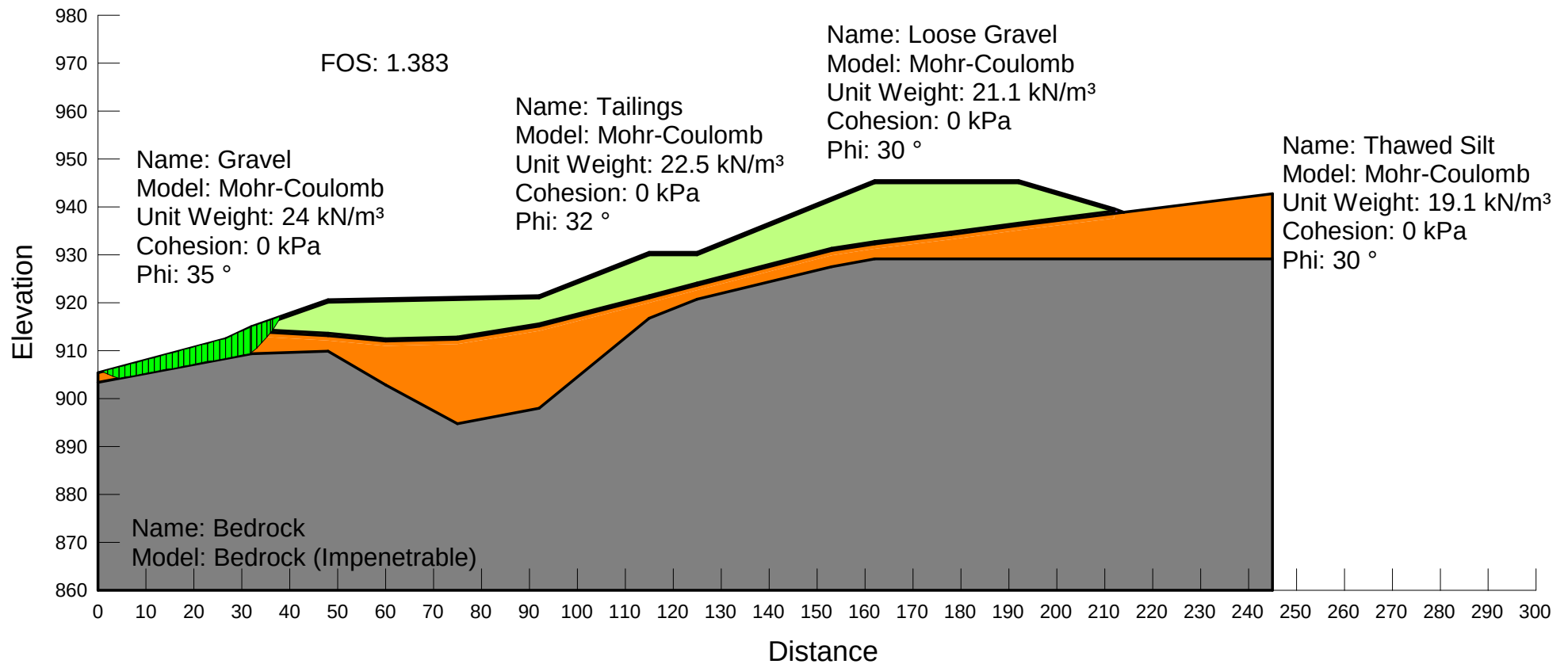
Name: Alignment A
Description: Static w/o PWP Conditions (Fully Thawed)
File Name: W14101178.011_AlignmentA_R06A1_Static_NoPWP.gsz
Method: Morgenstern-Price
Horz Seismic Load: 0
PWP Conditions Source: (none)
Length(L) Units: meters
Horizontal Scale: 1250
Vertical Scale: 1250
Minimum Slip Surface Depth: 1 m



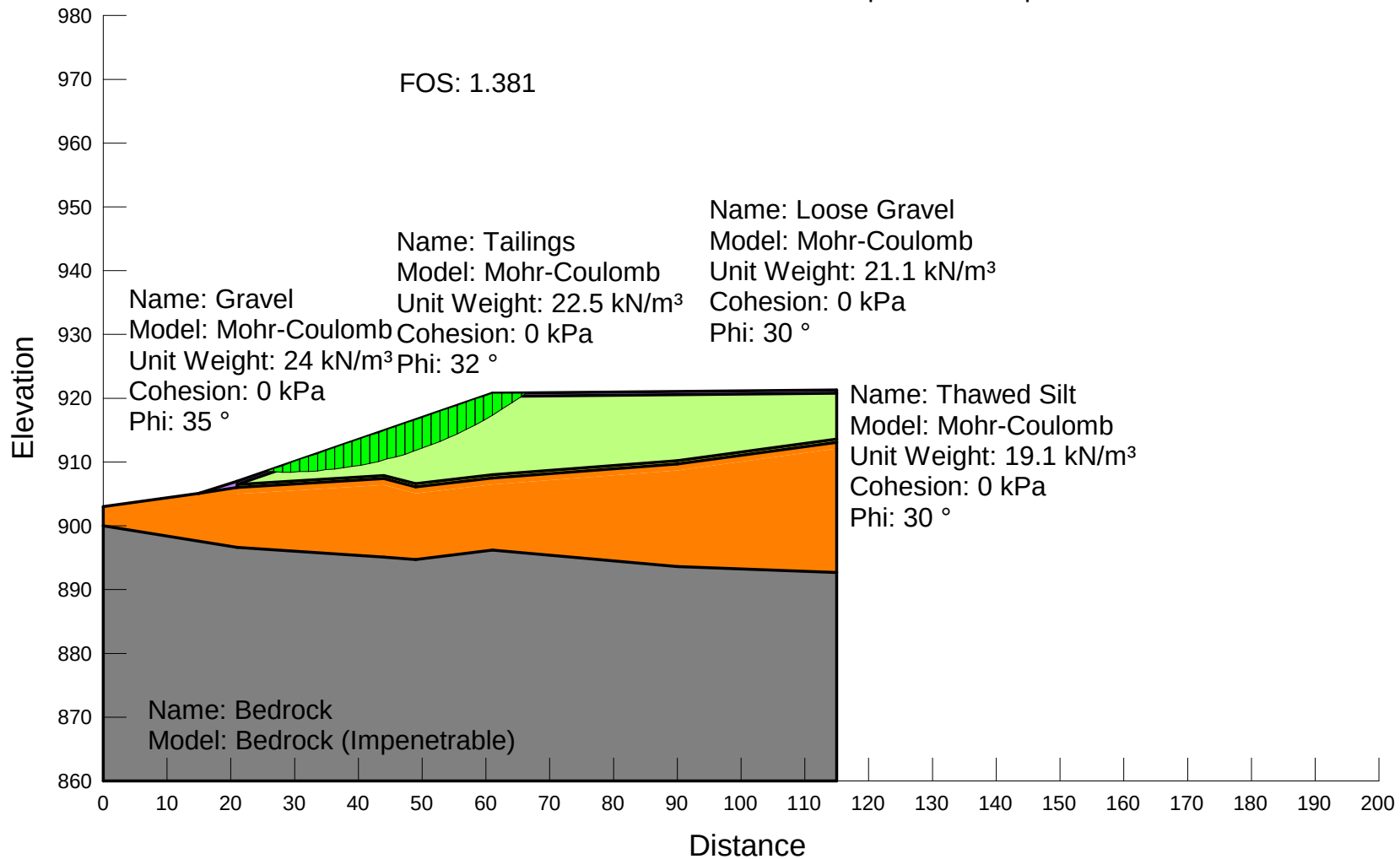
Name: Alignment B
Description: Static w/o PWP Conditions (Fully Thawed)
File Name: W14101178.011_AlignmentB_R06A1_Static_NoPWP.gsz
