Phase II Expansion Detailed Design – Revision 1
Dry Stack Tailings Facility
Keno Hill District Mill Site, Yukon


PRESENTED TO
Hecla Mining Company

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1.0 INTRODUCTION

NND EBA Land Protection Corp., operating as NELPCo Limited Partnership (NELPCo) was retained by Hecla Mining Company (Hecla) to complete the design for the Phase II expansion of the Dry Stacked Tailings Facility (DSTF) at the Keno Hill mine site located near Keno City, YT.

NELPCo is a limited partnership corporation owned by the NND Development Corporation (NNDDC) and Tetra Tech Canada Inc. (Tetra Tech). Tetra Tech is NELPCo's exclusive engineering services provider.

The detailed design for the existing DSTF, known as Phase I, was submitted in 2011. Since then, Tetra Tech has completed monitoring and reviews of the facility's construction and performance.

This report presents the background information related to the existing DSTF design, construction, and performance; summarizes the subsurface conditions encountered during geotechnical evaluations; and details the Phase II expansion design.

Additional information related to Tetra Tech's limitations on the use of this report are included in Appendix A.

1.1 Detailed Design Revision 1 Update

This revised and updated design was completed to address feedback provided by Yukon Government, Energy, Mines and Resources (EMR) related to incorporating facility classification and design criteria from their "Guidelines for Mine Waste Facilities" document issued in February 2023 (EMR, 2023).

Key components in this design revision include:

- Classification of Facility as Class II per Table 4-1 of 2023 EMR Guidelines.
- Update of design criteria per Class II facility as in Table 5-2 of 2023 EMR Guidelines, including updated design earthquake event and Factors of Safety (FOS) for stability.
- Completion of interface direct shear testing on foundation components and incorporation of results into design.
- Incorporation of tailings laboratory testing data completed since previous submission.
- Modifications of facility geometry including:
  - Redesign and alignment of toe buttress feature to tie into P1 berm constructed in fall 2023;
  - Addition of interior berm feature for stability;
  - Final tailings design slope now 3.25H:1V; and
  - Minor adjustments to overall facility shape and extents.
- Updated stability analyses and estimation of seismic displacement.
- Per Table 5-2 of the Guidelines, surface water conveyance systems are to be designed for a 1:200-year event during operations and 1:500 year during). The system will be constructed to the 1:200-year event for operations, and as mine and area plans are confirmed prior to closure, the capacity of the system will be reviewed and if necessary improved to address closure requirements (pers. Communication, H. McIntyre, November 9, 2023).

2.0 BACKGROUND

2.1 General

The Keno Hill Silver District Operation (Keno Hill) consists of a silver-lead-zinc mine operated by Alexco Keno Hill Mining Corporation (AKHM), which was acquired by Hecla Mining Company (Hecla) in 2022. The mill site is located approximately 1 km west of Keno City, Yukon.

The site is operated under Quartz Mining License No. QML-0009.

2.2 Phase I Summary

The existing Phase I of the DSTF was designed in 2011 by EBA, a Tetra Tech Company (EBA, A Tetra Tech Company 2011). This design summarized previously completed investigation, evaluation, and design work.

Phase I design drawings were updated in June 2022 to reflect the as-built conditions in the final design.

Construction and operation of Phase I area have generally progressed per the 2011 detailed design.

Tetra Tech understands that changes in mine planning led to the entire Phase I footprint not being constructed. An area included in the footprint immediately north of the mill is now used as a fuel storage area, turnaround, and laydown area.

Generally, the Phase I facility has performed well. Some areas of localized tension cracks and other near surface instabilities have been observed and are addressed by site staff as they occur with input from Tetra Tech. We have typically attributed these issues to expected permafrost thaw settlement and in some cases inconsistent tailings placement and compaction.

Monitoring instrumentation was installed during the design and construction of Phase 1, consisting of ground temperature cables (GTCs), slope indicators (SIs), and one standpipe piezometer. Data was collected over the years since installations, however to date, most of these instruments have been damaged beyond function or repair. Closure planning will include the design and installation of necessary instrumentation in Phase I.

The performance of Phase I to date has been considered in the design of Phase II.

2.3 Phase II Summary

The Phase II expansion is located immediately south and southwest of the existing Phase I. The area is mostly undeveloped and undisturbed, except for a waste rock storage area along the western edge of the footprint, and existing roadways along the footprint perimeters. Immediately north and northwest of Phase II is the former Keno City waste dump and access road, respectively.

Preliminary geotechnical investigation and design work was previously completed by Tetra Tech (Tetra Tech EBA 2015). The detailed design herein has expanded on the preliminary work completed and incorporates engineering observations and judgement of the performance of Phase 1 to date.

3.0 PHASE II GEOTECHNICAL INVESTIGATION

3.1 General

Tetra Tech completed a geotechnical investigation for the Phase II expansion consisting of a drilling program, laboratory testing on select samples, and installation of ground temperature monitoring instrumentation. Previously completed geotechnical investigative work was reviewed and referenced during the development of the drilling program.

Hecla retained Boart Longyear (Boart) to provide their track-mounted LS 250 MiniSonic drill rig for the geotechnical drilling program. The program was conducted September 25, 2022, to October 4, 2022. Ten boreholes (BH22-01 through BH22-10) were advanced to termination depths that ranged from 15.2 m to 30.5 m.

The boreholes were logged in the field by Jacob Swartz, EIT, a geotechnical engineer from Tetra Tech's Whitehorse office. Each borehole was advanced in 1.5 m increments, and disturbed samples were collected and returned to Tetra Tech's Whitehorse laboratory for geotechnical index testing. Disturbed samples were also collected for field jar tests to estimate ground ice contents.

Upon completion of drilling, boreholes were backfilled using drill cuttings to restore the original ground surface. Borehole locations are showing in the drawing package, and borehole logs and laboratory test results are included in Appendix B.

Select boreholes were chosen for GTC installation based on encountered subsurface conditions, and location within the proposed expansion.

3.2 Surface Conditions

The site of the Phase II expansion generally slopes approximately 5 – 15% to the west or southwest.

The western extents near the mill site have been used as a temporary waste rock storage area. The surface of this storage area is generally flat with a slight slope to the southwest. The waste rock layer tapers out into existing topography to the east and south and is estimated to extend up to 7 m in thickness along the northwestern edge prior to rock sourced for construction in 2023.

The remaining extents of the site are generally bordered by existing gravel roadways.

The interior of the expansion area is vegetated with shrubs and spruce trees. Vegetation is generally thicker and more mature to the east and southeast.

3.3 Subsurface Conditions

Subsurface conditions encountered within the Phase II DSTF footprint were similar to the Phase I conditions, with the exception of generally lower ground ice contents and moisture contents. The soils consisted of a thin organic cover overlying a locally ice-rich silt/sand till with sand and gravel seams deposited throughout. Coarse-grained sand/gravels were encountered underlying the till before the bedrock interface in BH22-01 and BH22-05.

BH22-04 was an outlier as the soil consisted mainly of a sand and gravel matrix for the entire depth. BH22-04 is located on a possible kame that is suspected to be a coarse-grained deposit deposited by glacial outwash. Large gravel and boulders were encountered in multiple boreholes throughout the drilling and are estimated up to 0.5 m in diameter.

Detailed descriptions of the conditions encountered in each borehole are shown on the borehole logs and laboratory test results, which are attached in Appendix B.

3.4 Groundwater

Groundwater was not encountered during the drilling program.

3.5 Permafrost

Permafrost was encountered in most areas throughout the proposed Phase II DSTF, the exception being within the coarse-grained soil encountered near BH22-04. The ground ice contents estimated in the field ranged from non-visible and non-excess to visible. The ground ice volumes were estimated as a percentage visually and volumetrically through jar testing and ranged from less than 5% up to 45% as a percentage of the total soil volume.

The ice rich permafrost was generally observed in the upper 2.0 m to 4.0 m of original ground. BH22-10 contained the most rice-rich soil with ice contents estimated up to 45% by volume. The ground ice encountered in the upper 4 m was contained randomly oriented and stratified lenses in the soil samples collected. Below this, the ground ice was non-visible and with no excess ice.

A detailed description of permafrost conditions encountered is shown on the borehole logs in Appendix B.

3.6 Bedrock

Bedrock in the Keno City area typically consists of quartzite or schist. Quartzite or suspected quartzite was encountered at depth in BH22-01, 04, 05, 07, and 09. Bedrock is also visible at the surface in a few locations near the southern border of Phase I.

3.7 Laboratory Testing

Laboratory testing included determining natural moisture content on all samples, and particle size distributions (sieve/hydrometer) on selected samples. Laboratory test results are included in Appendix B.

3.8 Ground Temperature Cables

One GTC was installed in BH22-40B to replace a damaged instrument and ensure long-term monitoring of the Phase I DSTF. In Phase II, GTCs were installed in seven of the ten drilled locations. The cables installed consist of Tetra Tech cables that require manual readings and Beaded Stream cables that read, record, and transmit the data via a data logger.

Data collected from these instruments indicate that the permafrost within the DSTF footprint is warm, generally above -0.4°C. Table 1 below shows the instrumentation details installed at each borehole. The borehole logs in Appendix B show a visual breakdown of the bead depth placement.

Table 1: Ground Temperature Cables

Borehole Number	BH22-01	BH22-05	BH22-06	BH22-07	BH22-08	BH22-09	BH22-10	BH22-40B
GTC Cable Type & No.	Tetra Tech #2819	Tetra Tech #2820	Tetra Tech #2821	Tetra Tech #2822	Beaded Stream #4473	Tetra Tech #2823	Beaded Stream #4474	Tetra Tech #2824
No. of Beads	16	16	16	16	36	16	25	16
OG Elevation (m)	917	931.7	933	924.4	926.5	924.1	918.6	N/A
Design Ground Elevation (m)	917	940	935.15	940	940	937.5	921.6	920
Bottom of Borehole Elevation (m)	902.5	904.9	902.5	909.9	903.6	895.8	896.0	906.6

The GTC cable length was chosen to accommodate the construction and placement of tailings to allow for long-term monitoring during and post-construction. The cables were ordered based on the design ground elevation and need to be adjusted throughout the construction process. It is recommended that Tetra Tech be contacted or on-site to ensure the GTC's are properly adjusted and set up throughout the construction and operation phases of the Phase II DSTF.

Ground temperature data collected to June 2023 is included in Appendix C.

4.0 PHASE II EXPANSION DESIGN

4.1 Design References and Background Documents

The following guidelines, references, and existing designs were reviewed during design:

- Guidelines for Mine Waste Management Facilities (EMR 2023).
- Guidelines for Mine Waste Dump and Stockpile Design by Mark Hawley and John Cunning (Hawley and Cunning 2017).
- Mined Rock and Overburden Piles – Investigation and Design Manual – British Columbia Mine Waste Rock Pile Research Committee (Piteau 1991).
- Detailed Design Dry-Stacked Tailings Facility, Keno Hill District Mill Site (EBA, A Tetra Tech Company 2011).
- Preliminary Engineering Design and Management Plan, Dry-Stacked Tailings Facility, Bellekeno Mine Mill Site (EBA 2010a).

- Runoff Diversion Structures Specifications, Dry-Stacked Tailings Facility, Keno Hill District Mill, YT (EBA 2010b).
- Various inspection reports, memorandums, and correspondence in relation to Phase I construction, operations, etc.

4.2 Design Classification and Criteria

The 2023 EMR Guidelines require filtered tailings facilities be classified using Table 4-1 and designed using criteria for that classification in Table 5-2.

Using Table 4-1, a classification of Class II for this facility is appropriate (based on presence of permafrost, and use of PAG materials). While the guidance suggests presence of permafrost that is not removed is rationale for a Class III designation, it is Tetra Tech's opinion based on experience monitoring Phase 1 and analyses of Phase 2 foundation soils that a reduction in designation for this criteria to Class II is appropriate.

Design criteria from Table 5-2 was used during the design including:

- Design earthquake event – 1:2,475-year event;
- Lower bound shear strength properties including interface friction angles;
- Upper bound phreatic surfaces;
- Limit equilibrium methods of stability calculations;
- Pseudo-static calculations for earthquake design including deformation analyses;
- Lower bound shear strength properties;
- Static Factor of Safey of 1.5; and
- Psuedo-static Factor of Safey of 1.5.

4.3 Tailings Parameters

Assumed parameters related to tailings, tailings production, and placement are shown in Table 2. Tetra Tech completed laboratory testing on tailings produced in early 2011 and also between December 2021 and January 2024. Generally, tailings are composed of SILT, sandy to and SAND, trace clay, to a SAND and SILT, trace clay. There is some variability in composition due to milling processes and host rock composition. The laboratory results are included in Appendix D.

Table 2: Tailings Parameters

Criteria	Value
Tailings Production Rate	See Section 6.2
Percentage of Tailings Stored in DSTF	
Typical Particle Size Description	SILT, sandy to and SAND, trace clay
Bulk Density	2250 kg/m^3
Moisture Content	10-20%
Maximum Dry Density / Optimum Moisture	1885 – 1960 kg/m^3 at 17% - 12%
Permeability, k	9.65E-8 m/s
Effective friction angle, ϕ’	30-32°
Effective cohesion, c’	8-30 kPa

During production and deposition into Phase II, tailings samples should be collected and provided to Tetra Tech for laboratory analyses to confirm assumptions related to geotechnical properties. This may include grainsize analysis and/or direct shear testing, per OMS requirements.

We understand that Hecla may like to explore options to incorporate a fine-grained sludge product into the pressing procedure to ultimately deposit a mixed final tailings product in the DSTF. Tetra Tech has completed some testing to date on this product, however a mixing ratio is not included in this design. Additional testing is required to be completed and options related to mixing ratios and proper control of mixing to create a uniform product will be reviewed prior to placement of any such material within the DSTF.

4.4 Considerations from Phase I Performance

Generally, the Phase I area has performed to the design expectations. Some movements and distortions were expected. These have manifested as several longitudinal tension cracks perpendicular to the slope, and several small sinkholes. These have been repaired by site staff as required.

Constructed slopes in Phase I are generally 2H:1V to 2.5H:1V, with some localized steeper areas. The observed localized instabilities may be attributed to these steeper slopes, combined with occurrences of inconsistent placement and compaction procedures, as well as possible consolidation due to thaw of the underlying ice-rich permafrost. We understand areas of steepened slopes are to be regraded to design as required for closure.

4.5 Foundation Soil and Permafrost Conditions

Generally, subsurface conditions within the Phase II expansion footprint consist of a thin organic layer, underlain by ice-rich silt or sand till, underlain by bedrock. Sands and gravels were noted to be interbedded in some boreholes.

Up to 7 m of waste rock was located along the western edge of the footprint, near the toe of the proposed Phase II expansion at the time of the drilling program. Since then, construction activities have sourced some of this rock and the thickness of this layer varies.

A bedrock surface was inferred based on the drilling program as well as contact locations previously provided by AKHM.

Permafrost is expected to exists under most of the Phase II footprint. For stability purposes the ice-rich silt till layer was assumed to extend to bedrock, or indefinitely. This is considered conservative, as ground ice contents estimated based on field observations, jar tests, and laboratory moisture contents, were observed to decrease with depth. The long-term thaw of the ice-rich silt layer was also reviewed.

Tetra Tech assumes Hecla will complete the necessary reviews of underground infrastructure / “ground control” in the areas near the DSTF as and when required.

4.6 Geometry

The location and geometry of the Phase II expansion are shown in the drawing package. The final geometry of the Phase II expansion is generally based on the preliminary design concepts. Boundaries have been assumed based on limits provided by Hecla.

Generally, the expansion ties into the southern extents of Phase 1, expanding to the east and west as it advances to the south. Final tailings slopes are 3.25H:1V have been designed.

A toe buttress has been incorporated into the design to assist in achieving minimum factors of safety against failures through the foundation materials. This buttress will also be utilized to collect and convey surface runoff along the western slope and toe. The surface of the buttress is expected to have a gradient of approximately 2%, sloping from the north to the south. A cut/fill operation is anticipated using the local waste rock that is on site. The height of the required fill varies up to approximately 5.5 m at the northern end. The north end of the buttress has been designed to tie into the P1 Berm constructed in Fall of 2023.

To meet stability requirements, an interior berm of waste rock was incorporated into the design, approximately 20 m upgradient or east of the toe buttress. This berm is typically 3 m high at its centerline, its crest is 2.5 m wide, and it has 1.5H:1V slopes.

A summary of geometric details is shown below in Table 3.

Table 3: Summary of Phase II Geometry and Volumes

Criteria	Value
Estimated Footprint	30,000 m^2
Final Tailings Slope	3.25H:1V
Slope Degrees	17.1°
Slope Percent	30.7%
Final Crest Elevation	940 m
Estimated Tailings Tonnage	543,000 tonnes (assuming 2.29 T/m^3)
Estimated Volume of Tailings	237,000 m^3
Estimated Toe Buttress Volume	6,700 m^3
Estimated Interior Berm Volume	3,000 m^3

4.7 Foundation Components

The foundation design for the expansion is consistent with that of Phase 1. Components of the foundation are discussed below, in order of construction.

4.7.1 Drainage Blanket

A 0.6 m thick layer of free-draining granular material will be placed directly on the existing, undisturbed organic surface. This drainage blanket layer will allow for drainage of water generated from near-surface permafrost thaw out of the footprint, if required. It also allows for site preparation and a suitable bearing surface for the other seepage collection system components.

4.7.2 Geosynthetic Clay Liner

A geosynthetic clay liner (GCL) is to be installed above the drainage blanket to intercept any seepage from the DSTF and prevent tailings seepage from infiltrating the drainage layer and underlying foundation soils.

The GCL consists of a layer of bentonite clay between layers of woven geotextile and nonwoven geotextile. The nonwoven geotextile should be oriented upwards.

4.7.3 Geonet and Non-Woven Geotextile Drain

A geonet topped with non-woven geotextile is placed above the GCL and directly underneath the compacted tailings. This drain will aid in alleviating porewater pressure build-up.

This foundation system was designed for Phase 1 under the assumption that porewater from the DSTF would drain after placement. Performance and observations of Phase 1 including a standpipe piezometer installed on the lower bench of Phase 1 have not indicated the presence of seepage water within the geocomposite drain. For this reason, preliminary designs for Phase II excluded the GCL and drain. However, these components were re-instated into a revised preliminary design (Tetra Tech 2015) in response to comments from the Yukon Water Board.

4.7.4 Interface Direct Shear Testing

Interface direct shear testing was completed on the following interfaces:

- Tailings and Geotextile;
- Geotextile and Geonet;
- Geonet and GCL; and
- GCL and Drainage Blanket material.

For stability modelling purposes, results from these tests indicated a maximum equivalent angle of friction of 20° (i.e., this was the lowest of the interface test results, and therefore carried through analyses). Results of direct shear testing are included in Appendix D.

4.7.5 Foundation Materials Quantities

Estimates for total quantities of each foundation component are provided below in Table 4.

Table 4: Estimated Foundation Material Quantities

Component	Estimated Quantity	Comments
Drainage Blanket	18,000 m^3	Total volume in place
GCL	35,000 m^2	Assuming 4.5 m wide rolls. 0.6 m overlap
Geocomposite Drain	35,000 m^2	Assuming 4.5 m wide rolls. 0.6 m overlap

4.8 Seismicity

The design seismic event selected was a 1 in 2,475-year return period as required by a Class II facility in Table 5-2 of EMR's 2023 Guidelines. A seismic site designation of Class D was selected.

4.9 Stability of DSTF

4.9.1 General

The stability of the Phase II expansion was evaluated using Geostudio 2021 Slope/W limit equilibrium slope stability software, commercially available from Geo-Slope International Ltd.

Sections for analyses were selected based on:

- Location relative to existing infrastructure;
- Final height of placement; and
- Existing topography grades.

All stability models assumed a subgrade slope (i.e., slope of drainage blanket material on which the liner is installed) of 4H:1V, or 14°. This was selected to account for any as-built or survey discrepancies with vegetation and increased conservatism in the stability models. The expected maximum subgrade or installed drainage blanket and liner slope along the footprint is flatter at approximately 5.5H:1V or 10°.

4.9.2 Acceptance Criteria

Acceptance criteria for stability analyses was selected from Table 5-2 of the EMR Guidelines based on a Class II facility and is shown below in Table 5.

Table 5: Slope Stability Factors of Safety

Case	Factor of Safety
Static Operations	1.5
Static Closure	1.5
Seismic (Psuedo-static)	1.0

Seismic Stability Analysis

As noted above in Section 4.7, the design seismic event selected was a 1 in 2,475-year return period. Pseudostatic analysis was used to evaluate the potential effect of seismic loading on the DSTF. This method simulates seismic loading by applying constant horizontal and/or vertical forces. A summary of seismic parameters used during the design is summarized below in Table 6.

Table 6: Seismic Stability Criteria

	Selected Value	Source / Comment
Design Event	1:2475 year	2023 EMR Guidelines
Horizontal Seismic Coefficient (k_h) of	½ x PGA (0.139), up to 1.0 x PGA (0.278) for Site Class D	Hynes-Griffin and Franklin,1984

4.9.3 Soil Strength Parameters

During the stability analyses, seven material types were modelled. These are shown in Table 7 and described in further detail in the sections below.

Table 7: Soil Strength Parameters in Stability Analysis

Material	Unit Weight (kN/m^3)	Frictional Strength	
		Friction (Φ)	Cohesion (kPa)
Bedrock	Bedrock was considered impenetrable in this analysis.		
Frozen Ice-Rich Silt Till	11.8	30°	0
Thawed Silt Till	19.1	30°	0
Tailings	22.5	30°	8
Cover and Drainage Blanket Gravel	24	35°	0
Geocomposite Liner and Drain	20	16°	0
Waste Rock	24	40°	0

4.9.3.1 Bedrock

Tetra Tech understands bedrock encountered in the area is typically competent quartzite. The strength of this material is assumed to be much greater than that of the foundation soils and overburden material. The bedrock has been assumed to be impenetrable for modelling purposes.

4.9.3.2 Frozen Ice-Rich Silt Till

The existing DSTF design assumed that the ice-rich silt till layer extended down to bedrock.

In Phase I, the ice-rich till was evaluated for short term conditions (i.e., construction, operations, psuedostatic case) assuming it behaved as a frictional material, and for long term conditions (i.e., closure) assuming only cohesive properties of frozen soil and negating any frictional strength.

For Phase II analyses, based on Tetra Tech's understanding through instrumentation monitoring completed for Phase I to date, and the updated thermal modelling discussed in Section 4.12, the frozen foundation soils are likely to thaw in the long term. Therefore, we have chosen to assume only a frictional behavior for the long-term case.

4.9.3.3 Thawed Silt Till

Under the long-term scenario, Tetra Tech has assumed the ice-rich till has thawed. Tetra Tech considers the assumed strengths which were determined by direct shear testing during Phase I design appropriate for application here.

4.9.3.4 Tailings

Tetra Tech has completed several iterations of direct shear testing on tailings produced. The lower bound limits of angle of friction and cohesion were used stability purposes. Bulk density has been estimated by assuming 15% moisture content applied to the laboratory determined maximum dry density.

4.9.3.5 Surface Cover and Drainage Blanket Gravels

The friction angle of the gravel was conservatively assumed as 35° based on Tetra Tech'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 2385 kg/m3. It is assumed that the gravel would be placed at 95% standard proctor maximum dry density and 8% moisture for the drain area and 90% density and 4% moisture for the cover material.

4.9.3.6 Foundation Materials

As noted in Section 4.7.5, interface direct shear testing was completed on foundation materials. The lower bound equivalent angle of friction from these tests was utilized during slope stability analyses – further reduced by 20% per recommendations by Hynes-Griffin and Franklin,1984.

4.9.4 Analysis Results

A summary of the determined FoS for each of the evaluated scenarios is provided below in Table 8. Slope stability figures are included in Appendix E.

Table 8: Phase II Slope Stability Analysis Results

Evaluated Scenario	Minimum FoS	Calculated FoS				
		Section A	Section B	Section C	Section D	Section E
Fully Frozen - Static Shallow (short-term)	1.5	2.2	2.2	2.2	1.9	1.7
Fully Frozen - Static Deep (short-term)	1.5	1.9	2.0	1.8	1.9	2.0
Fully Frozen - Pseudostatic Shallow (short-term)	1.0	1.5	1.4	1.5	1.4	1.4
Fully Frozen - Pseudostatic Deep (short-term)	1.0	1.3	1.4	1.3	1.3	1.4
Fully Thawed - Static Shallow (long-term)	1.5	2.1	2.1	2.2	2.0	1.7
Fully Thawed - Static Deep (long-term)	1.5	2.1	2.1	2.0	2.0	2.2
Fully Thawed - Pseudostatic Shallow (long-term)	1.0	1.4	1.4	1.5	1.4	1.0
Fully Thawed - Pseudostatic Deep (long-term)	1.0	1.4	1.4	1.3	1.4	1.3
Foundation Analysis - Static Deep (long-term)	1.5	2.1	1.6	1.5	1.5	1.6
Foundation Analysis - Pseudostatic Deep (long-term)	1.0	1.1	1.0	1.0	1.0	1.0

All calculated FoS met the minimums required.

4.10 Seismic Displacement

Seismic displacement was estimated using methods by Bray and Macedo for shallow crustal earthquakes. Assuming a relatively large 7.5 magnitude earthquake, displacements along different sections were estimated at approximately 35 cm with a probability of exceedance of 5%, and 54 cm with a probability of exceedance of 2%.

4.11 Thaw Consolidation

During the preliminary design of Phase I, thaw consolidation testing on select samples and one-dimensional thaw analysis were completed (EBA 2010a). This analysis attempted to provide upper bound estimates of the possible accumulative distortion in perpetuity due to the thaw of the ice-rich and ice-poor silt till. This analysis was considered conservative, and only applicable to the selected and analyzed borehole. The detailed design (EBA 2011) took a more generalized approach, indicating a potential and anticipation for localized differential movement and settlement to occur under the DSTF.

The Phase II expansion has been designed with a similar consideration, noting that in general the ground ice and moisture contents encountered within the Phase II footprint were lower than those encountered under Phase I, and therefore less overall thaw consolidation movement is expected.

4.12 Liquefaction Assessment

A liquefaction assessment was completed during the Phase I detailed design. This assessment concluded:

- The tailings are not considered to be liquifiable as they are expected to be drained and unsaturated; and
- A FoS greater than or equal to 1.0 was determined against cyclic liquefaction in the foundation soils for an earthquake magnitude less than 8.0, which is considered to be an extreme event. It was estimated that the consequences of any liquefaction would amount to limited movement and cracking of the tailings, as opposed to catastrophic failure.

The foundation soils within Phase II are similar to those encountered in Phase I, with typically lower ground ice and moisture contents. The liquefaction assessment completed for Phase I was reviewed and considered appropriate and applicable to the Phase II expansion.

4.13 Creep

Ice and ice-rich soils can creep over time. The magnitude of movement due to creep is a function of stresses developed in the ice or soils.

Previous monitoring of slope inclinometer (SI) instrumentation installed within and around the Phase 1 footprint provided no indication of significant movement in the existing DSTF in the early years of operations. Unfortunately, there are no longer any functioning SI's. No massive ice was encountered during the geotechnical investigation of Phase II. Ground ice contents, estimated visually and based on moisture contents on collected samples, are lower compared to those encountered in Phase 1.

Based on these considerations, coupled with the understanding that in the long-term, complete thaw of the permafrost and ground ice is anticipated, negligible creep deformation is expected within or under Phase II. Continued visual and survey monitoring of the DSTF throughout its life is recommended.

4.14 Geothermal Analysis

4.14.1 Phase I Pre-Construction Thermal Analysis

Thermal analysis was previously completed in 2011 (Tetra Tech EBA 2011) to investigate the long-term impact of dry stacked tailings placement on the thermal regime of the underlying ground in the DTSF area under climatic conditions including a climate change scenario. The thermal analysis was completed using GEOTHERM, Tetra Tech's proprietary two-dimensional finite element software. Climatic conditions (e.g., monthly air temperatures, wind speed, solar radiation, snow cover) were obtained from the Mayo weather station.

Historical air temperature data at Mayo for the period of 1970 to 2010 indicated that the long-term climatic trend at Mayo is warming. The climate change thermal analysis considered a moderate greenhouse gas emission scenario with 1971-2000 baseline as summarized in Table 9 following CSA (2010) for Zone W1. As will be discussed in Section 4.14.2.5.2, the newer climate models show warmer temperature changes than what was originally used in this previous assessment.

Table 9. Predicted Seasonal Air Temperature Changes in Zone W1 (CSA 2010)

Time of Year	2011 to 2040 (Celsius Degrees)	2041 to 2070 (Celsius Degrees)	2071 to 2100 (Celsius Degrees)
December to February	0.9	2.3	4.3
March to May	0.9	2.0	2.8
June to August	0.6	1.6	2.5
September to November	0.6	2.2	2.9

Several assumptions were made regarding the placement of the dry stacked tailings as summarized below. No records are available after the issuance of this thermal analysis memo to confirm these assumptions during construction of the facility.

- 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.

The predicted rate of thaw into the permafrost is negligible during first several years after completion of the tailings placement and then starts to increase with time after that period. Of the several cases simulated in the thermal model to investigate the influence of climate change, it was predicted that the permafrost will disappear between 22 and 29 years after construction, while the ice layer will disappear between 46 and 53 years.

4.14.2 Phase I Post-Construction Thermal Analysis

4.14.2.1 General

The commercially-available finite element software Temp/W in GeoStudio 2021 R2 (Seequent 2022) was used to model and analyze the thermal performance of the dry-stack tailings facility post-construction. Temp/W can analyze simple conduction problems to complex surface energy simulations using a rigorous phase change formulation, providing an accurate solution to problems involving freeze-thaw of saturated-unsaturated porous media. Temp/W has been used in the industry to simulate cyclic changes in ground temperatures for the purpose of exploring frost protection layers below trafficable surfaces, insulation configurations for foundations, or studying the preservation of frost in permafrost zones, mine wastes, and soil covers.

Two borehole locations have available thermistor data. BH40 was installed in February 2012 and has snapshot temperature with depth data available between installation and May 2013. BH22-40B was installed in February 2023 and has snapshot temperature with depth data available for April through June 2023.

The conceptual model for BH40 from 2012 consists of 5.25 m of tailings, 0.5 m of drainage blanket, 0.5 m of sand and gravel fill, 1.0 m of peat layer overlying 9.6 m of ice-rich silt, 0.9 m of massive ice, 1.8 m of silt and gravel, 2.7 m of massive ice, 3.1 m of gravel, 2.2 m of silt and gravel, and 0.9 m of sand over bedrock.

The conceptual model for BH22-40B from 2023 consists of 7.4 m of tailings, 0.5 m of drainage blanket, 0.5 m of sand and gravel fill, 1.0 m of peat layer overlying 8.35 m of ice-rich silt, 1.8 m of silt and gravel, 2.7 m of massive ice, 3.1 m of gravel, 2.2 m of silt and gravel, and 0.9 m of sand over bedrock. The soil layers below the drainage blanket were assumed to be the same with BH40, with thinner ice-rich silt and no massive ice between ice-rich silt and silt and gravel layers.

These conceptual borehole models are considered conservative as related to permafrost and ground ice conditions, as they are based on the poorest conditions encountered in the area, and not necessarily modelled based on actual conditions as now known.

4.14.2.2 Material Properties

The material properties from the nearby BH35, completed during Phase I design, were used to model the temperature behavior at BH40. The material properties for BH35 were previously reported in Tetra Tech EBA (2011) and are summarized in Table 10. The snow layer during the winter months was assumed to have a constant thermal conductivity of 0.25 W/m^2 (see Section 4.14.2.3).

Table 10. Material Properties at BH40

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	3.2	1.9	0.93	1.23	96
Sand and Gravel (Fill)	5	2.1	1.33	1.5	0.8	0.9	33
Peat before thaw consolidation	150	0.75	0.49	0.3	1.92	2.19	150
Peat after thaw consolidation	60	1.6	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	2.2	10	2.1	4.2	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	0.86	1.05	70
Silt and Gravel No. 2	15.5	2.19	2.59	1.7	0.92	1.2	98
Sand	10	2.25	2.27	1.73	0.86	1.05	68
Bedrock	1	2.63	4	4	0.75	0.77	9

4.14.2.3 Boundary Conditions

Mean monthly air temperatures from January 2010 to April 2023 for Environment Canada's Mayo Station are shown in Figure F-1 (Appendix F). Other climatic data needed for the Surface Energy Balance boundary condition in Temp/W is summarized in Table 11. The Surface Energy Balance boundary condition considers the coupled soil-atmosphere process that affects the thermal response of the ground. The monthly air temperatures in Table 11 were used to establish the initial ground conditions prior to tailings placement. The wind speed, snow cover, and solar radiation were assumed to be constant for each year of the analysis. Only the historical monthly air temperatures from the Mayo Station were varied in the analysis period.

The albedo was assumed to be equal to 0.7 when snow is present on the ground, and 0.35 when there is no snow. Albedo is the amount of solar radiation reflected by a surface, where 1.0 being a perfect reflector and 0 absorbing all incoming solar radiation. A heat flux of 0.089 W/m^2 was applied at the base of the model to account for the geothermal heat.

Table 116. Mean Climatic Conditions at Keno Hill

Month	Measured Monthly Air Temperature (a) (°C)	Measured Monthly Wind Speed (b) (km/h)	Estimated Monthly Snow Cover (c) (m)	Estimated Daily Solar Radiation (d) (W/m^2)
January	-14.7	7.7	0.57	7.9
February	-14.0	5.4	0.57	32.9
March	-14.4	12.4	0.53	93.3
April	-4.9	11.8	0.41	174.2
May	3.4	8.8	0	224.2
June	9.6	7.5	0	240.8
July	10.8	8.2	0	208.3
August	8.0	8.7	0	157.5
September	1.9	8.5	0	90.4
October	-5.1	8	0.34	36.7
November	-13.6	8.9	0.48	11.3
December	-10.2	5.5	0.56	3.8
Mean Annual	-3.6	-	-	-

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 data at Galena Hill station for the period of 2007 to 2010

(c) Based on mean month-end snow data at Mayo (Climate Normals 1971-2000, Environment Canada website) and environmental conditions report (Access Consulting Group, 2009)

(d) Based on Photovoltaic Potential and Solar Resource Maps of Canada

4.14.2.4 Climate Change Projection

The latest iteration of the global climate models (GCMs) for the Coupled Model Intercomparison Project Phase 6 (CMIP6) was released in 2021. The results of these GCMs were used in the latest Intergovernmental Panel on Climate Change (IPCC) Assessment Report (AR6) (IPCC 2021). A particular feature of the CMIP6 climate scenarios is the addition of the Shared Socio-economic Pathways (SSPs) that aims to include different mitigations and adaptations to ongoing growth in emissions. The SSPs are considered plausible narratives by the IPCC of global societal developments in the future without considering climate change, or mitigation or adaptation responses. SSP-based scenarios combine elements with the previous iteration of scenarios, the Representative Concentration Pathways (RCPs), which describe trajectories of change in atmospheric GHG and aerosol concentrations (and corresponding changes in radiative forcing) over time.

Two climate scenarios from the CMIP6 models were considered as summarized below. Table 12 provides an overview of the corresponding for the two climate scenarios used in the analysis.

- SSP3-7.0, radiative forcing between RCP6.0 (6 W/m^2) and RCP8.5 (8.5 W/m^2) and represents the medium to high end of the range of future forcing pathways.
- SSP4-6.0, radiative forcing of RCP6.0 (6 W/m^2) and fills in the range of medium forcing pathways.

Table 127. Overview of SSP Scenarios

Climate Scenario	Narrative
SSP3-7.0	▪ A resurgent nationalism, concerns about competitiveness and security, and regional conflicts push countries to increasingly focus on domestic or, at most, regional issues. ▪ Policies shift over time to become increasingly oriented toward national and regional security issues. ▪ Countries focus on achieving energy and food security goals within their own regions at the expense of broader-based development. ▪ Investments in education and technological development decline. ▪ Economic development is slow, consumption is material-intensive, and inequalities persist or worsen over time. ▪ Population growth is low in industrialized and high in developing countries. ▪ A low international priority for addressing environmental concerns leads to strong environmental degradation in some regions.
SSP4-6.0	▪ Highly unequal investments in human capital, combined with increasing disparities in economic opportunity and political power, lead to increasing inequalities and stratification both across and within countries. ▪ Over time, a gap widens between an internationally-connected society that contributes to knowledge- and capital-intensive sectors of the global economy, and a fragmented collection of lower-income, poorly educated societies that work in a labor intensive, low-tech economy. ▪ Social cohesion degrades and conflict and unrest become increasingly common. ▪ Technology development is high in the high-tech economy and sectors. ▪ The globally connected energy sector diversifies, with investments in both carbon-intensive fuels like coal and unconventional oil, but also low-carbon energy sources. Environmental policies focus on local issues around middle and high income areas.

Figure F-2 (Appendix F) from Riahi et al. (2016) shows a comparison of the temperature change at the Earth's surface between CMIP5 and CMIP6 models, and between each RCP and SSP climate scenarios. The CMIP6 models are slightly warmer than those projected from the CMIP5 models. SSP4-6.0 is analogous to the intermediate case in the previous iterations of the climate change models along with RCP4.5 (i.e., in CMIP5) and SSP2-4.5 (i.e., in CMIP6). Hausfather and Peters (2020) have demonstrated that both SSP5-8.5 and SSP3-7.0 are both highly unlikely and unlikely scenarios, respectively. Given the current climate policies, Hausfather and Peters (2020) showed that the likely plausible trajectory follows SSP4-6.0. SSP3-7.0 was still used in the climate change assessment as part of the sensitivity analysis.

The mean annual air temperature for the two climate scenarios is provided in Figure F-3 (Appendix F). The 50^{th} percentile for the region of Yukon averaged over 20 years was selected. Only the mean annual temperatures are shown in Figure F-3, but the analysis considered the temperature change with respect to seasonal variability relative to a reference period of 1995-2014 as summarized in Table 13 and Table 14 for SSP3-7.0 and SSP4-6.0, respectively. The temperature change is added at the beginning of the timestep (e.g., adding 1.90°C for the monthly mean temperatures of December to February for SSP3-7.0) and held constant for the subsequent 20 years. At year

2041, the increment between 2021-2040 and 2041-2060 is added to the temperatures calculated at 2040 (e.g., adding increment of 0.54°C for the monthly mean temperatures of December to February for SSP3-7.0) and held constant again for the subsequent 20 years. This process is repeated for each time of year and every 20 year period until 2100. As noted in the AR6 (IPCC 2021), the radiative forcing for SSP4-6.0 is expected to stabilize at the end of the century, hence the temperatures between 2080 and 2100 are less than that of the SSP3-7.0 values. SSP3-7.0 is projected to continue to increase after 2100.

Given the range of natural climate variability and uncertainties regarding future greenhouse gas emission pathways and climate responses, the literature suggests changes projected by one climate model should not be used in isolation (ECCC n.d.). Therefore, both SSP3-7.0 and SSP4-6.0 climate scenarios considered in the analysis used a multi-model ensemble that includes several GCM models. This data is publicly available in https://climate-scenarios.canada.ca/?page=cmip6-scenarios.

Table 13. Changes in Temperature using CMIP6 for SS3-7.0 (50th percentile)-Celsius Degrees

Time of Year	2021 to 2040	2041 to 2060	2061 to 2081	2081 to 2100
December to February	1.16	2.69	4.11	5.76
March to May	1.13	1.93	3.35	4.44
June to August	0.95	1.88	2.93	4.22
September to November	1.30	2.39	3.60	4.66
Annual	1.12	2.17	3.52	4.77

Table 14. Changes in Temperature using CMIP6 for SSP4-6.0 (50th percentile)-Celsius Degrees

Time of Year	2021 to 2040	2041 to 2060	2061 to 2081	2081 to 2100
December to February	0.94	2.97	4.53	5.48
March to May	1.07	2.11	2.94	4.00
June to August	1.25	2.14	2.83	3.52
September to November	1.26	2.63	4.10	4.39
Annual	1.16	2.46	3.67	4.37

The climate scenarios have been projected by climate modelers to 2100 but projected air temperature data is not available past 2100. There have been efforts to extend the models beyond 2100 but studies that focus on time horizons beyond 2100 have used reduced complexity because of the additional computational cost and not having available experiments to compare those results (Lyon et al. 2021, IPCC 2021). In this climate change assessment, both climate scenarios terminate at the end of 2100. It was assumed that the wind speed, snow depth, and solar radiation provided above are constant to 2100.

4.14.2.5 Results and Discussion

4.14.2.5.1 Calibration

Figure F-4 to F-7 (Appendix F) show the model results for BH40 between the months of September 2012 and May 2013. The general trend of modelled temperatures follows that of the measured values, which provide confidence in model results. The original permafrost layer prior to placement of the tailings was simulated in the model. The simulated top of permafrost is at El. 911.5 m, with an active layer thickness of 2.8 m with respect to the original ground surface. Both measured and model temperatures indicate that part of the tailings is below 0°C during this monitored period. Placement of the tailings raised the 0°C isotherm within the tailings during the monitoring period. No temperature readings are available after May 2013 at BH40. Extending the model to April 2023 indicates that the permafrost is still at or near its initial elevation prior to placement of tailings.

Figure F-8 (Appendix F) shows the snapshot model result at BH22-40B in April 2023. A frozen layer was identified at El. 911.2 m in the borehole log during the placement of the PVC pipe for the thermistor cable. This frozen layer is not reflected in the thermistor reading below the original ground surface. The model temperatures between El. 910 and 915 m are within a thermal difference of 0.5°C in reference to the measured temperatures. Measured temperatures below El. 910 m are slightly above 0°C, while the model temperatures are slightly below 0°C. The thermal difference between measured and model temperatures below 0°C are within 0.5°C. The model results follow the general trend of measured temperatures and therefore considered acceptable given that the actual placement of the tailings and corresponding temperatures during construction is not available.

The predicted thawing in Tetra Tech EBA (2011) is generally 0.0 m/yr between 2013 and 2015, and on average 0.15 m/yr between 2015 and 2035. The conditions simulated and calibrated in the current model is considered to supersede the previously modelled results in 2011. The model temperatures at the end of April 2023 for both boreholes are used as the initial thermal regime at the start of the climate change analysis.

4.14.2.5.2 Climate Change Projected Temperatures

The results of the climate change analysis for BH40 using SSP3-7.0 and SSP4-6.0 are shown in Figure F-9 and F-10 (Appendix F), respectively. The depth of the 0°C isotherm between 2030 and 2100 for both climate scenarios below the original ground surface are summarized in Table 15. On average, the depth of the 0°C isotherm and the thickness of the active layer with reference to the original ground surface between the two climate scenarios is generally the same. By 2040, the top of permafrost will be 4.3 m below original ground surface, which is equivalent to 1.6 m of degradation. Based on these climate scenarios, the permafrost will degrade by approximately 6.5 m by 2100 (i.e., 9.2 m from original ground surface), with the permafrost thickness reduced to 12.9 m. The average permafrost temperature in 2100 is -0.05°C. It is likely that the previous analysis in Tetra Tech EBA (2011) considered a cut-off temperature (e.g., -0.1°C) to delineate the permafrost for conservatism. Considering this cut-off temperature indicate that the permafrost will disappear between 2050 and 2070, consistent with the previous prediction noted in Section 4.14.1.

Table 15. Depth of Permafrost Thaw at BH40 from Original Ground Surface Elevation

Timestep	SSP3-7.0 (m)	SSP4-6.0 (m)	Average (m)	Permafrost Thickness (m)	Average Permafrost Temperature (°C)
2030	3.31	3.34	3.3	> 20.0	-0.13
2040	4.28	4.37	4.3	19.7	-0.12
2050	5.29	5.28	5.3	18.0	-0.11
2070	6.80	6.85	6.8	15.8	-0.08
2100	9.21	9.17	9.2	12.9	-0.05

The results of the climate change analysis for BH22-40B using SSP3-7.0 and SSP4-6.0 are shown in Figure F-11 and F-12 (Appendix F), respectively. The depth of the 0°C isotherm between 2030 and 2100 for both climate scenarios below the original ground surface are summarized in Table . On average, the depth of the 0°C isotherm and the thickness of the active layer with reference to the original ground surface between the two climate scenarios is generally the same. By 2040, the top of permafrost will be 3.3 m below original ground surface, which is equivalent to 0.8 m of degradation. Based on these climate scenarios, the permafrost will degrade by approximately 6.0 m by 2100 (i.e., 8.5 m from original ground surface), with the permafrost thickness reduced to 11.6 m. The average permafrost temperature in 2100 is -0.05°C.

Table 16. Depth of Permafrost Thaw at BH22-40B from Original Ground Surface Elevation

Timestep	SSP3-7.0 (m)	SSP4-6.0 (m)	Average (m)	Permafrost Thickness (m)	Average Permafrost Temperature (°C)
2030	2.29	2.43	2.4	> 20.3	-0.13
2040	3.16	3.31	3.3	20.3	-0.11
2050	4.05	4.16	4.1	17.5	-0.10
2070	5.56	5.64	5.6	15.0	-0.08
2100	8.48	8.49	8.5	11.6	-0.05

Continuous monitoring at BH22-40B will provide additional thermal data to track its thermal performance and the trend of climate change for the dry-stack tailings facility, in conjunction with climatic data for the region using available weather stations and thermistor readings throughout the site.

4.14.3 Phase II Thermal Analysis

4.14.3.1 General

Two thermistor cables were installed in February 2023 at BH22-08 and BH22-10 to monitor the ground temperatures at the two locations where the footprint of the dry-stack facility will be placed. Snapshot temperature readings with depth to date for BH22-08 are shown in Figures F-13 and F-14 (Appendix F), while temperature readings for BH22-10 are shown in Figures F-15 and F-16 (Appendix F, see also Section 4.14.3.5.1).

In the absence of a construction schedule and tailings placement, it was assumed that the tailings material is deposited at increments of 2 m per year until the design surface elevation is achieved. The total tailings placed in BH22-08 is 13 m, and 2.4 m in BH22-10. It was assumed that placement of tailings material will commence in May 2024.

The conceptual model for BH22-08 consists of 13 m of tailings, 0.5 m of drainage blanket, 0.9 m of sand and gravel fill, 0.25 m of peat layer overlying 7.95 m of silt, 0.6 m of sand and gravel, and 3.6 m of silt overlying 17.5 m of sand over bedrock. The conceptual model for BH22-10 consists of 2.4 m of tailings, 0.5 m of drainage blanket, 6.4 m of sand and gravel, 0.2 m of peat layer overlying 1.7 m of till, 0.9 m of massive ice, and 1.4 m of peat overlying 13.5 m of till over bedrock.

4.14.3.2 Material Properties

Material properties used in the thermal analyses for BH22-08 and BH22-10 are provided in Table 17 and Table 18, respectively using the most recent boreholes completed during the Phase II drilling program. The underlying stratigraphy was divided to several units to account for the change in water content with depth. These properties were determined indirectly from well-established correlations with soil index properties, gravimetric water content, grain size distribution, and bulk density (Farouki 1986, Johnston 1981). Uncertainties related to material properties and interpreted stratigraphy were reduced by comparing model results with measured temperature data from the ground temperature cables (see Section 4.14.3.5).

Table 17. Material Properties at BH22-08

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	3.2	1.9	0.93	1.23	96
Sand and Gravel (Fill)	5	2.1	1.33	1.5	0.8	0.9	33
Bedrock	1	2.63	4	4	0.75	0.77	9
Silt No. 1	21.6	1.86	1.69	1.31	1.08	1.35	79
Silt No. 2	10.9	1.70	0.96	0.94	0.99	1.07	24
Silt No. 3	6.7	1.63	0.68	0.68	0.94	0.95	3
Sand and Gravel	10	1.90	1.44	1.34	0.86	1.05	58
Sand No. 1	22.2	1.99	2.18	1.51	1.04	1.36	102
Sand No. 2	8.3	1.77	0.97	1.12	0.91	1.00	27

Table 18. Material Properties at BH22-10

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	3.2	1.9	0.93	1.23	96
Sand and Gravel (Fill)	5	2.1	1.33	1.5	0.8	0.9	33
Bedrock	1	2.63	4	4	0.75	0.77	9
Till No. 1	19.8	2.56	2.39	1.87	1.02	1.30	106
Till No. 2	12.2	2.18	2.07	1.76	0.95	1.11	57
Till No. 3	26.1	2.45	2.39	1.87	1.07	1.45	147
Till No. 4	12.5	2.18	2.11	1.77	0.95	1.12	59
Sand and Gravel	5.5	2.21	1.57	1.75	0.84	0.91	25

4.14.3.3 Boundary Conditions

The boundary conditions described in Section 4.14.2.3 (i.e., climate data, geothermal heat flux) from Phase 1 are applied in the same manner for the calibration of BH22-08 and BH22-10 between January 2022 and April 2023. The tailings material was assumed to have a placement temperature of 10°C (i.e., activation temperature) at each year of placement.

4.14.3.4 Climate Change Projection

The climate scenarios SSP3-7.0 and SSP4-6.0 described in Section 4.14.2.4 are applied in the same manner for the climate change assessment of BH22-08 and BH22-10.

4.14.3.5 Results and Discussion

4.14.3.5.1 Calibration

The results of model calibration for BH22-08 are shown in Figures F-13 and F-14 (Appendix F) for the months of March and April 2023, respectively. The modelled temperatures for the two months shown generally follow the trend of observed temperatures in the field. The depth of active layer is approximately 4.2 m, with top of permafrost layer at El. 922.3 m. The depth where temperatures are at or below 0°C extends to El. 907 m, with the permafrost having an approximate thickness of 15 m.