Method: Morgenstern-Price
Horz Seismic Load: 0
PWP Conditions Source: (none)
Length(L) Units: meters
Horizontal Scale: 1000
Vertical Scale: 1000
Minimum Slip Surface Depth: 1 m



Name: Alignment A
Description: Dynamic (1:475) w/o PWP Conditions (Fully Thawed)
File Name: W14101178.011_AlignmentA_R06B1_Dynamic475_NoPWP.gsz
Method: Morgenstern-Price
Horz Seismic Load: 0.138
PWP Conditions Source: (none)
Length(L) Units: meters
Horizontal Scale: 1250
Vertical Scale: 1250
Minimum Slip Surface Depth: 1 m



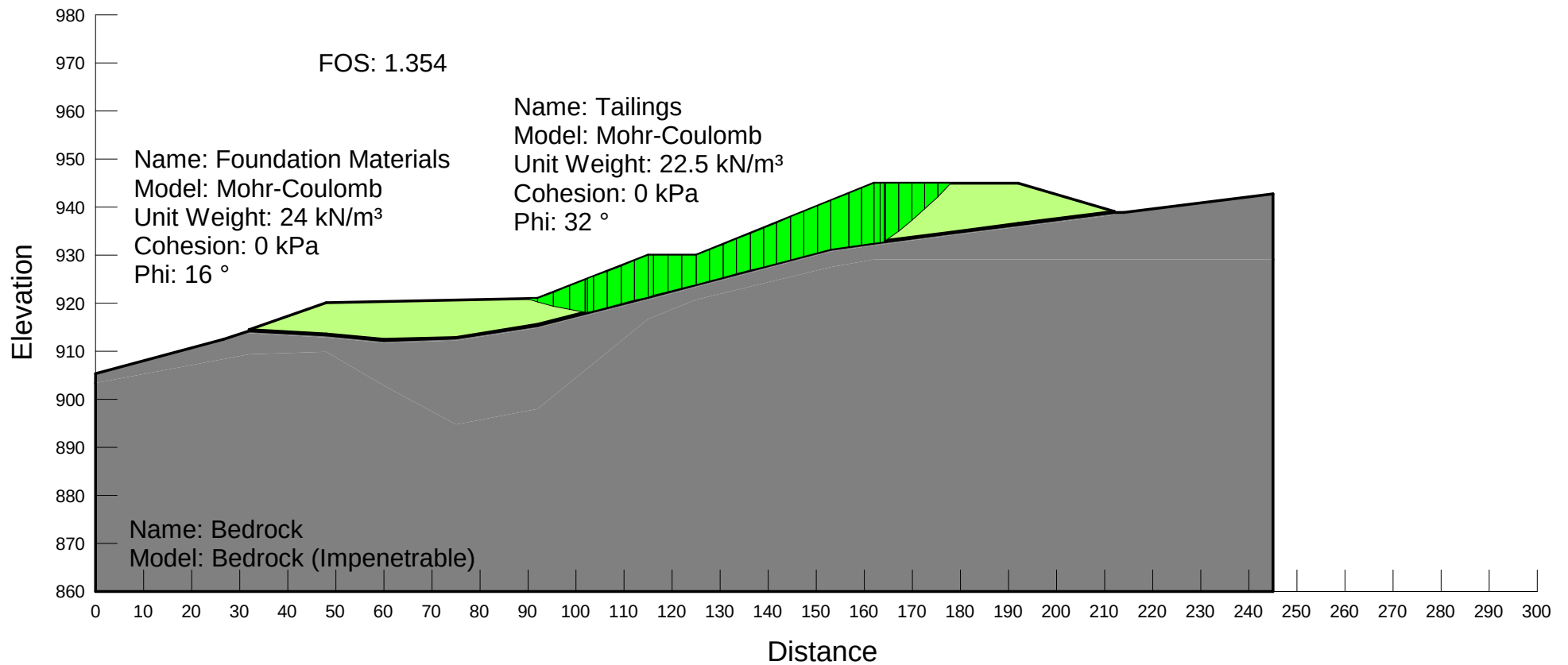
Name: Alignment B
Description: Dynamic (1:475) w/o PWP Conditions (Fully Thawed)
File Name: W14101178.011_AlignmentB_R06B2_Dynamic475_NoPWP.gsz
Method: Morgenstern-Price
Horz Seismic Load: 0.138
PWP Conditions Source: (none)
Length(L) Units: meters
Horizontal Scale: 1000
Vertical Scale: 1000
Minimum Slip Surface Depth: 1 m



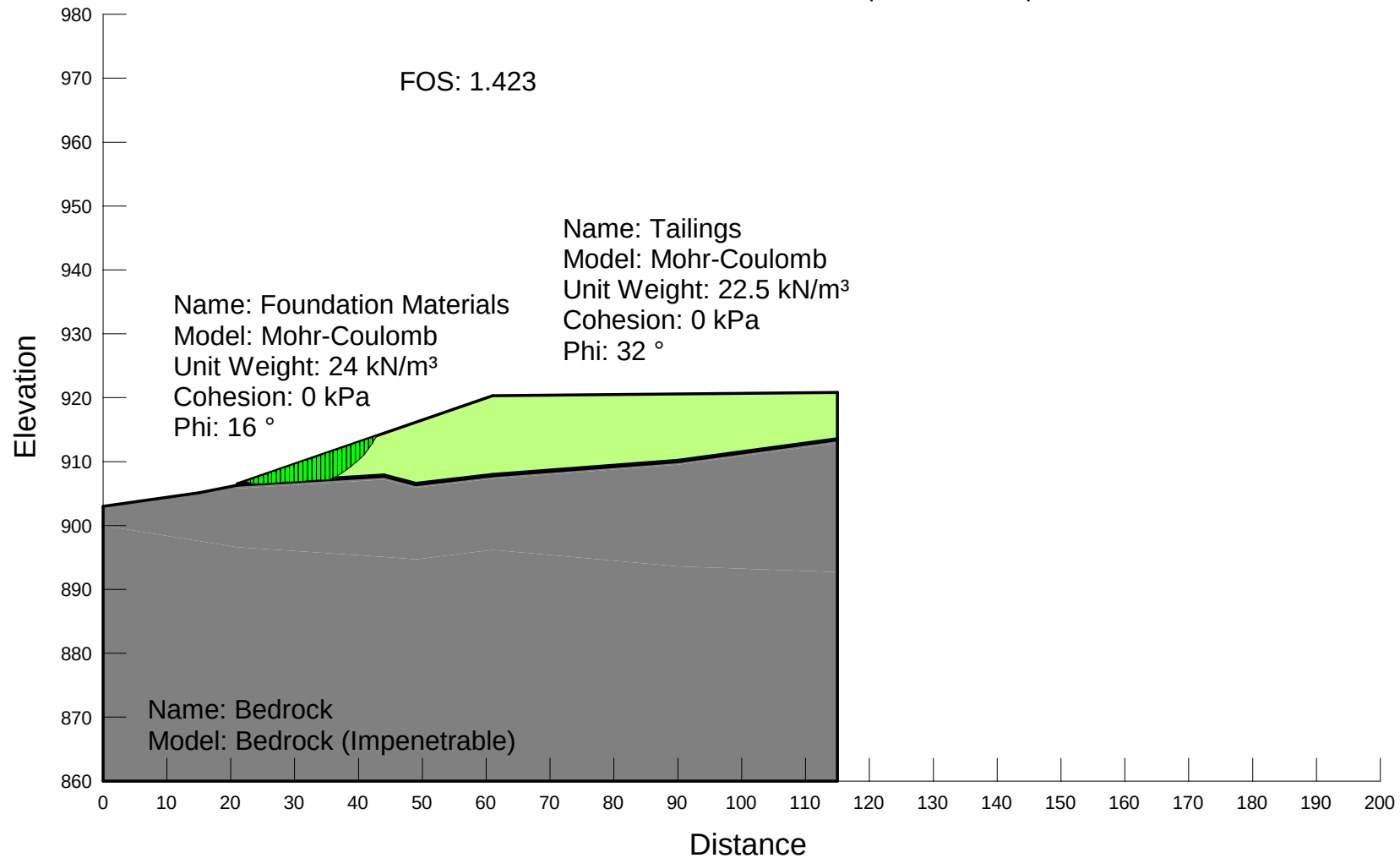
APPENDIX J

APPENDIX J SLOPE STABILITY RESULTS – DSTF FOUNDATION

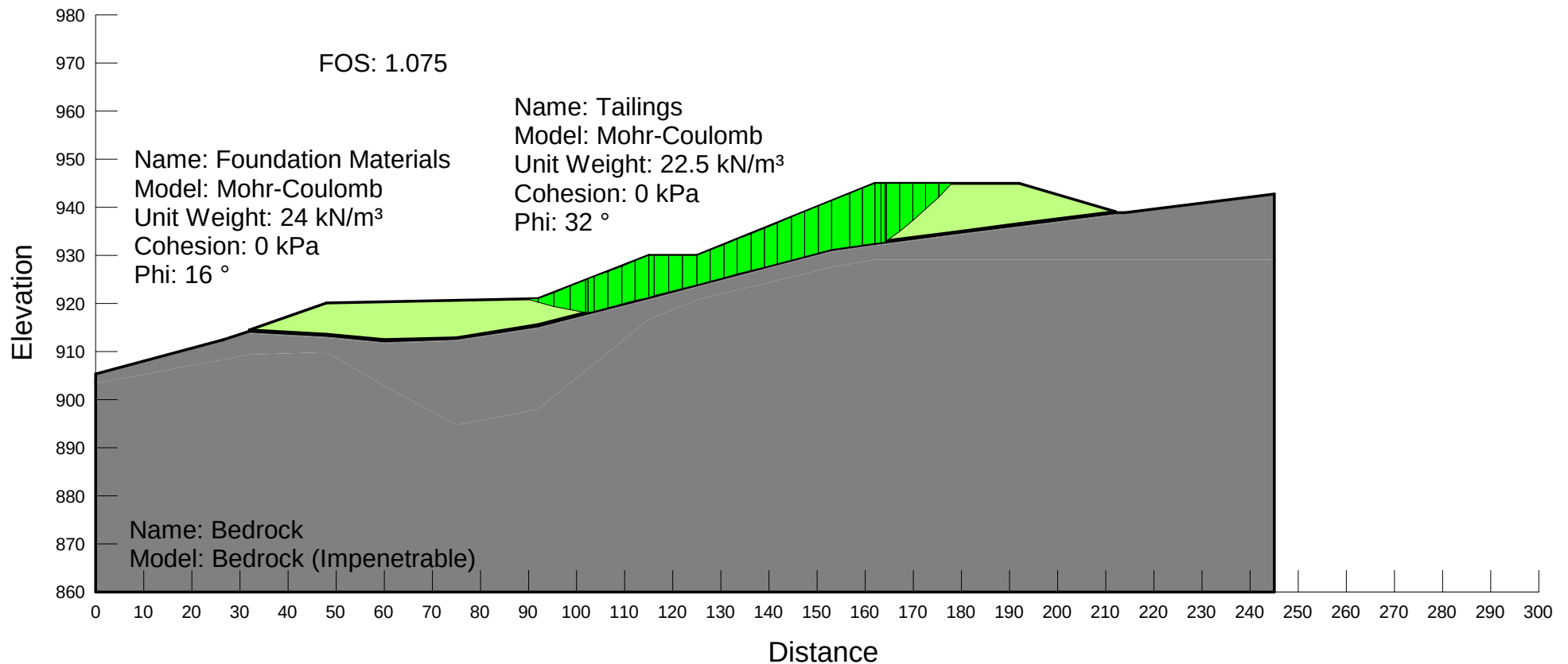
Name: Alignment A
Description: Static (Foundation Analysis)
File Name: W14101178.011_AlignmentA_R12_Static_Geomaterial.gsz
Method: Morgenstern-Price
Horz Seismic Load: 0
PWP Conditions Source: (none)
Length(L) Units: meters
Horizontal Scale: 1250
Vertical Scale: 1250
Minimum Slip Surface Depth: 1 m



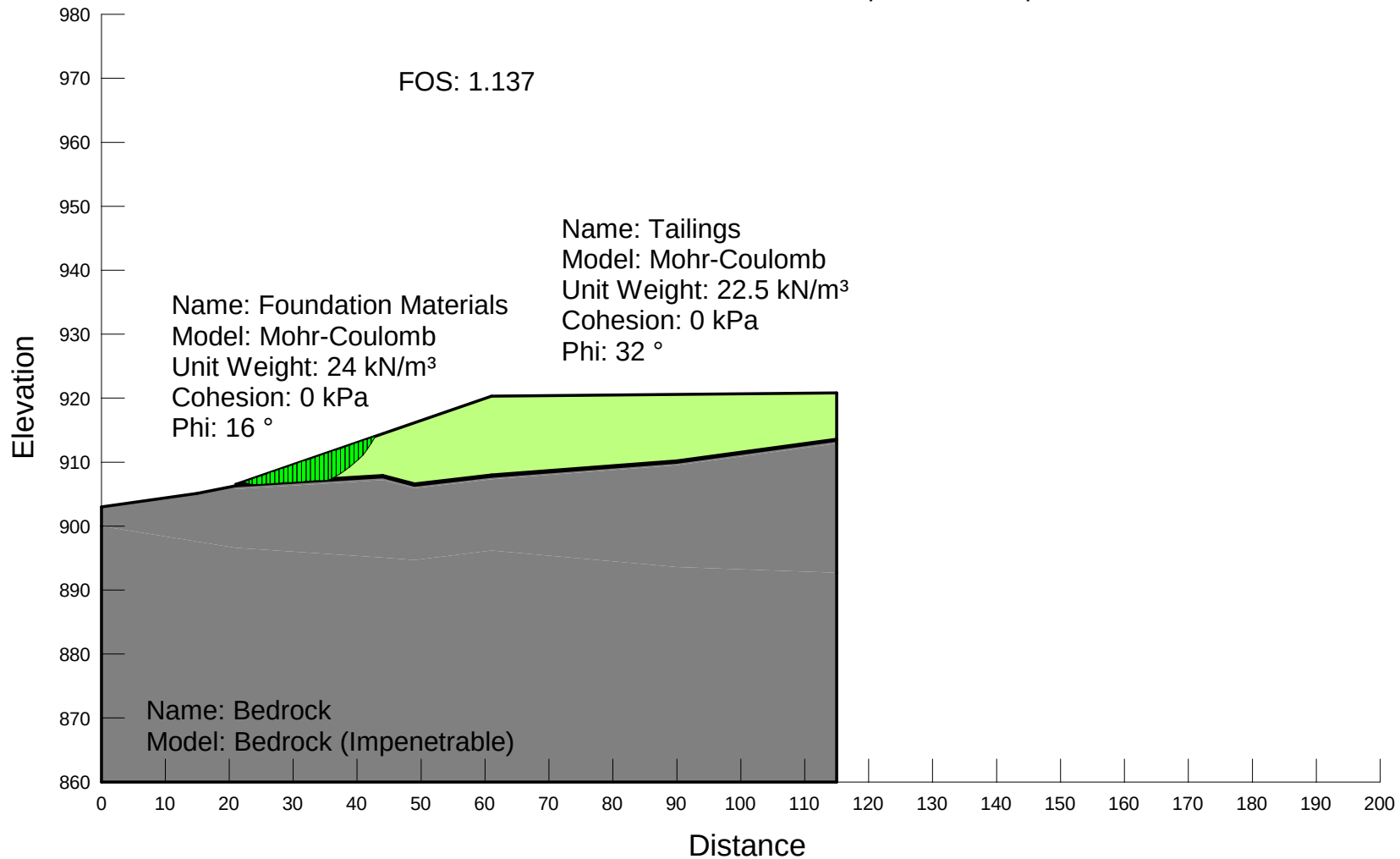
Name: Alignment B
Description: Static (Foundation Analysis)
File Name: W14101178.011_AlignmentB_R12_Static_Geomaterial.gs
Method: Morgenstern-Price
Horz Seismic Load: 0
PWP Conditions Source: (none)