The results of model calibration for BH22-10 are shown in Figures F-15 and F-16 (Appendix F) for the months of March and April 2023, respectively. The modelled temperatures for the two months shown generally follow the trend of observed temperatures in the field but there were differences observed in the active layer, which is primarily attributed to the three-dimensional effect of the surrounding facilities influencing its thermal regime. The depth of active layer is approximately 6 m, with top of permafrost layer at El. 912.7 m. The depth where temperatures are at or below 0°C extends to El. 900.9 m, with the permafrost having an approximate thickness of 12 m.

For both boreholes, additional data throughout the year will support future calibration of the proposed dry stack facility at this location.

4.14.3.5.2 Climate Change Projected Temperatures

The results of the climate change analysis for BH22-08 using SSP3-7.0 and SSP4-6.0 are shown in Figure F-17 and F-18 (Appendix F), respectively. The depth of the 0°C isotherm between 2030 and 2100 for both climate scenarios below the original ground surface are summarized in Table 19. On average, the depth of the 0°C isotherm and the thickness of the active layer with reference to the original ground surface between the two climate scenarios is generally the same. By 2040, the top of permafrost will be 5.5 m below original ground surface, which is equivalent to 1.3 m of degradation. Based on these climate scenarios, the permafrost will degrade by approximately 11.7 m by 2100 (i.e., 15.7 m from original ground surface), with the permafrost thickness reduced to 3.3 m. The average permafrost temperature in 2100 is -0.01°C.

Table 19. Depth of Permafrost Thaw at BH22-08 from Original Ground Surface Elevation

Timestep	SSP3-7.0 (m)	SSP4-6.0 (m)	Average (m)	Permafrost Thickness (m)	Average Permafrost Temperature (°C)
2030	4.72	1.34	3.1	> 14.0	-0.10
2040	6.13	4.78	5.5	14.0	-0.07
2050	7.38	6.33	6.9	12.6	-0.05
2070	13.29	11.28	12.3	6.7	-0.03
2100	15.89	15.45	15.7	3.3	-0.01

The results of the climate change analysis for BH22-08 using SSP3-7.0 and SSP4-6.0 are shown in Figure F-17 and F-18 (Appendix F), respectively. The depth of the 0°C isotherm between 2030 and 2070 for both climate scenarios below the original ground surface are summarized in Table 20. The permafrost is degrading beyond to 2070 until 2075 when the 0°C isotherm reaches the top of bedrock. Once the 0°C isotherm is in contact with the bedrock, significant thermal flow occurs owing to the high thermal conductivity of the bedrock layer. The model results indicate that there will be no permafrost at the vicinity of BH22-10 by 2076. Ground temperatures by 2100 at the top of bedrock are projected to be approximately 3°C. Similar to BH22-08, on average, the depth of the 0°C isotherm and the thickness of the active layer with reference to the original ground surface between the two climate scenarios is generally the same. By 2040, the top of permafrost will be 11.0 m below original ground surface, which is equivalent to 5.0 m of degradation. Based on these climate scenarios, the permafrost will degrade by approximately 9.4 m by 2075 (i.e., 15.4 m from original ground surface), with the permafrost thickness reduced to 2.6 m. The average permafrost temperature in 2075 is -0.02°C.

Table 20. Depth of Permafrost Thaw at BH22-10 from Original Ground Surface Elevation

Timestep	SSP3-7.0 (m)	SSP4-6.0 (m)	Average (m)	Permafrost Thickness (m)	Average Permafrost Temperature (°C)
2030	7.17	7.15	7.2	11.3	-0.06
2040	11.00	10.95	11.0	7.5	-0.05
2050	12.83	12.78	12.8	5.3	-0.03
2070	14.86	14.84	14.9	3.2	-0.02
2075	15.36	15.33	15.4	2.6	-0.02

It should be noted that a lower albedo (i.e., higher absorptivity) during the summer months, reduced snow cover during the winter months, and warmer air temperatures will accelerate the thawing of the permafrost. Continuous monitoring at BH22-08 and BH22-10 before, during, and after tailings placement will provide additional thermal data to track its thermal performance and the trend of climate change applicable to the new facility, in conjunction with climatic data using available weather stations for the region and thermistor readings throughout the site.

4.15 Surface Water Management

4.15.1 General

The general surface water management structures for the DSTF consists of runoff collection ditches leading to a collection sump. As necessary, water collected in the sump is conveyed to the water collection pond southeast of the mill. Tetra Tech understands the pond has a capacity of approximately 3,500 m^3, exceeding the volume expected to be generated by a 10-day freshet with a 1:200-year return period (Clearwater, 2009). Based on performance of the runoff collection ditches and collection sump to date in Phase I, this is considered reasonable for the addition of runoff collection from the Phase II expansion.

Based on the EMR Guidelines, the 1:200 year event is considered appropriate for operations. For closure, design should account for a 1:500 year event. At the present time, we understand mine plans are being developed. A final review and design for closure will be completed to ensure this design criteria is met.

4.15.2 Uphill Runoff Diversion Berm

The uphill runoff diversion berm is to be constructed in accordance with the Runoff Diversion Structures Specifications report issued in September 2010.

4.15.3 Toe Runoff Collection Ditch

Toe runoff collection ditches are to be constructed in accordance with the Runoff Diversion Structures Specifications report issued in September 2010.

4.15.4 Collection Sump and Conveyance

A sump will be required at the southwest corner of the facility to collect surface water from the Phase II expansion. This water is to be conveyed to the existing surface water collection pond using a 150 mm PVC or other appropriate conveyance system.

5.0 FOUNDATION PREPARATION AND CONSTRUCTION

5.1 DSTF Foundation

It is anticipated that construction of the Phase II will take place over several years. Tetra Tech recommends the entire foundation footprint be prepared prior to tailings placement, or at a minimum, all vegetation larger than 50 mm in diameter be removed. If a staged approach to foundation preparation is adopted, Hecla must ensure adequate drainage for control of surface runoff. This may necessitate temporary lined ditches and/or collection sumps.

Foundation preparation and construction shall consist of:

- Hand cutting and removal of all trees and vegetation larger than 50 mm in diameter with minimal disturbance to the organic surface;
- An as-built survey of the existing ground surface;
- Construction and placement of the foundation components comprising a 0.6 m thick granular drainage blanket, GCL, and geocomposite drain. To be installed as discussed in Section 4.6 and described in Runoff Diversion Structure Specs (EBA, 2010b);
- The liner materials should be installed on drainage blanket material at grades no steeper than 4H:1V, unless otherwise approved by the engineer; and
- An as-built survey of the surface of the foundation components.

As-built surveys and photographs taking during the various stages of foundation preparation and provide should be provided to Tetra Tech for review and approval prior to placement of tailings.

5.2 Buttress Construction

Buttress construction is to take place prior to placement of tailings. The upstream toe of the buttress may be required for runoff collection purposes prior to the final configuration of tailings placement. It is anticipated some field adjustments will be required at the north and south ends of the buttress.

The buttress should be constructed as follows:

- Height as shown in the drawings package;
- Minimum crest width of 5 m;
- Upstream slope of 2H:1V; and
- Downstream slope of 2.5H:1V.

Construction will require the excavation and cut/fill operations of the existing waste rock storage area, and placement and compaction along the alignment to the south and north.

Waste rock should be placed in maximum 500 mm lifts and compacted using a large vibratory drum compactor completing at least 8 full passes. Survey shall be completed prior to, during placement of each lift, and after buttress construction.

5.3 Interior Berm Construction

The interior berm should be constructed as follows:

- Minimum 3 m height at centerline;
- Minimum crest width of 2.5 m; and
- Upstream and downstream slopes of 1.5H:1V.

The berm will be constructed of waste rock placed in maximum 500 mm lifts and compacted using a large vibratory drum compactor completing at least 8 full passes. Survey shall be completed after berm construction.

6.0 OPERATION, MAINTENANCE, AND SURVEILLANCE

6.1 OMS Manual

Operations, Maintenance, and Surveillance (OMS) are to be completed in accordance with the active and most recent OMS manual.

At the time of this submission, Tetra Tech is updating the OMS under a separate cover.

It is expected that the OMS manual will be updated as required and reviewed for necessary updates at least annually.

6.2 Tailings Placement and Operation

Tailings placement can proceed once the foundation has been prepared, surveyed, and approved as discussed in the previous sections.

Tailings shall be placed and compacted within the DSTF as per the requirements in the OMS manual. This includes placement in maximum 300 mm lifts, and compaction using a vibratory roller to at least 95% Standard Proctor Maximum Dry Density (SPMDD). Tailings may require moisture conditioning (i.e., drying) prior to compaction. Any snow, ice, or other deleterious materials should be removed prior to placement. Tailings must be placed and compacted prior to freezing.

Hecla provided Tetra Tech with the tailings generation estimates shown in Table 21 below (B. Tang, pers. comm., May 21, 2023).

Table 21: Expected Tailings Generation. Provided by Hecla

Month	Tonnes (T)	Volume (m^3)	Month	Tonnes (T)	Volume (m^3)
June 2023	5,929	2585	April 2024	11,160	4,866
July 2023	8,893	3,877	May 2024	11,160	4,866
August 2023	11,858	5,170	June 2024	11,160	4,866
September 2023	11,858	5,170	July 2024	11,160	4,866
October 2023	11,858	5,170	August 2024	11,160	4,866
November 2023	11,858	5,170	September 2024	11,160	4,866
December 2023	11,858	5,170	October 2024	11,160	4,866
January 2024	11,160	4,866	November 2024	11,160	4,866
February 2024	11,160	4,866	December 2024	11,160	4,866
March 2024	11,160	4,866			

Based on discussions with Hecla, we understand that tentatively, beginning in 2025, a portion of generated tailings will be used as paste backfill for underground workings. Specifics on scheduling, volumes of paste backfill, etc., have not been provided, therefore the projected timeline to fill Phase II to capacity has not been estimated.

6.3 Instrumentation and Monitoring

Instrumentation and monitoring shall be completed as outlined in the OMS manual.

Visual inspections are expected to be completed weekly by Hecla / site staff. Annual inspections are to be completed by a geotechnical engineer.

Tailings placement record surveys shall be completed monthly during tailings placement operations.

Readings should be collected from ground temperature cables on at least a monthly basis, or as directed by Tetra Tech. Tetra Tech previously completed moisture and density testing on placed and compacted tailings using a nuclear densometer. This method was deemed not appropriate due to readings being impacted by the mineralogy of the tailings. Alternative methods of monitoring compaction including dynamic cone penetration testing (DCPT) are being reviewed and will be discussed further with Hecla.

Additional instrumentation will be required and is expected to include piezometers and slope indicators. Tetra Tech will recommend specifics for this instrumentation at a later date, and requirements will be adopted into the OMS manual.

7.0 DSTF CLOSURE PLAN

Closure planning for the Phase II expansion is consistent with that for Phase I. Once tailings placement for a portion of the DSTF is complete, a soil evapotranspirative cover of 0.5 m of loosely placed mixture of granular and organic materials will be placed over the surface of the compacted tailings to temporarily store runoff and allow it to evaporate or to be used by vegetation.

At this time, it is assumed that the water collection pond and diversion berms and ditches will be left in place and the berms will continue to divert runoff water away from the DSTF area. Tetra Tech understands that the entire footprint will be re-vegetated with plants to promote soil evapotranspiration.

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

8.0 CLOSURE

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

Respectfully submitted,
Tetra Tech Canada Inc.

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YUKON TERRITORY
IAN MACINTYRE
2024-03-29

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FIGURES

Figure 1	Overall DSTF Final Construction Plan
Figure 2	Phase II Final Construction Plan
Figure 3	Cross-sections 1 of 3
Figure 4	Cross-sections 2 of 3
Figure 5	Cross-sections 3 of 3
Figure 6	Typical Details
Figure 7	Instrumentation Plan

	VOLUME	TONNAGE *
PHASE 1 (ORIGINAL DESIGN) **	125,000 m^3	286,000
PHASE 1 (AS-BUILT)	100,000 m^3	229,090
PHASE 2 (DESIGN)	237,000 m^3	542,730
TOE BUTTRESS (DESIGN)	6,700 m^3	N / A

* TONNAGE BASED ON 2.29 T / m^3 PER HECLA

** FULL FOOTPRINT OF ORIGINAL DESIGN NOT CONSTRUCTED

0 100m

Scale: 1:2,000 @ 11"x17"

LEGEND

- DSTF TAILINGS FOOTPRINT
- PHASE I AS-BUILT FOOTPRINT
- PHASE II TAILINGS FOOTPRINT
- EXISTING SURFACE RUNOFF DITCH
- PROPOSED SURFACE RUNOFF DITCH (SHOWN WHITE)
- PHASE I ORIGINAL DESIGN FOOTPRINT

NOTE
- DRONE IMAGERY COLLECTED BY HECLA IN OCTOBER 2023

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2024-03-29
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DRY-STACKED TAILINGS FACILITY PHASE 2 DESIGN
KENO HILL DISTRICT MILL SITE, YUKON

OVERALL DSTF FINAL CONSTRUCTION PLAN

PROJECT NO.	DWN	CKD	REV
ENG.WARC04307-02	CB	IM	0

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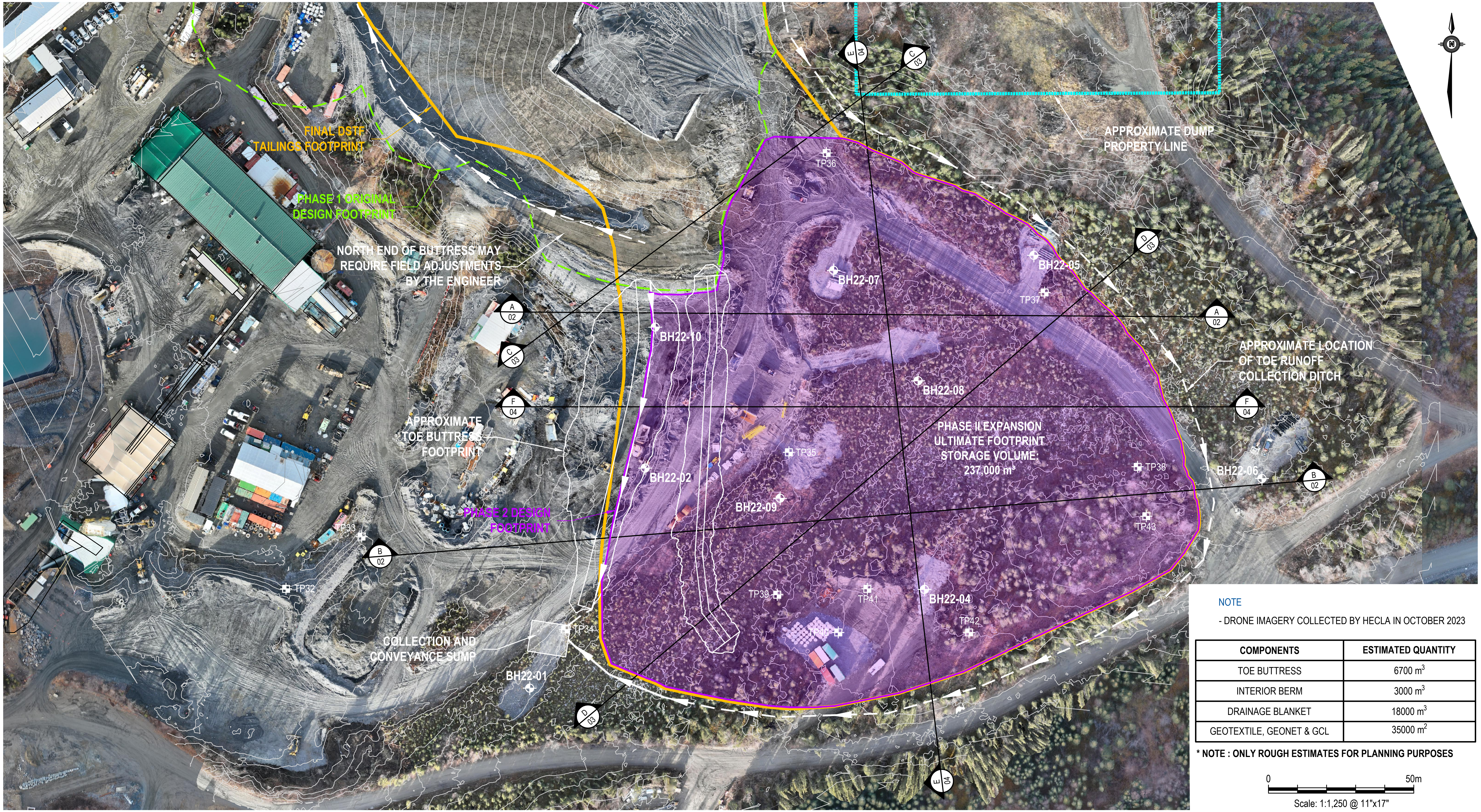
Figure 1

O:\Whitehorse\Data\0201drawings\Keno\ENG.WARC04307-02 DSTF Phase II Interface Direct Shear Testing & Stability Model Updates\ENG.WARC04307-02 Fig 1-R1.dwg [FIGURE 1] March 29, 2024 - 3:30:59 pm (BY: BUCHAN, CAMERON)



NOTE

- DRONE IMAGERY COLLECTED BY HECLA IN OCTOBER 2023

COMPONENTS	ESTIMATED QUANTITY
TOE BUTTRESS	6700 m^3
INTERIOR BERM	3000 m^3
DRAINAGE BLANKET	18000 m^3
GEOTEXTILE, GEONET & GCL	35000 m^2

* NOTE : ONLY ROUGH ESTIMATES FOR PLANNING PURPOSES

0 50m

Scale: 1:1,250 @ 11"x17"

LEGEND

- DSTF TAILINGS FOOTPRINT
- PHASE I AS-BUILT FOOTPRINT
- PHASE II TAILINGS FOOTPRINT
- EXISTING SURFACE RUNOFF DITCH
- PROPOSED SURFACE RUNOFF DITCH (SHOWN WHITE)
- PHASE I ORIGINAL DESIGN FOOTPRINT
- BOREHOLE LOCATION
- TESTPIT LOCATION

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PHASE 2 FINAL CONSTRUCTION PLAN

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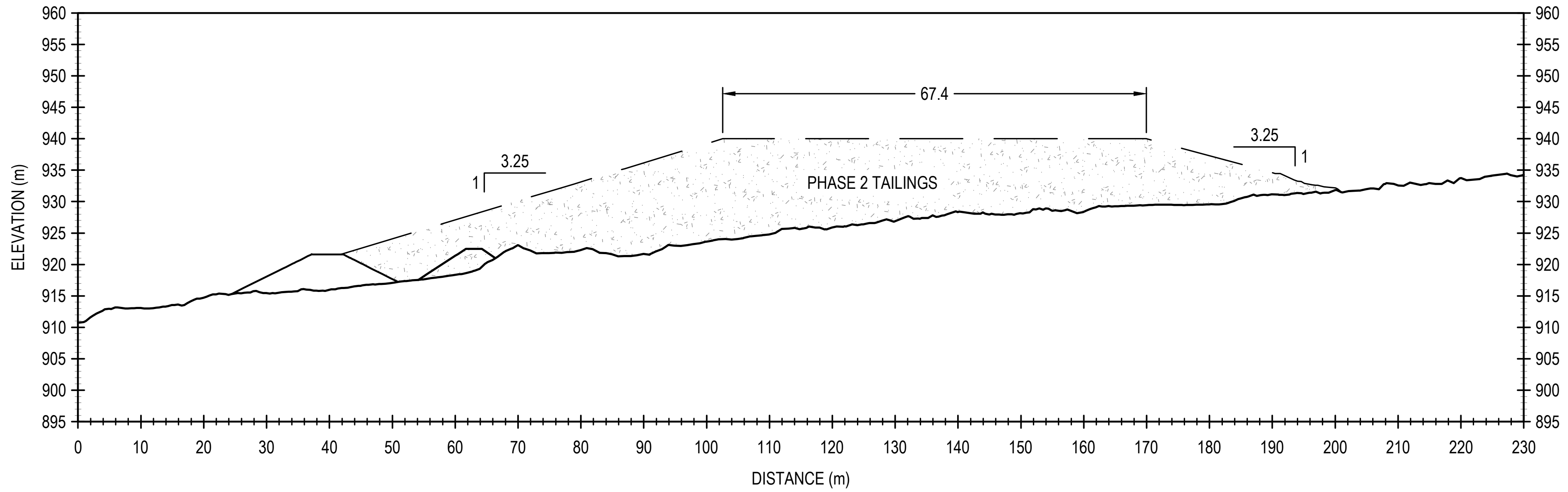
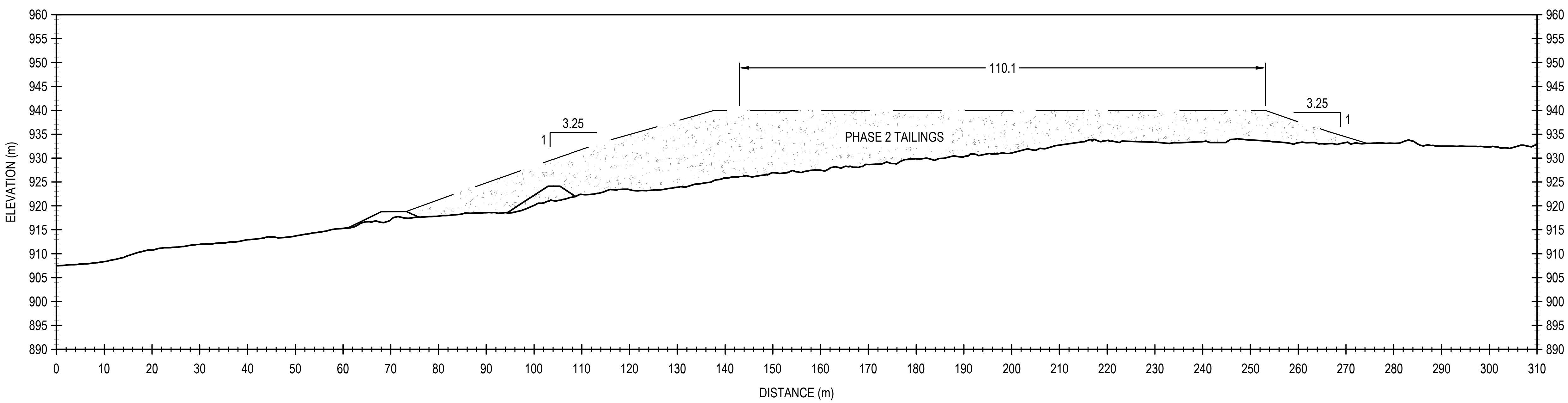
Figure 2

Q:\Whitehorse\Data\0201drawings\Keno\ENG.WARC04307-02 DSTF Phase II Interface Direct Shear Testing & Stability Model Updates\ENG.WARC04307-02 Fig 2-5-R1.dwg [FIGURE 2] March 29, 2024 - 3:24:28 pm (BY: BUCHAN, CAMERON)



SECTION A



SECTION B

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CROSS-SECTIONS
(1 OF 3)

PROJECT NO.	DWN	CKD	REV
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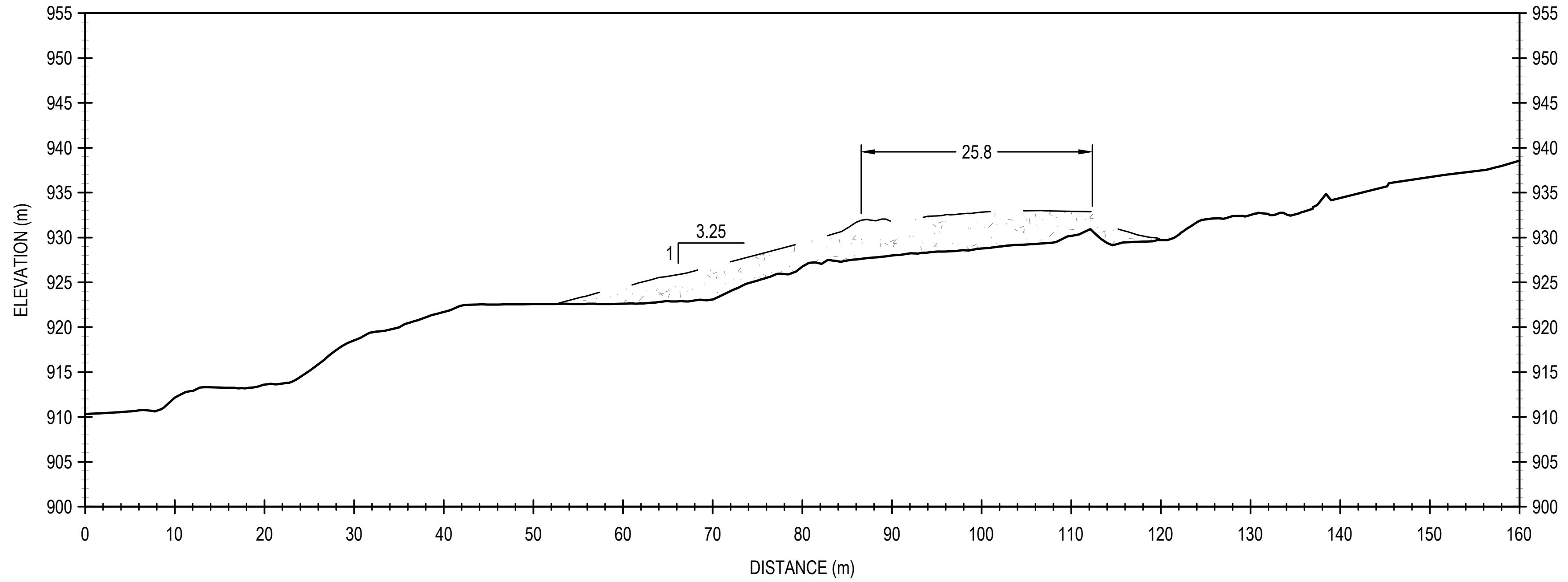
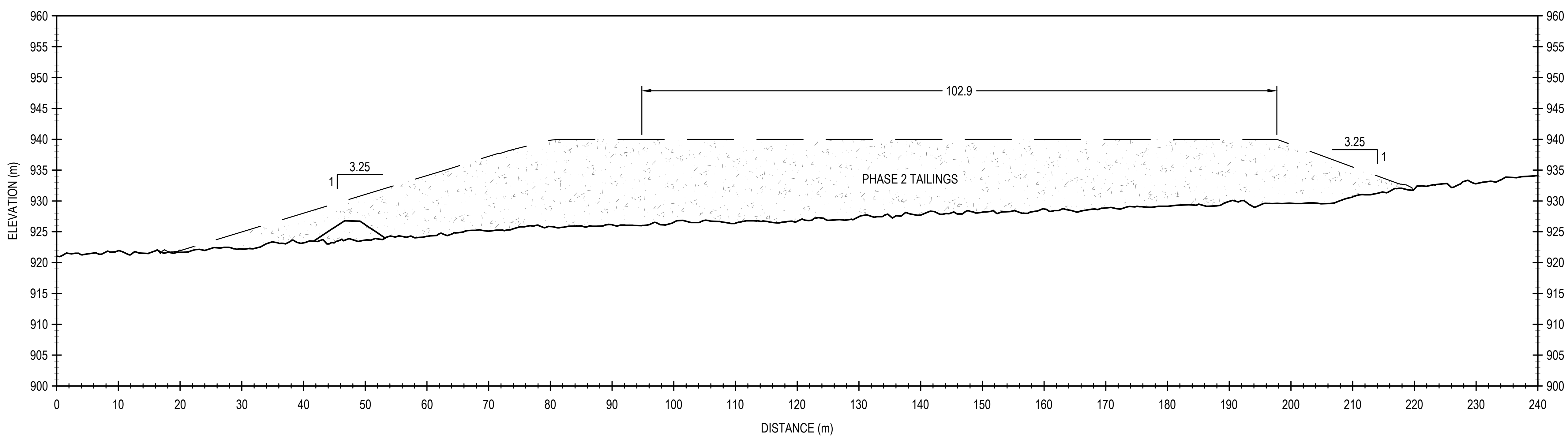
Figure 3



SECTION C



SECTION D

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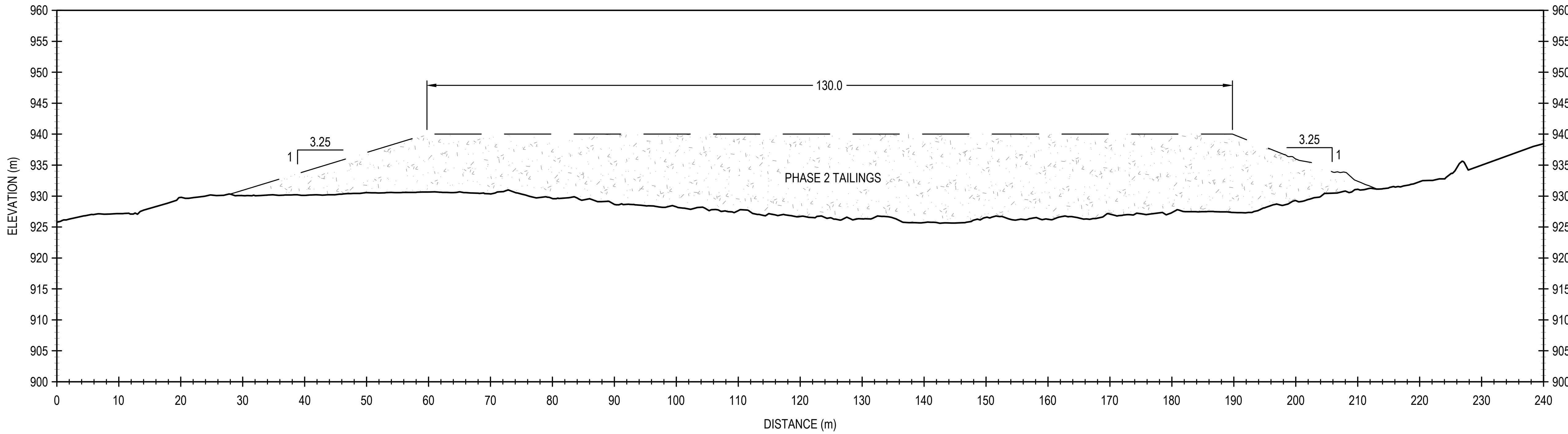
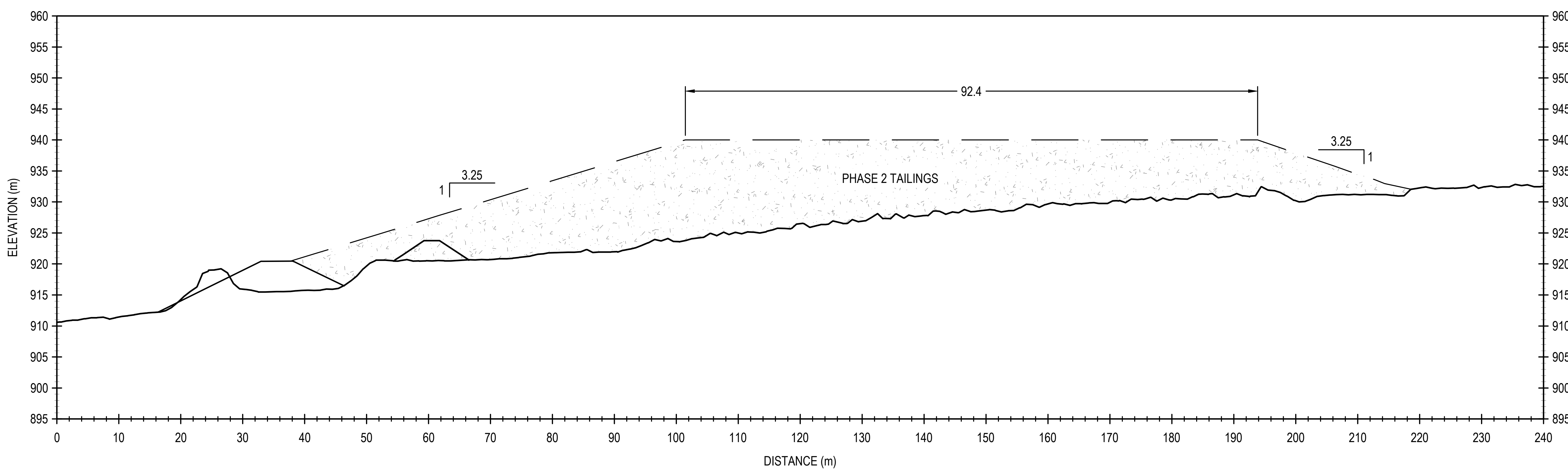
Figure 4

Q:\Whitehorse\Data\0201drawings\Keno\ENG.WARC04307-02 DSTF Phase II Interface Direct Shear Testing & Stability Model Updates\ENG.WARC04307-02 Fig 2-5-R1.dwg [FIGURE 4] March 29, 2024 - 3:27:17 pm (BY: BUCHAN, CAMERON)



SECTION E



SECTION F

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DRY-STACKED TAILINGS FACILITY PHASE 2 DESIGN
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CROSS-SECTIONS
(3 OF 3)

PROJECT NO.	DWN	CKD	REV
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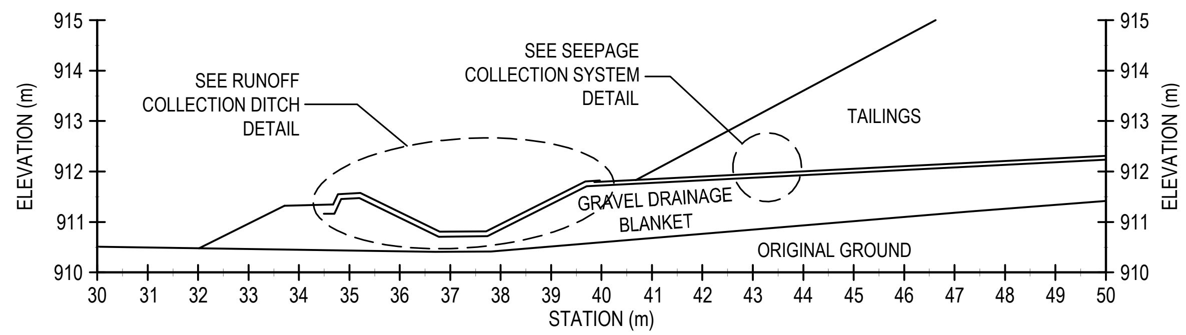
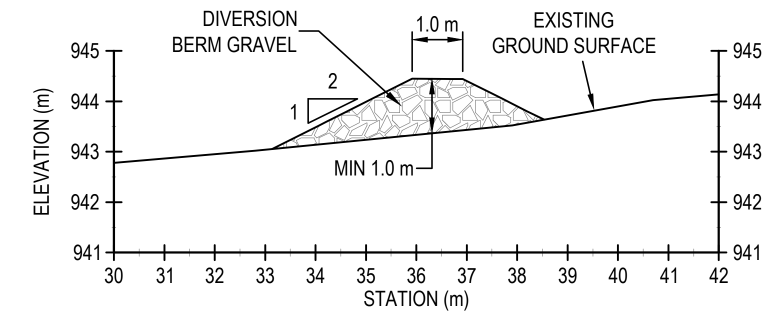
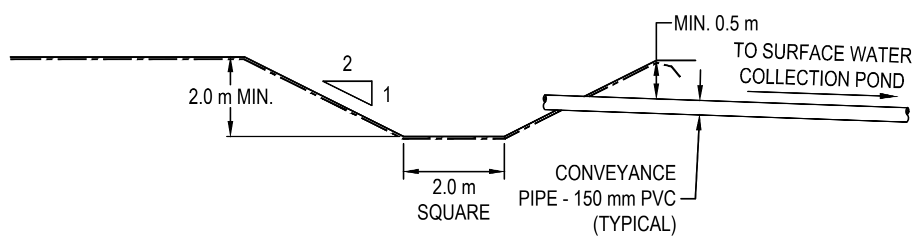
Figure 5



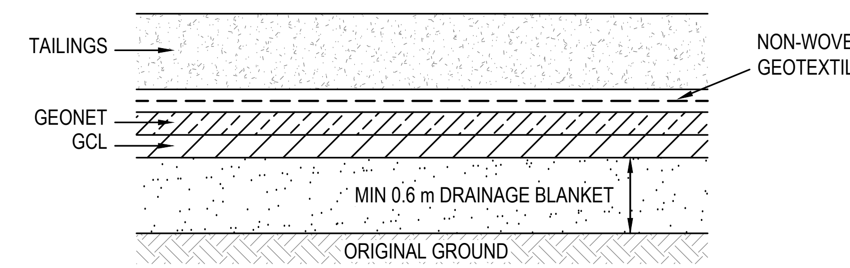
RUNOFF COLLECTION DITCH - TYPICAL SECTION



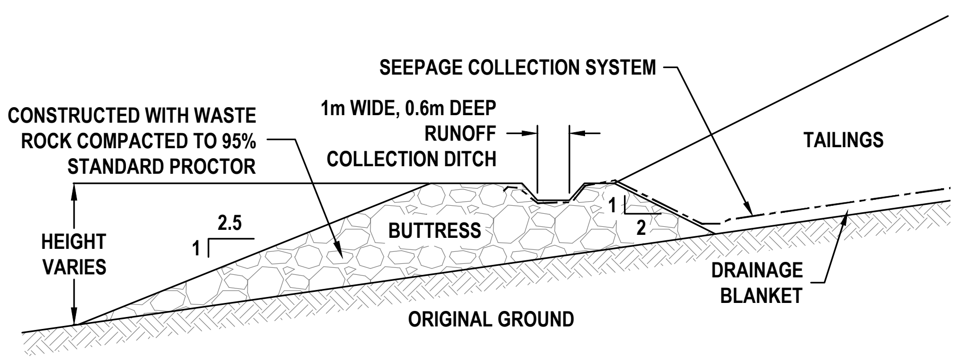
UPHILL DIVERSION BERM DETAIL



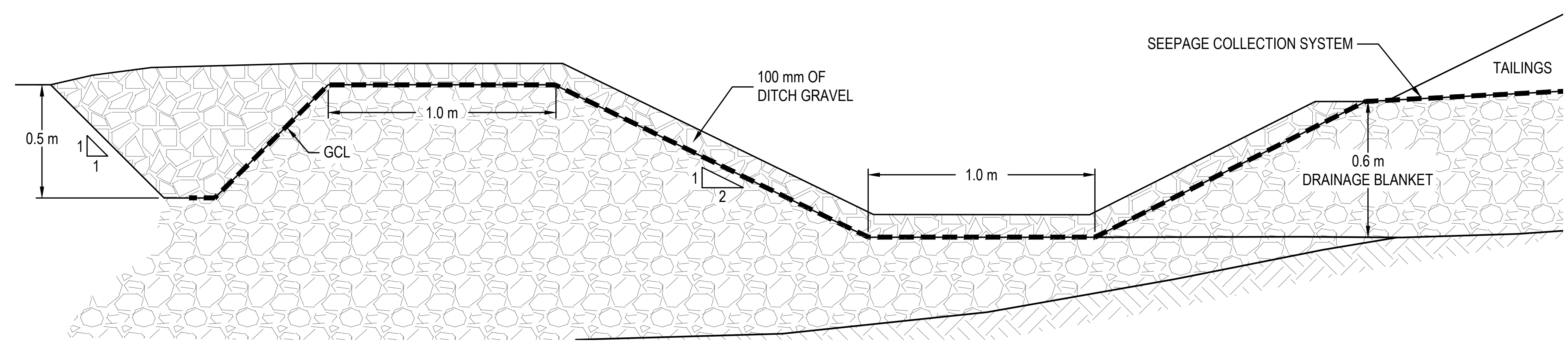
COLLECTION SUMP & CONVEYANCE PIPE



SEEPAGE COLLECTION SYSTEM DETAIL



TYPICAL TOE BUTTRESS AND RUNOFF COLLECTION DITCH DETAIL



TOE RUNOFF COLLECTION DITCH DETAIL

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PROFESSIONAL ENGINEER
YUKON TERRITORY
IAN MACINTYRE
2024-03-29

PROFESSIONAL SEAL

CLIENT
Hecla MINING COMPANY

TETRA TECH

DRY-STACKED TAILINGS FACILITY PHASE 2 DESIGN
KENO HILL DISTRICT MILL SITE, YUKON

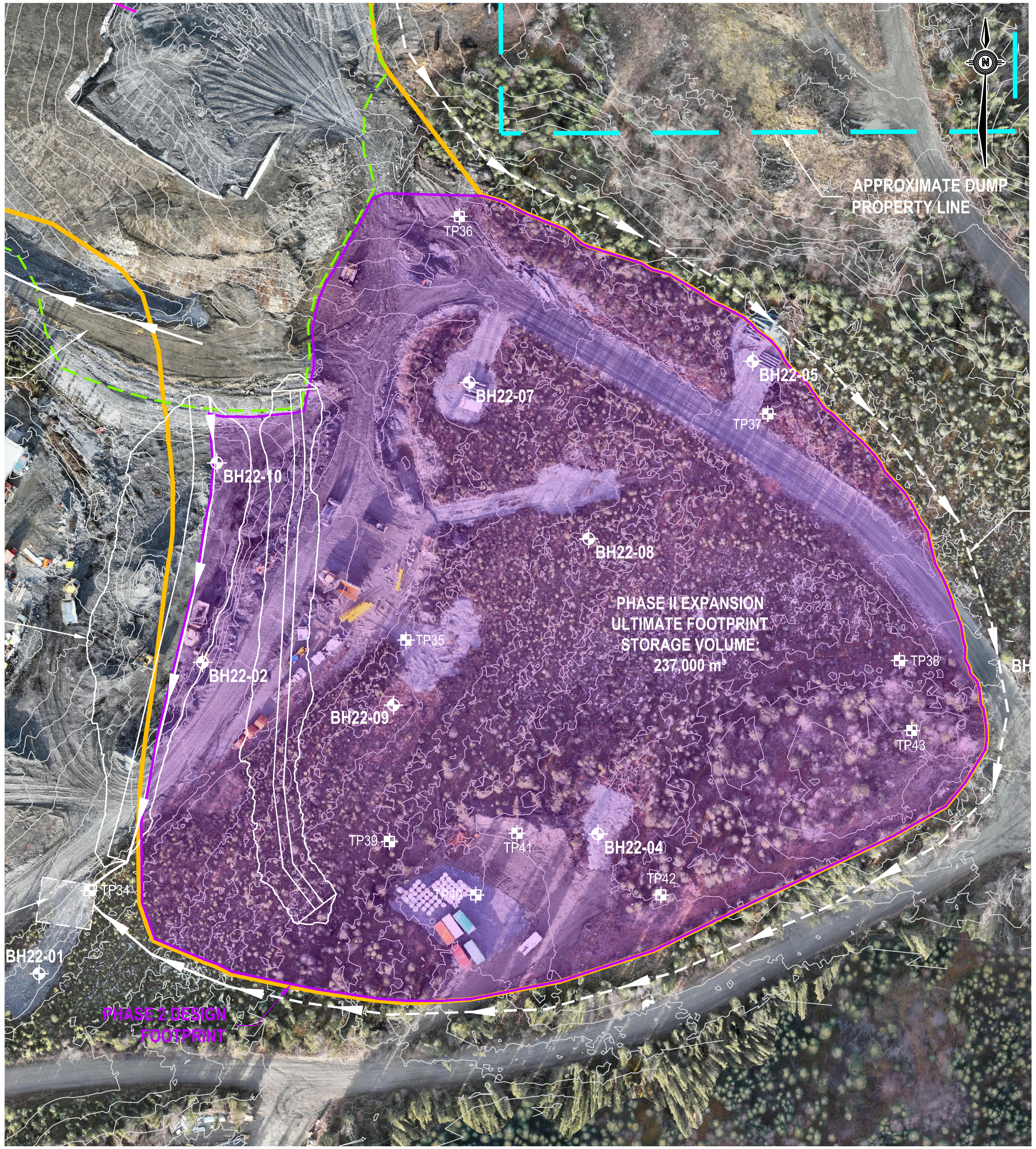
TYPICAL DETAILS

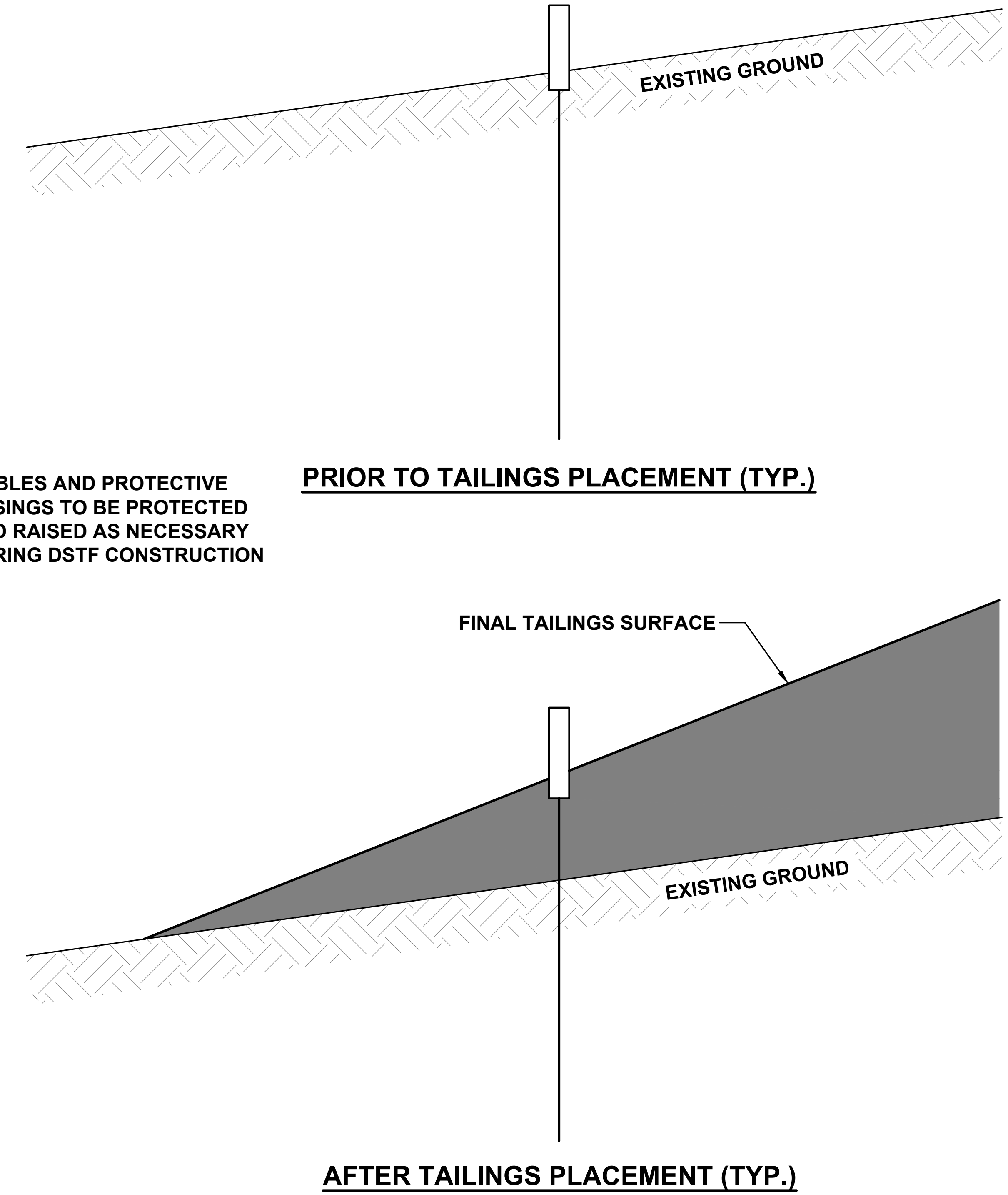
PROJECT NO.	DWN	CKD	REV
ENG.WARC04307-02	CB	IM	0

OFFICE	DATE
EBA-WHSE	March 29, 2024

Figure 6

Q:\Whitehorse\Data\0201drawings\Keno\ENG.WARC04307-02 DSTF Phase II Interface Direct Shear Testing & Stability Model Updates\ENG.WARC04307-02 Fig.6-7-R1.dwg [FIGURE 6] March 29, 2024 - 3:33:12 pm (BY: BUCHAN, CAMERON)





* CABLES AND PROTECTIVE CASINGS TO BE PROTECTED AND RAISED AS NECESSARY DURING DSTF CONSTRUCTION

LEGEND

- TETRATECH THERMISTOR CABLE LOCATION
- BEADED STREAM CABLE AND LOGGER LOCATION

0 50m

Scale: 1:1,250 @ 11"x17"

PERMIT TO PRACTICE
TETRA TECH CANADA INC.
SIGNATURE
Date 2024-03-29
PERMIT NUMBER PP003
Association of Professional Engineers of Yukon

PERMIT

PROFESSIONAL ENGINEER
YUKON
IAN MACINTYRE
TERRITORY
2024-03-29

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TETRA TECH

DRY-STACKED TAILINGS FACILITY PHASE 2 DESIGN
KENO HILL DISTRICT MILL SITE, YUKON

INSTRUMENTATION PLAN

PROJECT NO.	DWN	CKD	REV
ENG.WARC04307-02	CB	IM	0

OFFICE	DATE
EBA-WHSE	March 29, 2024

Figure 7

APPENDIX A

TETRA TECH'S LIMITATIONS ON THE USE OF THIS DOCUMENT

LIMITATIONS ON USE OF THIS DOCUMENT

GEOTECHNICAL

1.1 USE OF DOCUMENT AND OWNERSHIP

This document pertains to a specific site, a specific development, and a specific scope of work. The document may include plans, drawings, profiles and other supporting documents that collectively constitute the document (the "Professional Document").