Length(L) Units: meters
Horizontal Scale: 1000
Vertical Scale: 1000
Minimum Slip Surface Depth: 1 m



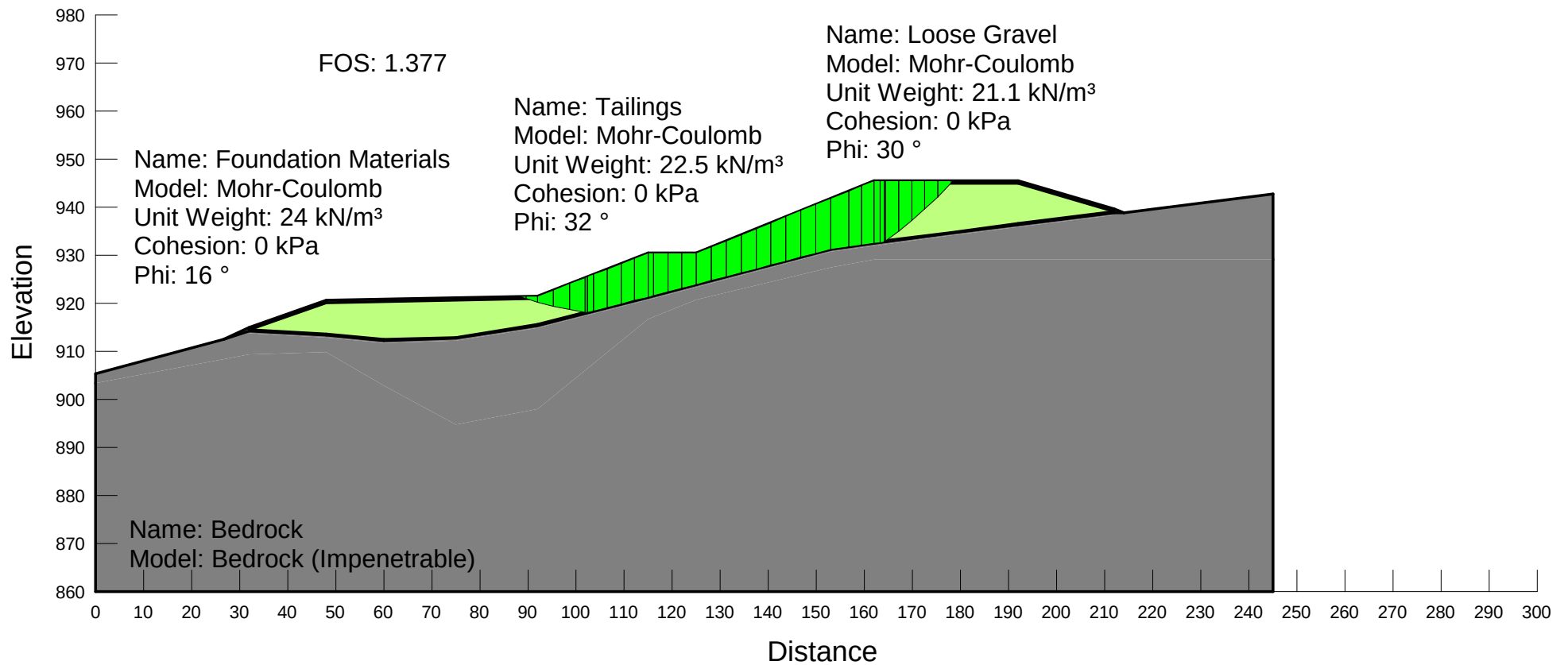
Name: Alignment A
Description: Dynamic (1:475) (Foundation Analysis)
File Name: W14101178.011_AlignmentA_R13_Dynamic475_Geomaterial.gsz
Method: Morgenstern-Price
Horz Seismic Load: 0.069
PWP Conditions Source: (none)
Length(L) Units: meters
Horizontal Scale: 1250
Vertical Scale: 1250
Minimum Slip Surface Depth: 1 m



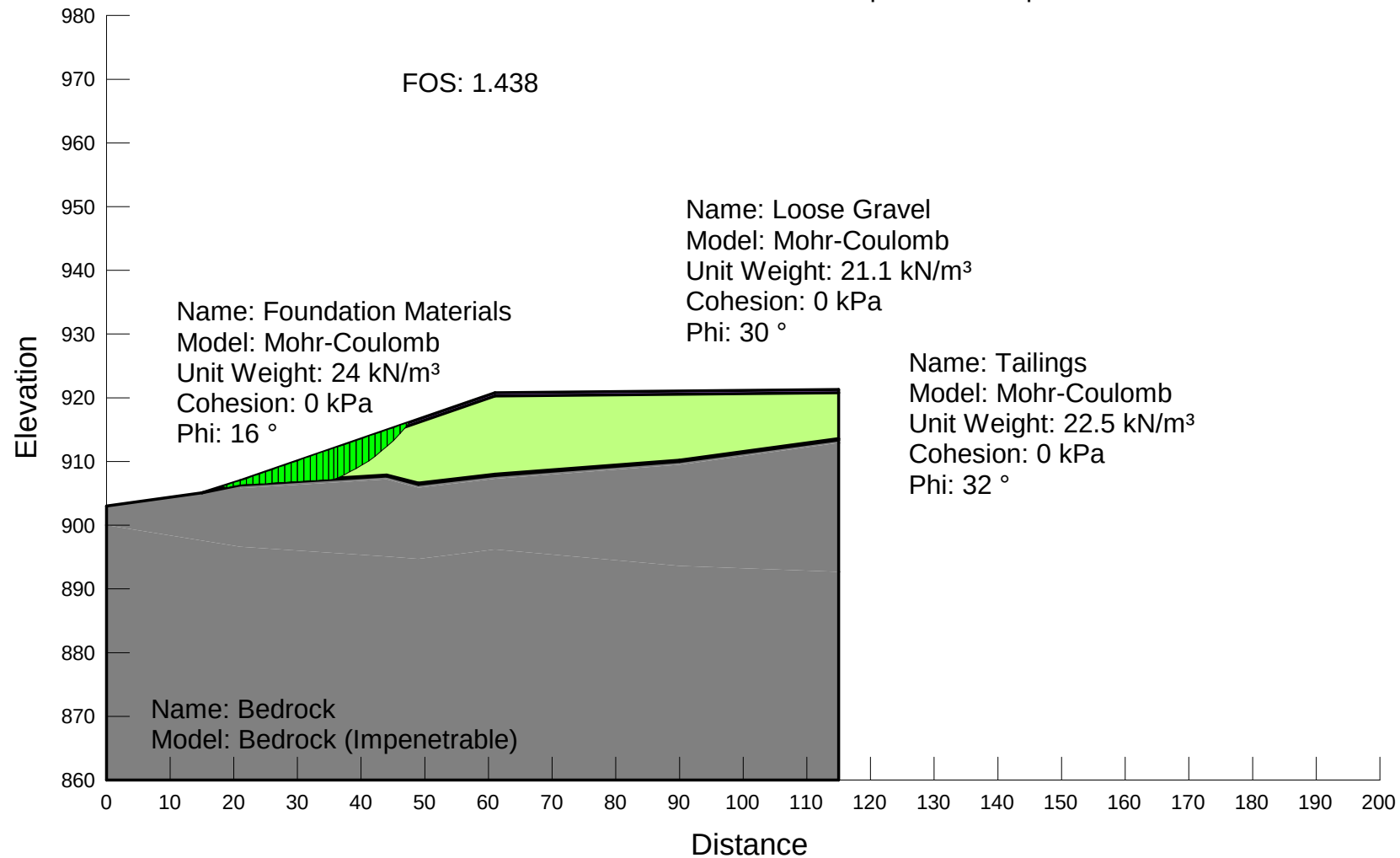
Name: Alignment B