The Professional Document is intended for the sole use of TETRA TECH's Client (the "Client") as specifically identified in the TETRA TECH Services Agreement or other Contractual Agreement entered into with the Client (either of which is termed the "Contract" herein). TETRA TECH does not accept any responsibility for the accuracy of any of the data, analyses, recommendations or other contents of the Professional Document when it is used or relied upon by any party other than the Client, unless authorized in writing by TETRA TECH.

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The Professional Document and any other form or type of data or documents generated by TETRA TECH during the performance of the work are TETRA TECH's professional work product and shall remain the copyright property of TETRA TECH.

The Professional Document is subject to copyright and shall not be reproduced either wholly or in part without the prior, written permission of TETRA TECH. Additional copies of the Document, if required, may be obtained upon request.

1.2 ALTERNATIVE DOCUMENT FORMAT

Where TETRA TECH submits electronic file and/or hard copy versions of the Professional Document or any drawings or other project-related documents and deliverables (collectively termed TETRA TECH's "Instruments of Professional Service"), only the signed and/or sealed versions shall be considered final. The original signed and/or sealed electronic file and/or hard copy version archived by TETRA TECH shall be deemed to be the original. TETRA TECH will archive a protected digital copy of the original signed and/or sealed version for a period of 10 years.

Both electronic file and/or hard copy versions of TETRA TECH's Instruments of Professional Service shall not, under any circumstances, be altered by any party except TETRA TECH. TETRA TECH's Instruments of Professional Service will be used only and exactly as submitted by TETRA TECH.

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

1.3 STANDARD OF CARE

Services performed by TETRA TECH for the Professional Document have been conducted in accordance with the Contract, in a manner consistent with the level of skill ordinarily exercised by members of the profession currently practicing under similar conditions in the jurisdiction in which the services are provided. Professional judgment has been applied in developing the conclusions and/or recommendations provided in this Professional Document. No warranty or guarantee, express or implied, is made concerning the test results, comments, recommendations, or any other portion of the Professional Document.

If any error or omission is detected by the Client or an Authorized Party, the error or omission must be immediately brought to the attention of TETRA TECH.

1.4 DISCLOSURE OF INFORMATION BY CLIENT

The Client acknowledges that it has fully cooperated with TETRA TECH with respect to the provision of all available information on the past, present, and proposed conditions on the site, including historical information respecting the use of the site. The Client further acknowledges that in order for TETRA TECH to properly provide the services contracted for in the Contract, TETRA TECH has relied upon the Client with respect to both the full disclosure and accuracy of any such information.

1.5 INFORMATION PROVIDED TO TETRA TECH BY OTHERS

During the performance of the work and the preparation of this Professional Document, TETRA TECH may have relied on information provided by third parties other than the Client.

While TETRA TECH endeavours to verify the accuracy of such information, TETRA TECH accepts no responsibility for the accuracy or the reliability of such information even where inaccurate or unreliable information impacts any recommendations, design or other deliverables and causes the Client or an Authorized Party loss or damage.

1.6 GENERAL LIMITATIONS OF DOCUMENT

This Professional Document is based solely on the conditions presented and the data available to TETRA TECH at the time the data were collected in the field or gathered from available databases.

The Client, and any Authorized Party, acknowledges that the Professional Document is based on limited data and that the conclusions, opinions, and recommendations contained in the Professional Document are the result of the application of professional judgment to such limited data.

The Professional Document is not applicable to any other sites, nor should it be relied upon for types of development other than those to which it refers. Any variation from the site conditions present, or variation in assumed conditions which might form the basis of design or recommendations as outlined in this document, at or on the development proposed as of the date of the Professional Document requires a supplementary exploration, investigation, and assessment.

TETRA TECH is neither qualified to, nor is it making, any recommendations with respect to the purchase, sale, investment or development of the property, the decisions on which are the sole responsibility of the Client.

1.7 ENVIRONMENTAL AND REGULATORY ISSUES

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

1.8 NATURE AND EXACTNESS OF SOIL AND ROCK DESCRIPTIONS

Classification and identification of soils and rocks are based upon commonly accepted systems, methods and standards 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. TETRA TECH 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.

1.9 LOGS OF TESTHOLES

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.

1.10 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 historical environment. TETRA TECH 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 exploration and review may be necessary.

1.11 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.

1.12 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.

1.13 INFLUENCE OF CONSTRUCTION ACTIVITY

Construction activity can impact 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, and construction sequence are known.

1.14 OBSERVATIONS DURING CONSTRUCTION

Because of the nature of geological deposits, the judgmental nature of geotechnical engineering, and 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.

1.15 DRAINAGE SYSTEMS

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. Where temporary or permanent drainage systems are installed within or around a structure, these systems must protect the structure from loss of ground due to mechanisms such as internal erosion and must be designed so as to assure continued satisfactory performance of the drains. Specific design details regarding the geotechnical aspects of such systems (e.g. bedding material, surrounding soil, soil cover, geotextile type) should be reviewed by the geotechnical engineer to confirm the performance of the system is consistent with the conditions used in the geotechnical design.

1.16 DESIGN PARAMETERS

Bearing capacities for Limit States or Allowable Stress Design, strength/stiffness properties and similar geotechnical design parameters 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 used in this report. Sufficient observations should be made by qualified geotechnical personnel during construction to assure that the soil and/or rock conditions considered in this report in fact exist at the site.

1.17 SAMPLES

TETRA TECH 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.

1.18 APPLICABLE CODES, STANDARDS, GUIDELINES & BEST PRACTICE

This document has been prepared based on the applicable codes, standards, guidelines or best practice as identified in the report. Some mandated codes, standards and guidelines (such as ASTM, AASHTO Bridge Design/Construction Codes, Canadian Highway Bridge Design Code, National/Provincial Building Codes) are routinely updated and corrections made. TETRA TECH cannot predict nor be held liable for any such future changes, amendments, errors or omissions in these documents that may have a bearing on the assessment, design or analyses included in this report.

APPENDIX B

BOREHOLE LOGS AND LABORATORY TESTING RESULTS

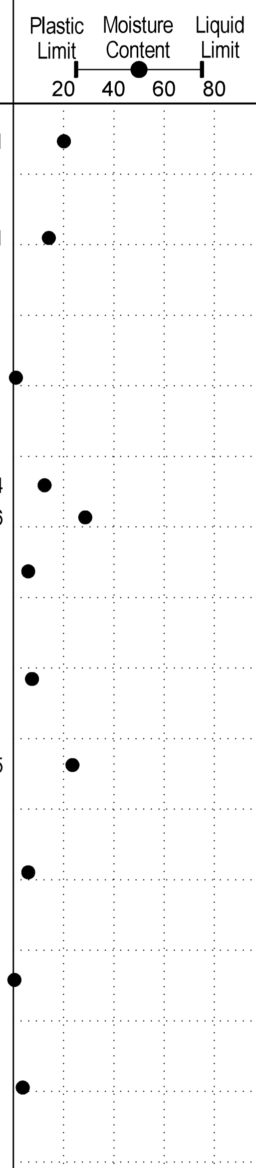
Borehole No: **BH22-01**

Project: DSTF Phase 2 Detailed Design	Project No: ENG.WARC04307-01
Location: Keno Hill Mine	Ground Elev: 917.7 m
Yukon	UTM: 484024.9195 E; 7086634.494 N; Z 8

Hecla MINING COMPANY

Depth (m)	Method	Soil Description	Ground Ice Description	Sample Number	Gravel (%)	Sand (%)	Silt & Clay (%)	Moisture Content (%)
0	Sonic	SAND AND GRAVEL (PAD FILL) - some silt, gravel to 300 mm diameter, wet, grey, (300 mm thick)	Unfrozen	SA11				20.1
		ORGANICS - (75 mm thick)						
		SILT - some gravel, trace sand, wet, brown, organic inclusions, (225 mm thick)						
		SAND AND GRAVEL - silty, wet, brown	Frozen, Vs, Vr 10%	SA12				14.1
		SILT (TILL) - some gravel, trace to some sand, wet, brown						
		- large boulder, SA13 has low moisture due to sample containing only rock		SA13				1
		SILT AND SAND (TILL) - gravelly, gravel to 75 mm diameter, wet, brown		SA14				12.4
			Vs	SA15				28.6
				SA16				5.9
				SA17	29	35	36	7.4
			Nbn	SA18				23.5
		SILT (TILL) - trace sand, grave gravel, wet, brown						
		SAND AND GRAVEL - silty, gravel to 75 mm diameter, wet, brown	Unfrozen	SA19				5.9
		BEDROCK - dark grey, white streaks		SA20				0.4
		- reddish grey		SA21				3.7

END OF BOREHOLE (15.2 metres)
25 mm PVC installed to 15.2 metres
Ground temperature cable installed inside PVC pipe to 14.50 metres
Note: Target depth reached



Columns: Sample Type, GTC, Elevation (m) 917–898

TETRA TECH

Contractor: Boart Longyear	Completion Depth: 15.2 m
Equipment Type: Track Mounted LS250 Mini Sonic	Start Date: 2022 September 27
Logged By: JS	Completion Date: 2022 September 27
Reviewed By: IM	Page 1 of 1

Borehole No: **BH22-02**

Project: DSTF Phase 2 Detailed Design	Project No: ENG.WARC04307-01
Location: Keno Hill Mine	Ground Elev: 915.6 m
Yukon	UTM: 484047.3037 E; 7086693.741 N; Z 8

Hecla MINING COMPANY

Depth (m)	Method	Soil Description	Ground Ice Description	Sample Number	Gravel (%)	Sand (%)	Silt & Clay (%)	Moisture Content (%)	Elevation (m)
0	Sonic	SAND AND GRAVEL (FILL) - silty, moist, grey	Unfrozen	SA22	54	40	6	12.7	915
1.5		ORGANICS - (100 mm thick)							914
1.9		SILT (TILL) - some sand, some gravel, wet, brown, organic inclusions	Frozen, N/Nf	SA23				18.9	913
		- no visible organics	Unfrozen	SA24				10.7	912
			Frozen, Nf	SA25				17.4	911
4.6		GRAVEL - sandy, silty, gravel to 50 mm diameter, very wet, greyish brown	Unfrozen	SA26				10.1	
				SA27				6.2	910
			Frozen, Nbe/Nbn	SA28				23.8	909
6.7		SILT (TILL) - some sand to sandy, some gravel, wet, brown							
		- trace gravel, trace sand	Nbn	SA29	0	6	94	26	908
				SA30				21.8	906
		- some gravel to gravelly	Nbn/Nf	SA31				15.4	904
			Unfrozen	SA32				9.3	903
		- trace to some gravel, moist to wet, dense		SA33				12.2	901
		- sandy, trace cobbles, moist		SA34	8	33	59	10.3	900
				SA35				11.2	898
		- gravelly seam		SA36				13.9	897
		- large cobble							896
20									

Plastic Limit — Moisture Content — Liquid Limit (20 40 60 80)

TETRA TECH

Contractor: Boart Longyear	Completion Depth: 30.5 m
Equipment Type: Track Mounted LS250 Mini Sonic	Start Date: 2022 September 28
Logged By: JS	Completion Date: 2022 September 28
Reviewed By: IM	Page 1 of 2

Borehole No: **BH22-02**

Project: DSTF Phase 2 Detailed Design	Project No: ENG.WARC04307-01
Location: Keno Hill Mine	Ground Elev: 915.6 m
Yukon	UTM: 484047.3037 E; 7086693.741 N; Z 8

Depth (m)	Method	Soil Description	Ground Ice Description	Sample Type	Sample Number	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
20–21	Sonic	SAND AND GRAVEL - silty, fine to coarse grained sand, subrounded to subangular gravel to 75 mm diameter, dry to damp, light brown			SA37					1.1	●	895
21–22	Sonic	SILT (TILL) - gravelly, some sand, subrounded to subangular gravel to 100 mm diameter, dry to damp, loose, light brownish grey			SA38					1.5	●	894
24	Sonic	- sandy			SA39					5.5	●	892
24.5	Sonic	- gravelly layer, trace sand			SA40					8.5	●	891
25	Sonic	- large cobble										890
26	Sonic	GRAVEL - sandy, silty, fine to coarse grained sand, large cobble, subrounded to subangular gravel to 100 mm diameter, moist, brown			SA41					3.7	●	889
28	Sonic	- some silt - gravel to 75 mm diameter			SA42	58	30	12		3.6	●	887
29	Sonic	- damp, brown grey			SA43					1.6	●	886
30.5		END OF BOREHOLE (30.5 metres) Note: Target depth reached										885

Depth scale: 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40

Elevation scale: 895, 894, 893, 892, 891, 890, 889, 888, 887, 886, 885, 884, 883, 882, 881, 880, 879, 878, 877, 876

TETRA TECH

Contractor: Boart Longyear	Completion Depth: 30.5 m
Equipment Type: Track Mounted LS250 Mini Sonic	Start Date: 2022 September 28
Logged By: JS	Completion Date: 2022 September 28
Reviewed By: IM	Page 2 of 2

Borehole No: **BH22-03**

Project: DSTF Phase 2 Detailed Design	Project No: ENG.WARC04307-01
Location: Keno Hill Mine	Ground Elev: 919.6 m
Yukon	UTM: 484066.38 E; 7086745.73 N; Z 8

Method: Sonic

Depth (m)	Soil Description	Ground Ice Description	Sample Number	Gravel (%)	Sand (%)	Silt & Clay (%)	Moisture Content (%)
0	SAND (FILL) - gravelly, silty, subangular to angular gravel to 30 mm diameter, moist, grey	Unfrozen					
			SA44				13.2
			SA45				4
3	GRAVEL (FILL) - sandy, silty, very wet, dark grey, wood and metal inclusions						
			SA46				12.3
5	SILT (TILL) - trace gravel, trace sand, wet, dark brown, organic inclusions	Frozen, Nbn/Nf	SA47				70.8
	- sandy, some gravel	Vr 40%					
			SA48				58.6
			SA49				30.8
		Vx, Vr 30%	SA50				14.3
			SA51				21.5
	- trace sand, trace gravel						
	- gravel to 25 mm diameter	Nb/Nf					
			SA52				13.3
	- sandy						
			SA53	19	37	44	12.7
		Nbn	SA54				27.4
		Unfrozen					
	- some sand to sandy, some gravel, some cobbles, moist						
			SA55				9.8
	- some sand to sandy						
			SA56				10.8
			SA57				9.7
18.3	END OF BOREHOLE (18.3 metres) Note: Stopped due to refusal Core barrel fell off						

Contractor: Boart Longyear	Completion Depth: 18.3 m
Equipment Type: Track Mounted LS250 Mini Sonic	Start Date: 2022 September 28
Logged By: JS	Completion Date: 2022 September 29
Reviewed By: IM	Page 1 of 1

Borehole No: **BH22-04**

Project: DSTF Phase 2 Detailed Design	Project No: ENG.WARC04307-01
Location: Keno Hill Mine	Ground Elev: 930.8 m
Yukon	UTM: 484165.2557 E; 7086670.469 N; Z 8

Hecla MINING COMPANY

Depth (m)	Method	Soil Description	Ground Ice Description	Sample Number	Gravel (%)	Sand (%)	Silt & Clay (%)	Moisture Content (%)	Elevation (m)
0	Sonic	SAND AND GRAVEL (PAD FILL) - silty, moist, grey	Unfrozen						
		ORGANICS - (50 mm thick)							
1		SILT - sandy, trace gravel, moist, brown, organic inclusions, (250 mm thick)		SA58				5.1	930
		SILT - sandy, some gravel, wet, greyish brown							
2		SAND - gravelly, some silt, fine to coarse grained sand, subrounded to subangular gravel to 50 mm diameter, moist, brown, organic inclusions		SA59				10.2	929
3		- silty, some gravel, finer grained sand, wet							928
		- trace gravel							
4		- gravelly, some silt, well graded, damp to moist		SA60				2.7	927
		- trace gravel							
5		- gravelly		SA61				7.9	926
6		- 300 mm thick gravel seam							925
		- silty, some gravel							
7		- gravelly, some silt		SA62	58	33	9	2.4	924
8				SA63				4	923
9									922
		SILT - sandy, some gravel, wet, greyish brown		SA64				10.5	
10		SAND - gravelly, some silt, fine to coarse grained sand, subrounded to subangular gravel to 50 mm diameter, damp, brown							921
11		- trace silt		SA65				2.2	920
12		- silty, some gravel, gravel to 100 mm diameter, moist, brown							919
13				SA66				7.6	918
14		- gravelly, some silt, damp		SA67				7.6	917
		- no visible gravel							
15		- some silt to silty							916
		- silty, trace to some gravel							
16		- gravelly, some silt		SA68				10.9	915
17		- silty, trace to some gravel		SA69				11.8	914
18		- gravelly, some silt, subangular to angular gravel, wet							913
19		- silty, trace gravel, grey		SA70				15.3	912
20									911

Plastic Limit — Moisture Content — Liquid Limit (20 40 60 80)

TETRA TECH

Contractor: Boart Longyear	Completion Depth: 20.4 m
Equipment Type: Track Mounted LS250 Mini Sonic	Start Date: 2022 September 29
Logged By: JS	Completion Date: 2022 September 29
Reviewed By: IM	Page 1 of 2

Borehole No: **BH22-04**

Project: DSTF Phase 2 Detailed Design	Project No: ENG.WARC04307-01
Location: Keno Hill Mine	Ground Elev: 930.8 m
Yukon	UTM: 484165.2557 E; 7086670.469 N; Z 8

HECLA MINING COMPANY

Depth (m)	Method	Soil Description	Ground Ice Description	Sample Type	Sample Number	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Plastic Limit / Moisture Content / Liquid Limit (20 40 60 80)	Elevation (m)
20			Unfrozen		SA71					4.1	●	
		END OF BOREHOLE (20.4 metres) Note: Stopped due to refusal on suspected bedrock										
21												910
22												909
23												908
24												907
25												906
26												905
27												904
28												903
29												902
30												901
31												900
32												899
33												898
34												897
35												896
36												895
37												894
38												893
39												892
40												891

TETRA TECH

Contractor: Boart Longyear	Completion Depth: 20.4 m
Equipment Type: Track Mounted LS250 Mini Sonic	Start Date: 2022 September 29
Logged By: JS	Completion Date: 2022 September 29
Reviewed By: IM	Page 2 of 2

Borehole No: **BH22-05**

Hecla MINING COMPANY

Project: DSTF Phase 2 Detailed Design	Project No: ENG.WARC04307-01
Location: Keno Hill Mine	Ground Elev: 931.7 m
Yukon	UTM: 484206.6407 E; 7086784.693 N; Z 8

Method: Sonic

Depth (m)	Soil Description	Ground Ice Description	Sample Number	Gravel (%)	Sand (%)	Silt & Clay (%)	Moisture Content (%)
0	SAND AND GRAVEL (FILL) - silty, moist, grey, (150 mm thick)	Unfrozen					
	ORGANICS - (100 mm thick)	Frozen, Vx 25%	SA72				290.2
	SILT AND ORGANICS - some sand, dark brown						
2	SAND (TILL) - silty, some gravel, greyish brown		SA73				13.9
	- gravelly	Vx, N, frozen intermittently	SA74				14.1
	- some silt, trace gravel		SA75	10	76	14	17.5
	- some gravel, moist		SA76				7.7
	- gravelly, coarse grained sand seams throughout		SA77				8.1
	- some gravel	Nb	SA78				22.1
			SA79				11.3
	- gravelly		SA80				9.7
13.8	GRAVEL AND SAND - some silt, wet, brown	Unfrozen	SA81	49	37	14	12.6
	- damp		SA82				5.6
	- some silt to silty		SA83				6.5

Plastic Limit / Moisture Content / Liquid Limit: 20 40 60 80

GTC

Elevation (m): 931, 930, 929, 928, 927, 926, 925, 924, 923, 922, 921, 920, 919, 918, 917, 916, 915, 914, 913, 912

TETRA TECH

Contractor: Boart Longyear	Completion Depth: 26.8 m
Equipment Type: Track Mounted LS250 Mini Sonic	Start Date: 2022 September 30
Logged By: JS	Completion Date: 2022 September 30
Reviewed By: IM	Page 1 of 2

Borehole No: **BH22-05**

Project: DSTF Phase 2 Detailed Design	Project No: ENG.WARC04307-01
Location: Keno Hill Mine	Ground Elev: 931.7 m
Yukon	UTM: 484206.6407 E; 7086784.693 N; Z 8

Depth (m)	Method	Soil Description	Ground Ice Description	Sample Type	Sample Number	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Elevation (m)
20–22	Sonic	GRAVEL - sandy, silty, medium to coarse grained sand, subangular to subrounded gravel, damp, brown			SA84					5.1	911
22–23	Sonic	SAND AND GRAVEL - silty, medium to coarse grained sand, subrounded to subangular gravel, damp, brown			SA85					4.7	910–909
23–24.4	Sonic	SAND - gravelly, silty, fine to coarse grained sand, subrounded to subangular gravel to 75 mm diameter, moist, brown			SA86					4.5	908
24.4–26.8	Sonic	GRAVEL - trace sand, trace silt, subangular to subrounded gravel, damp, greyish brown			SA87					0.9	907–905
26.8		END OF BOREHOLE (26.8 metres) 25 mm PVC installed to 26.8 metres Ground temperature cable installed inside PVC pipe to 25.20 metres Note: Stopped due to refusal on suspected bedrock Beads 1-5 are coiled up outside of the monument and will be installed accordingly throughout the construction process									

Plastic Limit — Moisture Content — Liquid Limit: 20, 40, 60, 80

GTC | PVC

Contractor: Boart Longyear	Completion Depth: 26.8 m
Equipment Type: Track Mounted LS250 Mini Sonic	Start Date: 2022 September 30
Logged By: JS	Completion Date: 2022 September 30
Reviewed By: IM	Page 2 of 2

TETRA TECH

Borehole No: **BH22-06**

Project: DSTF Phase 2 Detailed Design	Project No: ENG.WARC04307-01
Location: Keno Hill Mine	Ground Elev: 933 m
Yukon	UTM: 484291.6924 E; 7086718.514 N; Z 8

Hecla MINING COMPANY

Method: Sonic

Soil Description	Ground Ice Description
SAND AND GRAVEL (FILL) - silty, moist, grey, (150 mm thick)	Unfrozen
ORGANICS - (50 mm thick)	Frozen, Vx, Vs 45%
SAND (FILL) - silty, trace gravel, fine to coarse grained sand, wet, brown - organic inclusions	Nbn
ORGANICS - peat, dark brown to black, wood chunks	
SAND (TILL) - silty, trace gravel, moist, greyish brown - gravelly	
SILT (TILL) - sandy, trace to some gravel, moist, greyish brown	
SAND (TILL) - gravelly, some silt, medium to coarse grained sand, wet - damp	
SILT (TILL) - sandy, gravelly, fine to coarse grained sand, wet, brown - sand and gravel seam - large gravel and cobbles pieces to 100 mm diameter, moist	
GRAVEL - silty, some sand, subrounded to subangular gravel to 50 mm diameter, wet	
SILT (TILL) - sandy, gravelly, wet, brown	
SAND (TILL) - some silt, medium to coarse grained sand - 300 mm thick cobble - silty, gravelly, fine to coarse grained sand, moist, brown - damp	Vx
GRAVEL - subrounded to angular gravel to 75 mm diameter	
SAND (TILL) - silty, occasional gravel, fine grained sand, brown - gravelly, some silt, fine to coarse grained sand, wet - medium to coarse grained sand - trace gravel	Nbn-Nf (from ~15.3 m) Unfrozen (from ~16.8 m)

Sample Number	Gravel (%)	Sand (%)	Silt & Clay (%)	Moisture Content (%)
SA88				37.6
SA89				182.9
SA90				11.8
SA91				3.6
SA92	45	30	25	17.7
SA93				8.8
SA94				21.7
SA95				7.3
SA96				2.4
SA97				1
SA98				24.1
SA99	34	46	20	8.6
SA100				8.8

Plastic Limit — Moisture Content — Liquid Limit (20, 40, 60, 80)

Depth (m): 0–20; Elevation (m): 933–913

TETRA TECH

Contractor: Boart Longyear	Completion Depth: 30.5 m
Equipment Type: Track Mounted LS250 Mini Sonic	Start Date: 2022 September 30
Logged By: JS	Completion Date: 2022 September 30
Reviewed By: IM	Page 1 of 2

Borehole No: **BH22-06**

Project: DSTF Phase 2 Detailed Design	Project No: ENG.WARC04307-01
Location: Keno Hill Mine	Ground Elev: 933 m
Yukon	UTM: 484291.6924 E; 7086718.514 N; Z 8

Depth (m)	Method	Soil Description	Ground Ice Description	Sample Type	Sample Number	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Elevation (m)
20	Sonic	- some silt, fine grained sand, damp			SA101					5.4	913
21		- trace silt, fine to medium grained sand, wet									912
22		- some silt									911
23		- damp			SA102					16.1	910
					SA103					5.2	
24		- silty, some gravel, moist									909
25		- gravelly, some silt - occasional gravel			SA104					4.4	908
26					SA105					19.5	907
27		- damp									906
28					SA106A					5.5	905
29		- silty, wet, dark brown			SA107A					23.8	904
30		- some silt, moist, light brown									903

Particle Size Distribution: Silt & Clay (%)

Plastic Limit — Moisture Content — Liquid Limit: 20 40 60 80

GTC | PVC

END OF BOREHOLE (30.5 metres)
25 mm PVC installed to 30.5 metres
Ground temperature cable installed inside PVC pipe to 29.33 metres
Note: Target depth reached
Beads 1 and 2 are coiled up outside of the monument and will be installed accordingly throughout the construction process

Depth: 31 32 33 34 35 36 37 38 39 40 — Elevation: 902 901 900 899 898 897 896 895 894 893

TETRA TECH

Contractor: Boart Longyear	Completion Depth: 30.5 m
Equipment Type: Track Mounted LS250 Mini Sonic	Start Date: 2022 September 30
Logged By: JS	Completion Date: 2022 September 30
Reviewed By: IM	Page 2 of 2

Borehole No: **BH22-07**

Project: DSTF Phase 2 Detailed Design	Project No: ENG.WARC04307-01
Location: Keno Hill Mine	Ground Elev: 924.4 m
Yukon	UTM: 484130.6059 E; 7086777.122 N; Z 8

Depth (m)	Method	Soil Description	Ground Ice Description	Sample Number	Gravel (%)	Sand (%)	Silt & Clay (%)	Moisture Content (%)
0–0.9	Sonic	SAND AND GRAVEL (PAD FILL) - silty, moist, grey	Unfrozen	SA106B				20.1
0.9		ORGANICS - (50 mm thick)	Frozen, Nbn					
		ORGANICS AND SILT - trace sand, trace gravel, wet, brown, organics inclusions						
2.1		SILT (TILL) - sandy, some gravel, wet, brown	Vx 25%	SA107B				12.5
			Nbe, Nbn	SA108				15.2
4.5		SAND (TILL) - gravelly, silty		SA109	38	36	26	24.6
		- trace gravel		SA110				19.8
		- some gravel	Nbn	SA111				18.4
		- gravelly						
		- silty, some gravel, suspected cobble, gravel to 100 mm diameter, moist, brown		SA112				7.8
		- gravelly, some silt, wet		SA113	45	35	20	9.2
		- wet		SA114				6.7
		- 150 mm thick gravel layer						
		- coarse grained sand		SA115				18.8
				SA117				9.4
15.3		GRAVEL - sandy, silty, subrounded to subangular gravel to 75 mm diameter, medium to coarse grained sand, very wet, brown		SA116				23.3
16.8		SAND - silty, no visible gravel, wet, brown						
		- fine to coarse grained sand						
		- trace gravel, fine to medium grained sand						
		- some gravel, fine to coarse grained sand	Nbn-Nf					
		- trace gravel, medium to coarse grained sand, weak foliated flat rock throughout	Nf	SA118				13.7
			Nbn	SA119				24.2

Plastic Limit — Moisture Content — Liquid Limit: 20 40 60 80

GTC

Elevation (m): 924, 923, 922, 921, 920, 919, 918, 917, 916, 915, 914, 913, 912, 911, 910, 909, 908, 907, 906, 905

Contractor: Boart Longyear	Completion Depth: 27.4 m
Equipment Type: Track Mounted LS250 Mini Sonic	Start Date: 2022 October 2
Logged By: JS	Completion Date: 2022 October 2
Reviewed By: IM	Page 1 of 2

TETRA TECH

Borehole No: **BH22-07**

Project: DSTF Phase 2 Detailed Design	Project No: ENG.WARC04307-01
Location: Keno Hill Mine	Ground Elev: 924.4 m
Yukon	UTM: 484130.6059 E; 7086777.122 N; Z 8

Method: Sonic

Depth (m)	Soil Description	Ground Ice Description	Sample Type	Sample Number	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	GTC	PVC	Elevation (m)
20–20.7	- fine to medium grained sand, no visible foliated rock		▬	SA120					19.5			904
20.7–22.2	SILT - sandy, no visible gravel, brown, grey laminations throughout - sandy seam											903
22.2–27.4	SAND - some silt, no visible gravel, fine to medium grained sand, brown		▬	SA121					22.7			902
	- some silt, wet	Unfrozen	▬	SA122					23.4			901
	- fine grained sand, damp		▬	SA123					11.3			900, 899
	- silty, wet		▬	SA124					15.6			898
	- suspected bedrock											897

END OF BOREHOLE (27.4 metres)
slough - 14.5 metres at completion
PVC installed to 14.5 metres
Ground temperature cable installed inside PVC pipe to 13.42 metres
Note: Stopped due to refusal on suspected bedrock
Beads 1-10 are coiled up outside of the monument and will be installed accordingly throughout the construction process

Depth scale: 20–40 m; Elevation scale: 904–885 m

Plastic Limit / Moisture Content / Liquid Limit: 20 40 60 80

Contractor: Boart Longyear	Completion Depth: 27.4 m
Equipment Type: Track Mounted LS250 Mini Sonic	Start Date: 2022 October 2
Logged By: JS	Completion Date: 2022 October 2
Reviewed By: IM	Page 2 of 2

Borehole No: **BH22-08**

Project: DSTF Phase 2 Detailed Design	Project No: ENG.WARC04307-01
Location: Keno Hill Mine	Ground Elev: 926.5 m
Yukon	UTM: 484162.3135 E; 7086750.62 N; Z 8

Method: Sonic

Soil Description	Ground Ice Description
SAND AND GRAVEL (PAD FILL) - silty, wet, grey	Unfrozen
ORGANICS - (125 mm thick)	Frozen, Vx 10%
SILT AND ORGANICS - dark brown	Vx, Nb
SILT - trace sand, trace gravel, brown, organic inclusions - sandy, some gravel - coarse grained sand layers throughout - some sand, moist - grey	Nbn-Nf Nbn
SAND AND GRAVEL - silty, coarse grained sand, gravel to 50 mm diameter, wet, brown	
SILT - gravelly, some sand, gravel to 50 mm diameter, wet, brown	Frozen intermittedly
SAND AND GRAVEL - silty, fine to coarse grained sand, moist, brown	
SAND - some silt, no visible gravel, fine to coarse grained sand - coarser grained sand - silty	Nf Nb-Nf

Sample Number	Gravel (%)	Sand (%)	Silt & Clay (%)	Moisture Content (%)
SA125				32.7
SA126				21.1
SA127	1	45	54	22.1
SA128				11.4
SA129				10.6
SA130				10.6
SA131				8.5
SA132				4.8
SA133				23.2
SA134				22.1
SA135				20.8
SA136				21.1
SA137	0	53	47	23.5

Plastic Limit — Moisture Content — Liquid Limit: 20 40 60 80

GTC | PVC | Elevation (m): 926 – 907

Depth (m): 0 – 20

Contractor: Boart Longyear	Completion Depth: 30.5 m
Equipment Type: Track Mounted LS250 Mini Sonic	Start Date: 2022 October 2
Logged By: JS	Completion Date: 2022 October 2
Reviewed By: IM	Page 1 of 2

TETRA TECH

Borehole No: **BH22-08**

Hecla MINING COMPANY

Project: DSTF Phase 2 Detailed Design	Project No: ENG.WARC04307-01
Location: Keno Hill Mine	Ground Elev: 926.5 m
Yukon	UTM: 484162.3135 E; 7086750.62 N; Z 8

Depth (m)	Method	Soil Description	Ground Ice Description	Sample Type	Sample Number	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Elevation (m)
20	Sonic	- trace gravel, damp	Unfrozen								
				▬	SA138					2.9	906
22		- silty, fine grained sand									
				▬	SA139					13.3	904
23		- 300 mm thick fine to coarse grained sand layer									
		- trace gravel, moist, dense, greyish brown		▬	SA140					10.5	903
24		- some silt, brown									902
25		- silty, some gravel, moist, grey									
				▬	SA141					10.9	901
26				▬	SA142					9.7	900
27		- some silt, medium to coarse grained sand									899
28		- silty, fine to coarse grained sand		▬	SA143					2.6	898
29				▬	SA144					8.4	897
30.5		END OF BOREHOLE (30.5 metres) 25 mm PVC installed to 22.9 metres Ground temperature cable installed inside PVC pipe to 22.47 metres Note: Target depth reached Beads 1-13 are coiled up outside of the monument and will be installed accordingly throughout the construction process									896

Plastic Limit — Moisture Content — Liquid Limit: 20 40 60 80

GTC | PVC

Depth scale: 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40

Elevation scale: 906, 905, 904, 903, 902, 901, 900, 899, 898, 897, 896, 895, 894, 893, 892, 891, 890, 889, 888, 887

TETRA TECH

Contractor: Boart Longyear	Completion Depth: 30.5 m
Equipment Type: Track Mounted LS250 Mini Sonic	Start Date: 2022 October 2
Logged By: JS	Completion Date: 2022 October 2
Reviewed By: IM	Page 2 of 2

Borehole No: **BH22-09**

Hecla MINING COMPANY

Project: DSTF Phase 2 Detailed Design	Project No: ENG.WARC04307-01
Location: Keno Hill Mine	Ground Elev: 924.1 m
Yukon	UTM: 484129.5937 E; 7086715.272 N; Z 8

Method: Sonic

Depth (m)	Soil Description	Ground Ice Description
0	SAND AND GRAVEL (PAD FILL) - silty, wet, grey, (250 mm thick)	Unfrozen
	ORGANICS - (50 mm thick)	Frozen, V 5-10%
1	SILT - sandy, gravelly, fine to coarse grained sand	
	- some gravel, moist to wet	Vx 30% Nf
3	- trace gravel, moist	Nb-Nf
6		Intermittently frozen, Nbn
7	- gravelly, coarse grained sand	
7.6	SAND - gravelly, silty, fine to coarse grained sand, wet, brown	Nf
8.5	- trace gravel	
9	- some gravel, wet	
11		Intermittently frozen
11.5	- trace gravel, fine grained grained	Nbn
12.2	SILT (TILL) - sandy, some gravel, subrounded to subangular gravel to 50 mm diameter, moist, greyish brown	
14	- trace clay, dark grey	
14.1		Unfrozen
15.4	- trace sand	
16.9	- cobbles for 600 mm	
18.4	- dense	
18.8	- some sand, fine to coarse grained sand	

Sample Number	Gravel (%)	Sand (%)	Silt & Clay (%)	Moisture Content (%)
SA145				24.9
SA146				10.2
SA147	7	31	62	14.9
SA148				11
SA149				24.3
SA150				10.9
SA151				7.9
SA152				32.8
SA153				11.4
SA154				11
SA155	18	39	43	9
SA156				8.7

Plastic Limit / Moisture Content / Liquid Limit: 20 40 60 80

Elevation (m): 924, 923, 922, 921, 920, 919, 918, 917, 916, 915, 914, 913, 912, 911, 910, 909, 908, 907, 906, 905

GTC

TETRA TECH

Contractor: Boart Longyear	Completion Depth: 28.3 m
Equipment Type: Track Mounted LS250 Mini Sonic	Start Date: 2022 October 3
Logged By: JS	Completion Date: 2022 October 3
Reviewed By: IM	Page 1 of 2

Borehole No: **BH22-09**

Hecla MINING COMPANY

Project: DSTF Phase 2 Detailed Design	Project No: ENG.WARC04307-01
Location: Keno Hill Mine	Ground Elev: 924.1 m
Yukon	UTM: 484129.5937 E; 7086715.272 N; Z 8

Depth (m)	Method	Soil Description	Ground Ice Description	Sample Type	Sample Number	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Elevation (m)
20	Sonic	- damp									904
20.6	Sonic				SA157					7.7	
21.8	Sonic				SA158					7.2	
23.3	Sonic				SA159					9.1	
25.2	Sonic				SA160					8.3	
26.7	Sonic				SA161					6.9	
28.3		END OF BOREHOLE (28.3 metres) 25 mm PVC to 28.3 metres Ground temperature cable installed inside PVC pipe to 27.63 metres Note: Stopped due to refusal Beads 1-8 are coiled up outside of the monument and will be installed accordingly throughout the construction process									

Depth scale: 20–40 m; Elevation scale: 904–885 m. Plastic Limit / Moisture Content / Liquid Limit scale: 20, 40, 60, 80. GTC installed to ~27.6 m; PVC to 28.3 m.

TETRA TECH

Contractor: Boart Longyear	Completion Depth: 28.3 m
Equipment Type: Track Mounted LS250 Mini Sonic	Start Date: 2022 October 3
Logged By: JS	Completion Date: 2022 October 3
Reviewed By: IM	Page 2 of 2

Borehole No: **BH22-10**

Project: DSTF Phase 2 Detailed Design	Project No: ENG.WARC04307-01
Location: Keno Hill Mine	Ground Elev: 918.7 m
Yukon	UTM: 484054.54 E; 7086731.18 N; Z 8

Method: Sonic

Depth (m)	Soil Description	Ground Ice Description	Sample Number	Gravel (%)	Sand (%)	Silt & Clay (%)	Moisture Content (%)
0	SAND AND GRAVEL (FILL) - silty, angular to subangular fine grained gravel, moist, grey	Unfrozen					
~0.5			SA162				5.1
~2.0			SA163	62	28	10	5.8
~3.2	- no recovery to 6.1 metres						
~6.4	ORGANICS - (50 mm thick)	Frozen, Nbn					
~6.8	SILT AND ORGANICS - (150 mm thick)		SA164				18.9
~7.1	SILT (TILL) - sandy, some gravel, brown						
~7.9		V, 10-40% ice	SA165				20.6
~9.0		10-20% ice	SA166				45.3
~9.3	- 150 mm thick organic layer - wood pieces						
~10.3			SA167				14.2
~10.8	- gravelly, cobbles, wet						
~11.1			SA168	35	33	32	10.2
~12.3	- some gravel	Nbn					
~13.3		Vx 5%, small ice inclusion Nbn	SA169				31.7
~13.6	- some sand, trace gravel - clean sand layers throughout						
~14.2			SA170				20.4
~17.0	- sandy, some gravel, moist						
~17.3			SA171				9.7
~18.4		Intermittently frozen					
~19.4		Nbn	SA172				26.1

Plastic Limit – Moisture Content – Liquid Limit scale: 20 40 60 80

GTC

Elevation (m): 918, 917, 916, 915, 914, 913, 912, 911, 910, 909, 908, 907, 906, 905, 904, 903, 902, 901, 900, 899

TETRA TECH

Contractor: Boart Longyear	Completion Depth: 23.2 m
Equipment Type: Track Mounted LS250 Mini Sonic	Start Date: 2022 October 4
Logged By: JS	Completion Date: 2022 October 4
Reviewed By: IM	Page 1 of 2

Borehole No: **BH22-10**

Project: DSTF Phase 2 Detailed Design	Project No: ENG.WARC04307-01
Location: Keno Hill Mine	Ground Elev: 918.7 m
Yukon	UTM: 484054.54 E; 7086731.18 N; Z 8

Depth (m)	Method	Soil Description	Ground Ice Description	Sample Type	Sample Number	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Elevation (m)
20–23.2	Sonic	- gravelly, coarse grained sand	Unfrozen								
		- trace gravel, fine to medium grained sand			SA173					13.7	898
		- coarse grained angular gravel			SA174					0.6	896
23.2		END OF BOREHOLE (23.2 metres) 25 mm PVC installed to 22.6 metres Ground temperature cable installed inside PVC pipe to 20.04 metres Note: Stopped due to refusal Beads 1 and 2 are coiled up outside of the monument and will be installed accordingly throughout the construction process									

Plastic Limit — Moisture Content — Liquid Limit (20, 40, 60, 80)

Columns: GTC, PVC

Depth scale (m): 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40

Elevation scale (m): 898, 897, 896, 895, 894, 893, 892, 891, 890, 889, 888, 887, 886, 885, 884, 883, 882, 881, 880, 879

Contractor: Boart Longyear	Completion Depth: 23.2 m
Equipment Type: Track Mounted LS250 Mini Sonic	Start Date: 2022 October 4
Logged By: JS	Completion Date: 2022 October 4
Reviewed By: IM	Page 2 of 2

Borehole No: **BH22-40B**

Project: DSTF Phase 2 Detailed Design	Project No: ENG.WARC04307-01
Location: Keno Hill Mine	Ground Elev: 919.84 m
Yukon	UTM: 483978.2 E; 7086940 N; Z 8

Depth (m)	Method	Soil Description	Ground Ice Description	Sample Type	Sample Number	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Moisture Content (%)	Elevation (m)
0	Sonic	ORGANICS - (100 mm thick)	Unfrozen								
		SAND AND SILT (TAILINGS) - moist, grey			SA01					11.4	919
2					SA02					12.4	918
3					SA03					12.4	917
5		- more compact to dense			SA04					16.9	915
7					SA05					13.1	913
7.5		SILT - trace sand, trace gravel, organics, gravel to 50 mm diameter, wet, brown, liner pieces			SA06					12.5	912
8.5		- 600 mm thick organic layer									
9		- trace to some gravel, trace to some sand, gravel to 100 mm diameter	Frozen, Nbn								
10		- 50 mm thick drier layer			SA07					5.6	910
11.5					SA08					11.8	908
12		BEDROCK			SA09					0.4	
13.4					SA10					0.6	
		END OF BOREHOLE (13.4 metres) 25 mm PVC installed to 13.4 metres Note: Target depth reached									

Plastic Limit — Moisture Content — Liquid Limit: 20 40 60 80

PVC: 25 mm PVC installed to 13.4 m

Contractor: Boart Longyear	Completion Depth: 13.4 m
Equipment Type: Track Mounted LS250 Mini Sonic	Start Date: 2022 September 26
Logged By: JS	Completion Date: 2022 September 26
Reviewed By: IM	Page 1 of 1

TETRA TECH

MOISTURE CONTENT TEST RESULTS

ASTM D2216

Project:	AKHM DSTF Phase 2 Detailed Design	Sample No.:	Various
Project Number:	ENG.WARC04307-01	Date Tested:	November 9, 2022
Client:	Hecla	Tested By:	BW
Project Manager:	Ian MacIntyre	Page:	1 of 8

B.H. Number	Sample Number	Moisture Content (%)	Visual Description of Soil
BH22-04B	SA01	11.4	
	SA02	12.4	
	SA03	12.4	
	SA04	16.9	
	SA05	13.1	
	SA06	12.5	
	SA07	5.6	
	SA08	11.8	
	SA09	0.4	
	SA10	0.6	
BH22-01	SA11	20.1	
	SA12	14.1	
	SA13	1.0	
	SA14	12.4	
	SA15	28.6	
	SA16	5.9	
	SA17	7.4	SILT and SAND - gravelly
	SA18	23.5	
	SA19	5.9	
	SA20	0.4	
	SA21	3.7	
BH22-02	SA22	12.7	GRAVEL and SAND - trace silt
	SA23	18.9	
	SA24	10.7	
	SA25	17.4	

Reviewed By: ____________________ P.Eng.

TETRA TECH

MOISTURE CONTENT TEST RESULTS

ASTM D2216

Project:	AKHM DSTF Phase 2 Detailed Design	Sample No.:	Various
Project Number:	ENG.WARC04307-01	Date Tested:	November 9, 2022
Client:	Hecla	Tested By:	BW
Project Manager:	Ian MacIntyre	Page:	2 of 8

B.H. Number	Sample Number	Moisture Content (%)	Visual Description of Soil
BH22-02	SA26	10.1	
	SA27	6.2	
	SA28	23.8	
	SA29	26.0	SILT - trace sand
	SA30	21.8	
	SA31	15.4	
	SA32	9.3	
	SA33	12.2	
	SA34	10.3	SILT - sandy, trace gravel
	SA35	11.2	
	SA36	13.9	
	SA37	1.1	
	SA38	1.5	
	SA39	5.5	
	SA40	8.5	
	SA41	3.7	
	SA42	3.6	GRAVEL - sandy, some silt
	SA43	1.6	
BH22-03	SA44	13.2	
	SA45	4.0	
	SA46	12.3	
	SA47	70.8	
	SA48	58.6	
	SA49	30.8	
	SA50	14.3	

Reviewed By: ______________________ P.Eng.

TETRA TECH

MOISTURE CONTENT TEST RESULTS

ASTM D2216

Project:	AKHM DSTF Phase 2 Detailed Design	Sample No.:	Various
Project Number:	ENG.WARC04307-01	Date Tested:	November 10, 2022
Client:	Hecla	Tested By:	BW
Project Manager:	Ian MacIntyre	Page:	3 of 8

B.H. Number	Sample Number	Moisture Content (%)	Visual Description of Soil
BH22-03	SA51	21.5	
	SA52	13.3	
	SA53	12.7	SILT and SAND - some gravel
	SA54	27.4	
	SA55	9.8	
	SA56	10.8	
	SA57	9.7	
BH22-04	SA58	5.1	
	SA59	10.2	
	SA60	2.7	
	SA61	7.9	
	SA62	2.4	GRAVEL - sandy, trace silt
	SA63	4.0	
	SA64	10.5	
	SA65	2.2	
	SA66	7.6	
	SA67	7.6	
	SA68	10.9	
	SA69	11.8	
	SA70	15.3	
	SA71	4.1	
BH22-05	SA72	290.2	
	SA73	13.9	
	SA74	14.1	
	SA75	17.5	SAND - some silt, trace gravel

Reviewed By: ______________________ P.Eng.

TETRA TECH

MOISTURE CONTENT TEST RESULTS

ASTM D2216

Project:	AKHM DSTF Phase 2 Detailed Design	Sample No.:	Various
Project Number:	ENG.WARC04307-01	Date Tested:	November 11, 2022
Client:	Hecla	Tested By:	BW
Project Manager:	Ian MacIntyre	Page:	4 of 8

B.H. Number	Sample Number	Moisture Content (%)	Visual Description of Soil
BH22-05	SA76	7.7	
	SA77	8.1	
	SA78	22.1	
	SA79	11.3	
	SA80	9.7	
	SA81	12.6	GRAVEL and SAND - some silt
	SA82	5.6	
	SA83	6.5	
	SA84	5.1	
	SA85	4.7	
	SA86	4.5	
	SA87	0.9	
BH22-06	SA88	37.6	
	SA89	182.9	
	SA90	11.8	
	SA91	3.6	
	SA92	17.7	GRAVEL - sandy silty
	SA93	8.8	
	SA94	21.7	
	SA95	7.3	
	SA96	2.4	
	SA97	1.0	
	SA98	24.1	
	SA99	8.6	SAND - gravelly, some silt
	SA100	8.8	

Reviewed By: ______________________ P.Eng.

TETRA TECH

MOISTURE CONTENT TEST RESULTS

ASTM D2216

Project:	AKHM DSTF Phase 2 Detailed Design	Sample No.:	Various
Project Number:	ENG.WARC04307-01	Date Tested:	November 15, 2022
Client:	Hecla	Tested By:	BW
Project Manager:	Ian MacIntyre	Page:	5 of 8

B.H. Number	Sample Number	Moisture Content (%)	Visual Description of Soil
BH22-06	SA101	5.4	
	SA102	16.1	
	SA103	5.2	
	SA104	4.4	
	SA105	19.5	
	SA106A	5.5	
	SA107A	23.8	
BH22-07	SA106B	20.1	
	SA107B	12.5	
	SA108	15.2	
	SA109	24.6	GRAVEL and SAND - silty
	SA110	19.8	
	SA111	18.4	
	SA112	7.8	
	SA113	9.2	GRAVEL - sandy, some silt
	SA114	6.7	
	SA115	18.8	
	SA116	9.4	
	SA117	23.3	
	SA118	13.7	
	SA119	24.2	
	SA120	19.5	
	SA121	22.7	
	SA122	23.4	
	SA123	11.3	

Reviewed By: ____________________ P.Eng.