Description: Dynamic (1:475) (Foundation Analysis)
File Name: W14101178.011_AlignmentB_R13_Dynamic475_Geomaterial.gs
Method: Morgenstern-Price
Horz Seismic Load: 0.069
PWP Conditions Source: (none)
Length(L) Units: meters
Horizontal Scale: 1000
Vertical Scale: 1000
Minimum Slip Surface Depth: 1 m



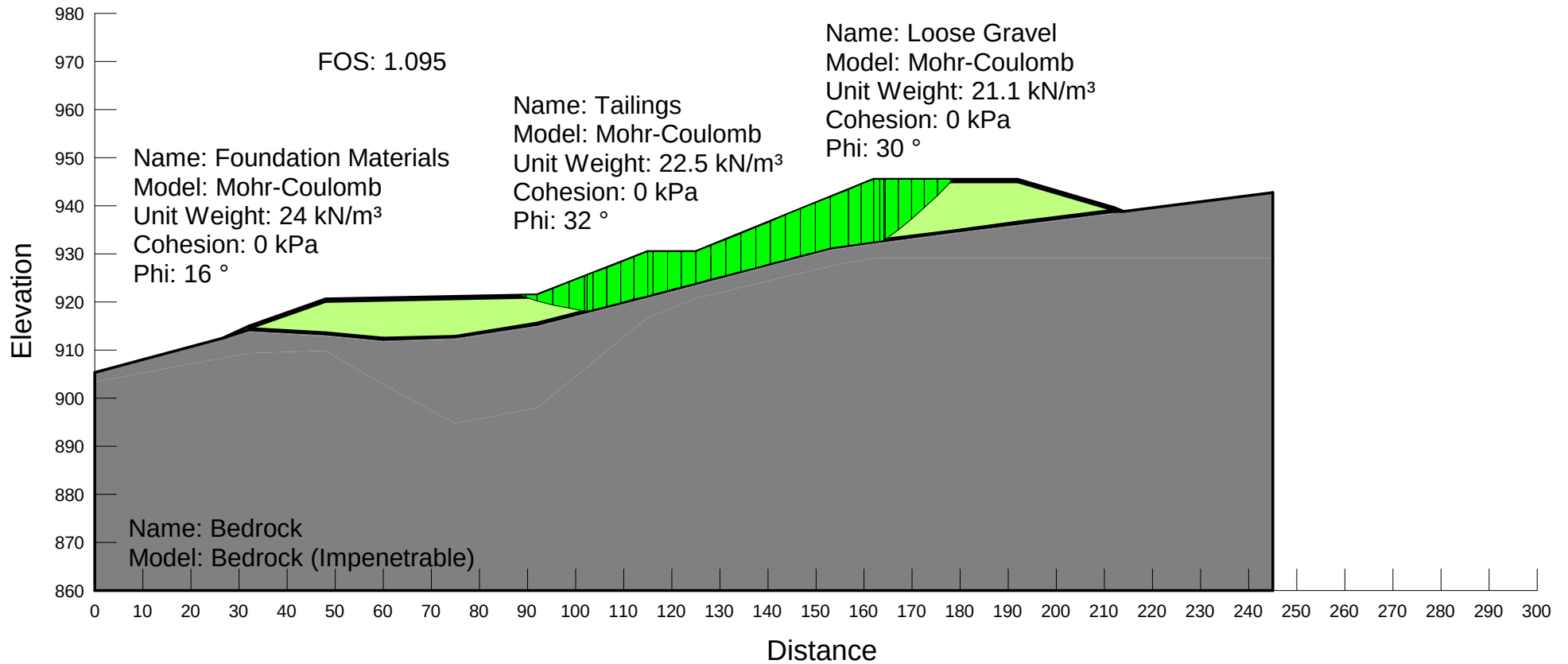
Name: Alignment A
Description: Static (Foundation Analysis)
File Name: W14101178.011_AlignmentA_R14_Static_Geomaterial.gsz
Method: Morgenstern-Price
Horz Seismic Load: 0
PWP Conditions Source: (none)