MOISTURE CONTENT TEST RESULTS

ASTM D2216

Project:	AKHM DSTF Phase 2 Detailed Design	Sample No.:	Various
Project Number:	ENG.WARC04307-01	Date Tested:	November 16, 2022
Client:	Hecla	Tested By:	BW
Project Manager:	Ian MacIntyre	Page:	6 of 8

B.H. Number	Sample Number	Moisture Content (%)	Visual Description of Soil
BH22-07	SA124	15.6	
BH22-08	SA125	32.7	
	SA126	20.1	
	SA127	22.1	SILT and SAND - trace gravel
	SA128	11.4	
	SA129	10.6	
	SA130	10.6	
	SA131	8.5	
	SA132	4.8	
	SA133	23.2	
	SA134	22.1	
	SA135	20.8	
	SA136	21.1	
	SA137	23.5	SAND and SILT
	SA138	2.9	
	SA139	13.3	
	SA140	10.5	
	SA141	10.9	
	SA142	9.7	
	SA143	2.6	
	SA144	8.4	
BH22-09	SA145	24.9	
	SA146	10.2	
	SA147	14.9	SILT - sandy, trace gravel
	SA148	11.0	

Reviewed By: ______________________ P.Eng.

MOISTURE CONTENT TEST RESULTS

ASTM D2216

Project:	AKHM DSTF Phase 2 Detailed Design	Sample No.:	Various
Project Number:	ENG.WARC04307-01	Date Tested:	November 17, 2022
Client:	Hecla	Tested By:	BW
Project Manager:	Ian MacIntyre	Page:	7 of 8

B.H. Number	Sample Number	Moisture Content (%)	Visual Description of Soil
BH22-09	SA149	24.3	
	SA150	10.9	
	SA151	7.9	
	SA152	32.8	
	SA153	11.4	
	SA154	11.0	
	SA155	9.0	SILT and SAND - some gravel
	SA156	8.7	
	SA157	7.7	
	SA158	7.2	
	SA159	9.1	
	SA160	8.3	
	SA161	6.9	
BH22-10	SA162	5.1	
	SA163	5.8	GRAVEL - sandy, trace silt
	SA164	18.9	
	SA165	20.6	
	SA166	45.3	
	SA167	14.2	
	SA168	10.2	GRAVEL - sandy, silty
	SA169	31.7	
	SA170	20.4	
	SA171	9.7	
	SA172	26.1	
	SA173	13.7	

Reviewed By: ______________________ P.Eng.

TETRA TECH

MOISTURE CONTENT TEST RESULTS

ASTM D2216

Project:	AKHM DSTF Phase 2 Detailed Design	Sample No.:	Various
Project Number:	ENG.WARC04307-01	Date Tested:	November 17, 2022
Client:	Hecla	Tested By:	BW
Project Manager:	Ian MacIntyre	Page:	8 of 8

B.H. Number	Sample Number	Moisture Content (%)	Visual Description of Soil
BH22-10	SA174	0.6	

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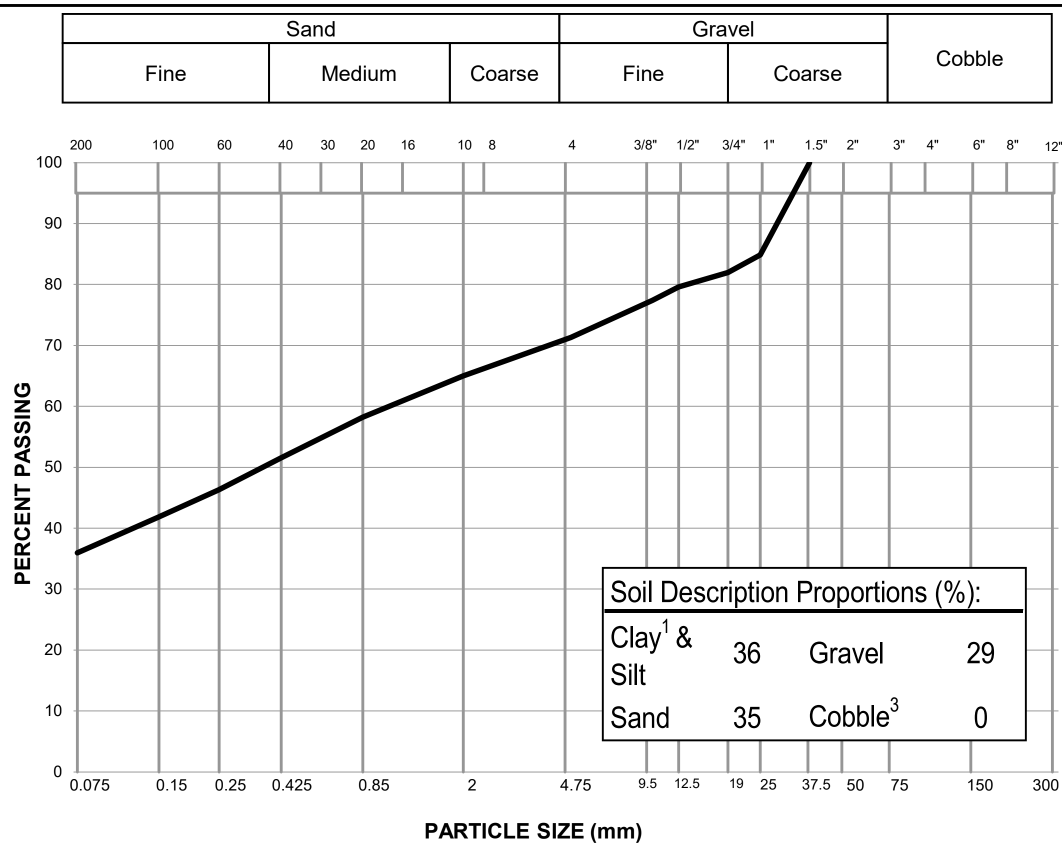
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D7928 & C136

Project:	AKHM DSTF Phase 2 Detailed Design	Sample No.:	SA17
Project No.:	ENG.WARC04307-01	Material Type:	Tailings
Site:	Alexco Keno Hill Mine	Sample Loc.:	BH22-01
Client:	Hecla	Sample Depth:	8.2 m
Client Rep.:	Peter Johnson	Sampling Method:	Grab
Date Tested:	November 14, 2022 By: KD	Date Sampled:	-
Soil Description[2]:	SILT and SAND - gravelly	Sampled By:	JS
		USC Classification:	ML Cu: #N/A
Moisture Content:	7.4%		Cc: #N/A

Particle Size (mm)	Percent Passing
300	
200	
150	
100	
75	
50	
38	100
25	85
19	82
12.5	80
10	77
5	71
2	65
0.85	58
0.425	52
0.25	46
0.15	42
0.075	36.0



Soil Description Proportions (%):			
Clay[1] & Silt	36	Gravel	29
Sand	35	Cobble[3]	0

Notes: [1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual
[2] The description is visually based & subject to Tt WM4400 description protocols
[3] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification:

Remarks:

Reviewed By: ________ P.Eng.

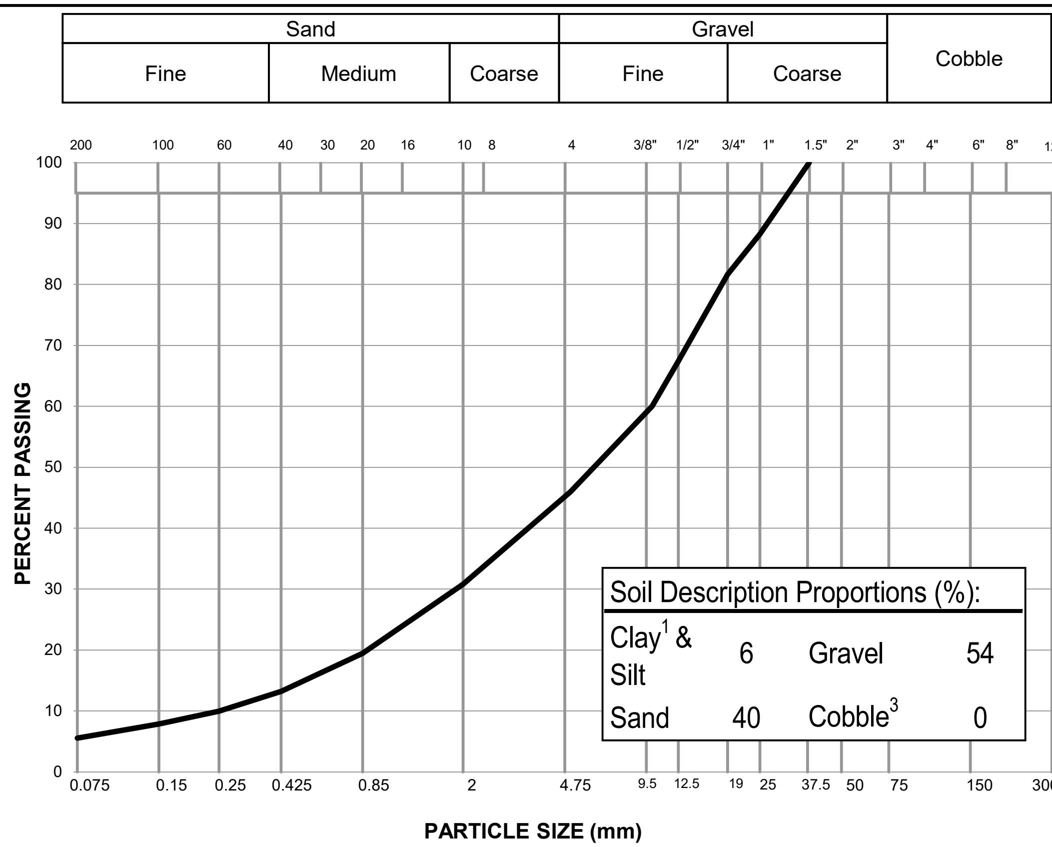
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D7928 & C136

Project:	AKHM DSTF Phase 2 Detailed Design	Sample No.:	SA22
Project No.:	ENG.WARC04307-01	Material Type:	Tailings
Site:	Alexco Keno Hill Mine	Sample Loc.:	BH22-02
Client:	Hecla	Sample Depth:	0.8 m
Client Rep.:	Peter Johnson	Sampling Method:	Grab
Date Tested:	November 14, 2022 By: KD	Date Sampled:	-
Soil Description[2]:	GRAVEL and SAND - trace silt	Sampled By:	JS
		USC Classification:	GW Cu: 39.8
Moisture Content:	12.7%		Cc: 1.5

Particle Size (mm)	Percent Passing
300	
200	
150	
100	
75	
50	
38	100
25	88
19	82
12.5	67
10	60
5	46
2	31
0.85	19
0.425	13
0.25	10
0.15	8
0.075	5.6



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

[2] The description is visually based & subject to Tt WM4400 description protocols

[3] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification: ____________________

Remarks: ____________________

Reviewed By: ____________________ P.Eng.

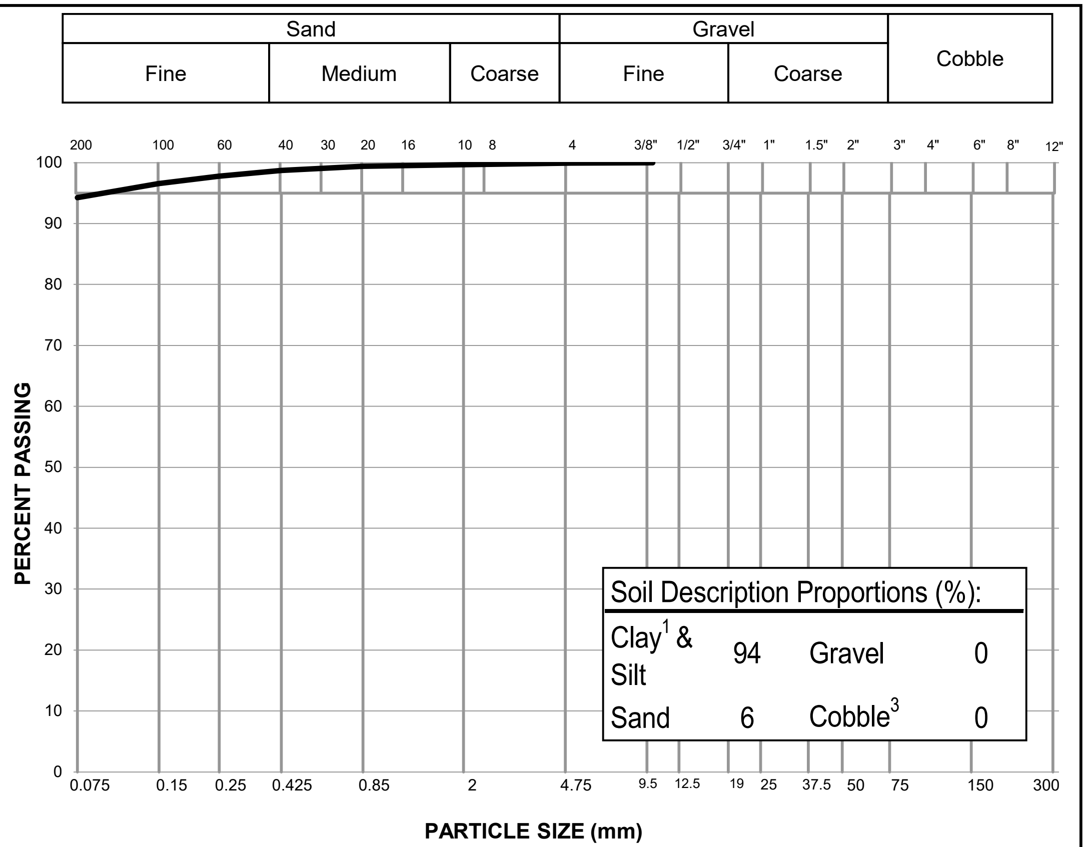
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D7928 & C136

Project:	AKHM DSTF Phase 2 Detailed Design	Sample No.:	SA29
Project No.:	ENG.WARC04307-01	Material Type:	Tailings
Site:	Alexco Keno Hill Mine	Sample Loc.:	BH22-02
Client:	Hecla	Sample Depth:	7.9 m
Client Rep.:	Peter Johnson	Sampling Method:	Grab
Date Tested:	November 14, 2022 By: KD	Date Sampled:	-
Soil Description[2]:	SILT - trace sand	Sampled By:	JS
		USC Classification:	ML Cu: #N/A
Moisture Content:	26.0%		Cc: #N/A

Particle Size (mm)	Percent Passing
300	
200	
150	
100	
75	
50	
38	
25	
19	
12.5	
10	100
5	100
2	100
0.85	99
0.425	99
0.25	98
0.15	97
0.075	94.3



Soil Description Proportions (%):			
Clay[1] & Silt	94	Gravel	0
Sand	6	Cobble[3]	0

Notes: [1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual
[2] The description is visually based & subject to Tt WM4400 description protocols
[3] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification:

Remarks:

Reviewed By: ________________ P.Eng.

TETRA TECH

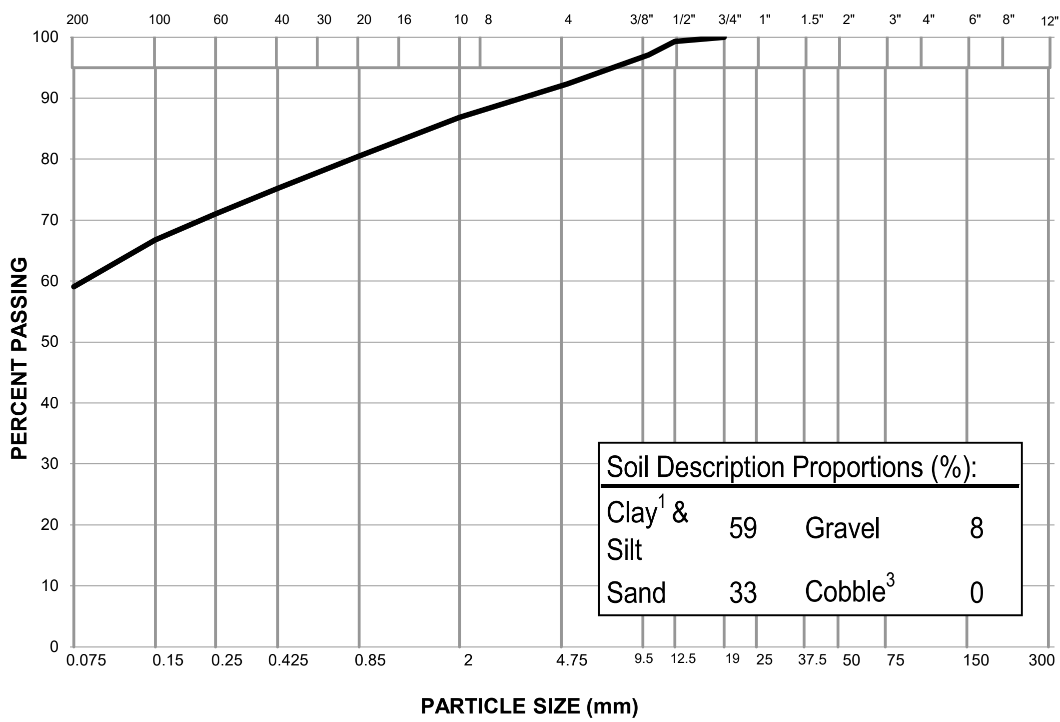
PARTICLE SIZE ANALYSIS REPORT

ASTM D7928 & C136

Project:	AKHM DSTF Phase 2 Detailed Design	Sample No.:	SA34
Project No.:	ENG.WARC04307-01	Material Type:	Tailings
Site:	Alexco Keno Hill Mine	Sample Loc.:	BH22-02
Client:	Hecla	Sample Depth:	15.8 m
Client Rep.:	Peter Johnson	Sampling Method:	Grab
Date Tested:	November 17, 2022 By: BW	Date Sampled:	-
Soil Description[2]:	SILT - sandy, trace gravel	Sampled By:	JS
		USC Classification:	ML Cu: #N/A
Moisture Content:	10.3%		Cc: #N/A

Particle Size (mm)	Percent Passing
300	
200	
150	
100	
75	
50	
38	
25	
19	100
12.5	99
10	97
5	92
2	87
0.85	80
0.425	75
0.25	71
0.15	67
0.075	59.1

Sand			Gravel		Cobble
Fine	Medium	Coarse	Fine	Coarse	



Notes: [1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual
[2] The description is visually based & subject to Tt WM4400 description protocols
[3] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification:

Remarks:

Reviewed By: ____________________ P.Eng.

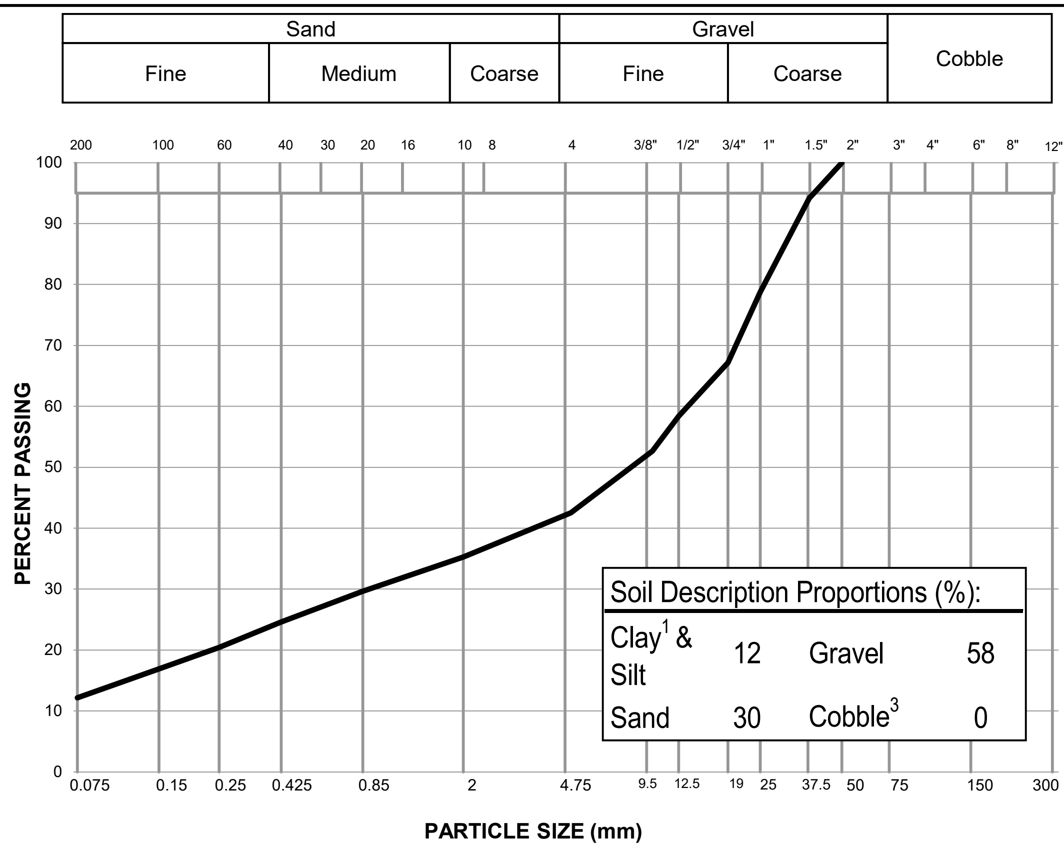
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D7928 & C136

Project:	AKHM DSTF Phase 2 Detailed Design	Sample No.:	SA42
Project No.:	ENG.WARC04307-01	Material Type:	Tailings
Site:	Alexco Keno Hill Mine	Sample Loc.:	BH22-02
Client:	Hecla	Sample Depth:	28.3 m
Client Rep.:	Peter Johnson	Sampling Method:	Grab
Date Tested:	November 17, 2022 By: BW	Date Sampled:	-
Soil Description[2]:	GRAVEL - sandy, some silt	Sampled By:	JS
		USC Classification:	GP Cu: #N/A
Moisture Content:	3.6%		Cc: #N/A

Particle Size (mm)	Percent Passing
300	
200	
150	
100	
75	
50	100
38	94
25	79
19	67
12.5	58
10	53
5	43
2	35
0.85	30
0.425	25
0.25	20
0.15	17
0.075	12.2



Soil Description Proportions (%):			
Clay[1] & Silt	12	Gravel	58
Sand	30	Cobble[3]	0

Notes: [1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual
[2] The description is visually based & subject to Tt WM4400 description protocols
[3] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification:

Remarks:

Reviewed By: P.Eng.

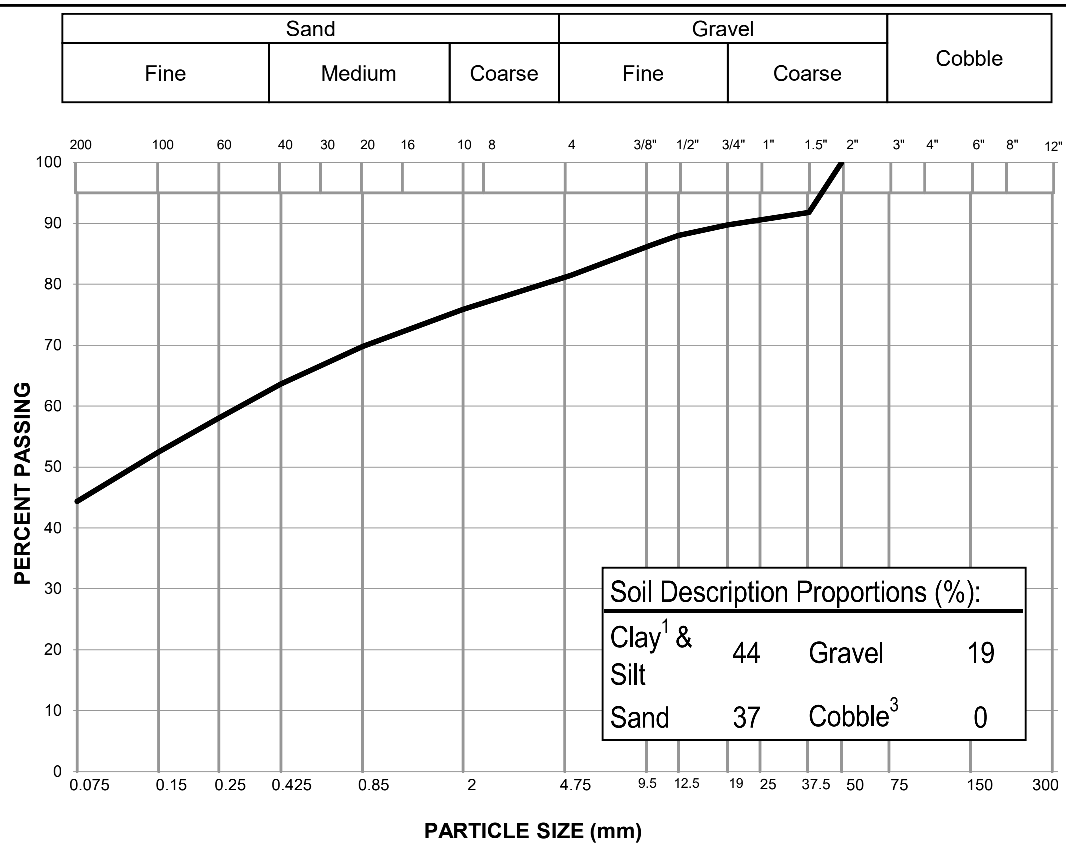
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D7928 & C136

Project:	AKHM DSTF Phase 2 Detailed Design	Sample No.:	SA53
Project No.:	ENG.WARC04307-01	Material Type:	Tailings
Site:	Alexco Keno Hill Mine	Sample Loc.:	BH22-03
Client:	Hecla	Sample Depth:	11.3 m
Client Rep.:	Peter Johnson	Sampling Method:	Grab
Date Tested:	November 14, 2022 By: KD	Date Sampled:	-
Soil Description[2]:	SILT and SAND - some gravel	Sampled By:	JS
		USC Classification:	ML Cu: #N/A
Moisture Content:	12.7%		Cc: #N/A

Particle Size (mm)	Percent Passing
300	
200	
150	
100	
75	
50	100
38	92
25	
19	90
12.5	88
10	86
5	81
2	76
0.85	70
0.425	64
0.25	58
0.15	52
0.075	44.4



Soil Description Proportions (%):			
Clay[1] & Silt	44	Gravel	19
Sand	37	Cobble[3]	0

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

[2] The description is visually based & subject to Tt WM4400 description protocols

[3] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification:

Remarks:

Reviewed By: P.Eng.

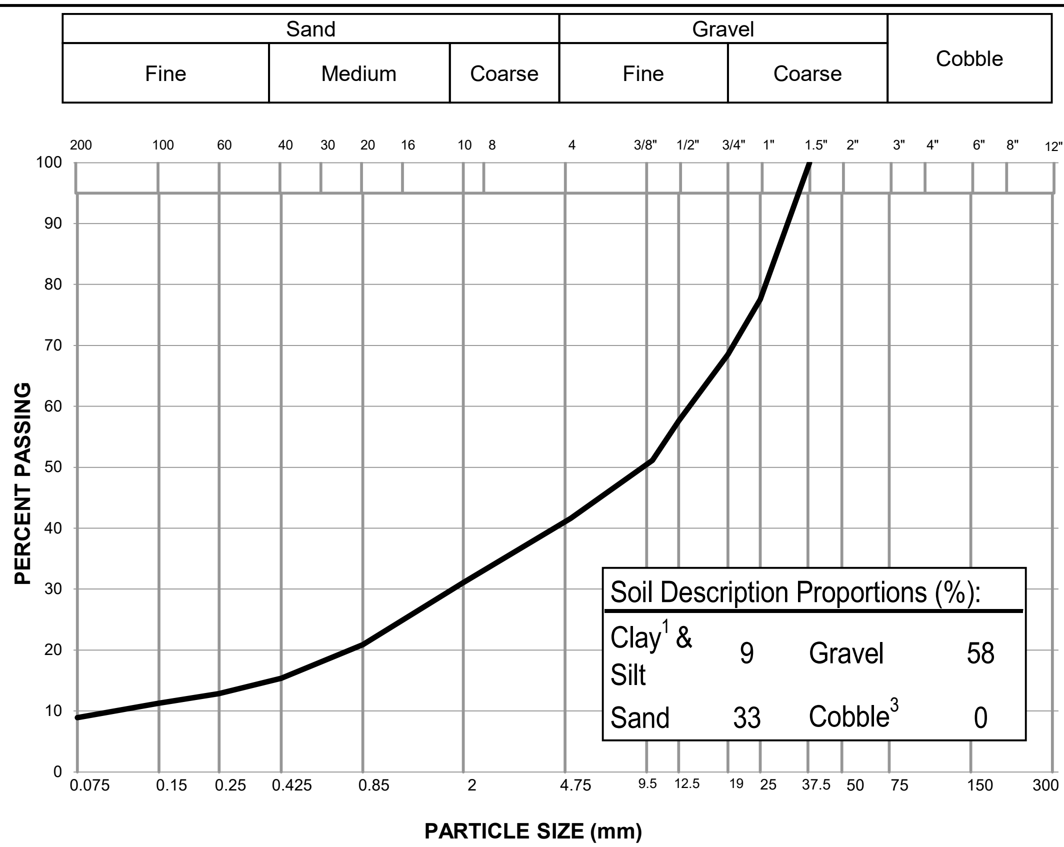
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D7928 & C136

Project:	AKHM DSTF Phase 2 Detailed Design	Sample No.:	SA62
Project No.:	ENG.WARC04307-01	Material Type:	Tailings
Site:	Alexco Keno Hill Mine	Sample Loc.:	BH22-04
Client:	Hecla	Sample Depth:	7.3 m
Client Rep.:	Peter Johnson	Sampling Method:	Grab
Date Tested:	November 17, 2022 By: BW	Date Sampled:	-
Soil Description[2]:	GRAVEL - sandy, trace silt	Sampled By:	JS
		USC Classification:	GW Cu: 128.7
Moisture Content:	2.4%		Cc: 2.3

Particle Size (mm)	Percent Passing
300	
200	
150	
100	
75	
50	
38	100
25	78
19	69
12.5	58
10	51
5	42
2	31
0.85	21
0.425	15
0.25	13
0.15	11
0.075	9.0



Soil Description Proportions (%):

Clay[1] & Silt	9	Gravel	58
Sand	33	Cobble[3]	0

Notes: [1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual
[2] The description is visually based & subject to Tt WM4400 description protocols
[3] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification:

Remarks:

Reviewed By: P.Eng.

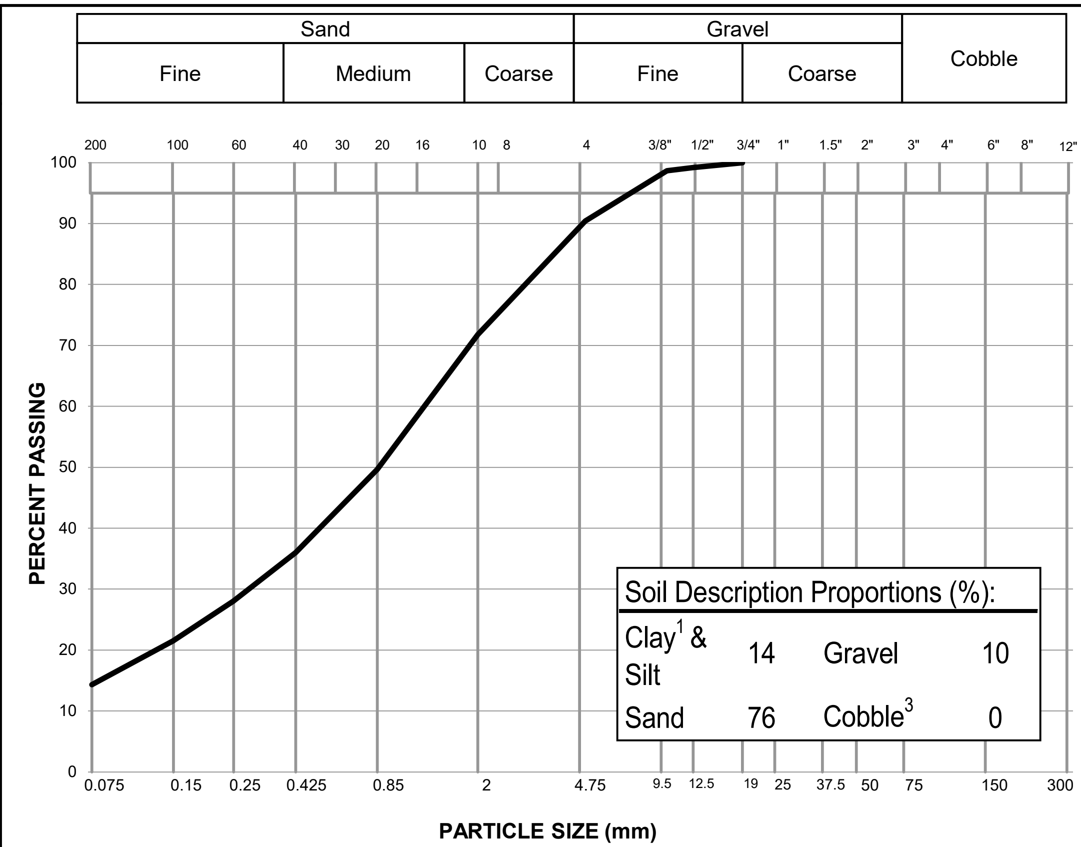
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D7928 & C136

Project:	AKHM DSTF Phase 2 Detailed Design	Sample No.:	SA75
Project No.:	ENG.WARC04307-01	Material Type:	Tailings
Site:	Alexco Keno Hill Mine	Sample Loc.:	BH22-05
Client:	Hecla	Sample Depth:	5.2 m
Client Rep.:	Peter Johnson	Sampling Method:	Grab
Date Tested:	November 18, 2022 By: BW	Date Sampled:	-
Soil Description[2]:	SAND - some silt, trace gravel	Sampled By:	JS
		USC Classification:	GM-ML Cu: #N/A
Moisture Content:	17.5%		Cc: #N/A

Particle Size (mm)	Percent Passing
300	
200	
150	
100	
75	
50	
38	
25	
19	100
12.5	99
10	99
5	90
2	72
0.85	50
0.425	36
0.25	28
0.15	22
0.075	14.3



Soil Description Proportions (%):			
Clay[1] & Silt	14	Gravel	10
Sand	76	Cobble[3]	0

Notes: [1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual
[2] The description is visually based & subject to Tt WM4400 description protocols
[3] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification: ______

Remarks: ______

Reviewed By: ______ P.Eng.

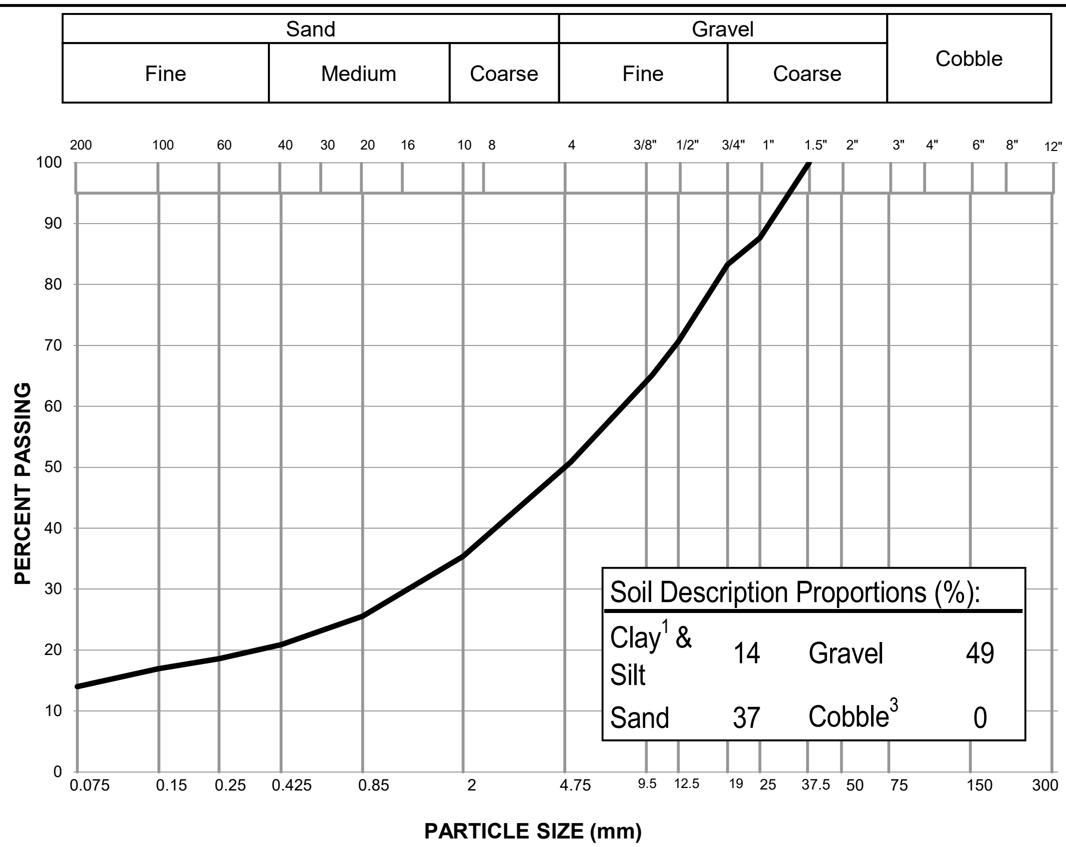
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D7928 & C136

Project:	AKHM DSTF Phase 2 Detailed Design	Sample No.:	SA81
Project No.:	ENG.WARC04307-01	Material Type:	Tailings
Site:	Alexco Keno Hill Mine	Sample Loc.:	BH22-05
Client:	Hecla	Sample Depth:	2.1 m
Client Rep.:	Peter Johnson	Sampling Method:	Grab
Date Tested:	November 17, 2022 By: BW	Date Sampled:	-
Soil Description[2]:	GRAVEL and SAND - some silt	Sampled By:	JS
		USC Classification:	GP-GM Cu: #N/A
Moisture Content:	12.6%		Cc: #N/A

Particle Size (mm)	Percent Passing
300	
200	
150	
100	
75	
50	
38	100
25	88
19	83
12.5	71
10	65
5	51
2	35
0.85	26
0.425	21
0.25	19
0.15	17
0.075	14.0



Soil Description Proportions (%):

Clay[1] & Silt	14	Gravel	49
Sand	37	Cobble[3]	0

Notes:
[1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual
[2] The description is visually based & subject to Tt WM4400 description protocols
[3] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification:

Remarks:

Reviewed By: _______________ P.Eng.

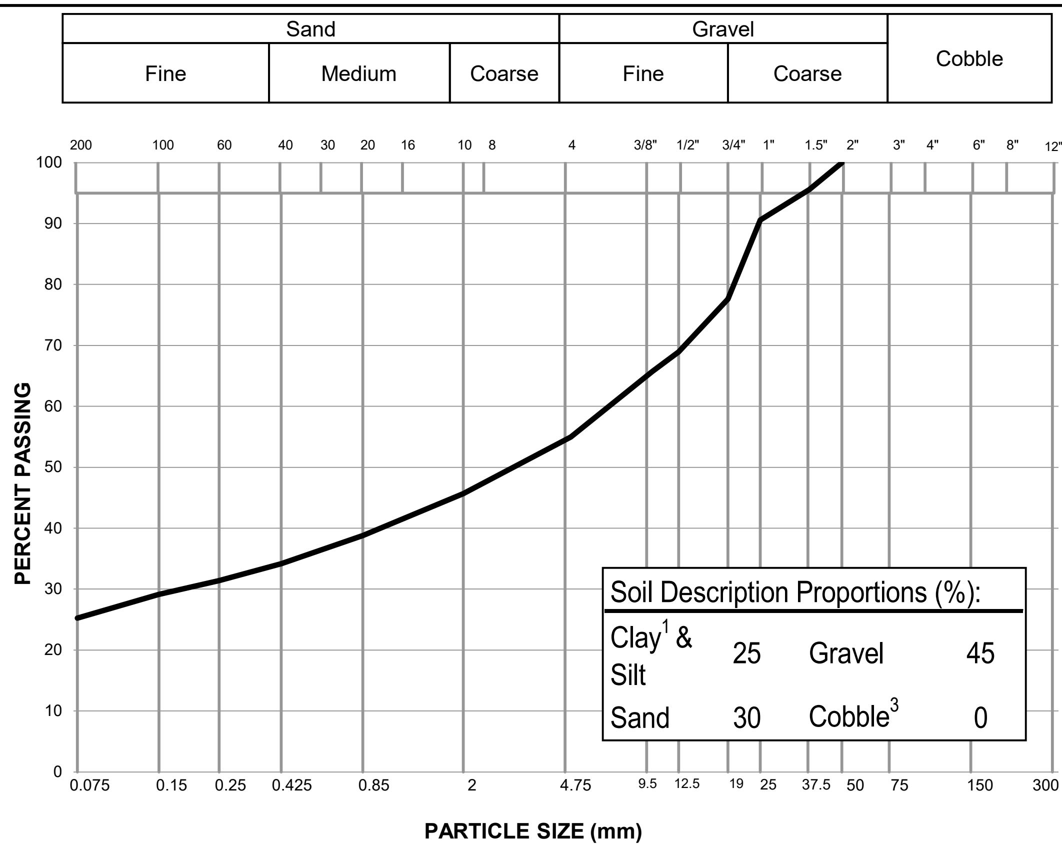
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D7928 & C136

Project:	AKHM DSTF Phase 2 Detailed Design	Sample No.:	SA92
Project No.:	ENG.WARC04307-01	Material Type:	Tailings
Site:	Alexco Keno Hill Mine	Sample Loc.:	BH22-06
Client:	Hecla	Sample Depth:	6.7 m
Client Rep.:	Peter Johnson	Sampling Method:	Grab
Date Tested:	November 18, 2022 By: BW	Date Sampled:	-
Soil Description[2]:	GRAVEL - sandy, silty	Sampled By:	JS
		USC Classification:	GM-ML Cu: #N/A
Moisture Content:	17.7%		Cc: #N/A

Particle Size (mm)	Percent Passing
300	
200	
150	
100	
75	
50	100
38	96
25	91
19	78
12.5	69
10	66
5	55
2	46
0.85	39
0.425	34
0.25	31
0.15	29
0.075	25.3



Soil Description Proportions (%):

Clay[1] & Silt	25	Gravel	45
Sand	30	Cobble[3]	0

Notes: [1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual
[2] The description is visually based & subject to Tt WM4400 description protocols
[3] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification:

Remarks:

Reviewed By: ________________ P.Eng.

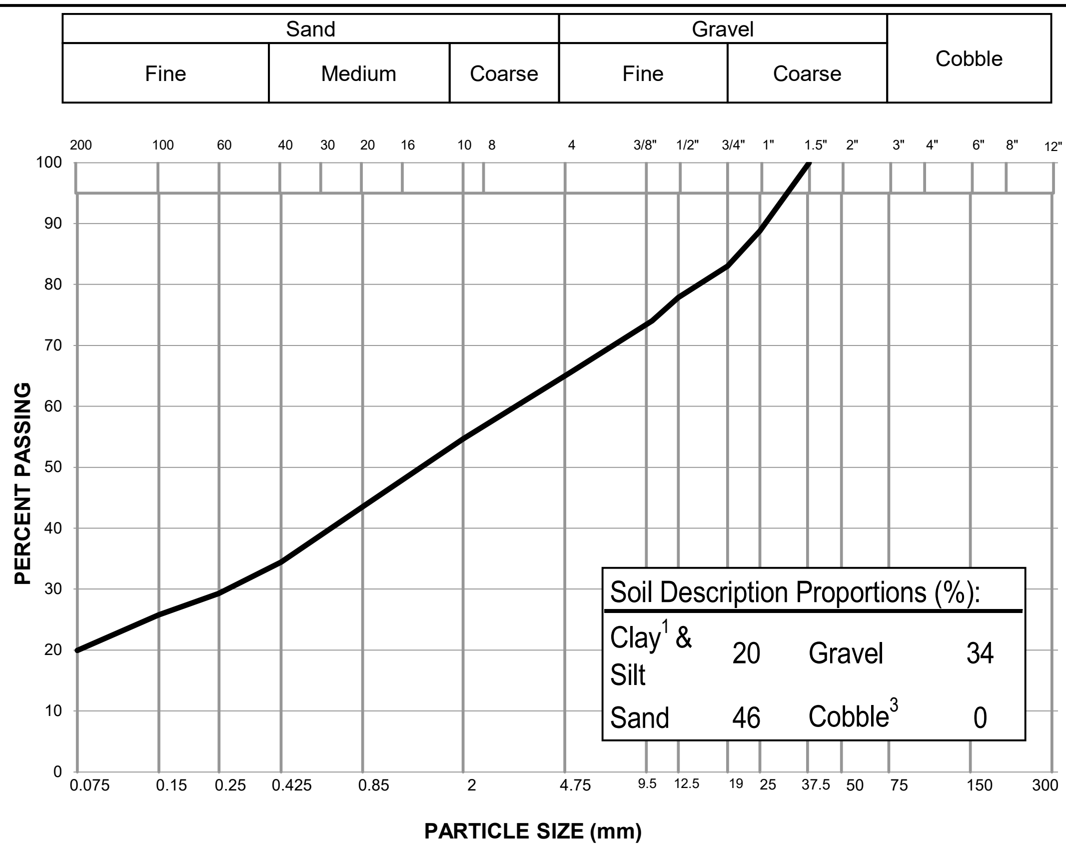
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D7928 & C136

Project:	AKHM DSTF Phase 2 Detailed Design	Sample No.:	SA99
Project No.:	ENG.WARC04307-01	Material Type:	Tailings
Site:	Alexco Keno Hill Mine	Sample Loc.:	BH22-06
Client:	Hecla	Sample Depth:	17.4 m
Client Rep.:	Peter Johnson	Sampling Method:	Grab
Date Tested:	November 17, 2022 By: BW	Date Sampled:	-
Soil Description[2]:	SAND - gravelly, some silt	Sampled By:	JS
		USC Classification:	SP-SM Cu: #N/A
Moisture Content:	8.6%		Cc: #N/A

Particle Size (mm)	Percent Passing
300	
200	
150	
100	
75	
50	
38	100
25	89
19	83
12.5	78
10	74
5	66
2	55
0.85	44
0.425	34
0.25	29
0.15	26
0.075	20.0



Soil Description Proportions (%):

Clay[1] & Silt	20	Gravel	34
Sand	46	Cobble[3]	0

Notes: [1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual
[2] The description is visually based & subject to Tt WM4400 description protocols
[3] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification:

Remarks:

Reviewed By: ____________ P.Eng.

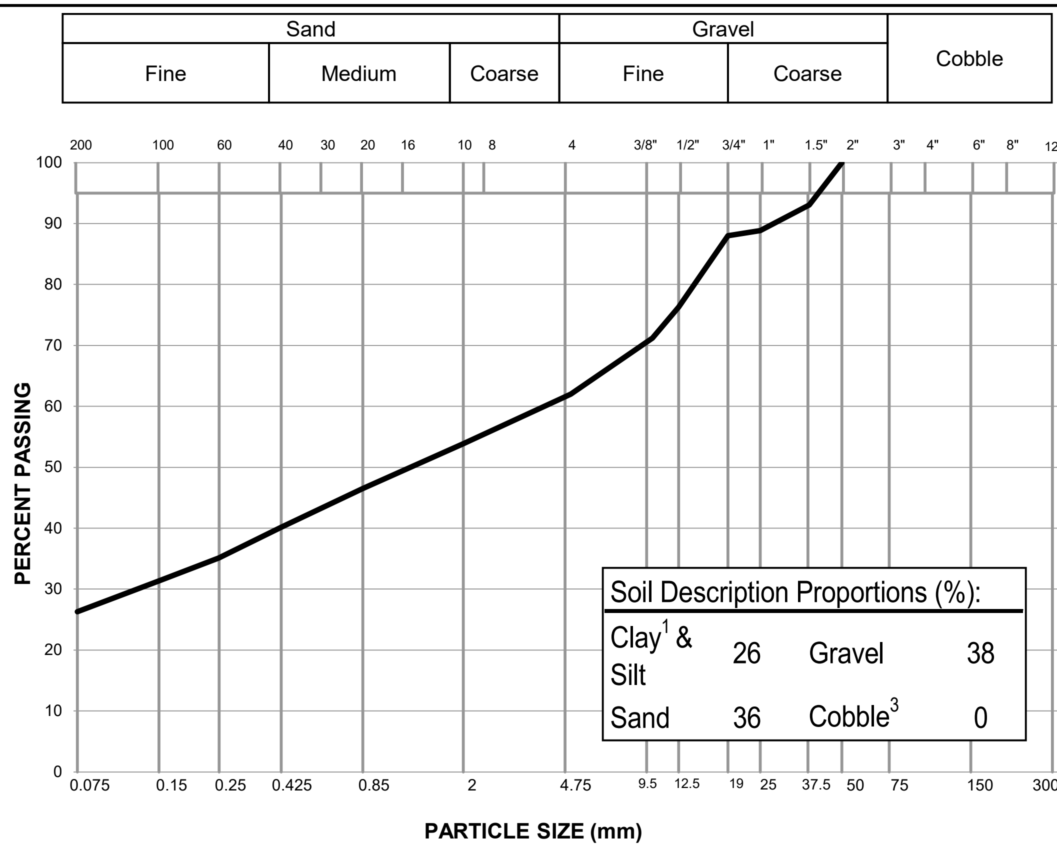
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D7928 & C136

Project:	AKHM DSTF Phase 2 Detailed Design	Sample No.:	SA109
Project No.:	ENG.WARC04307-01	Material Type:	Tailings
Site:	Alexco Keno Hill Mine	Sample Loc.:	BH22-07
Client:	Hecla	Sample Depth:	5.2 m
Client Rep.:	Peter Johnson	Sampling Method:	Grab
Date Tested:	November 21, 2022 By: BW	Date Sampled:	-
Soil Description[2]:	GRAVEL and SAND - silty	Sampled By:	JS
		USC Classification:	GM-ML Cu: #N/A
Moisture Content:	24.6%		Cc: #N/A

Particle Size (mm)	Percent Passing
300	
200	
150	
100	
75	
50	100
38	93
25	89
19	88
12.5	76
10	71
5	62
2	54
0.85	47
0.425	40
0.25	35
0.15	31
0.075	26.3



Soil Description Proportions (%):

Clay[1] & Silt	26	Gravel	38
Sand	36	Cobble[3]	0

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

[2] The description is visually based & subject to Tt WM4400 description protocols

[3] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification:

Remarks:

Reviewed By: [signature] P.Eng.

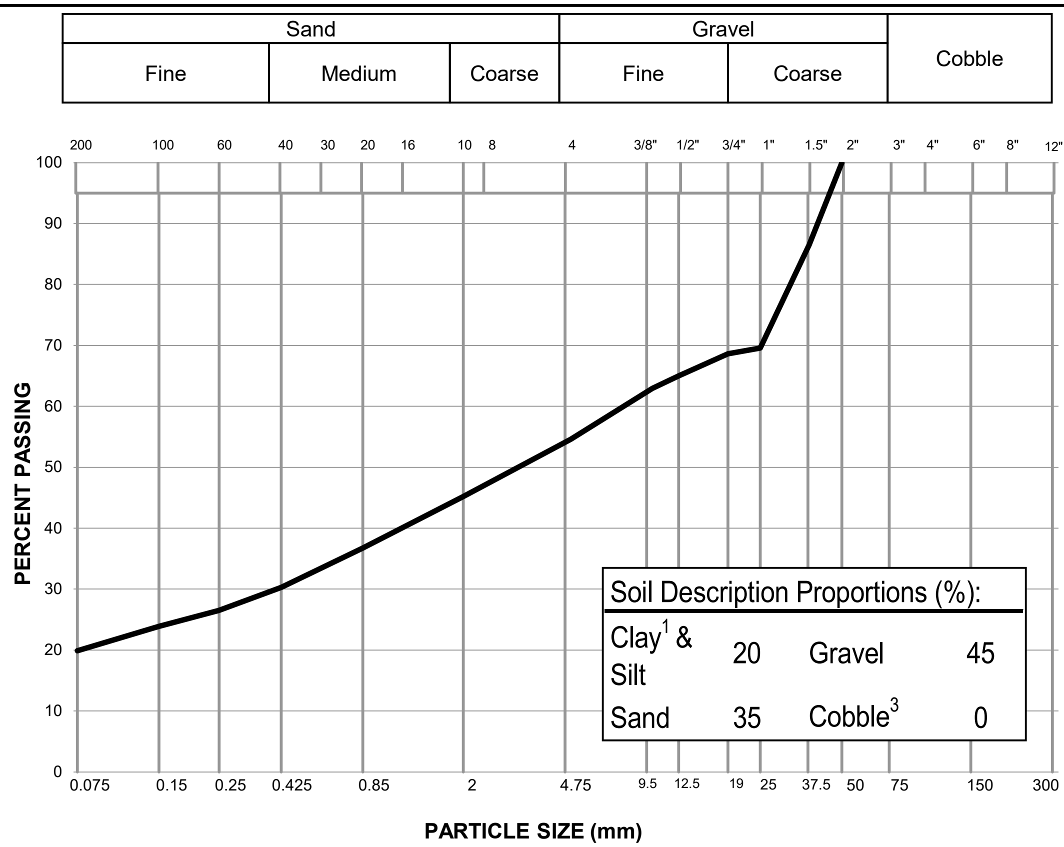
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D7928 & C136

Project:	AKHM DSTF Phase 2 Detailed Design	Sample No.:	SA113
Project No.:	ENG.WARC04307-01	Material Type:	Tailings
Site:	Alexco Keno Hill Mine	Sample Loc.:	BH22-07
Client:	Hecla	Sample Depth:	11.6 m
Client Rep.:	Peter Johnson	Sampling Method:	Grab
Date Tested:	November 21, 2022 By: BW	Date Sampled:	-
Soil Description[2]:	GRAVEL - sandy, some silt	Sampled By:	JS
		USC Classification:	GP-GM Cu: #N/A
Moisture Content:	9.2%		Cc: #N/A

Particle Size (mm)	Percent Passing
300	
200	
150	
100	
75	
50	100
38	86
25	70
19	69
12.5	65
10	63
5	55
2	45
0.85	37
0.425	30
0.25	26
0.15	24
0.075	19.9



Soil Description Proportions (%):			
Clay[1] & Silt	20	Gravel	45
Sand	35	Cobble[3]	0

Notes: [1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual
[2] The description is visually based & subject to Tt WM4400 description protocols
[3] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification:

Remarks:

Reviewed By: P.Eng.

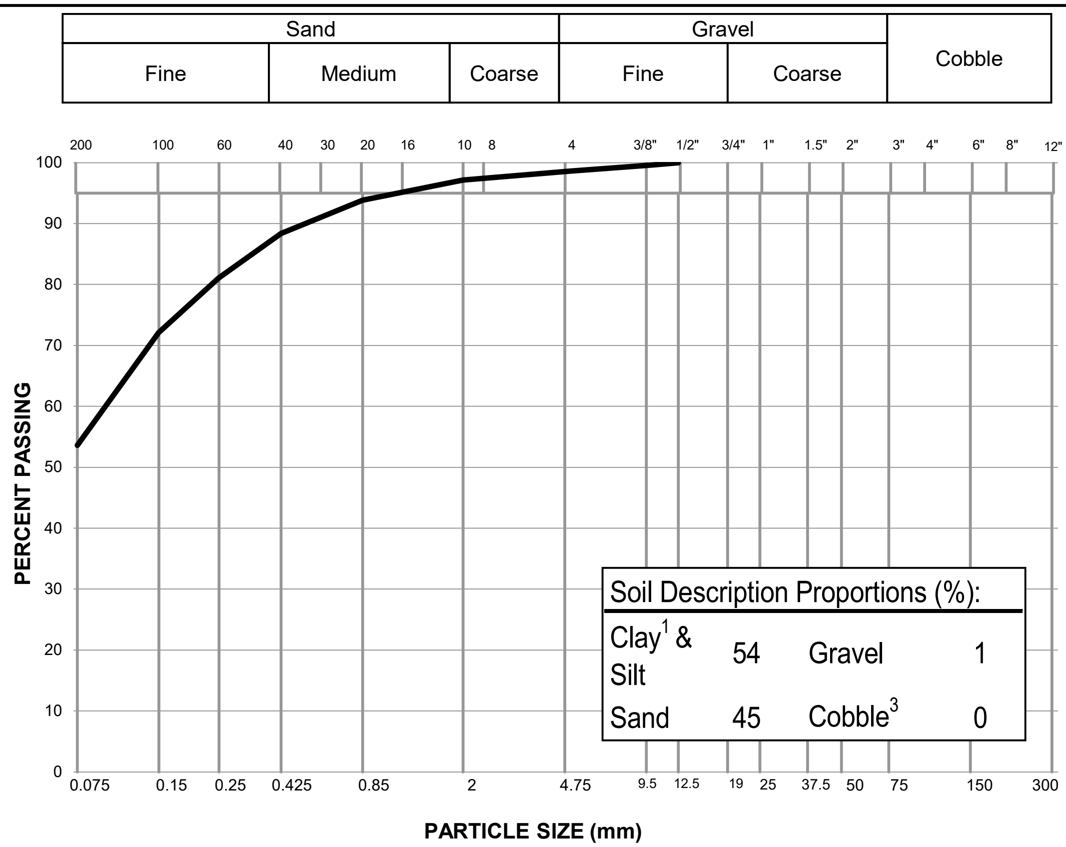
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D7928 & C136

Project:	AKHM DSTF Phase 2 Detailed Design	Sample No.:	SA127
Project No.:	ENG.WARC04307-01	Material Type:	Tailings
Site:	Alexco Keno Hill Mine	Sample Loc.:	BH22-08
Client:	Hecla	Sample Depth:	3.7 m
Client Rep.:	Peter Johnson	Sampling Method:	Grab
Date Tested:	November 17, 2022 By: BW	Date Sampled:	-
Soil Description[2]:	SILT and SAND - trace gravel	Sampled By:	JS
		USC Classification:	ML Cu: #N/A
Moisture Content:	22.1%		Cc: #N/A

Particle Size (mm)	Percent Passing
300	
200	
150	
100	
75	
50	
38	
25	
19	
12.5	100
10	100
5	99
2	97
0.85	94
0.425	88
0.25	81
0.15	72
0.075	53.6



Soil Description Proportions (%):

Clay[1] & Silt	54	Gravel	1
Sand	45	Cobble[3]	0

Notes: [1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual
[2] The description is visually based & subject to Tt WM4400 description protocols
[3] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification:

Remarks:

Reviewed By: ____________ P.Eng.

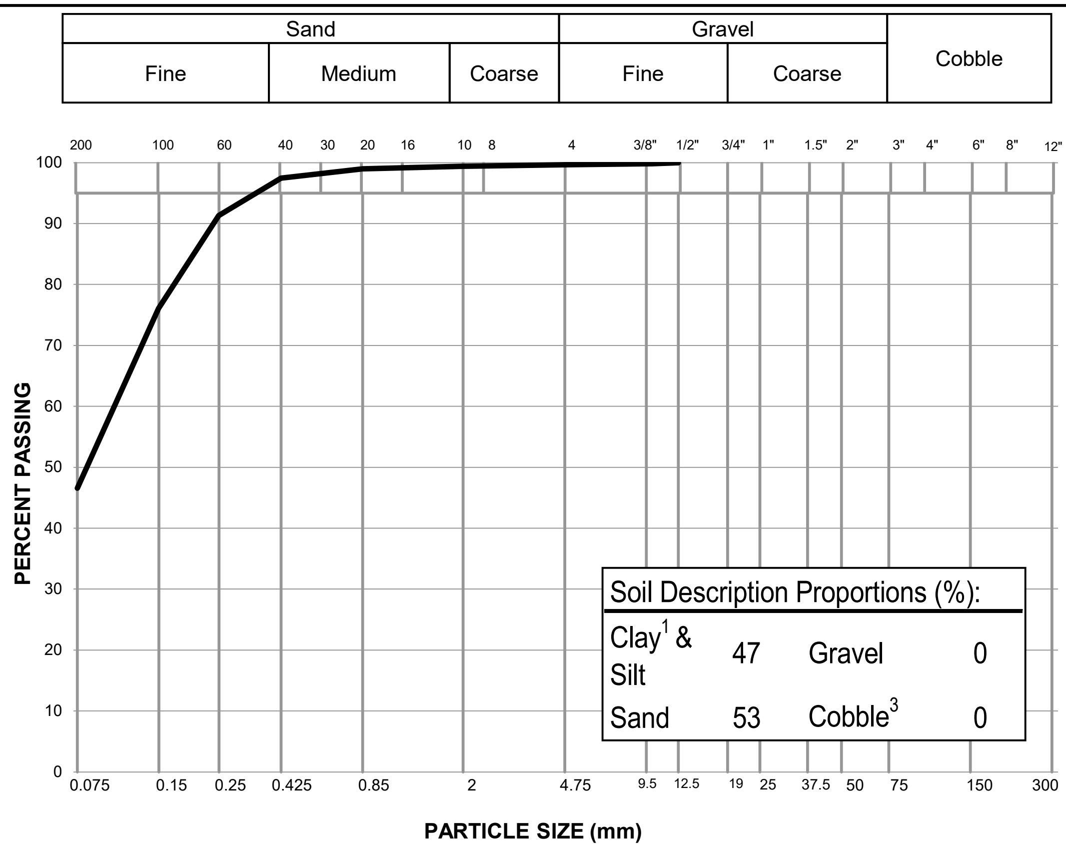
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D7928 & C136

Project:	AKHM DSTF Phase 2 Detailed Design	Sample No.:	SA137
Project No.:	ENG.WARC04307-01	Material Type:	Tailings
Site:	Alexco Keno Hill Mine	Sample Loc.:	BH22-08
Client:	Hecla	Sample Depth:	18.9 m
Client Rep.:	Peter Johnson	Sampling Method:	Grab
Date Tested:	November 18, 2022 By: BW	Date Sampled:	-
Soil Description[2]:	SAND and SILT	Sampled By:	JS
		USC Classification:	SM-ML Cu: #N/A
Moisture Content:	23.5%		Cc: #N/A

Particle Size (mm)	Percent Passing
300	
200	
150	
100	
75	
50	
38	
25	
19	
12.5	100
10	100
5	100
2	99
0.85	99
0.425	97
0.25	91
0.15	76
0.075	46.6



Soil Description Proportions (%):

Clay[1] & Silt	47	Gravel	0
Sand	53	Cobble[3]	0

Notes: [1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual
[2] The description is visually based & subject to Tt WM4400 description protocols
[3] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification:

Remarks:

Reviewed By: ______________ P.Eng.

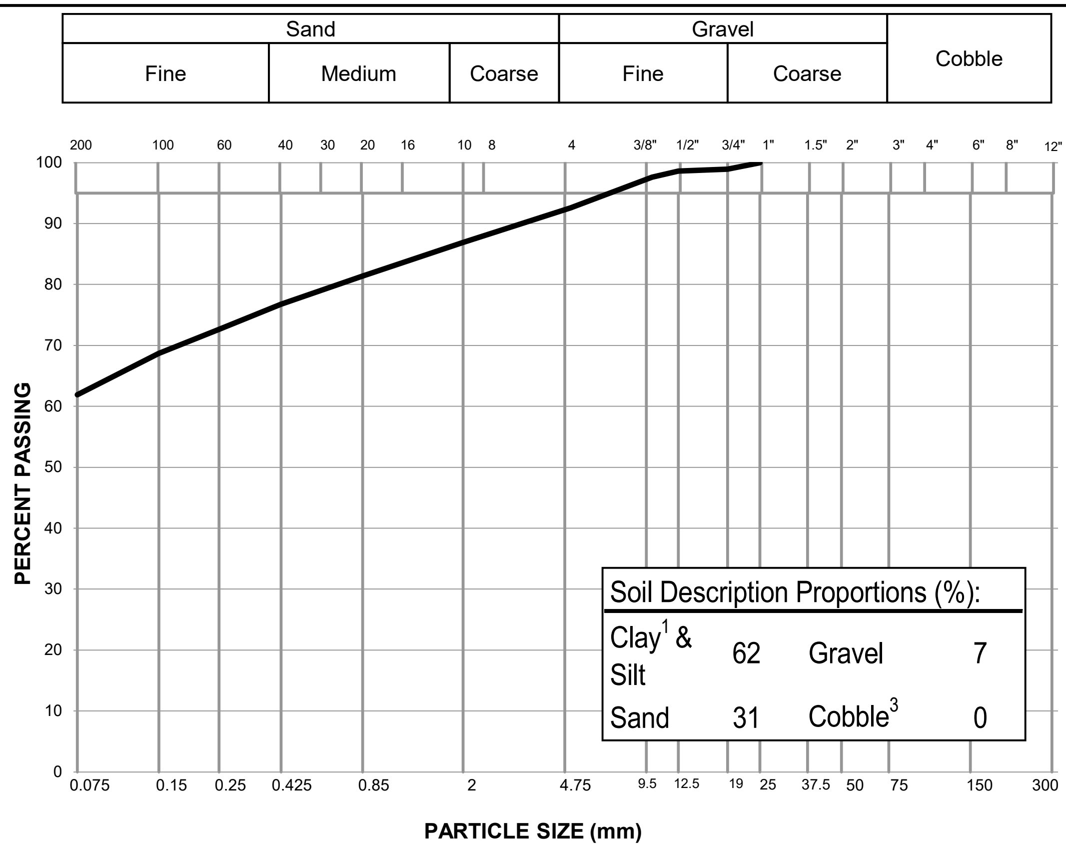
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D7928 & C136

Project:	AKHM DSTF Phase 2 Detailed Design	Sample No.:	SA147
Project No.:	ENG.WARC04307-01	Material Type:	Tailings
Site:	Alexco Keno Hill Mine	Sample Loc.:	BH22-09
Client:	Hecla	Sample Depth:	3.7 m
Client Rep.:	Peter Johnson	Sampling Method:	Grab
Date Tested:	November 17, 2022 By: BW	Date Sampled:	-
Soil Description[2]:	SILT - sandy, trace gravel	Sampled By:	JS
		USC Classification:	ML Cu: #N/A
Moisture Content:	14.9%		Cc: #N/A

Particle Size (mm)	Percent Passing
300	
200	
150	
100	
75	
50	
38	
25	100
19	99
12.5	99
10	98
5	93
2	87
0.85	81
0.425	77
0.25	73
0.15	69
0.075	61.9



Soil Description Proportions (%):			
Clay[1] & Silt	62	Gravel	7
Sand	31	Cobble[3]	0

Notes: [1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual
[2] The description is visually based & subject to Tt WM4400 description protocols
[3] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification:

Remarks:

Reviewed By: P.Eng.

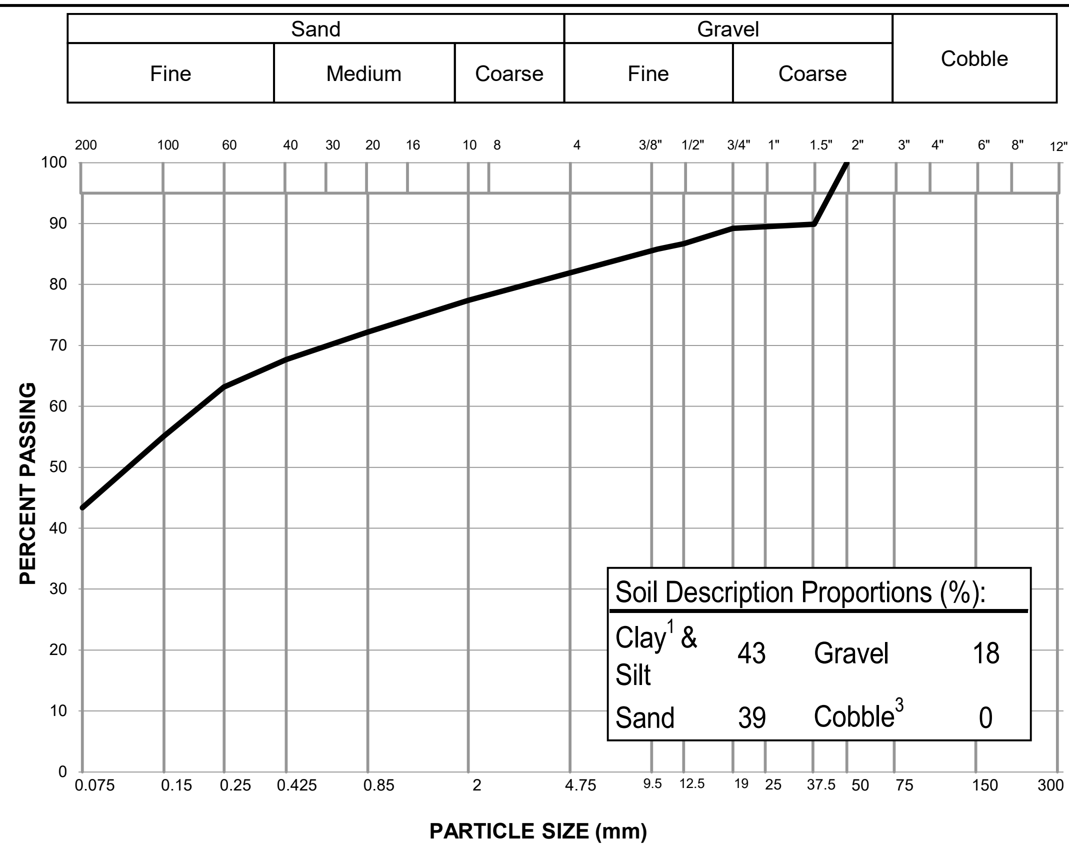
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D7928 & C136

Project:	AKHM DSTF Phase 2 Detailed Design	Sample No.:	SA155
Project No.:	ENG.WARC04307-01	Material Type:	Tailings
Site:	Alexco Keno Hill Mine	Sample Loc.:	BH22-09
Client:	Hecla	Sample Depth:	16.2 m
Client Rep.:	Peter Johnson	Sampling Method:	Grab
Date Tested:	November 17, 2022 By: BW	Date Sampled:	-
Soil Description[2]:	SILT and SAND - some gravel	Sampled By:	JS
		USC Classification:	ML Cu: #N/A
Moisture Content:	9.0%		Cc: #N/A

Particle Size (mm)	Percent Passing
300	
200	
150	
100	
75	
50	100
38	90
25	
19	89
12.5	87
10	86
5	82
2	77
0.85	72
0.425	68
0.25	63
0.15	55
0.075	43.4



Soil Description Proportions (%):			
Clay[1] & Silt	43	Gravel	18
Sand	39	Cobble[3]	0

Notes: [1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual
[2] The description is visually based & subject to Tt WM4400 description protocols
[3] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification: __________

Remarks: __________

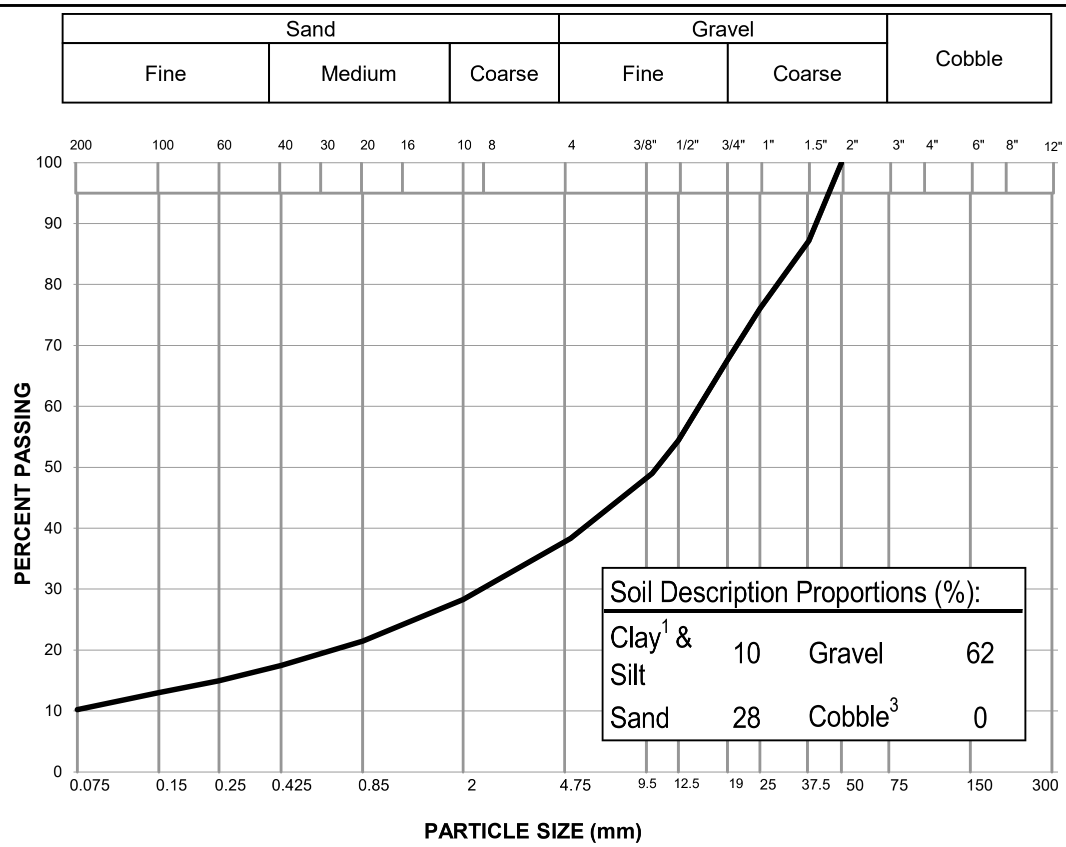
Reviewed By: __________ P.Eng.

PARTICLE SIZE ANALYSIS REPORT

ASTM D7928 & C136

Project:	AKHM DSTF Phase 2 Detailed Design	Sample No.:	SA163
Project No.:	ENG.WARC04307-01	Material Type:	Tailings
Site:	Alexco Keno Hill Mine	Sample Loc.:	BH22-09
Client:	Hecla	Sample Depth:	2.1 m
Client Rep.:	Peter Johnson	Sampling Method:	Grab
Date Tested:	November 18, 2022 By: BW	Date Sampled:	-
Soil Description[2]:	GRAVEL - sandy, trace silt	Sampled By:	JS
		USC Classification:	GP Cu: #N/A
Moisture Content:	5.8%		Cc: #N/A

Particle Size (mm)	Percent Passing
300	
200	
150	
100	
75	
50	100
38	87
25	76
19	68
12.5	54
10	49
5	38
2	28
0.85	21
0.425	17
0.25	15
0.15	13
0.075	10.3



Soil Description Proportions (%):			
Clay[1] & Silt	10	Gravel	62
Sand	28	Cobble[3]	0

Notes:
[1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual
[2] The description is visually based & subject to Tt WM4400 description protocols
[3] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification:

Remarks:

Reviewed By: ______________ P.Eng.

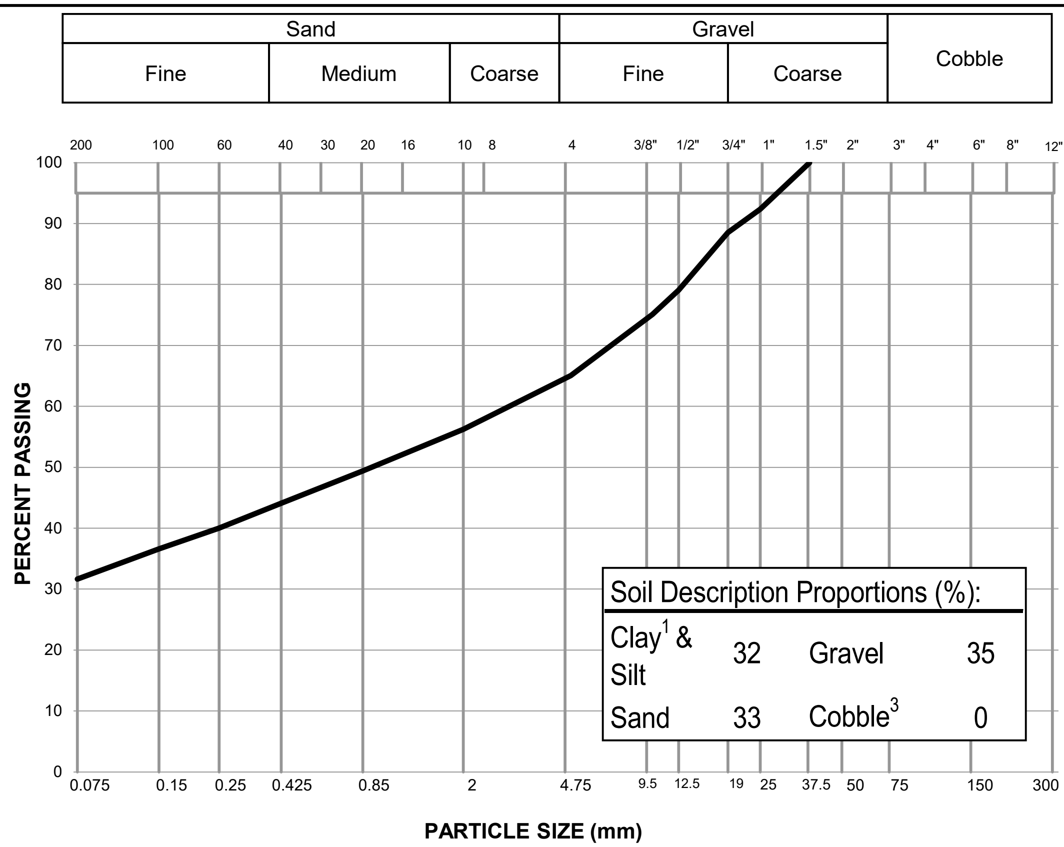
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D7928 & C136

Project:	AKHM DSTF Phase 2 Detailed Design	Sample No.:	SA168
Project No.:	ENG.WARC04307-01	Material Type:	Tailings
Site:	Alexco Keno Hill Mine	Sample Loc.:	BH22-10
Client:	Hecla	Sample Depth:	11.3 m
Client Rep.:	Peter Johnson	Sampling Method:	Grab
Date Tested:	November 17, 2022 By: BW	Date Sampled:	-
Soil Description[2]:	GRAVEL - sandy, silty	Sampled By:	JS
		USC Classification:	GM-ML Cu: #N/A
Moisture Content:	10.2%		Cc: #N/A

Particle Size (mm)	Percent Passing
300	
200	
150	
100	
75	
50	
38	100
25	92
19	88
12.5	79
10	75
5	65
2	56
0.85	49
0.425	44
0.25	40
0.15	37
0.075	31.7



Notes: [1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual
[2] The description is visually based & subject to Tt WM4400 description protocols
[3] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification: ______

Remarks: ______

Reviewed By: ______ P.Eng.

TETRA TECH

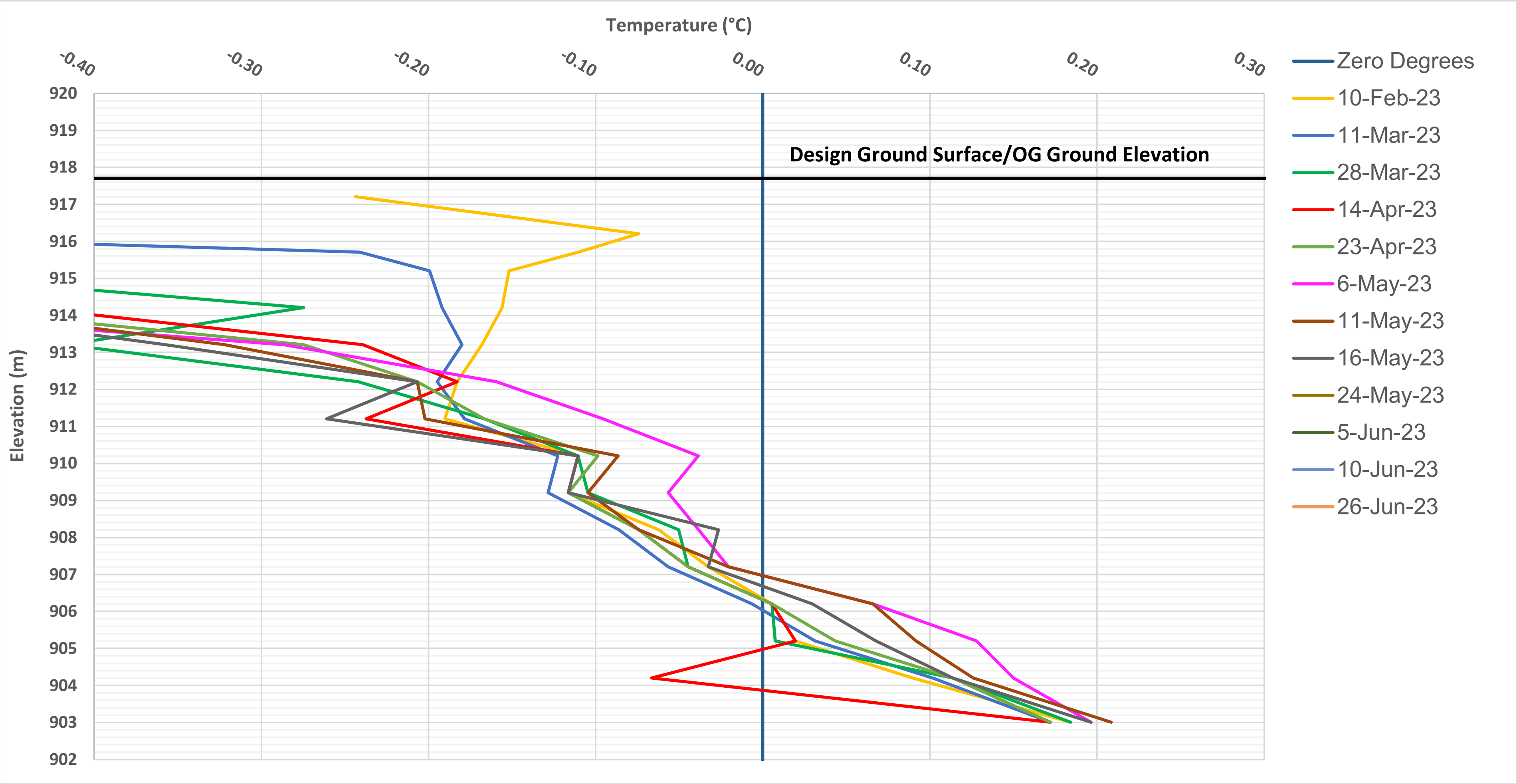
APPENDIX C

GROUND TEMPERATURE CABLE DATA

Ground Temperature Readings

Project: AKHM DSTF Phase II Detailed Design
Project No: 704-ENG.WARC04307-01
Client: Hecla

ISSUED FOR USE
2023 Ground Temperature Data



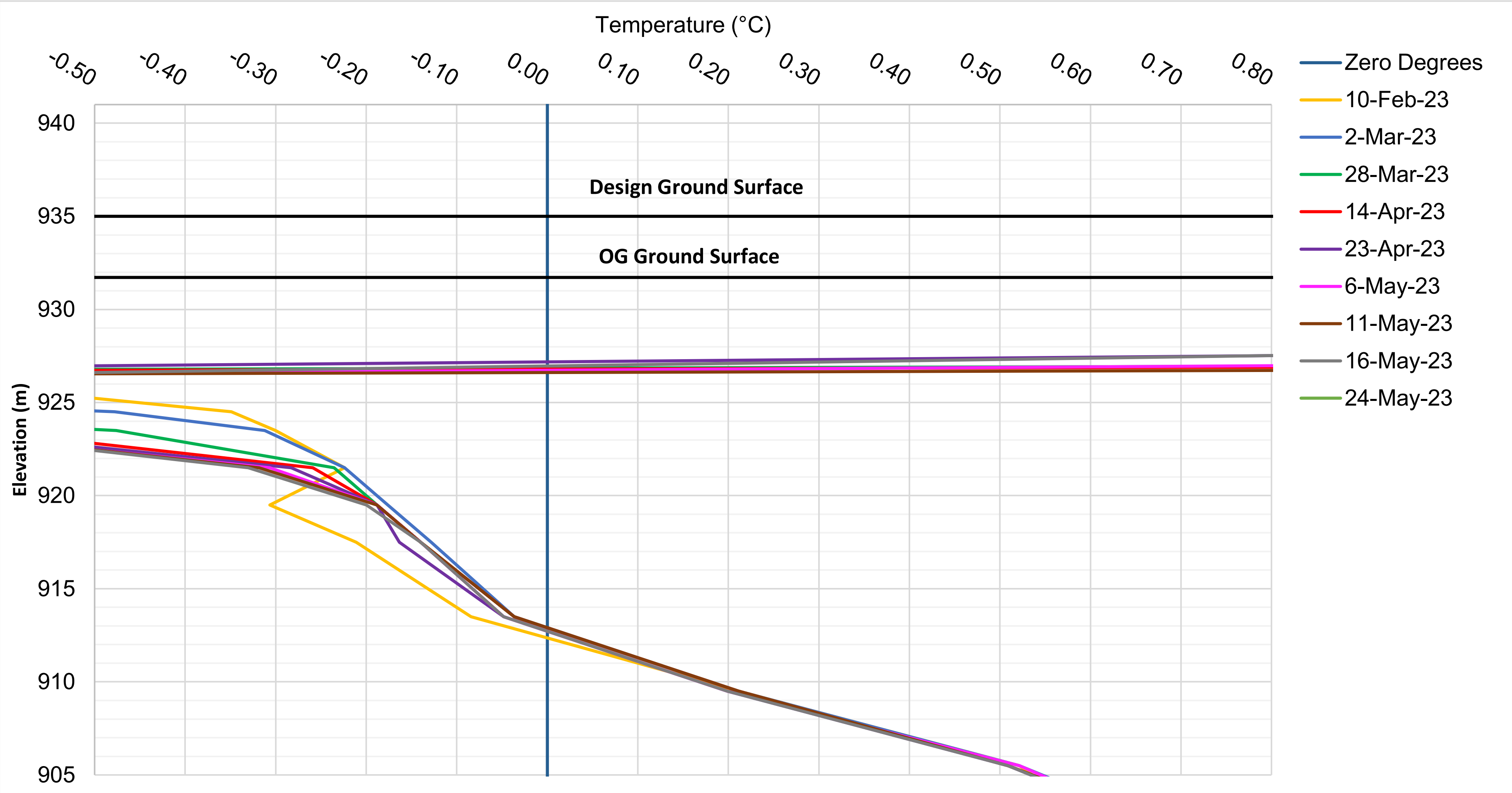
Instrument ID: **BH22-01**
Cable ID: **2819**

TETRA TECH

Ground Temperature Readings

Project: AKHM DSTF Phase II Detailed Design
Project No: 704-ENG.WARC04307-01
Client: Hecla

ISSUED FOR USE
2023 Ground Temperature Data



Instrument ID: **BH22-05**
Cable ID: **2820**

TETRA TECH

Ground Temperature Readings

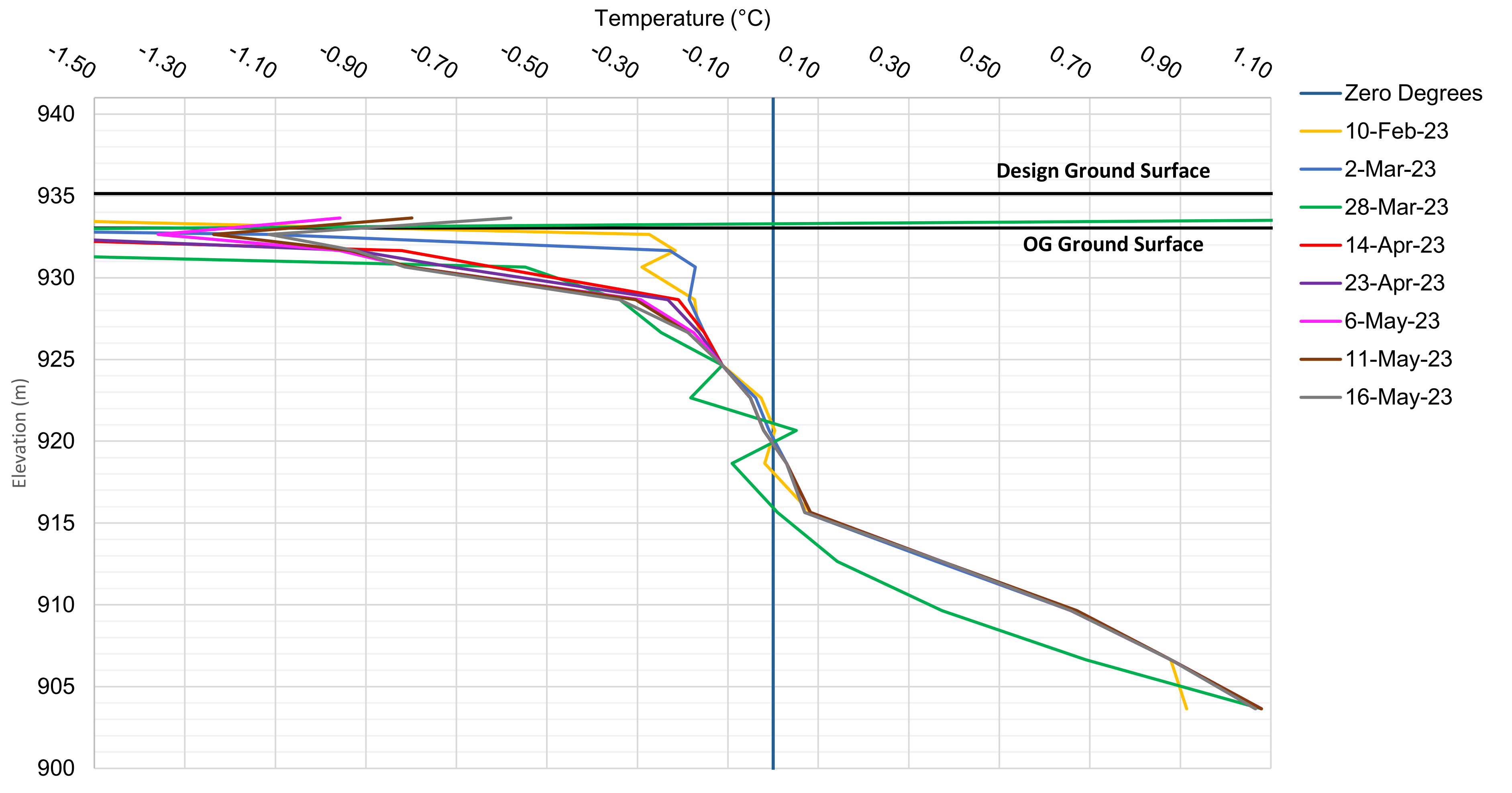
Project: AKHM DSTF Phase II Detailed Design

Project No: 704-ENG.WARC04307-01

Client: Hecla

ISSUED FOR USE

2023 Ground Temperature Data



Instrument ID: **BH22-06**

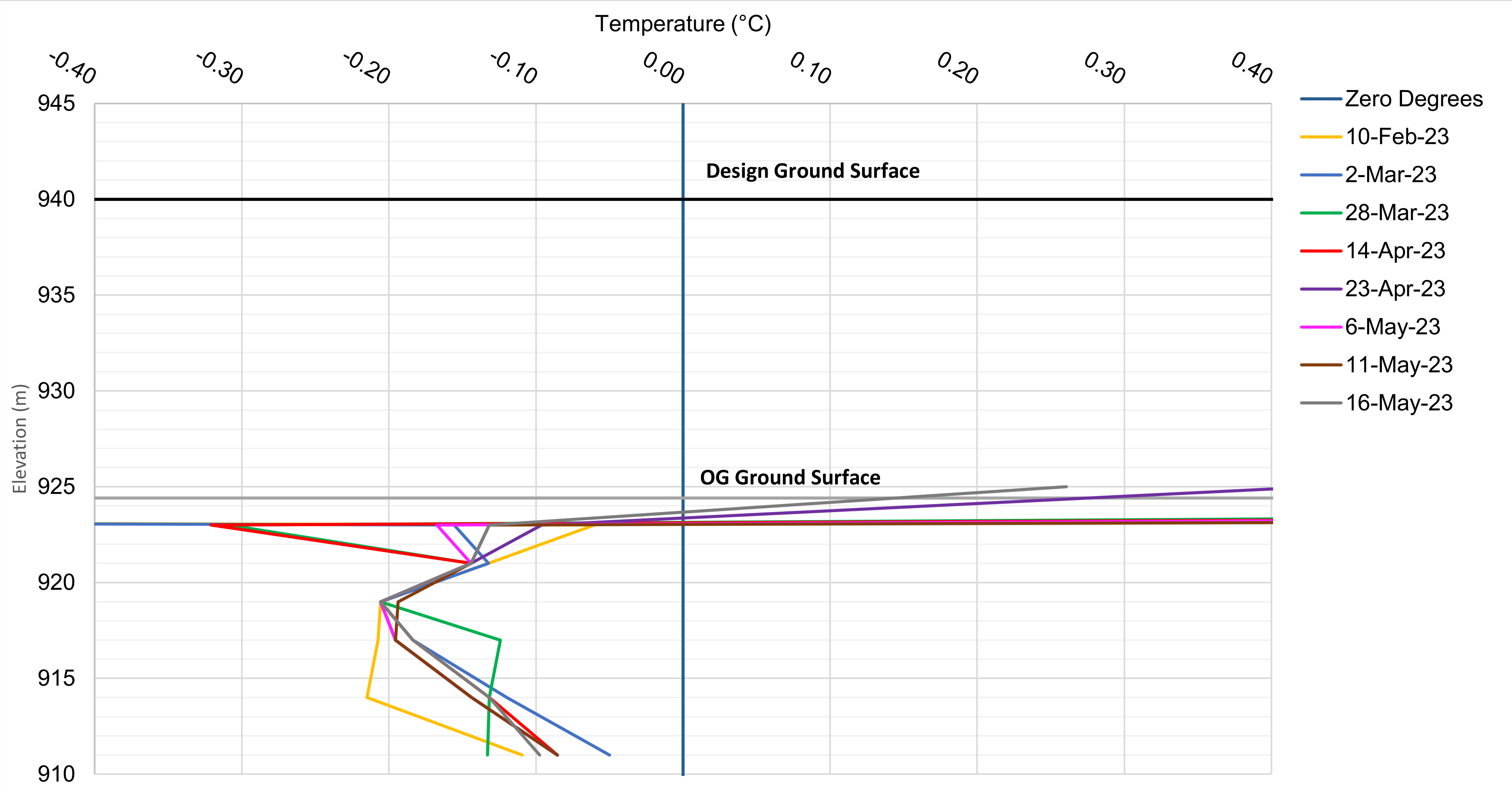
Cable ID: **2821**

TETRA TECH

Ground Temperature Readings

Project: AKHM DSTF Phase II Detailed Design
Project No: 704-ENG.WARC04307-01
Client: Hecla

ISSUED FOR USE
2023 Ground Temperature Data



Instrument ID: **BH22-07**
Cable ID: **2822**

TETRA TECH

Ground Temperature Readings

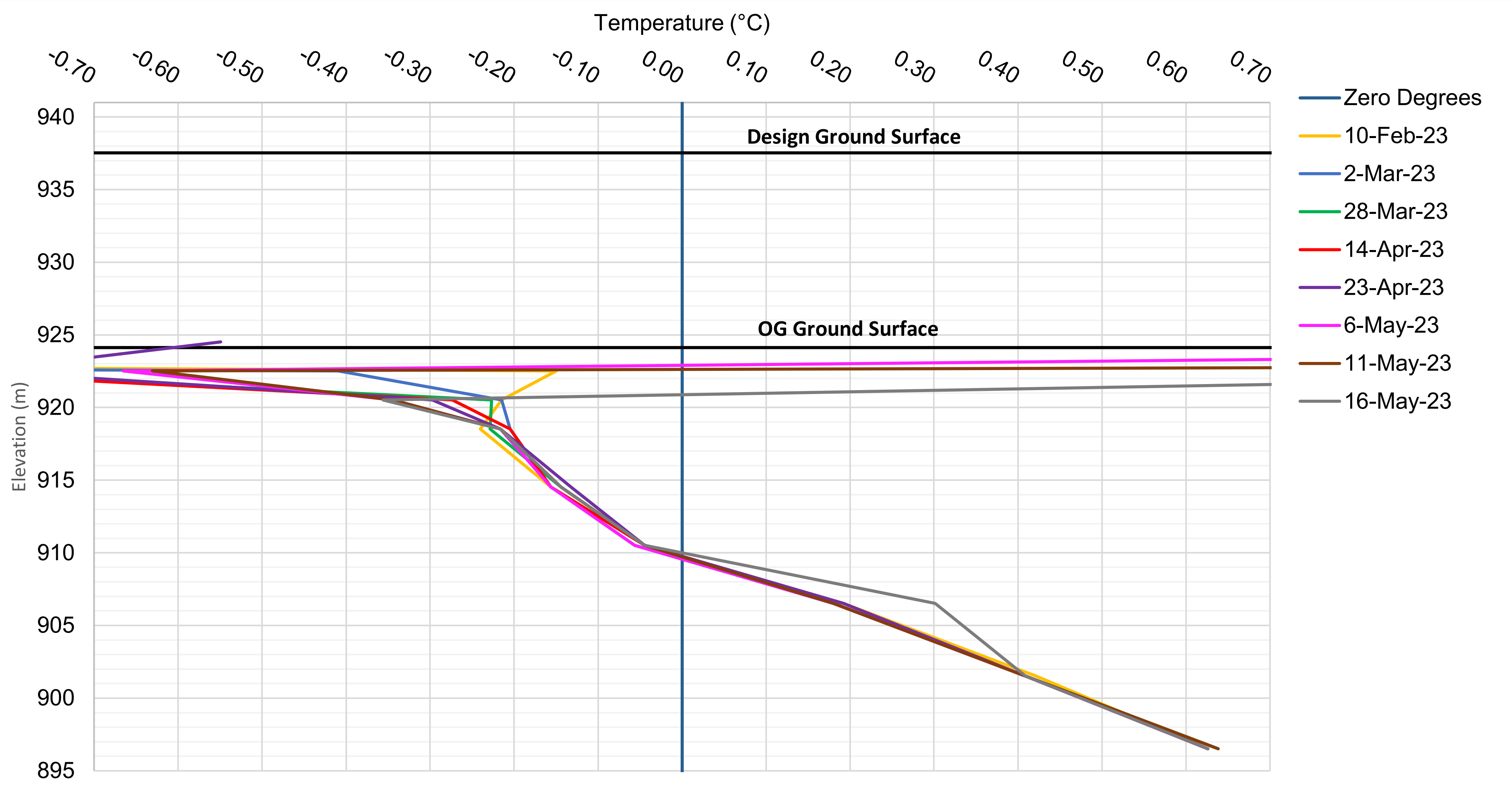
Project: AKHM DSTF Phase II Detailed Design