Length(L) Units: meters
Horizontal Scale: 1250
Vertical Scale: 1250
Minimum Slip Surface Depth: 1 m



Name: Alignment B
Description: Static (Foundation Analysis)
File Name: W14101178.011_AlignmentB_R14_Static_Geomaterial.gsz
Method: Morgenstern-Price
Horz Seismic Load: 0
PWP Conditions Source: (none)
Length(L) Units: meters
Horizontal Scale: 1000
Vertical Scale: 1000
Minimum Slip Surface Depth: 1 m



Name: Alignment A
Description: Dynamic (1:475) (Foundation Analysis)
File Name: W14101178.011_AlignmentA_R15_Dynamic475_Geomaterial.g
Method: Morgenstern-Price
Horz Seismic Load: 0.069
PWP Conditions Source: (none)
Length(L) Units: meters
Horizontal Scale: 1250
Vertical Scale: 1250
Minimum Slip Surface Depth: 1 m



Name: Alignment B
Description: Dynamic (1:475) (Foundation Analysis)
File Name: W14101178.011_AlignmentB_R15_Dynamic475_Geomaterial.gsz
Method: Morgenstern-Price
Horz Seismic Load: 0.069
PWP Conditions Source: (none)
Length(L) Units: meters
Horizontal Scale: 1000
Vertical Scale: 1000
Minimum Slip Surface Depth: 1 m