Project No: 704-ENG.WARC04307-01

Client: Hecla

ISSUED FOR USE

2023 Ground Temperature Data



Instrument ID: BH22-09

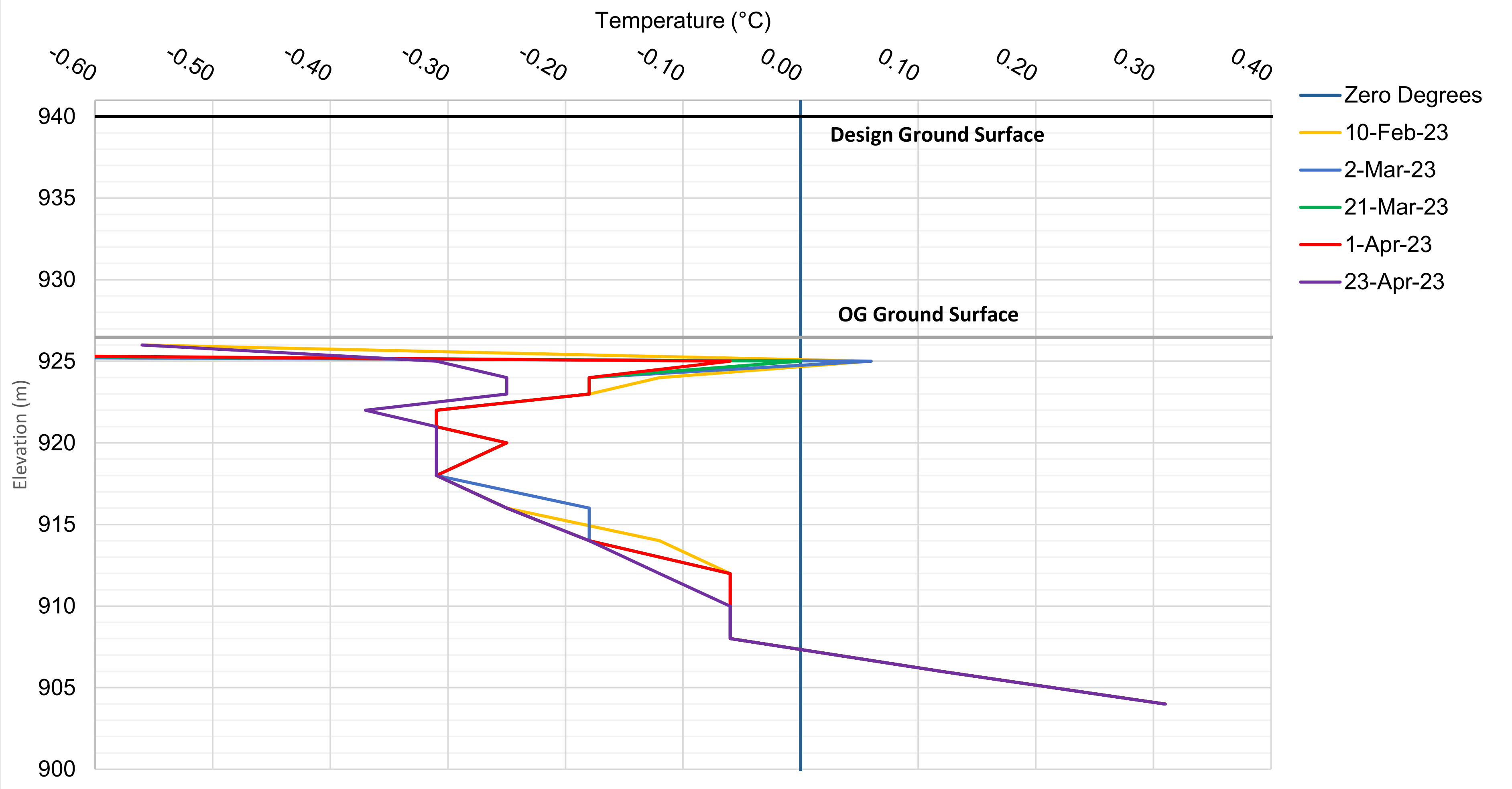
Cable ID: 2823

TETRA TECH

Ground Temperature Readings

Project: AKHM DSTF Phase II Detailed Design
Project No: 704-ENG.WARC04307-01
Client: Hecla

ISSUED FOR USE
2023 Ground Temperature Data



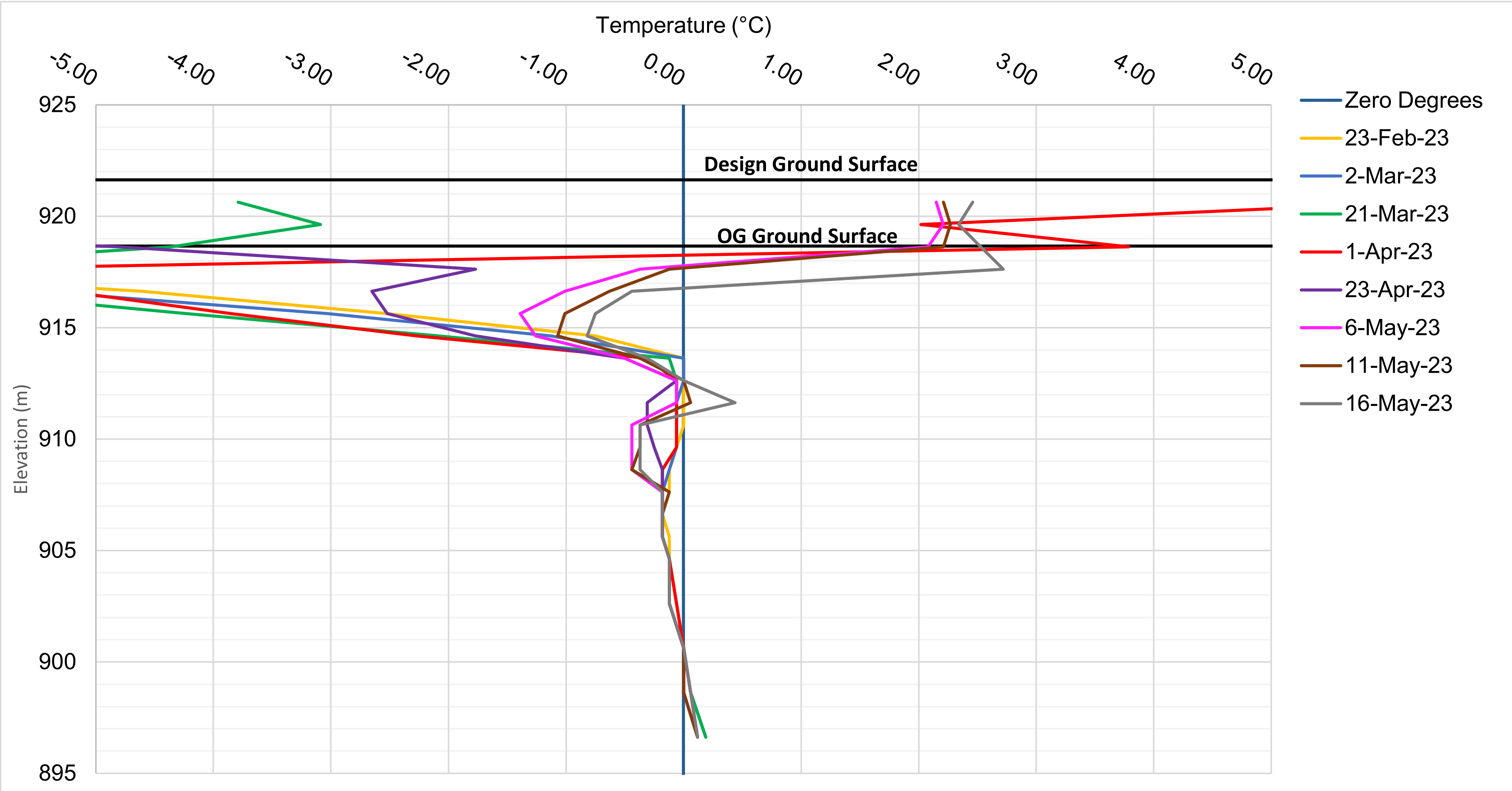
Instrument ID: **BH22-08**
Cable ID: **4473**
Logger ID: **D6050215**

TETRA TECH

Ground Temperature Readings

Project: AKHM DSTF Phase II Detailed Design
Project No: 704-ENG.WARC04307-01
Client: Hecla

ISSUED FOR USE
2023 Ground Temperature Data



Instrument ID: **BH22-10**
Cable ID: **4474**
Logger ID: **D6050221**

TETRA TECH

Ground Temperature Readings

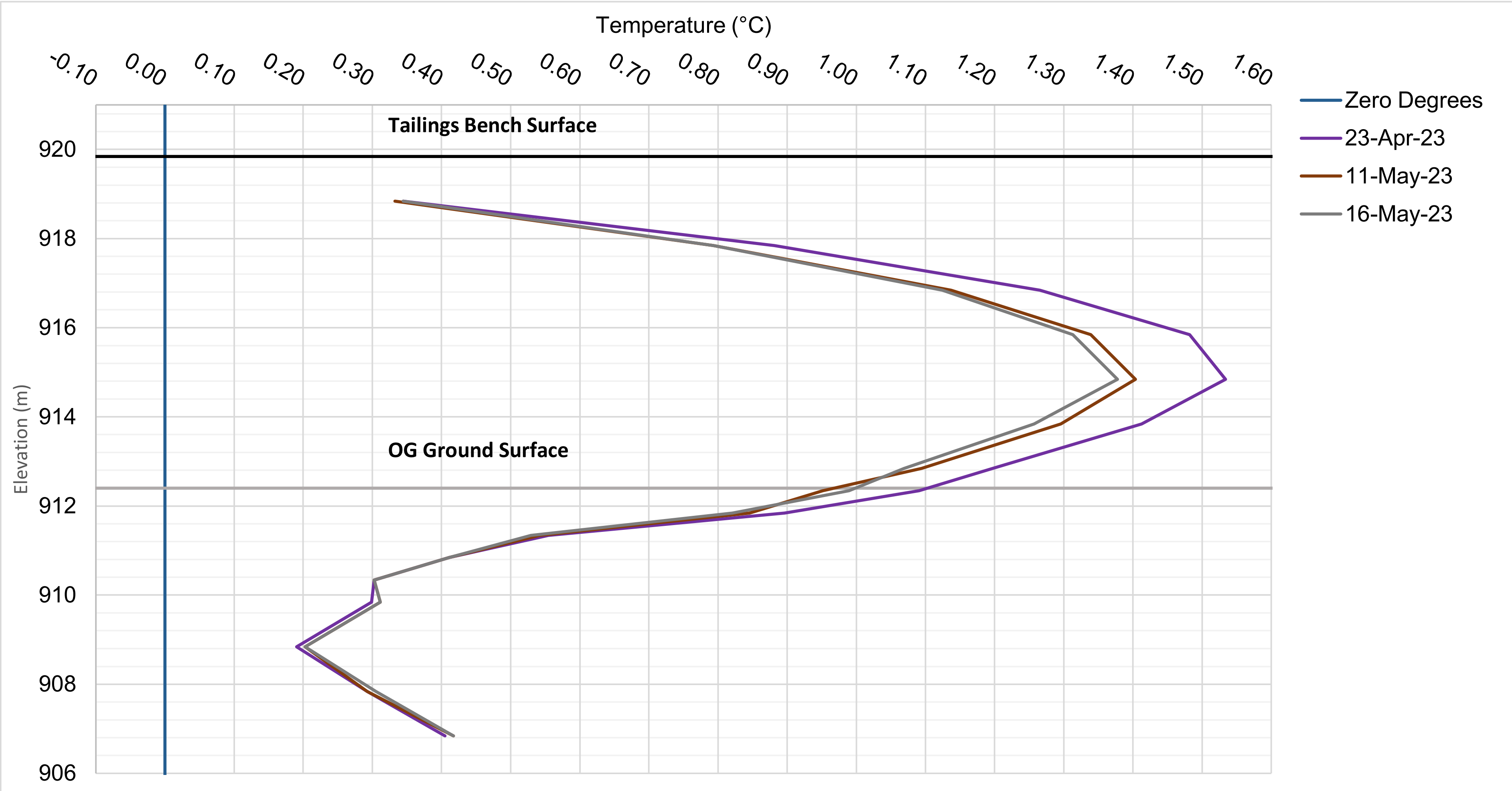
Project: AKHM DSTF Phase II Detailed Design

Project No: 704-ENG.WARC04307-01

Client: Hecla

ISSUED FOR USE

2023 Ground Temperature Data



Instrument ID: **BH22-40B**

Cable ID: **2824**

TETRA TECH

APPENDIX D

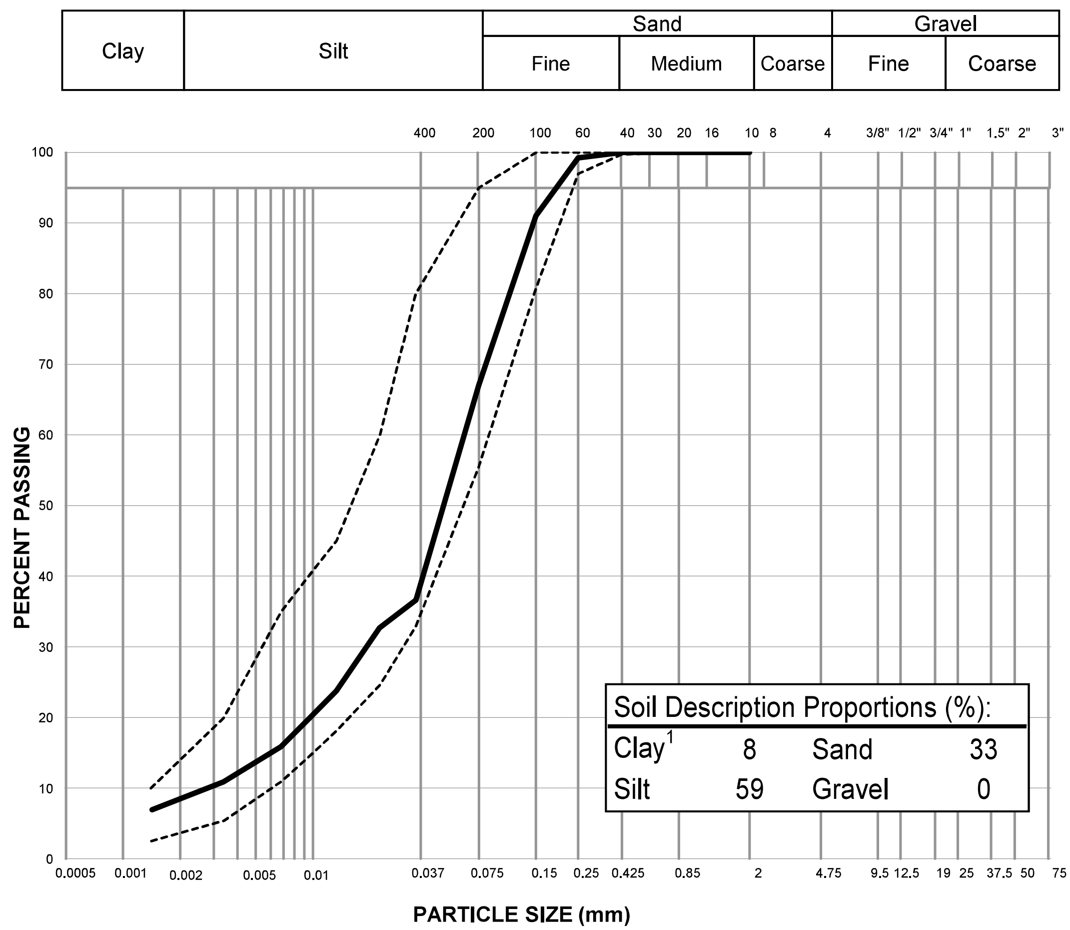
TAILINGS AND INTERFACE DIRECT SHEAR LABORATORY TEST DATA

PARTICLE SIZE ANALYSIS REPORT

ASTM D7928 & C136

Project:	Keno Hill Tailings	Sample No.:	SA01
Project No.:	ENG.WARC04415-07	Material Type:	Tailings
Site:	Keno Hill	Sample Loc.:	-
Client:	NELPCo	Sample Depth:	-
Client Rep.:	-	Sampling Method:	Grab
Date Tested:	February 1, 2024 By: BW	Date Sampled:	December 1, 2023
Soil Description[2]:	SILT - sandy, trace clay	Sampled By:	Client
		USC Classification:	ML Cu: 22.4
Moisture Content:	18.8%		Cc: 2.0

Particle Size (mm)	Percent Passing
75	
50	
38	
25	
19	
12.5	
10	
5	
2	100
0.85	100
0.425	100
0.25	99
0.15	91
0.075	67.0
0.0350	36.6
0.0224	32.7
0.0133	23.8
0.0095	19.8
0.0068	15.8
0.0034	10.9
0.0014	6.9



Soil Description Proportions (%):			
Clay[1]	8	Sand	33
Silt	59	Gravel	0

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

[2] The description is visually based & subject to Tetra Tech description protocols

Specification:

Remarks:

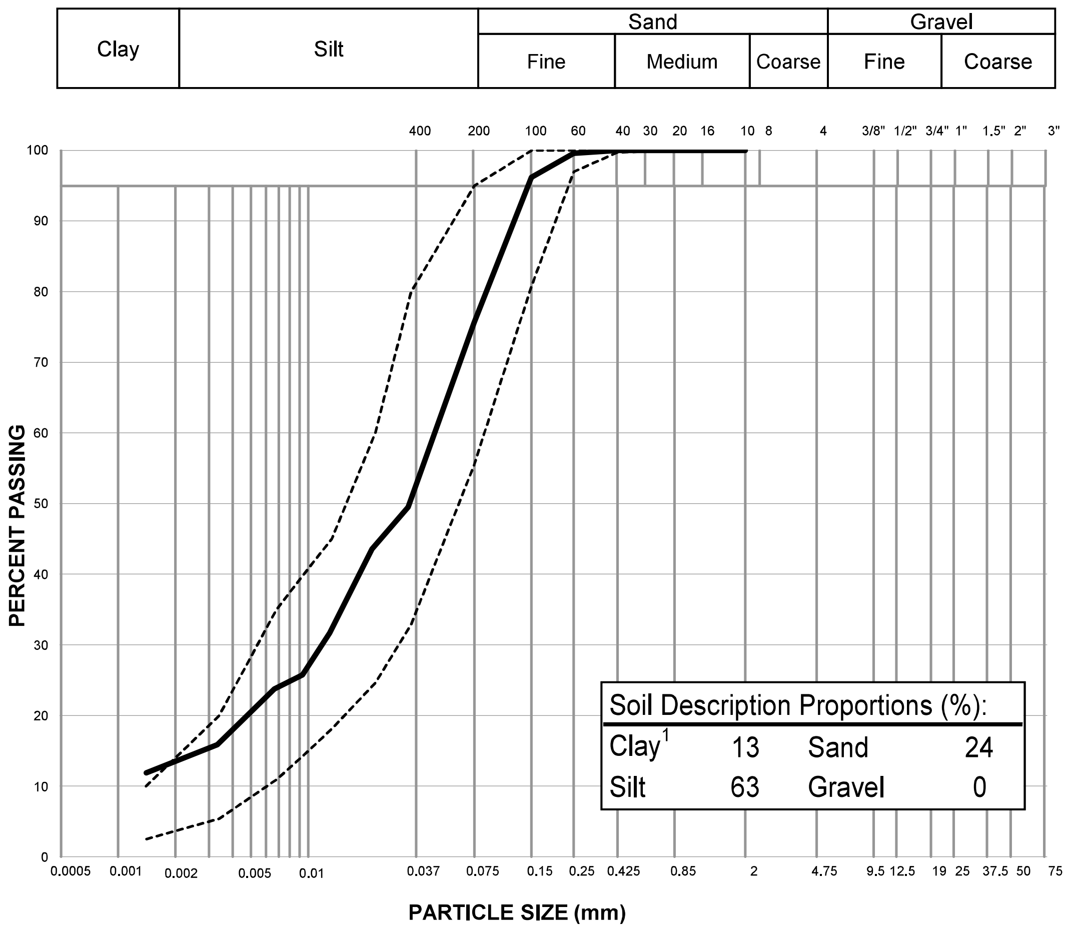
Reviewed By: ______________________ P.Eng.

PARTICLE SIZE ANALYSIS REPORT

ASTM D7928 & C136

Project:	Keno Hill Tailings	Sample No.:	SA02
Project No.:	ENG.WARC04415-07	Material Type:	Tailings
Site:	Keno Hill	Sample Loc.:	"Final Tailings"
Client:	NELPCo	Sample Depth:	-
Client Rep.:	-	Sampling Method:	Grab
Date Tested:	February 1, 2024 By: BW	Date Sampled:	January 1, 2024
Soil Description[2]:	SILT - sandy, trace clay	Sampled By:	Client
		USC Classification:	ML Cu: #N/A
Moisture Content:	19.9%		Cc: #N/A

Particle Size (mm)	Percent Passing
75	
50	
38	
25	
19	
12.5	
10	
5	
2	100
0.85	100
0.425	100
0.25	100
0.15	96
0.075	75.6
0.0336	49.5
0.0217	43.6
0.0130	31.7
0.0094	25.7
0.0066	23.8
0.0033	15.8
0.0014	11.9



Soil Description Proportions (%):

Clay[1]	13	Sand	24
Silt	63	Gravel	0

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

[2] The description is visually based & subject to Tetra Tech description protocols

Specification:

Remarks:

Reviewed By: ______________________ P.Eng.

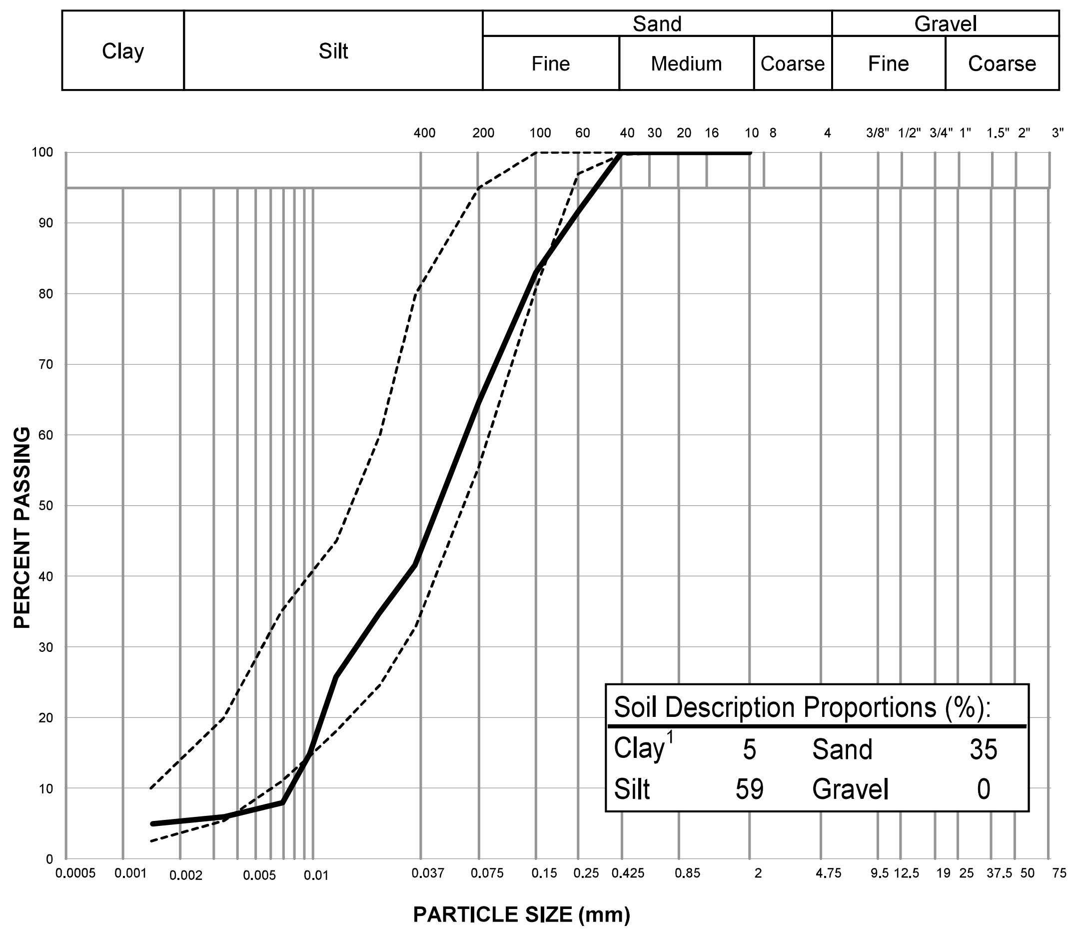
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D7928 & C136

Project:	Keno Hill Tailings	Sample No.:	SA03
Project No.:	ENG.WARC04415-07	Material Type:	Tailings
Site:	Keno Hill	Sample Loc.:	-
Client:	NELPCo	Sample Depth:	-
Client Rep.:	-	Sampling Method:	Grab
Date Tested:	February 7, 2024 By: BW	Date Sampled:	January 29, 2024
Soil Description[2]:	SILT - sandy, trace clay	Sampled By:	Client
		USC Classification:	ML Cu: 8.6
Moisture Content:	18.0%		Cc: 0.6

Particle Size (mm)	Percent Passing
75	
50	
38	
25	
19	
12.5	
10	
5	
2	100
0.85	100
0.425	100
0.25	92
0.15	83
0.075	64.6
0.0346	41.6
0.0223	34.7
0.0132	25.7
0.0097	14.9
0.0069	7.9
0.0034	5.9
0.0014	5.0



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

[2] The description is visually based & subject to Tetra Tech description protocols

Specification:

Remarks:

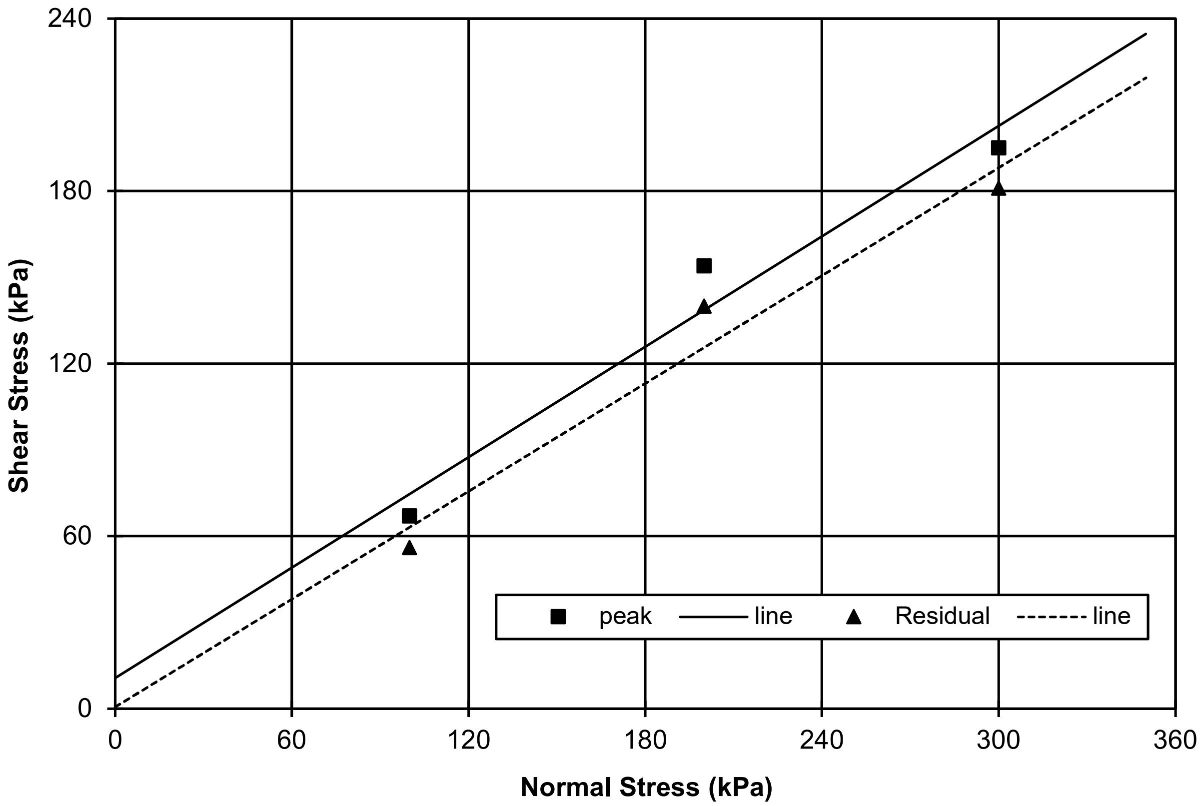
Reviewed By: ______________________ P.Eng.

TETRA TECH

SUMMARY of DIRECT SHEAR TEST RESULTS

ASTM D3080

Project:	Keno Hill Mine Tailings	Source:	Flame & Moth Mill
Project No.:	ENG.WARC04415-07	Location:	Tailings Discharge
Client:	NELPCo.	Date:	October 26, 2023
Attention:	Joanne Huang	Tested By:	TD
Email:		Office:	Edmonton



Inferred Shear Strength Parameters :-

	Cohesion Intercept (kPa)	Inferred Angle of Shearing Resistance (Degrees)
Peak Strength:	**10.7**	**32.6**
Residual Strength:	**0.7**	**32.0**

Remarks: Remolded to 90%

Reviewed By: ______________________ P.Eng.

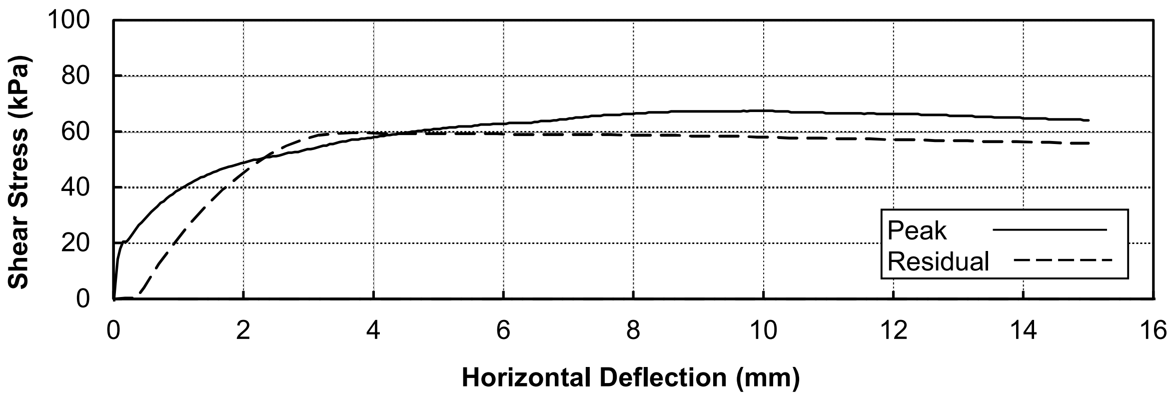
TETRA TECH

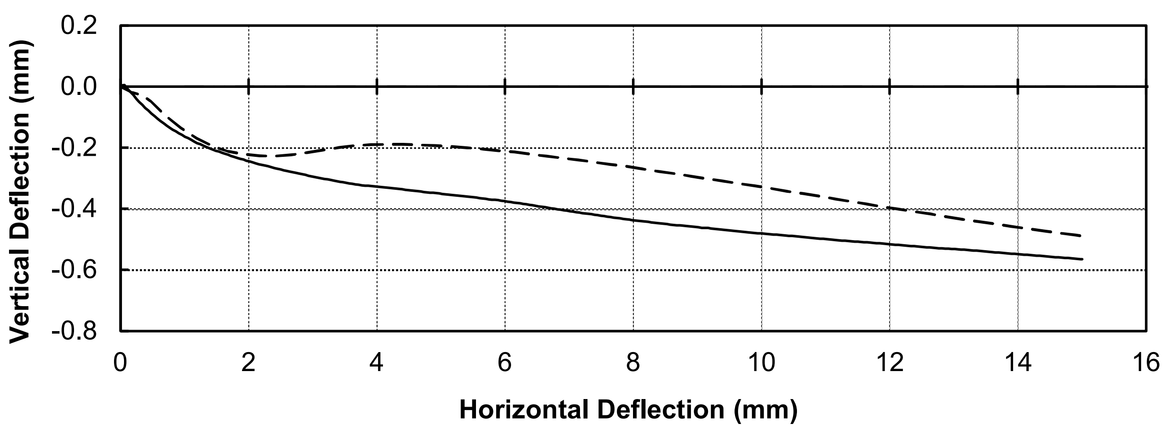
DIRECT SHEAR TEST

ASTM D3080

Project:	Keno Mine Tailings	Source:	Flame & Moth Mill
Project No.:	ENG.WARC04415-07	Location:	Tailings Discharge
Client:	NELPCo.	Test No.:	DS-1
Date Tested:	October 26, 2023	Machine:	4
Description:	Filtered Tailings	Preparation:	Remolded

Normal Stress (kPa) =	100	Moisture Content (%)	13.2
Peak Stress (kPa) =	67	Wet Density (Mg/m^3)	1.881
Residual Stress (kPa) =	56	Dry Density (Mg/m^3)	1.662





Remarks: Remolded to 90%

Reviewed By: ______ P.Eng.

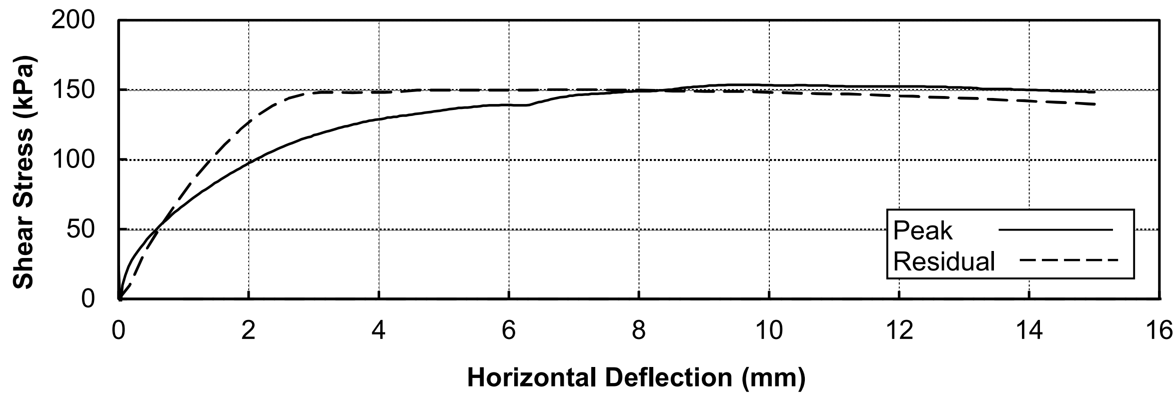
TETRA TECH

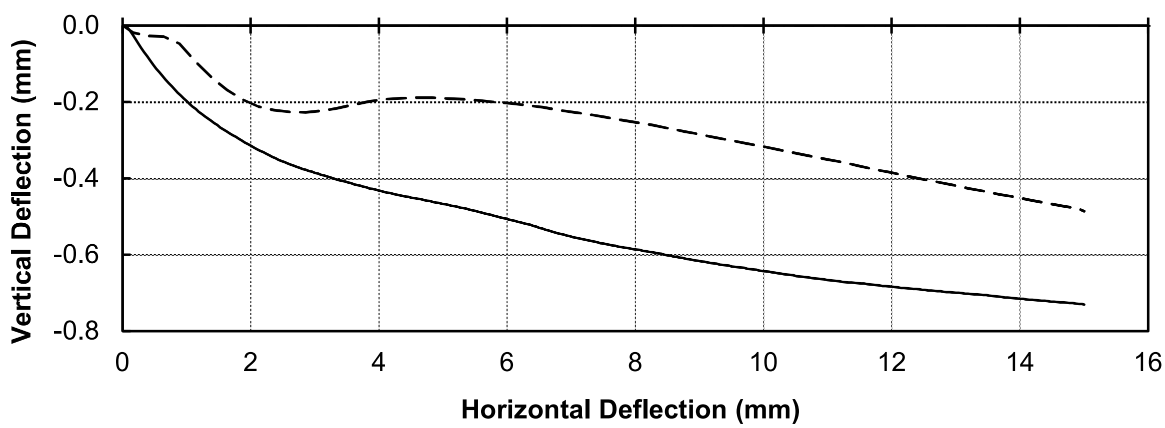
DIRECT SHEAR TEST

ASTM D3080

Project:	Keno Mine Tailings	Source:	Flame & Moth Mill
Project No.:	ENG.WARC04415-07	Location:	Tailings Discharge
Client:	NELPCo.	Test No.:	DS-2
Date Tested:	October 26, 2023	Machine:	5
Description:	Filtered Tailings	Preparation:	Remolded

Normal Stress (kPa) =	200	Moisture Content (%)	18.3
Peak Stress (kPa) =	154	Wet Density (Mg/m^3)	1.881
Residual Stress (kPa) =	140	Dry Density (Mg/m^3)	1.590





Remarks: Remolded to 90%

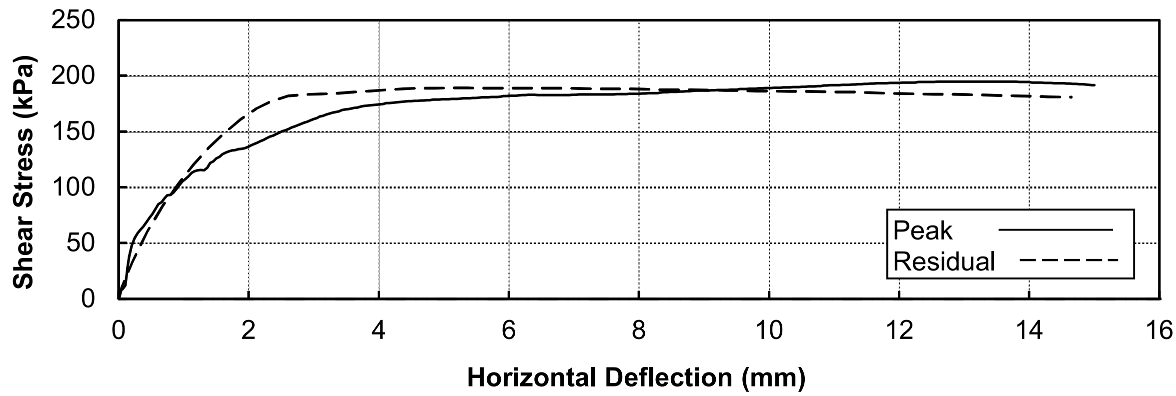
Reviewed By: ______________________ P.Eng.

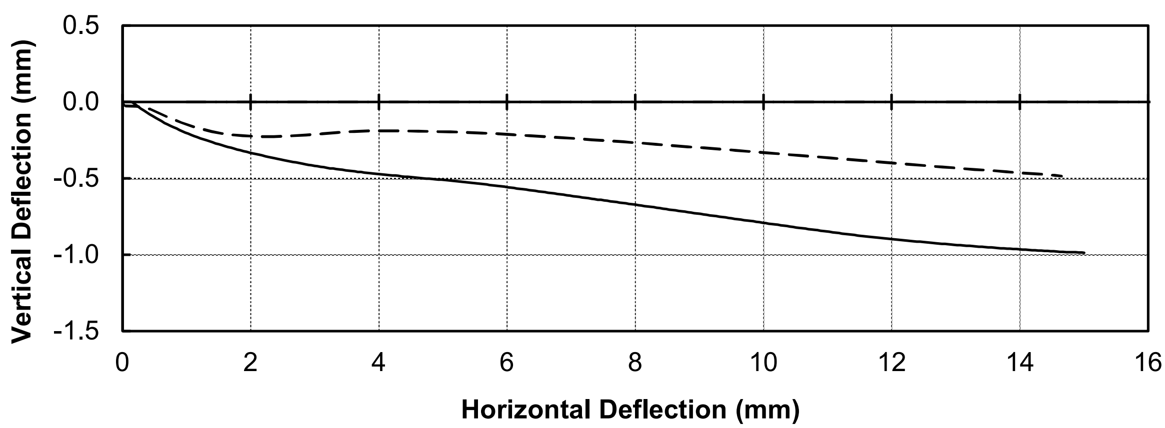
DIRECT SHEAR TEST

ASTM D3080

Project:	Keno Mine Tailings	Source:	Flame & Moth Mill
Project No.:	ENG.WARC04415-07	Location:	Tailings Discharge
Client:	NELPCo.	Test No.:	DS-3
Date Tested:	October 26, 2023	Machine:	6
Description:	Filtered Tailings	Preparation:	Remolded

Normal Stress (kPa) =	300	Moisture Content (%)	13.3
Peak Stress (kPa) =	195	Wet Density (Mg/m^3)	1.881
Residual Stress (kPa) =	181	Dry Density (Mg/m^3)	1.661





Remarks: Remolded to 90%

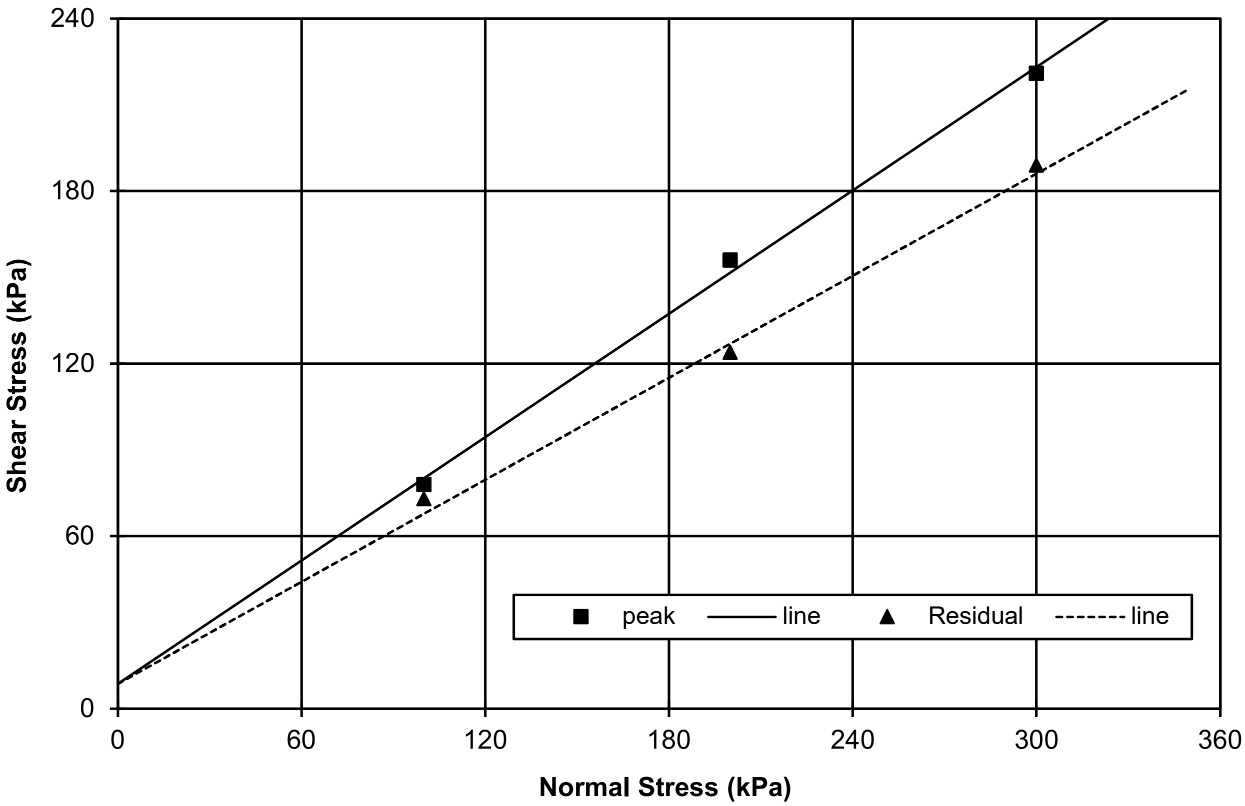
Reviewed By: ____________________ P.Eng.

TETRA TECH

SUMMARY of DIRECT SHEAR TEST RESULTS

ASTM D3080

Project:	Keno Hill Mine Tailings	Source:	Flame & Moth Mill
Project No.:	ENG.WARC04415-07	Location:	Tailings Discharge
Client:	NELPCo.	Date:	October 26, 2023
Attention:	Joanne Huang	Tested By:	TD
Email:		Office:	Edmonton



Inferred Shear Strength Parameters :-

	Cohesion Intercept (kPa)	Inferred Angle of Shearing Resistance (Degrees)
Peak Strength:	**8.7**	**35.6**
Residual Strength:	**8.7**	**30.6**

Remarks: Remolded to 95%

Reviewed By: ______________ P.Eng.

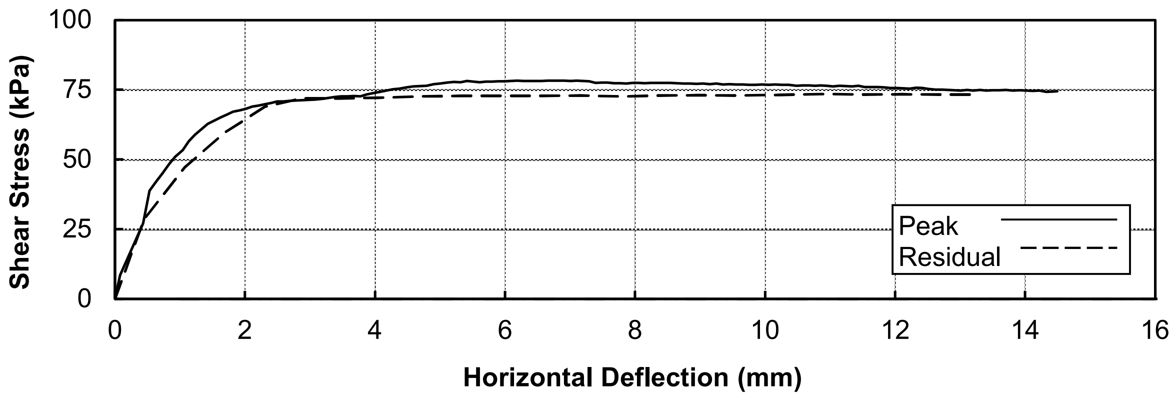
TETRA TECH

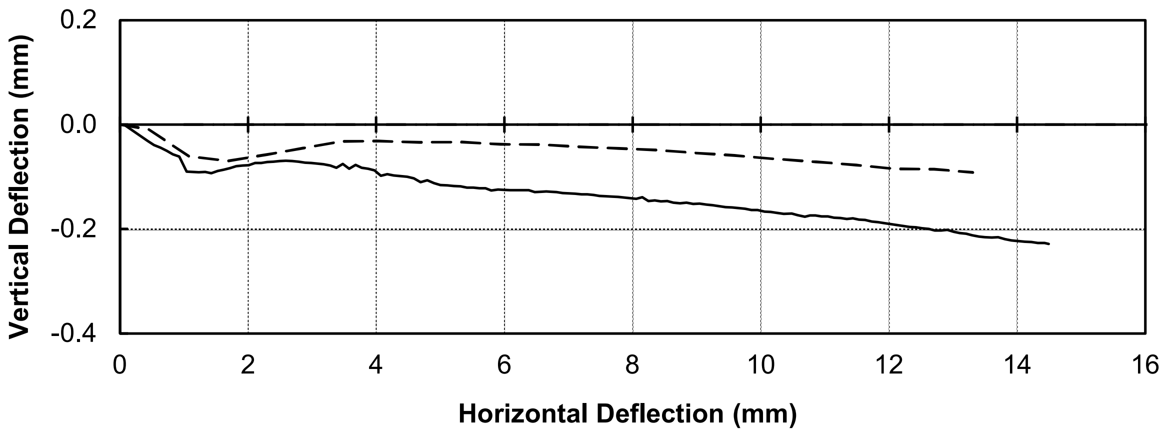
DIRECT SHEAR TEST

ASTM D3080

Project:	Keno Hill Tailings	Source:	Flame & Moth Mill
Project No.:	ENG.WARC04415-07	Location:	Tailings Discharge
Client:	NELPCo.	Test No.:	DS-4
Date Tested:	October 26, 2023	Machine:	1
Description:	Filtered Tailings	Preparation:	Remolded

			Initial
Normal Stress (kPa) =	100	Moisture Content (%)	13.1
Peak Stress (kPa) =	78	Wet Density (Mg/m^3)	1.986
Residual Stress (kPa) =	73	Dry Density (Mg/m^3)	1.756





Remarks: Remolded to 95%

Reviewed By: ______________________ P.Eng.

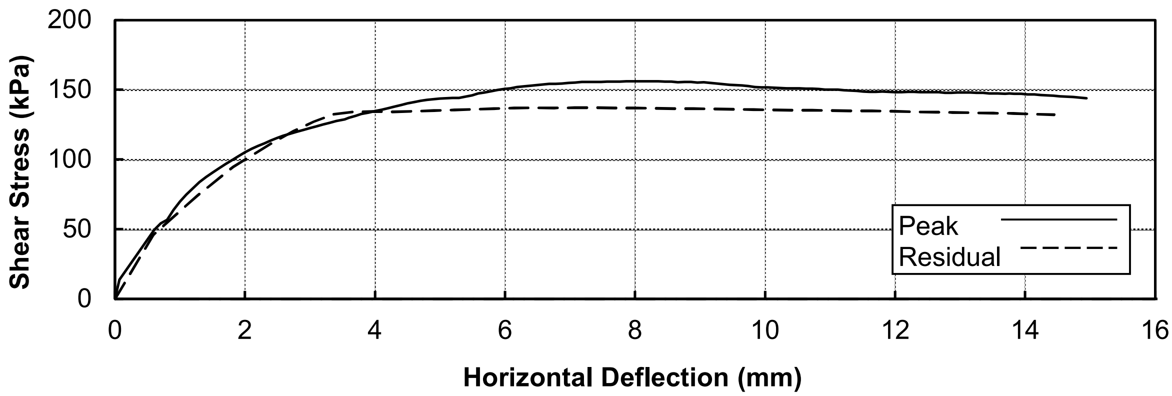
TETRA TECH

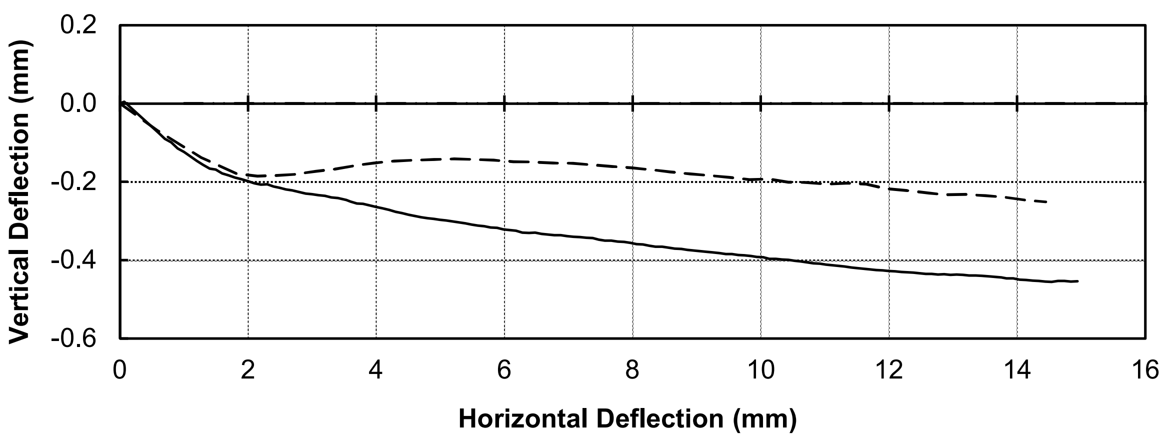
DIRECT SHEAR TEST

ASTM D3080

Project:	Keno Hill Tailings	Source:	Flame & Moth Mill
Project No.:	ENG.WARC04415-07	Location:	Tailings Discharge
Client:	NELPCo.	Test No.:	DS-5
Date Tested:	October 26, 2023	Machine:	2
Description:	Filtered Tailings	Preparation:	Remolded

			Initial
Normal Stress (kPa) =	200	Moisture Content (%)	13.1
Peak Stress (kPa) =	156	Wet Density (Mg/m^3)	1.986
Residual Stress (kPa) =	132	Dry Density (Mg/m^3)	1.756





Remarks: Remolded to 95%

Reviewed By: ______________________ P.Eng.

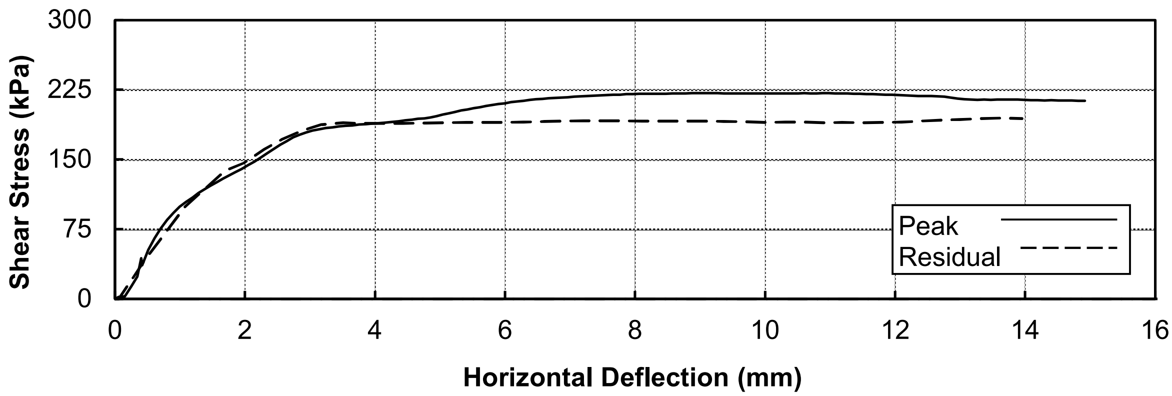
TETRA TECH

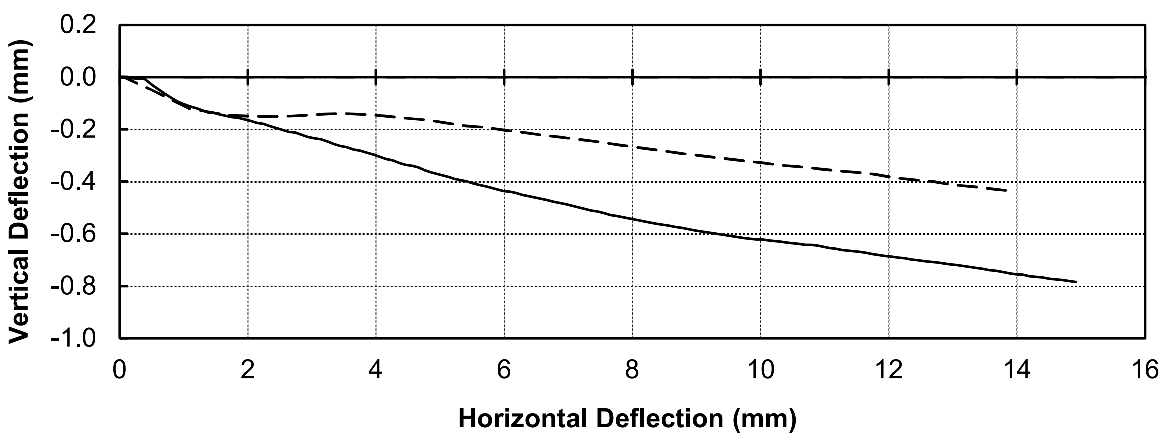
DIRECT SHEAR TEST

ASTM D3080

Project:	Keno Hill Tailings	Source:	Flame & Moth Mill
Project No.:	ENG.WARC04415-07	Location:	Tailings Discharge
Client:	NELPCo.	Test No.:	DS-6
Date Tested:	October 26, 2023	Machine:	3
Description:	Filtered Tailings	Preparation:	Remolded

			Initial
Normal Stress (kPa) =	300	Moisture Content (%)	13.2
Peak Stress (kPa) =	221	Wet Density (Mg/m^3)	1.986
Residual Stress (kPa) =	189	Dry Density (Mg/m^3)	1.754





Remarks: Remolded to 95%

Reviewed By: ______________________ P.Eng.

TETRA TECH

MOISTURE-DENSITY RELATIONSHIP (Proctor) REPORT

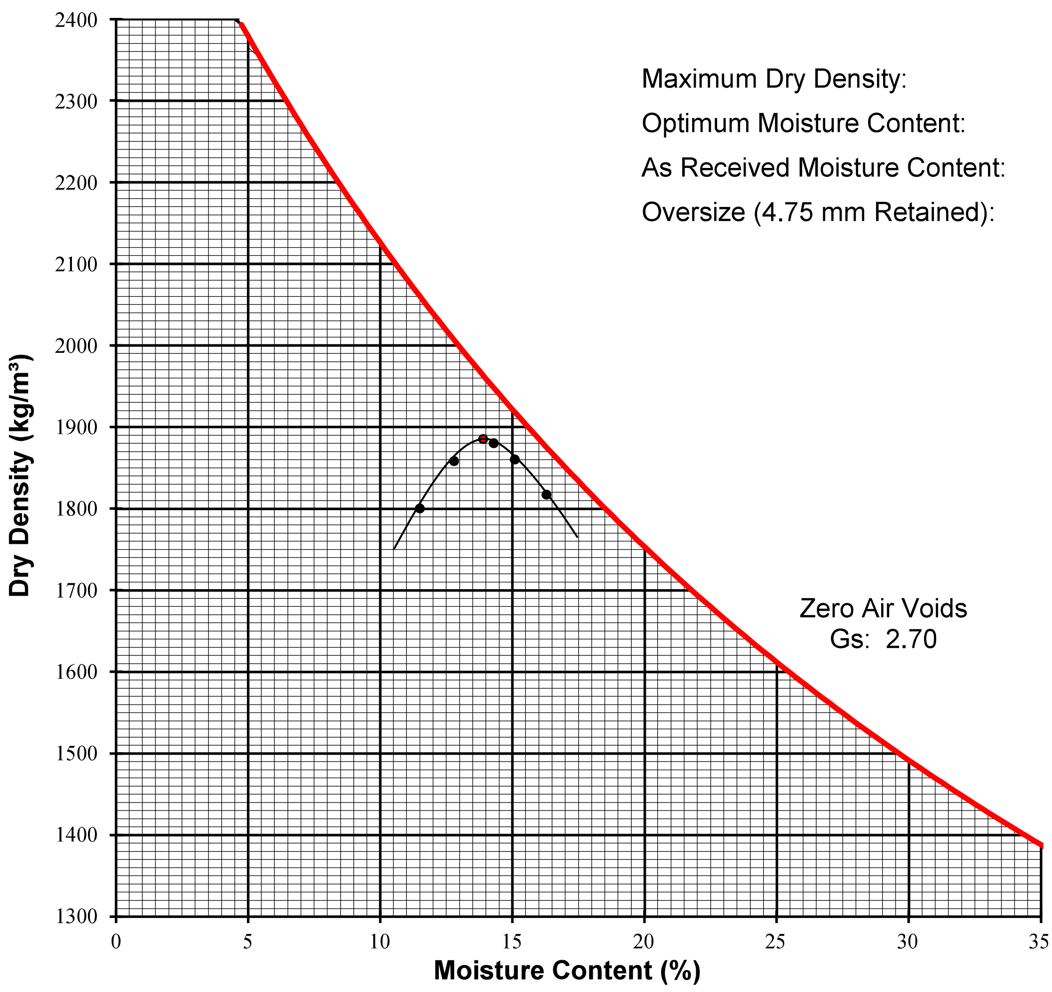
ASTM D698 (Standard Proctor)

Project:	2022 Keno DSTF Tailings Characterization	Sample No.:	1948
Project No.:	ENG.WARC04181-01	Sampled By:	AKHM
Client:	Alexco Keno Mining Corp.	Date Received:	Apr 7, 2022
Attention:	Peter Johnson	Test Date:	Apr 11, 2022
E-mail:		Test By:	MA
Source:	Mill	Test Method:	A (Manual)

Sample Location: Dry Stack Tailings Facility

Sample Description: SILT, sandy, trace clay, grey

Maximum Dry Density:	**1885**	kg/m³
Optimum Moisture Content:	**13.9**	%
As Received Moisture Content:	17.2	%
Oversize (4.75 mm Retained):	0	%



Remarks:

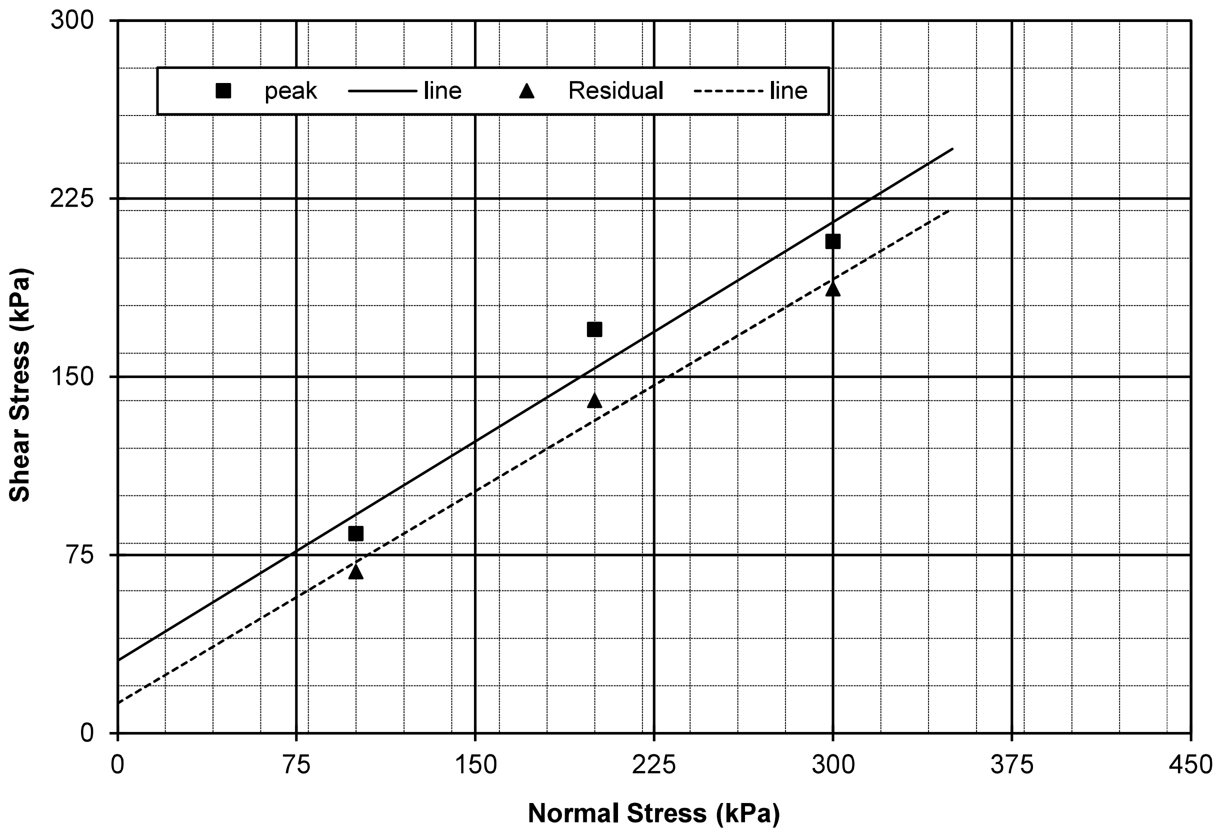
Reviewed By: ______________ P.Eng.

TETRA TECH

SUMMARY of DIRECT SHEAR TEST RESULTS

ASTM D3080

Project:	2022 Keno DSTF Tailings Characterization	Sample No.:	1948
Project No.:	ENG.WARC04181-01	Location:	Dry Stack Tailings Facility
Client:	Alexco Keno Mining Corp.	Date:	Apr 21, 2022
Attention:	Peter Johnson	Tested By:	TD
Email:		Office:	Edmonton



Inferred Shear Strength Parameters :-

	Cohesion Intercept (kPa)	Inferred Angle of Shearing Resistance (Degrees)
Peak Strength:	**30.7**	**31.6**
Residual Strength:	**12.7**	**30.8**

Reviewed By: ______________________ P.Eng.

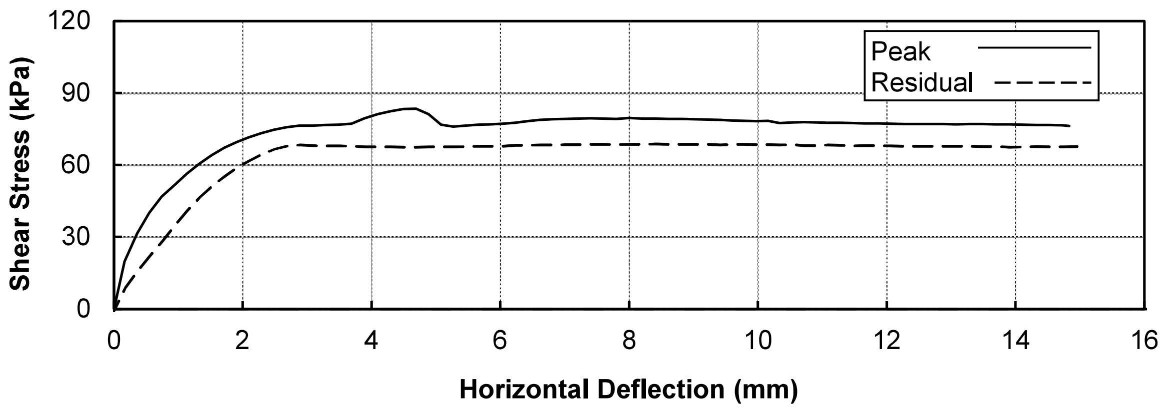
TETRA TECH

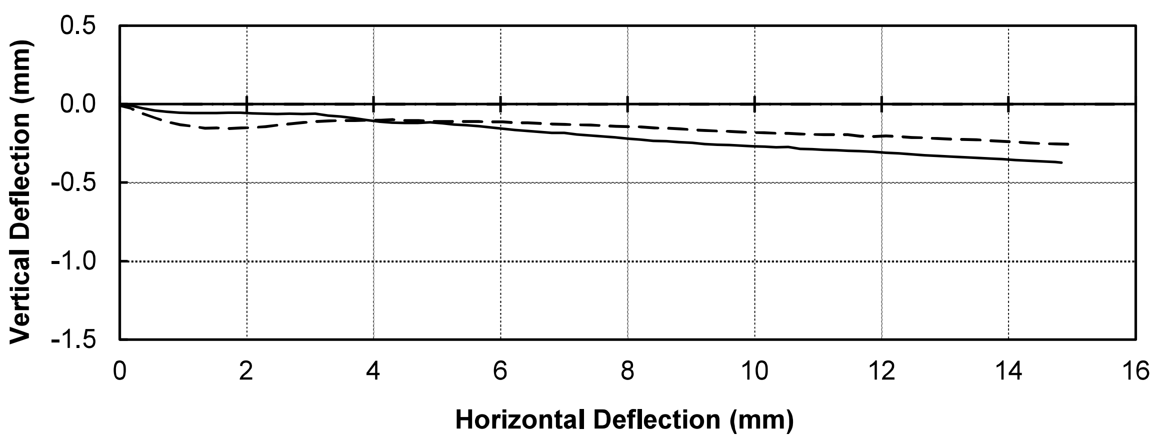
DIRECT SHEAR TEST

ASTM D3080

Project:	2022 Keno DSTF Tailings Characterization	Sample No.:	1948
Project No.:	ENG.WARC04181-01	Location:	Dry Stack Tailings Facility
Client:	Alexco Keno Mining Corp.	Test No.:	DS-4
Date Tested:	Apr 21, 2022	Machine:	3
Description:	SAND, silty, trace clay, grey	Preparation:	Remolded

			Initial	Final
Normal Stress (kPa) =	100	Moisture Content (%)	15.3	18.1
Peak Stress (kPa) =	84	Wet Density (Mg/m^3)	2.059	2.023
Residual Stress (kPa) =	68	Dry Density (Mg/m^3)	1.786	1.713





Remarks: Remolded sample

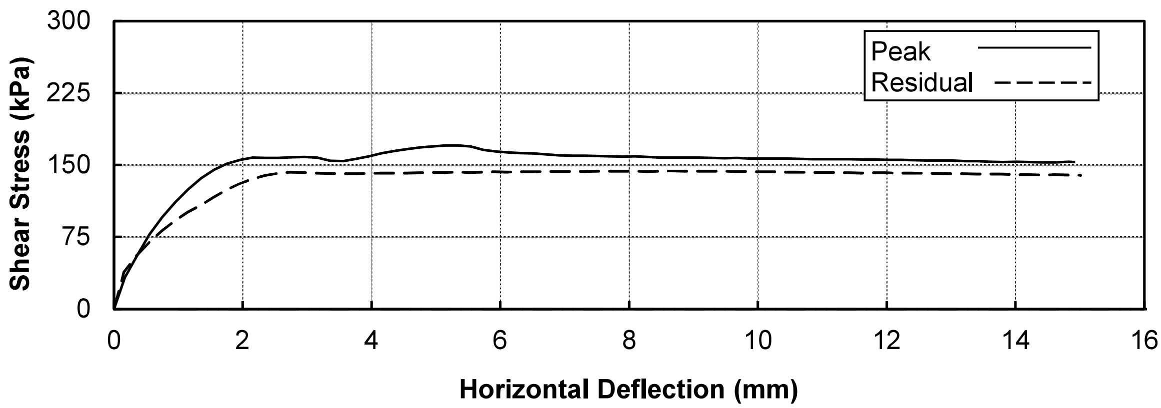
Reviewed By: ____________________ P.Eng.

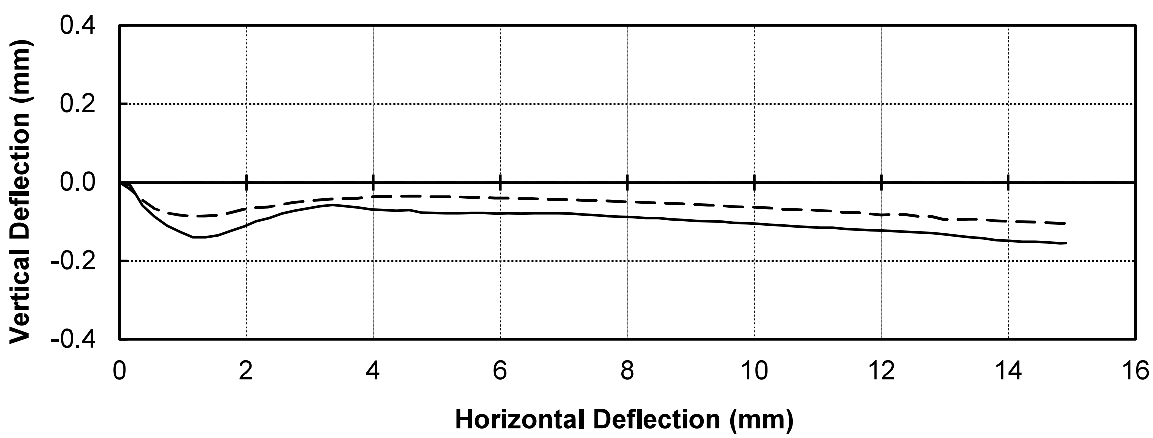
DIRECT SHEAR TEST

ASTM D3080

Project:	2022 Keno DSTF Tailings Characterization	Sample No.:	1948
Project No.:	ENG.WARC04181-01	Location:	Dry Stack Tailings Facility
Client:	Alexco Keno Mining Corp.	Test No.:	DS-5
Date Tested:	Apr 21, 2022	Machine:	2
Description:	SAND, silty, trace clay, grey	Preparation:	Remolded

			Initial	Final
Normal Stress (kPa) = 200		Moisture Content (%)	15.1	17.1
Peak Stress (kPa) = 170		Wet Density (Mg/m^3)	2.059	2.006
Residual Stress (kPa) = 140		Dry Density (Mg/m^3)	1.790	1.713





Remarks: Remolded sample

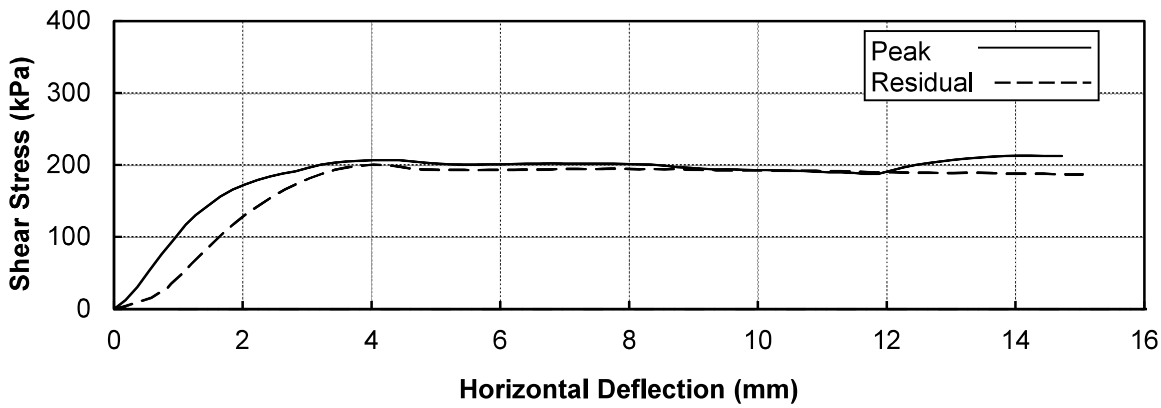
Reviewed By: ______________________ P.Eng.

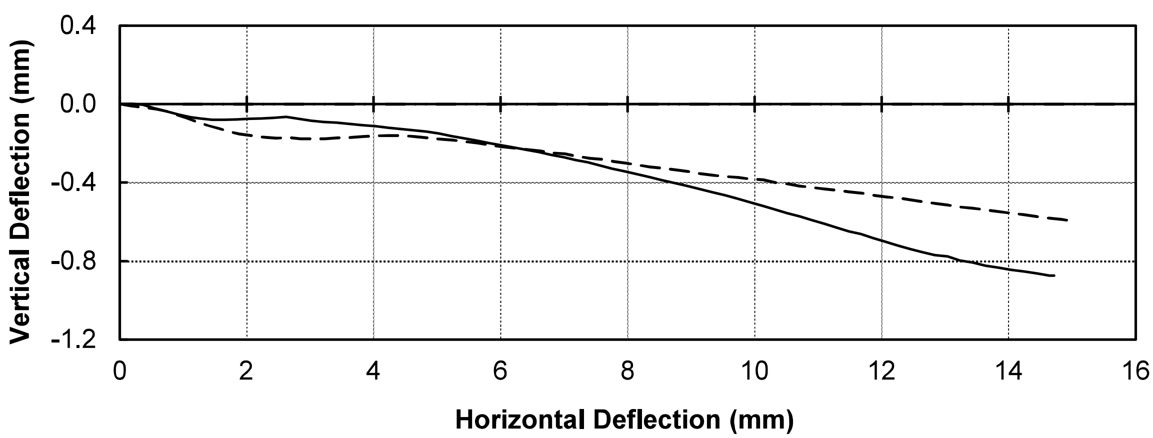
DIRECT SHEAR TEST

ASTM D3080

Project:	2022 Keno DSTF Tailings Characterization	Sample No.:	1948
Project No.:	ENG.WARC04181-01	Location:	Dry Stack Tailings Facility
Client:	Alexco Keno Mining Corp.	Test No.:	DS-6
Date Tested:	Apr 21, 2022	Machine:	1
Description:	SAND, silty, trace clay, grey	Preparation:	Remolded

			Initial	Final
Normal Stress (kPa) = 300		Moisture Content (%)	15.2	17.6
Peak Stress (kPa) = 213		Wet Density (Mg/m^3)	2.060	1.809
Residual Stress (kPa) = 187		Dry Density (Mg/m^3)	1.788	1.538





Remarks: Remolded sample

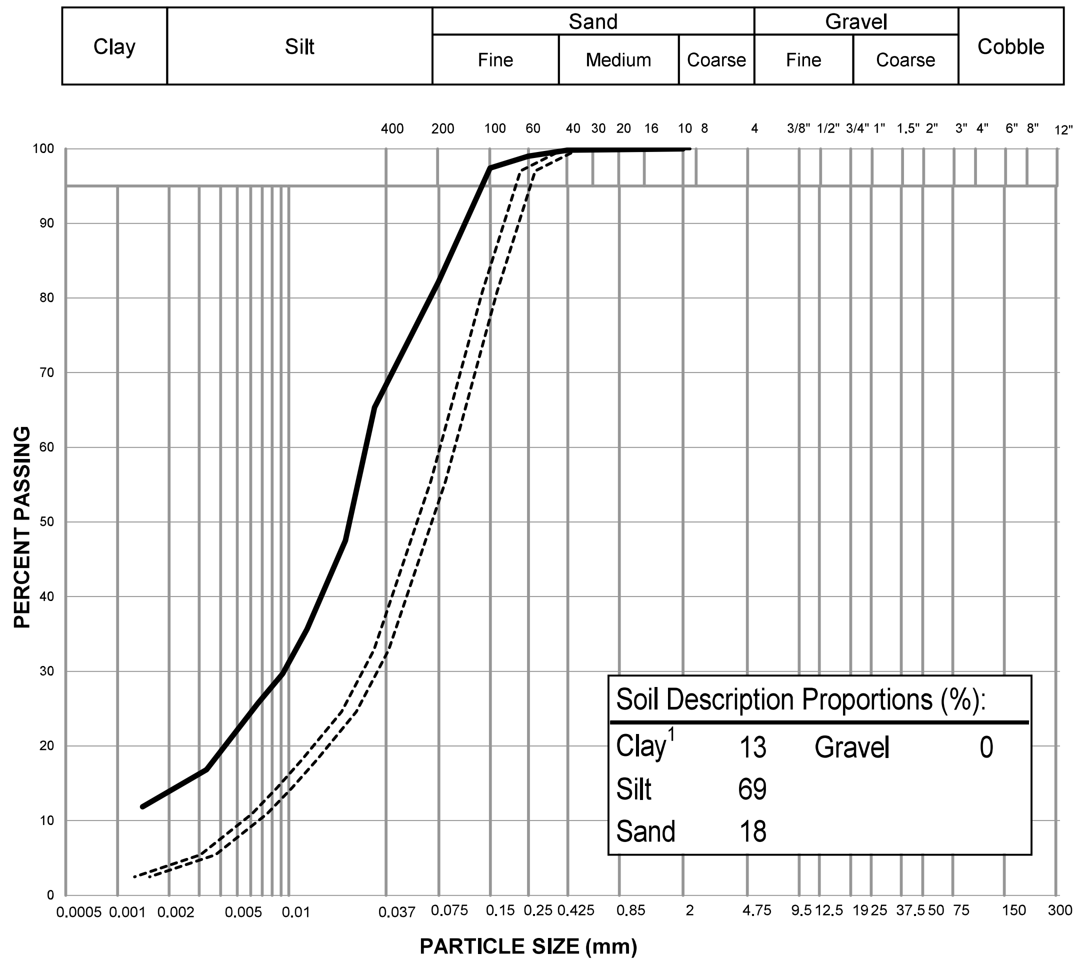
Reviewed By: ____________________ P.Eng.

PARTICLE SIZE ANALYSIS REPORT

ASTM D7928 & C136

Project:	2022 Keno DSTF Tailings	Sample No.:	SA01
Project No.:	ENG.WARC04181-01	Material Type:	Tailings
Site:	Alexco Keno Mine	Sample Loc.:	-
Client:	Alexco Keno Hill Mining Corp.	Sample Depth:	-
Client Rep.:	Peter Johncon	Sampling Method:	Grab
Date Tested:	March 22, 2022 By: BW	Date Sampled:	December 1, 2021
Soil Description[2]:	SILT - some sand, some clay	Sampled By:	Client
		USC Classification:	ML Cu: #N/A
Moisture Content:	20.5%		Cc: #N/A

Particle Size (mm)	Percent Passing
300	
200	
150	
100	
75	
50	
38	
25	
19	
12.5	
10	
5	
2	100
0.85	
0.425	100
0.25	99
0.15	97
0.075	82.2
0.0318	65.3
0.0214	47.5
0.0128	35.6
0.0092	29.7
0.0066	25.7
0.0033	16.8
0.0014	11.9



Soil Description Proportions (%):			
Clay[1]	13	Gravel	0
Silt	69		
Sand	18		

Notes: [1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual [2] The description is visually based & subject to Tetra Tech description protocols [3] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification:

Remarks: December 08-14, 2021

Reviewed By: ____________ P.Eng.

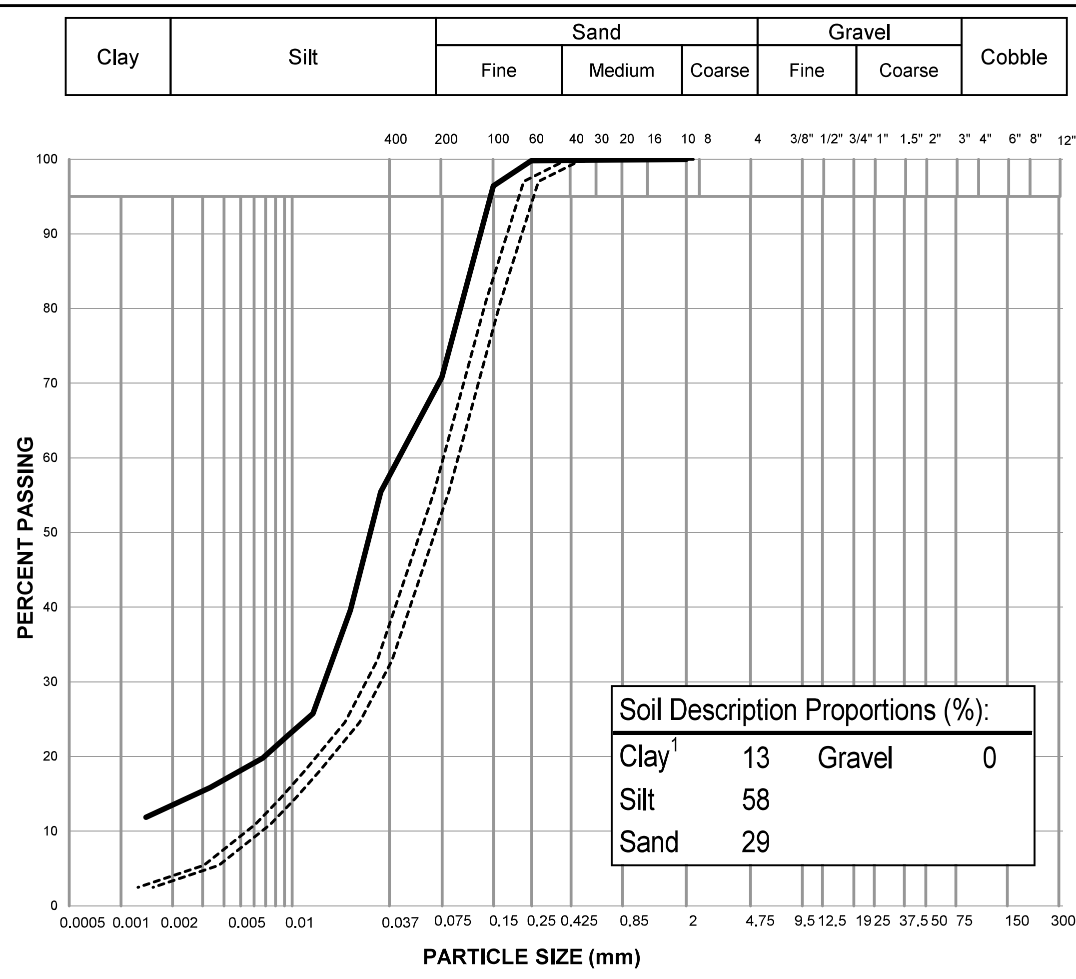
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D7928 & C136

Project:	2022 Keno DSTF Tailings	Sample No.:	SA02
Project No.:	ENG.WARC04181-01	Material Type:	Tailings
Site:	Alexco Keno Mine	Sample Loc.:	-
Client:	Alexco Keno Hill Mining Corp.	Sample Depth:	-
Client Rep.:	Peter Johncon	Sampling Method:	Grab
Date Tested:	March 22, 2022 By: BW	Date Sampled:	December 1, 2021
Soil Description[2]:	SILT - sandy, some clay	Sampled By:	Client
		USC Classification:	ML Cu: #N/A
Moisture Content:	18.6%		Cc: #N/A

Particle Size (mm)	Percent Passing
300	
200	
150	
100	
75	
50	
38	
25	
19	
12.5	
10	
5	
2	100
0.85	
0.425	
0.25	100
0.15	96
0.075	70.8
0.0329	55.4
0.0219	39.6
0.0132	25.7
0.0094	22.8
0.0067	19.8
0.0033	15.8
0.0014	11.9



Notes: [1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual [2] The description is visually based & subject to Tetra Tech description protocols [3] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification:

Remarks: February 01-07, 2022

Reviewed By: ______________________ P.Eng.

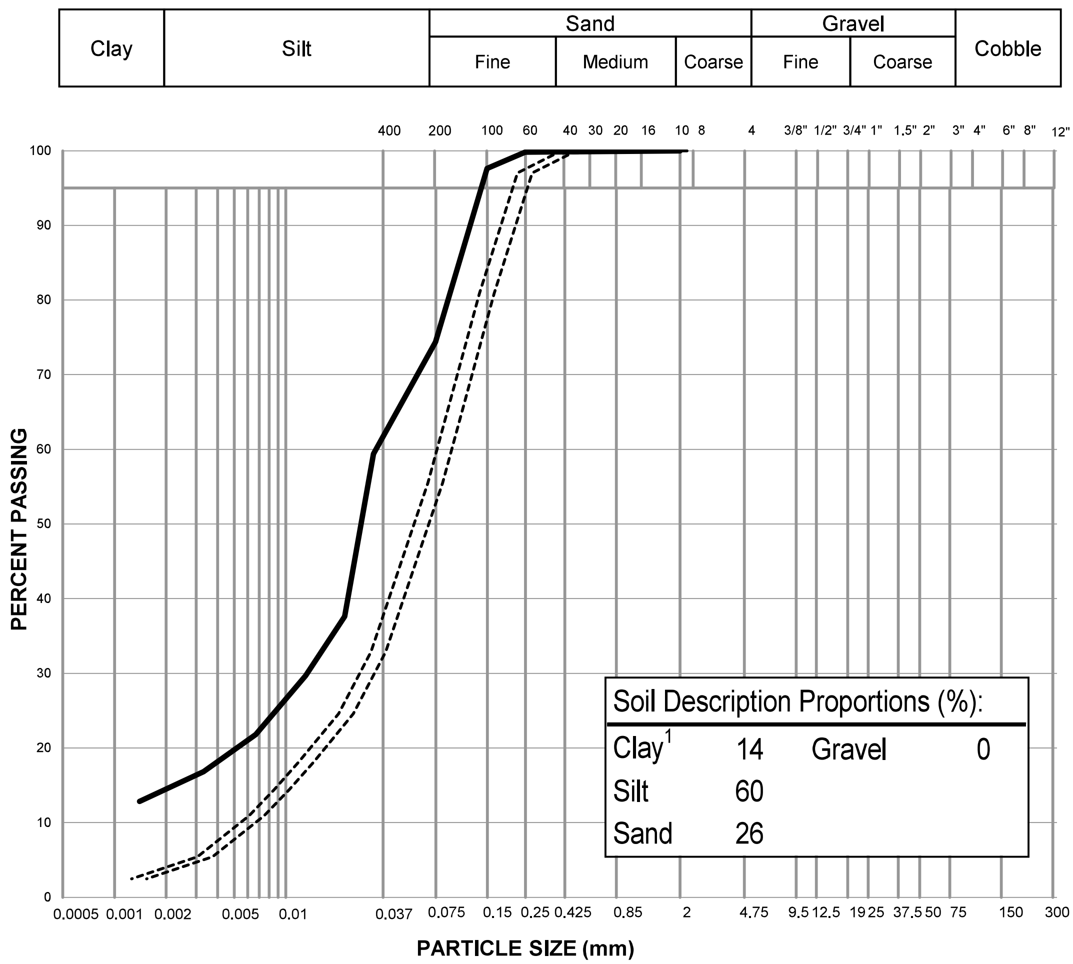
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D7928 & C136

Project:	2022 Keno DSTF Tailings	Sample No.:	SA03
Project No.:	ENG.WARC04181-01	Material Type:	Tailings
Site:	Alexco Keno Mine	Sample Loc.:	-
Client:	Alexco Keno Hill Mining Corp.	Sample Depth:	-
Client Rep.:	Peter Johncon	Sampling Method:	Grab
Date Tested:	March 22, 2022 By: BW	Date Sampled:	December 1, 2021
Soil Description[2]:	SILT - sandy, some clay	Sampled By:	Client
		USC Classification:	ML Cu: #N/A
Moisture Content:	20.9%		Cc: #N/A

Particle Size (mm)	Percent Passing
300	
200	
150	
100	
75	
50	
38	
25	
19	
12.5	
10	
5	
2	100
0.85	
0.425	
0.25	100
0.15	98
0.075	74.4
0.0325	59.4
0.0221	37.6
0.0131	29.7
0.0094	25.7
0.0067	21.8
0.0033	16.8
0.0014	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 Tetra Tech description protocols [3] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification:

Remarks: March 08-14, 2022

Reviewed By: ______________________ P.Eng.

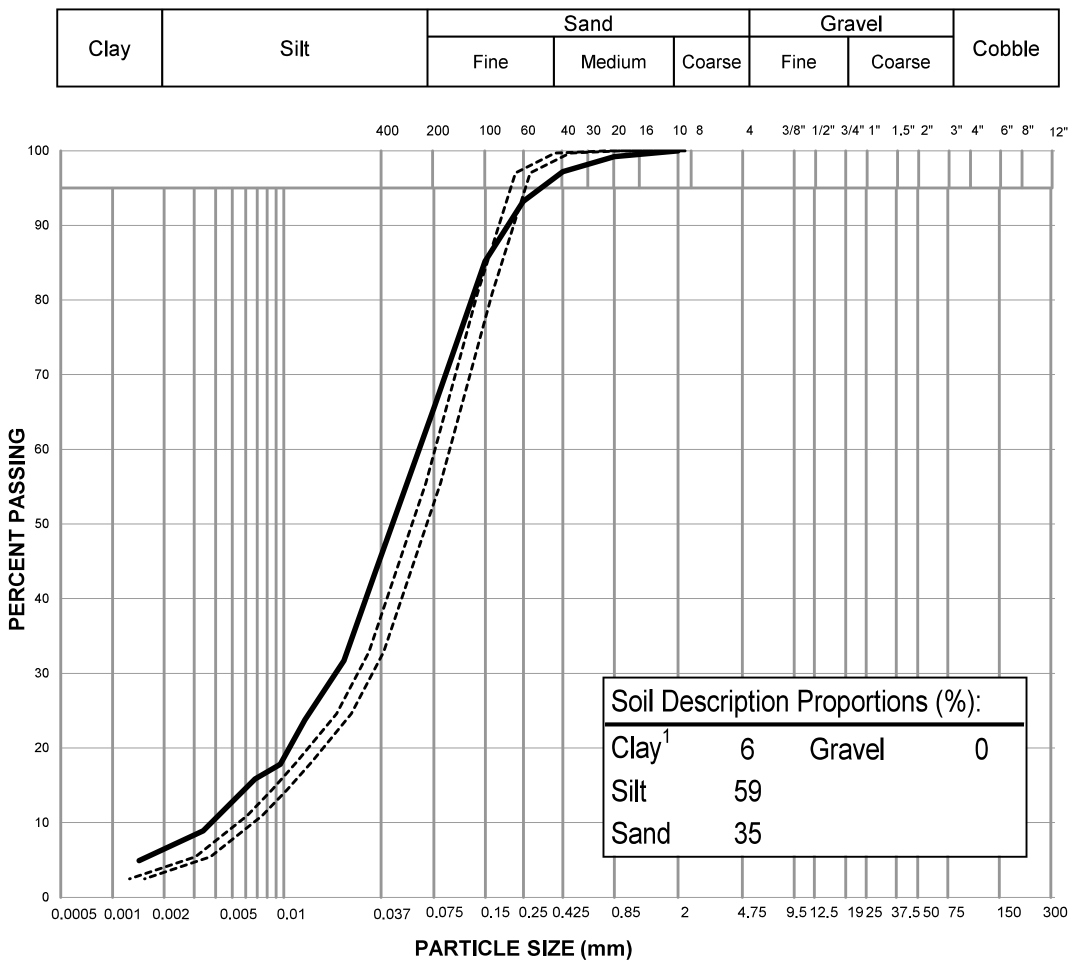
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D7928 & C136

Project:	2022 Keno DSTF Tailings	Sample No.:	SA04
Project No.:	ENG.WARC04181-01	Material Type:	Tailings
Site:	Alexco Keno Mine	Sample Loc.:	-
Client:	Alexco Keno Hill Mining Corp.	Sample Depth:	-
Client Rep.:	Peter Johncon	Sampling Method:	Grab
Date Tested:	April 5, 2022 By: BW	Date Sampled:	March 29, 2022
Soil Description[2]:	SILT - sandy, trace clay	Sampled By:	Client
		USC Classification:	ML Cu: 16.5
Moisture Content:	17.5%		Cc: 1.7

Particle Size (mm)	Percent Passing
300	
200	
150	
100	
75	
50	
38	
25	
19	
12.5	
10	
5	
2	100
0.85	99
0.425	97
0.25	93
0.15	85
0.075	65.4
0.0343	43.6
0.0225	31.7
0.0133	23.8
0.0096	17.8
0.0068	15.8
0.0034	8.9
0.0014	5.0



Soil Description Proportions (%):			
Clay[1]	6	Gravel	0
Silt	59		
Sand	35		

Notes: [1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual [2] The description is visually based & subject to Tetra Tech description protocols [3] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification:

Remarks: March 29th, 2022

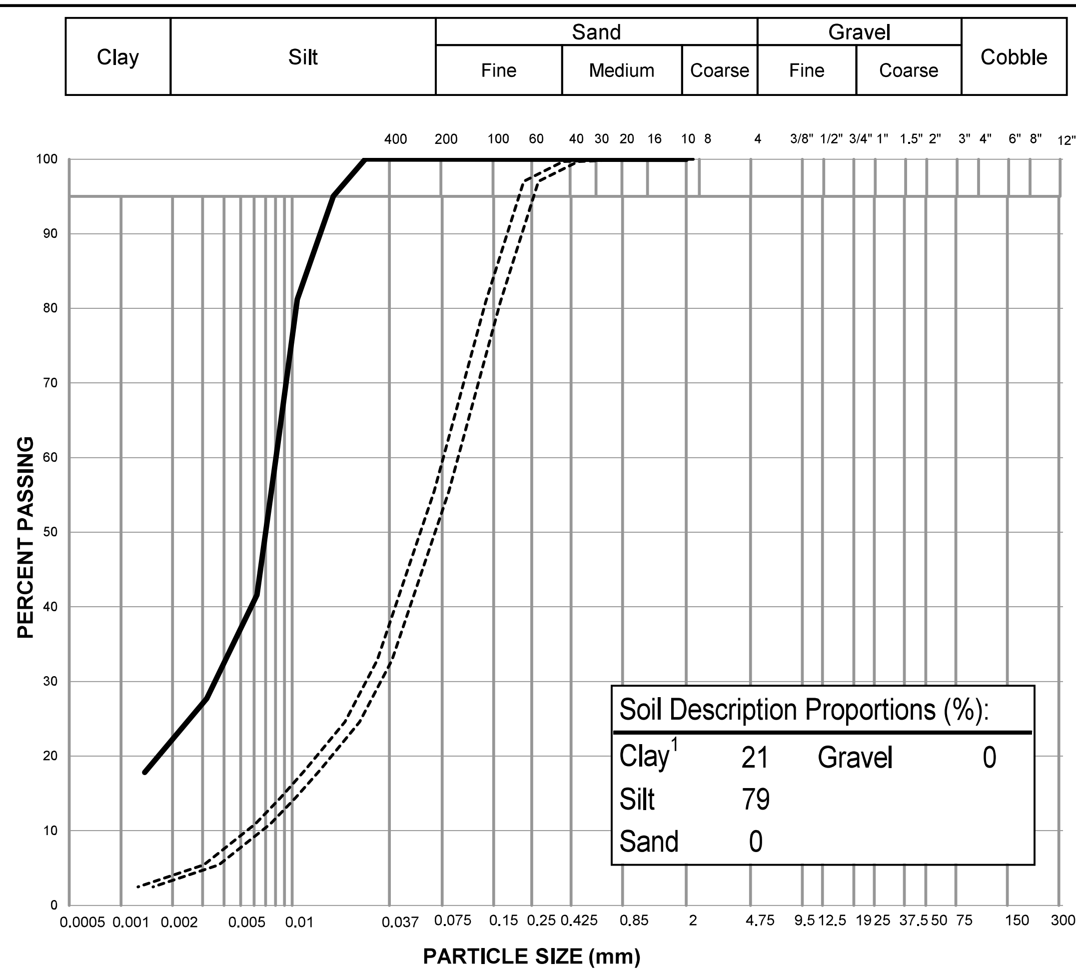
Reviewed By: ______________________ P.Eng.

PARTICLE SIZE ANALYSIS REPORT

ASTM D7928 & C136

Project:	2022 Keno DSTF Tailings	Sample No.:	SA13
Project No.:	ENG.WARC04181-01	Material Type:	F and M Sludge
Site:	Alexco Keno Mine	Sample Loc.:	-
Client:	Alexco Keno Hill Mining Corp.	Sample Depth:	-
Client Rep.:	Peter Johnson	Sampling Method:	Grab
Date Tested:	June 13, 2022 By: CP	Date Sampled:	-
Soil Description[2]:	SILT and SAND - some clay	Sampled By:	Client
		USC Classification:	ML Cu: #N/A
Moisture Content:	124.2%		Cc: #N/A

Particle Size (mm)	Percent Passing
300	
200	
150	
100	
75	
50	
38	
25	
19	
12.5	
10	
5	
2	100
0.85	
0.425	
0.25	
0.15	
0.075	
0.0269	100.0
0.0174	95.0
0.0108	81.2
0.0082	61.4
0.0062	41.6
0.0032	27.7
0.0014	17.8



Notes: [1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual [2] The description is visually based & subject to Tetra Tech description protocols [3] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification:

Remarks:

Reviewed By: [signature] P.Eng.

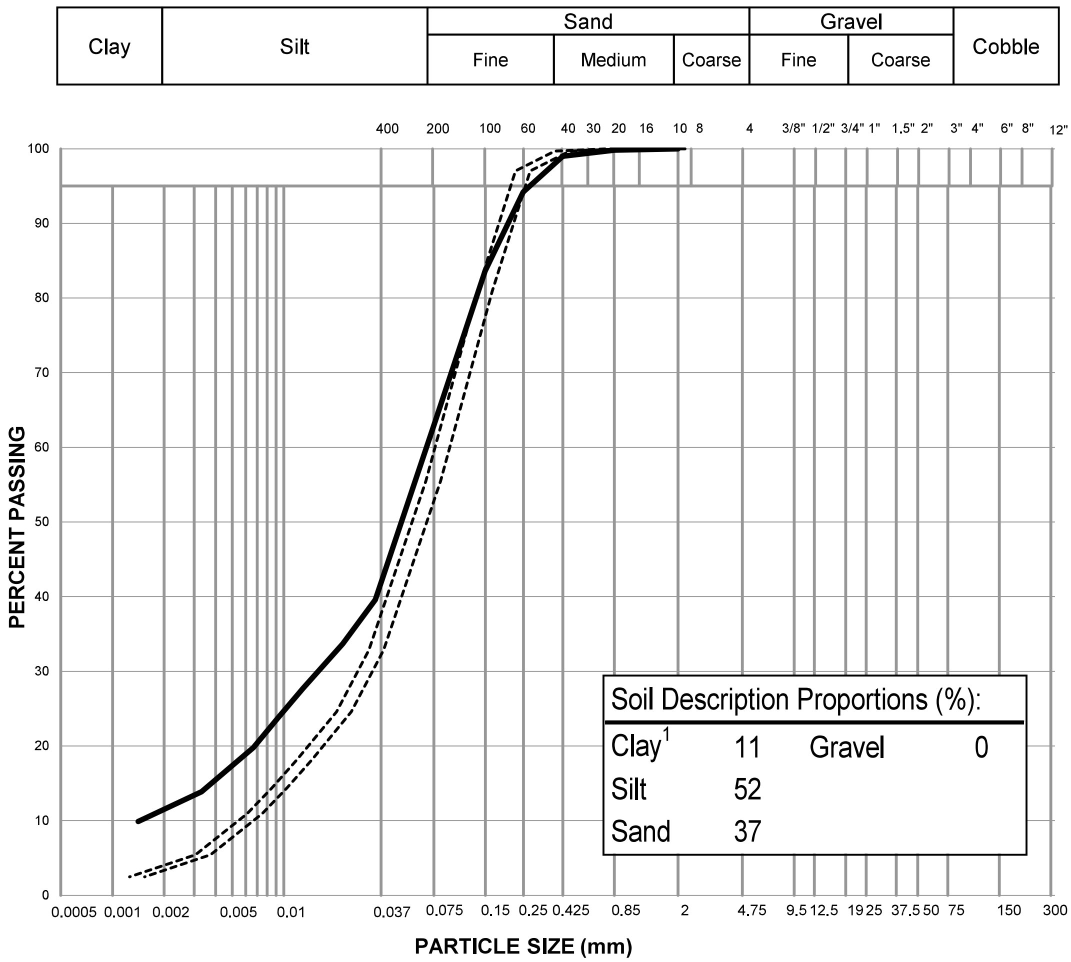
TETRA TECH

PARTICLE SIZE ANALYSIS REPORT

ASTM D7928 & C136

Project:	2022 Keno DSTF Tailings	Sample No.:	SA14
Project No.:	ENG.WARC04181-01	Material Type:	Tailings
Site:	Alexco Keno Mine	Sample Loc.:	-
Client:	Alexco Keno Hill Mining Corp.	Sample Depth:	-
Client Rep.:	Peter Johnson	Sampling Method:	Grab
Date Tested:	June 13, 2022 By: CP	Date Sampled:	May 25, 2022
Soil Description[2]:	SILT and SAND - some clay	Sampled By:	Client
		USC Classification:	ML Cu: 48.0
Moisture Content:	12.1%		Cc: 2.7

Particle Size (mm)	Percent Passing
300	
200	
150	
100	
75	
50	
38	
25	
19	
12.5	
10	
5	
2	100
0.85	100
0.425	99
0.25	94
0.15	84
0.075	62.8
0.0343	39.6
0.0221	33.7
0.0130	27.7
0.0093	23.8
0.0067	19.8
0.0033	13.9
0.0014	9.9



Soil Description Proportions (%):			
Clay[1]	11	Gravel	0
Silt	52		
Sand	37		

Notes: [1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual [2] The description is visually based & subject to Tetra Tech description protocols [3] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification:

Remarks:

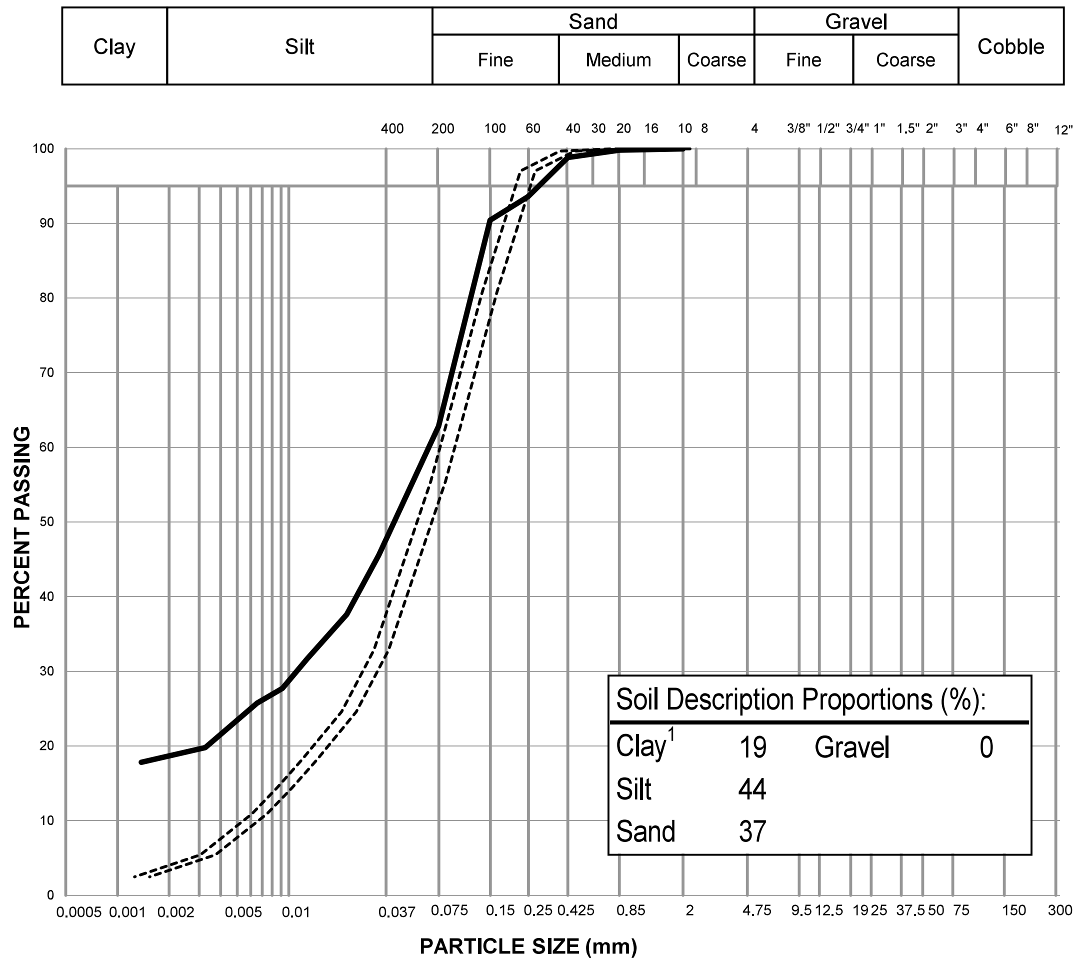
Reviewed By: ______________________ P.Eng.

PARTICLE SIZE ANALYSIS REPORT

ASTM D7928 & C136

Project:	2022 Keno DSTF Tailings	Sample No.:	SA15
Project No.:	ENG.WARC04181-01	Material Type:	Tailings
Site:	Alexco Keno Mine	Sample Loc.:	-
Client:	Alexco Keno Hill Mining Corp.	Sample Depth:	-
Client Rep.:	Peter Johnson	Sampling Method:	Grab
Date Tested:	June 13, 2022 By: CP	Date Sampled:	May 31, 2022
Soil Description[2]:	SILT and SAND - some clay	Sampled By:	Client
		USC Classification:	ML Cu: #N/A
Moisture Content:	15.6%		Cc: #N/A

Particle Size (mm)	Percent Passing
300	
200	
150	
100	
75	
50	
38	
25	
19	
12.5	
10	
5	
2	100
0.85	100
0.425	99
0.25	94
0.15	90
0.075	62.8
0.0336	45.5
0.0218	37.6
0.0128	31.7
0.0092	27.7
0.0065	25.7
0.0033	19.8
0.0014	17.8



Notes: [1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual [2] The description is visually based & subject to Tetra Tech description protocols [3] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification:

Remarks:

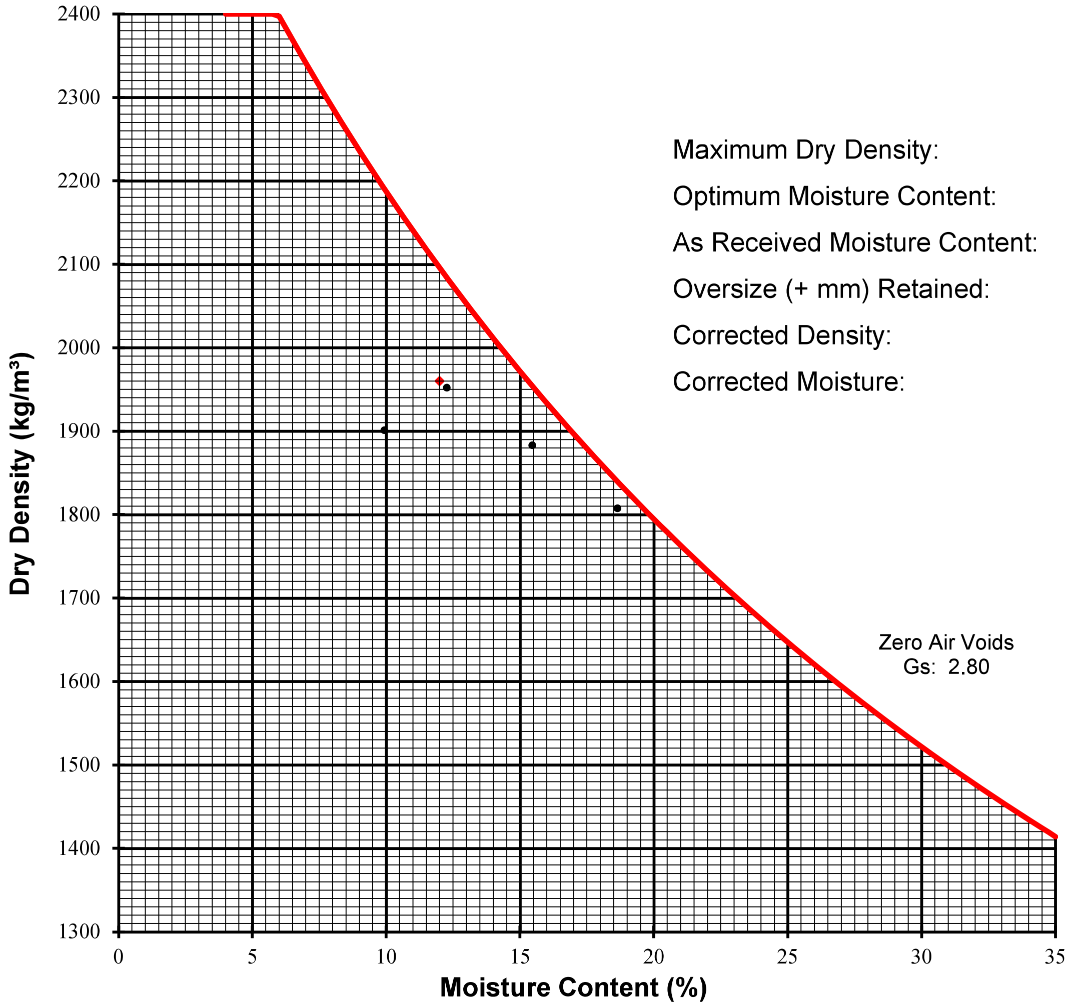
Reviewed By: ______________________ P.Eng.

TETRA TECH

MOISTURE-DENSITY RELATIONSHIP (Proctor) REPORT

ASTM D698 Standard

Project:	2022 Keno DSTF Tailings	Sample No.:	SA15
Client:	Alexco Keno Hill Mining	Sampled By:	Client
Attention:	Peter Johnson	Sample Date:	May 31, 2022
Project No.:	ENG.WARC04181-01	Test Date:	June 10, 2022
Description:	SILT and SAND - some clay	Preparation:	Moist
Source:	Dry Stack Tailings Facility	Compaction:	Manual



Maximum Dry Density:	**1960**	kg/m³
Optimum Moisture Content:	**12.0**	%
As Received Moisture Content:		%
Oversize (+ mm) Retained:		%
Corrected Density:		%
Corrected Moisture:	**12.0**	%

Remarks: -

Reviewed By: ____________________ P.Eng.

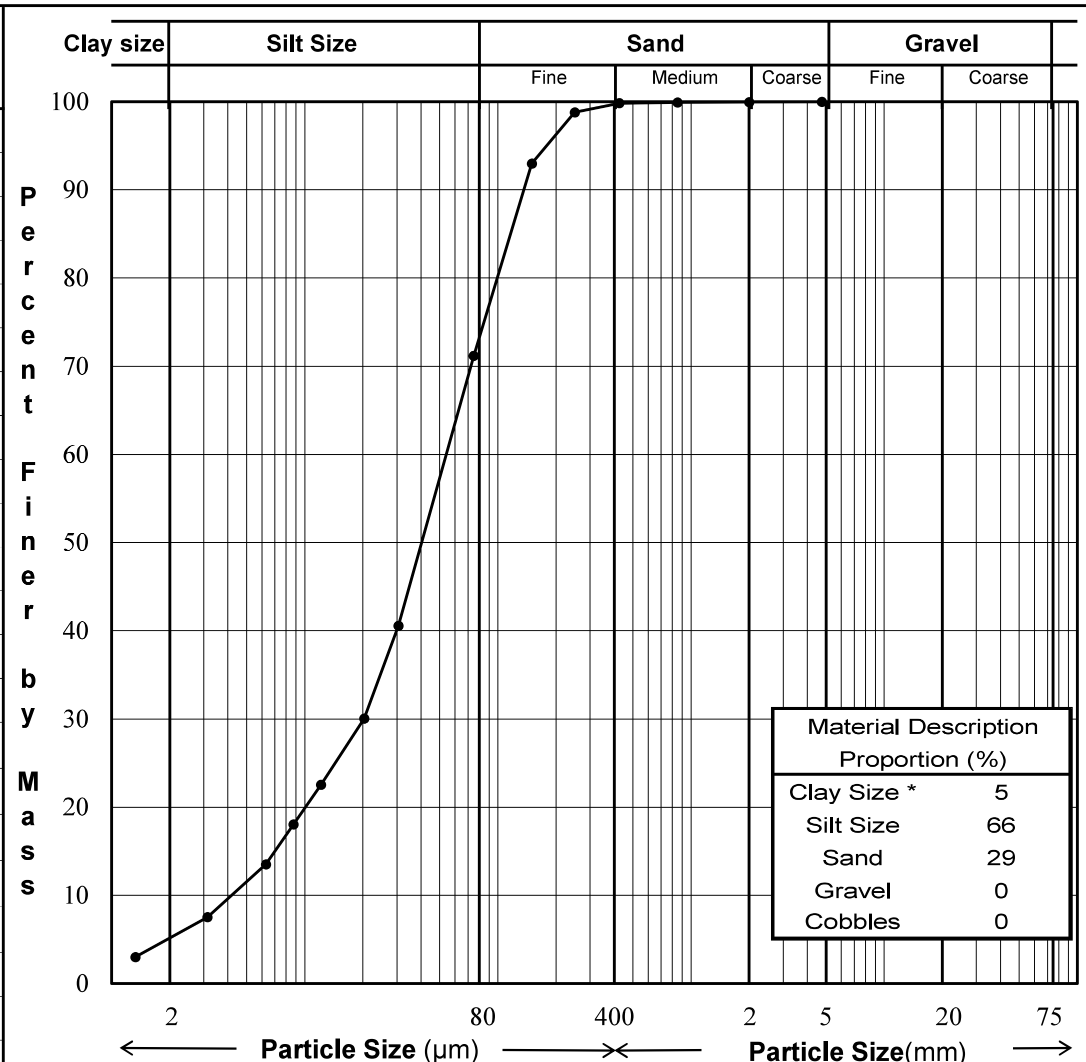
TETRA TECH

PARTICLE SIZE ANALYSIS (Hydrometer) TEST REPORT

ASTM D7928 †

Project:	2022 Keno DSTF Tailings Characterization	Sample No.:	1948
Client:	Alexco Keno Hill Mining Corp.	BH Location:	
Project No.:	ENG.WARC04181-01	Depth:	
Location:	Dry Stack Tailings Facility	Date Tested	April 13, 2022
Description **:	SILT, sandy, trace clay, grey	Tested By:	OO

Particle Size	Percent Passing
100 mm	
75 mm	
50 mm	
37.5 mm	
25 mm	
19 mm	
12.5 mm	
9.5 mm	
4.75 mm	100
2.0 mm	100
850 µm	100
425 µm	100
250 µm	99
150 µm	93
75 µm	71
31 µm	41
20 µm	30
12 µm	23
9 µm	18
6 µm	14
3 µm	8
1 µm	3



Material Description	Proportion (%)
Clay Size *	5
Silt Size	66
Sand	29
Gravel	0
Cobbles	0

Remarks: † Unless expressly stated, this test was performed by the Air Dry Method
* The upper clay size of 2 um, per the Canadian Foundation Engineering Manual
** The description is behaviour based & subject to Tetra Tech description protocols.

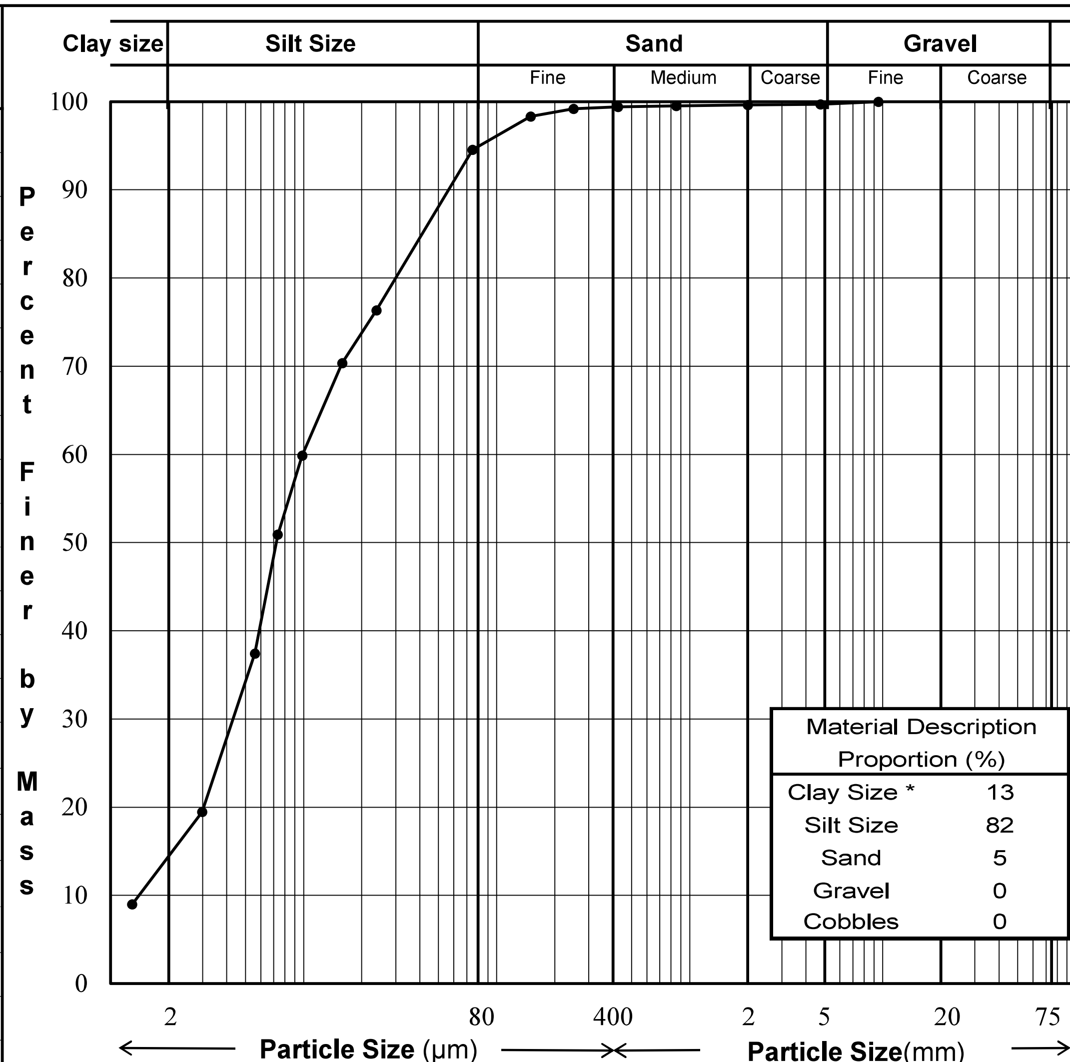
Reviewed By: ______________ P.Eng.

PARTICLE SIZE ANALYSIS (Hydrometer) TEST REPORT

ASTM D7928 †

Project:	2022 Keno DSTF Tailings Characterization	Sample No.:	1950
Client:	Alexco Keno Hill Mining Corp.	BH Location:	
Project No.:	ENG.WARC04181-01	Depth:	
Location:	Dry Stack Tailings Facility	Date Tested	April 14, 2022
Description **:	SILT, some clay, trace sand, grey	Tested By:	OO

Particle Size	Percent Passing
100 mm	
75 mm	
50 mm	
37.5 mm	
25 mm	
19 mm	
12.5 mm	
9.5 mm	100
4.75 mm	100
2.0 mm	100
850 µm	100
425 µm	99
250 µm	99
150 µm	98
75 µm	95
24 µm	76
16 µm	70
10 µm	60
7 µm	51
6 µm	37
3 µm	19
1 µm	9



Material Description	Proportion (%)
Clay Size *	13
Silt Size	82
Sand	5
Gravel	0
Cobbles	0

Remarks: † Unless expressly stated, this test was performed by the Air Dry Method
* The upper clay size of 2 um, per the Canadian Foundation Engineering Manual
** The description is behaviour based & subject to Tetra Tech description protocols.

Reviewed By: ____________ P.Eng.

CTT

ANALYSIS REPORT
SCC Accreditation No.: 40‡

Mr. Ian MacIntyre	Date: February 14, 2024
Tetra Tech	Report: 6710-001S-1A-en

IDENTIFICATION: Interface test #1: Tailings Vs GTX Non-woven
Project: 704-ENV.WARC 04415-09
Tailings received on January 03, 2024
Received: January 9, 2024

STANDARD:

TEST: Shear Strength of Soil-Geosynthetic and Geosynthetic-Geosynthetic Interfaces by Direct Shear — ASTM D5321/D5321M-21

TEST CONDITIONS:
Shear surface 304 x 304 mm;
Data acquisition period (seconds): 6.00
Flat surfaces grips fixed with 4 bolts + rasp surface in lower box and upper box ;
Normal load: Micro-Stepper Motor
Rate of horizontal displacement(mm/min); 0.2
Tested in machine direction ;
Submerged interface ;
Thickness: 5 measurements per specimen according to ASTM D5199 (Non-woven Geotextile);
Mass per unit area: 1 measurement per specimen according to ASTM D5261 (Non-woven Geotextile);
Testing configuration - Upper box / Lower box: Tailings / Non-woven Geotextile
Date of test: between January 24 and February 6, 2024

RESULTS:

	Individual Data		
Normal Compressive Pressure (kPa):	102.4	201.7	400.4
GEOTEXTILE PROPERTIES			
Mass per unit area of the geosynthetic estimated basing on the weight of the specimen (g/m²):	302	293	279
Specimen thickness (mils):	76	70	70
PROPERTIES OF THE SOIL			
Water content of compaction (%):	15.5	15.1	15.3
Dry unit weight after compaction (kg/m³):	1860	1880	1870
Duration of the consolidation (hours):	16	16	16
TEST RESULTS			
Peak shear stress (kPa):	84.4	150.7	308.2

Prepared by: Marlon Bustos, M.Eng.
Technician

Approved by: Omar Kamla, Eng.
Project Leader

Date: February 14, 2024

***** Any question regarding this report or its authenticity? Please contact Omar Kamla *****

ANALYSIS REPORT
SCC Accreditation No.: 40‡

Mr. Ian MacIntyre
Tetra Tech

Date: February 14, 2024
Report: 6710-001S-1A-en

IDENTIFICATION: Interface test #1: Tailings Vs GTX Non-woven
Project: 704-ENV.WARC 04415-09
Tailings received on January 03, 2024
Received: January 9, 2024

STANDARD:

TEST: Shear Strength of Soil-Geosynthetic and Geosynthetic-Geosynthetic Interfaces by Direct Shear — ASTM D5321/D5321M-21

RESULTS (CONT):

	Individual Data		
Shear stress at large displacement (kPa):	64.1	108.7	241.2
Estimated peak angle of friction (°):	37		
Estimated peak adhesion (kPa):	3.4		
Estimated angle of friction at large displacement (°):	30		
Estimated adhesion at large displacement (kPa):	0.0		

REMARKS: -The thickness of the soil layer was reduced to 40 mm to facilitate consolidation and minimize experimental problems.

Consolidation:
- 100kPa: 1 hour at 10kPa, 1 hour at 50kPa, 16 hours at 100kPa.
- 200kPa: 1 hour at 10kPa, 1 hour at 50kPa, 1 hour at 100kPa, 16 hours at 200kPa.
- 400kPa: 1 hour at 10kPa, 1 hour at 50kPa, 1 hour at 100kPa, 1 hour at 200kPa, 16 hours at 400kPa.

- See graphs and pictures in appendix.

Prepared by: Marlon Bustos, M.Eng., Technician

Approved by: Omar Kamla, Eng., Project Leader

Date: February 14, 2024

***** Any question regarding this report or its authenticity? Please contact Omar Kamla *****

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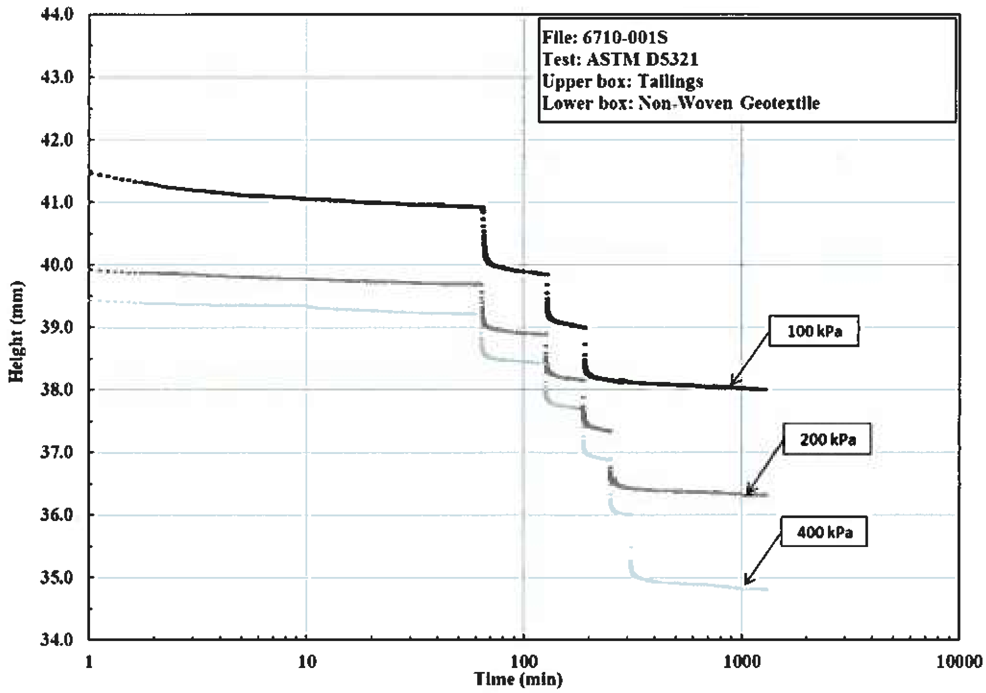
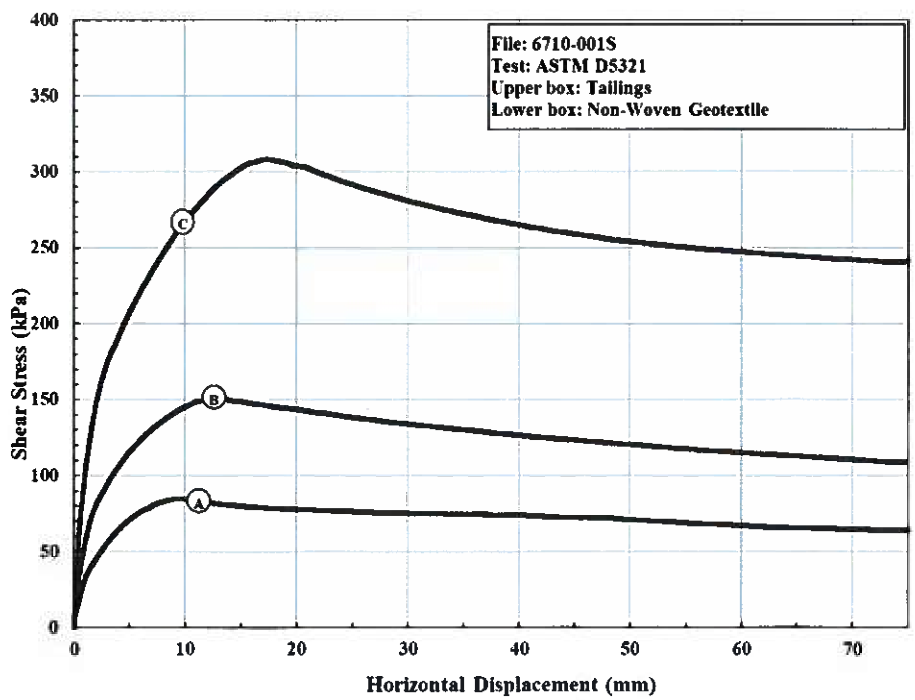
APPENDIX
Graphs

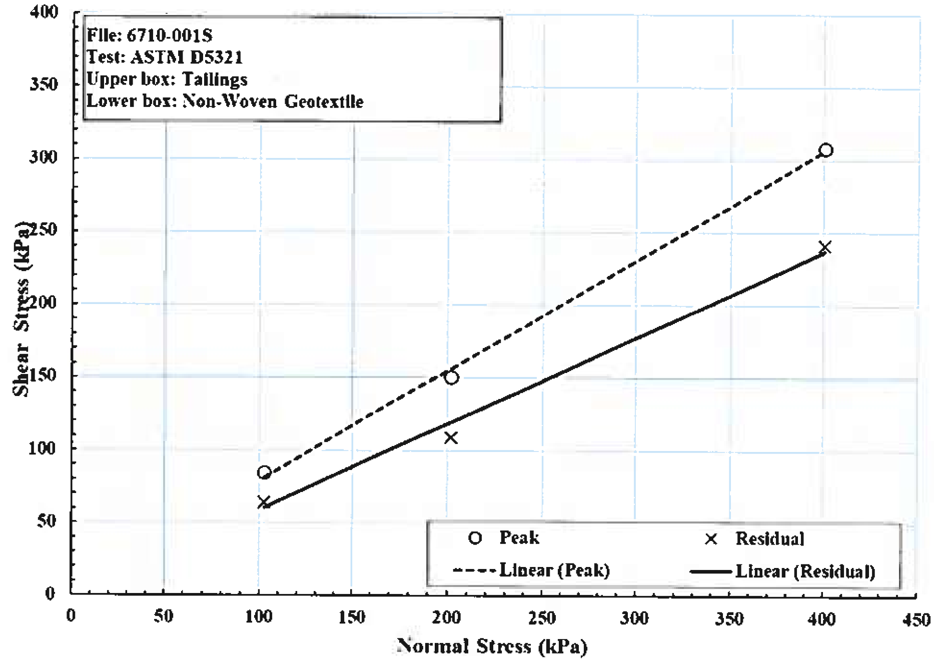


Consolidation curve



Shear Stress *vs* Horizontal Displacement

File: 6710-001S



Shear Stress *vs* Normal Stress

Groupe CTT Inc.
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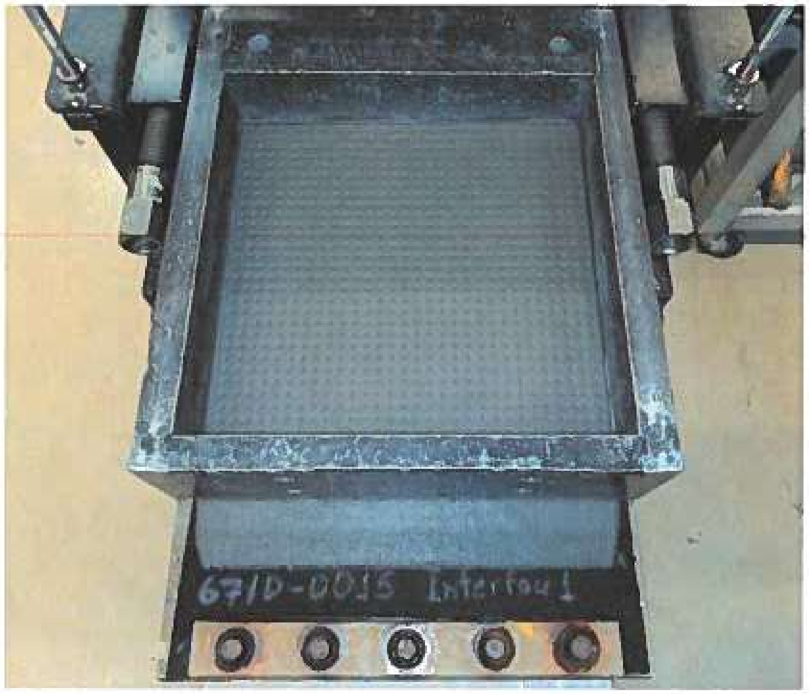
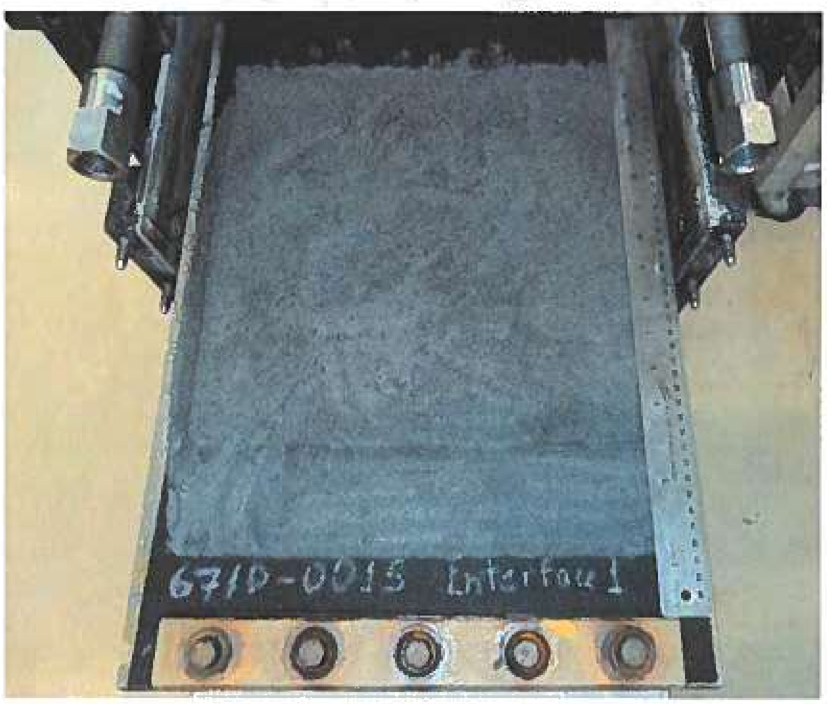
File: 6710-001S

Pictures

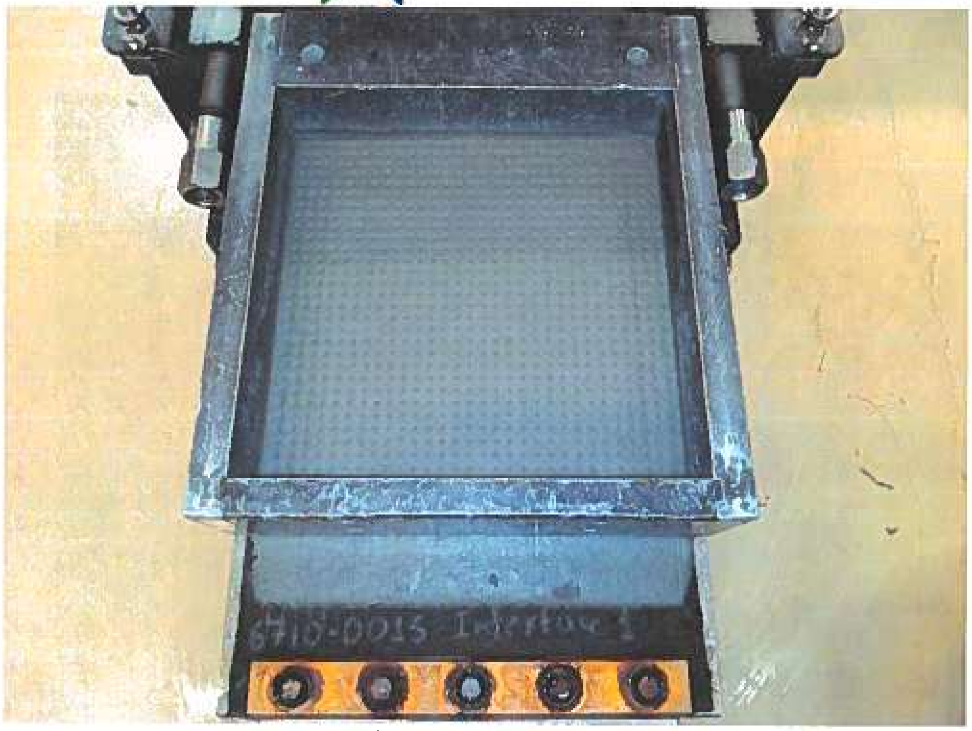


Interface #1 - Test at 100kPa

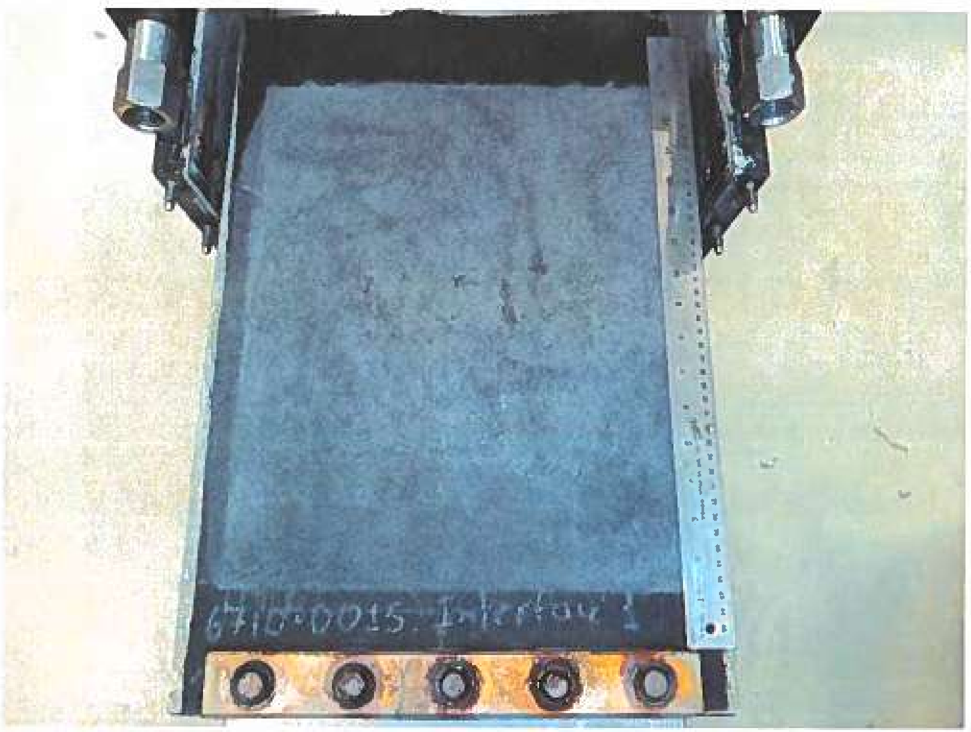


Non-woven Geotextile after the test – Test at 100kPa

Groupe CTT Inc.
3000, avenue Boullé, St-Hyacinthe, QC, Canada, J2S 1H9
T.:(+1) 877 288-8378

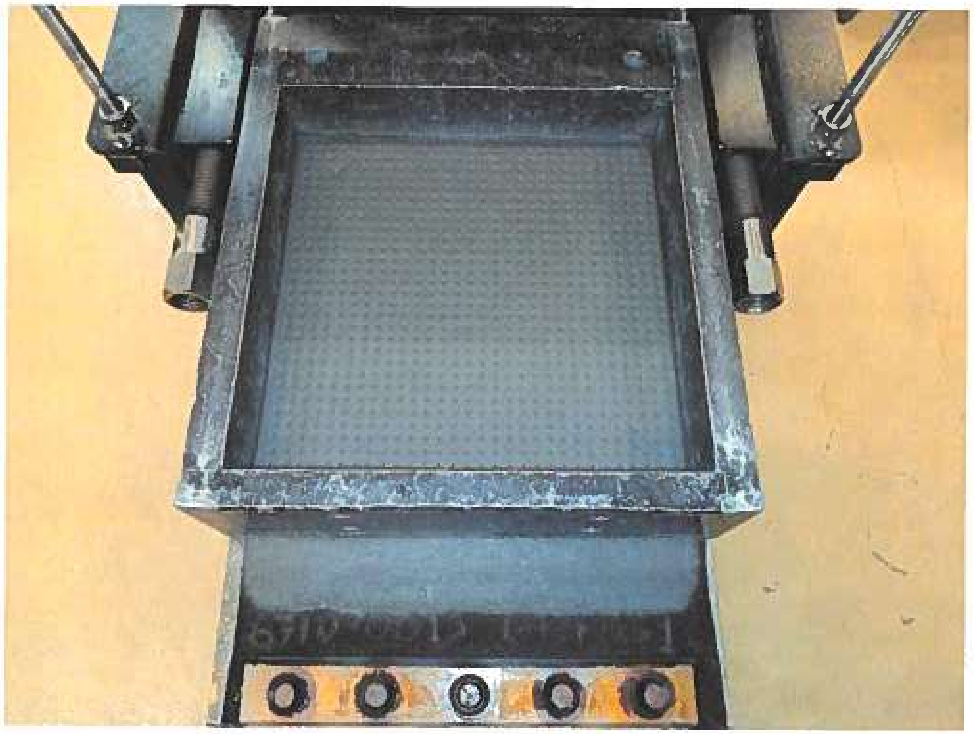


Interface #1 - Test at 200kPa

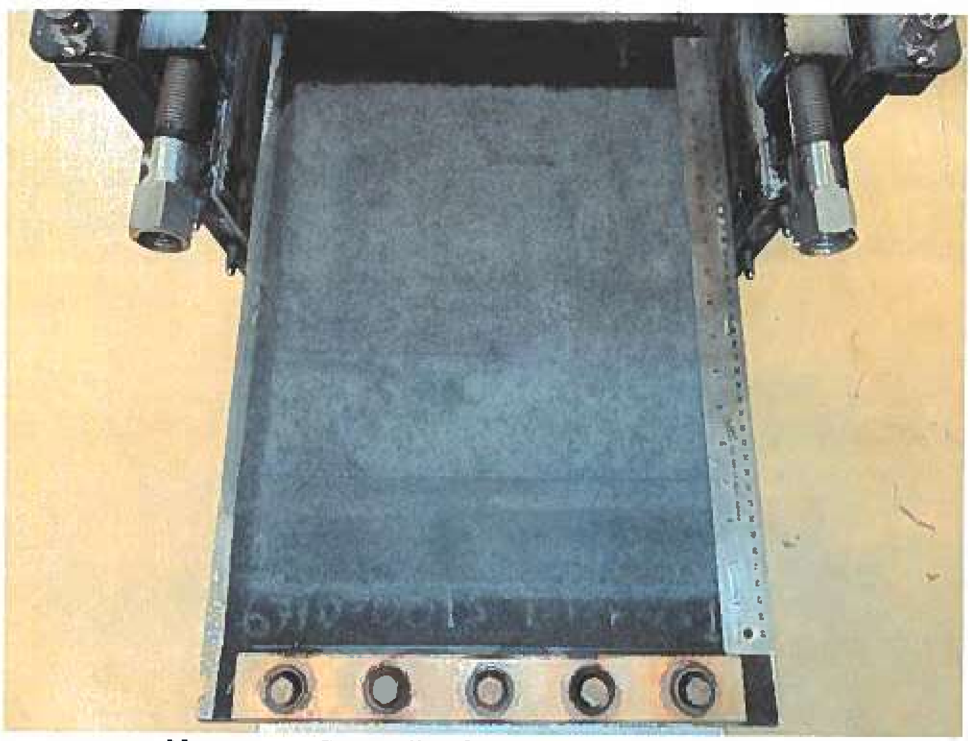


Non-woven Geotextile after the test – Test at 200kPa

Groupe CTT Inc.
3000, avenue Boullé, St-Hyacinthe, QC, Canada, J2S 1H9
T.:(+1) 877 288-8378



Interface #1 - Test at 400kPa



Non-woven Geotextile after the test – Test at 400kPa

CTT

ANALYSIS REPORT
SCC Accreditation No.: 40‡

Mr. Ian MacIntyre
Tetra Tech

Date: February 14, 2024
Report: 6710-001S-2A-en

IDENTIFICATION:	Interface test #2: GTX Non-woven Vs Geonet Hydranet 220 # GN000131 Project: 704-ENV.WARC 04415-09 Received: January 9, 2024
STANDARD:	
TEST:	Shear Strength of Soil-Geosynthetic and Geosynthetic-Geosynthetic Interfaces by Direct Shear — ASTM D5321/D5321M-21
TEST CONDITIONS:	Shear surface 304 x 304 mm; Data acquisition period (seconds): 0.24 Flat surfaces grips fixed with 4 bolts + rasp surface in lower box and upper box ; Normal load: Micro-Stepper Motor Rate of horizontal displacement(mm/min): 5 Tested in machine direction ; Submerged interface ; Thickness: 5 measurements per specimen according to ASTM D5199 (Non-woven Geotextile and Geonet); Mass per unit area: 1 measurement per specimen according to ASTM D5261 (Non-woven Geotextile); Testing configuration - Upper box / Lower box: Non-woven Geotextile / Geonet Date of test: January 19, 2024

RESULTS:

	Individual Data		
Normal Compressive Pressure (kPa):	101.9	198.9	397.6
GEOTEXTILE PROPERTIES			
Mass per unit area of the geosynthetic estimated basing on the weight of the specimen (g/m²):	261	293	301
Specimen thickness (mils):	71	73	74
GEONET PROPERTIES			
Specimen thickness (mils):	197	196	195
Duration of the consolidation (hours):	1	1	1
TEST RESULTS			
Peak shear stress (kPa):	31.2	65.3	154.6
Shear stress at large displacement (kPa):	23.5	49.8	92.1

Prepared by: Marlon Bustos, M.Eng., Technician

Approved by: Omar Kamla, Eng., Project Leader

Date: February 14, 2024

***** Any question regarding this report or its authenticity? Please contact Omar Kamla *****

ANALYSIS REPORT
SCC Accreditation No.: 40‡

Mr. Ian MacIntyre
Tetra Tech

Date: February 14, 2024
Report: 6710-001S-2A-en

IDENTIFICATION:	Interface test #2: GTX Non-woven Vs Geonet Hydranet 220 # GN000131 Project: 704-ENV.WARC 04415-09 Received: January 9, 2024	
STANDARD:		
TEST:	Shear Strength of Soil-Geosynthetic and Geosynthetic-Geosynthetic Interfaces by Direct Shear	ASTM D5321/D5321M-21

RESULTS (CONT): Individual Data

Estimated peak angle of friction (°):	20
Estimated peak adhesion (kPa):	0.0
Estimated angle of friction at large displacement (°):	12
Estimated adhesion at large displacement (kPa):	1.8

REMARKS: - See graphs and pictures in Appendix.

Prepared by:
Marlon Bustos, M.Eng.
Technician

Approved by:
Omar Kamla, Eng.
Project Leader

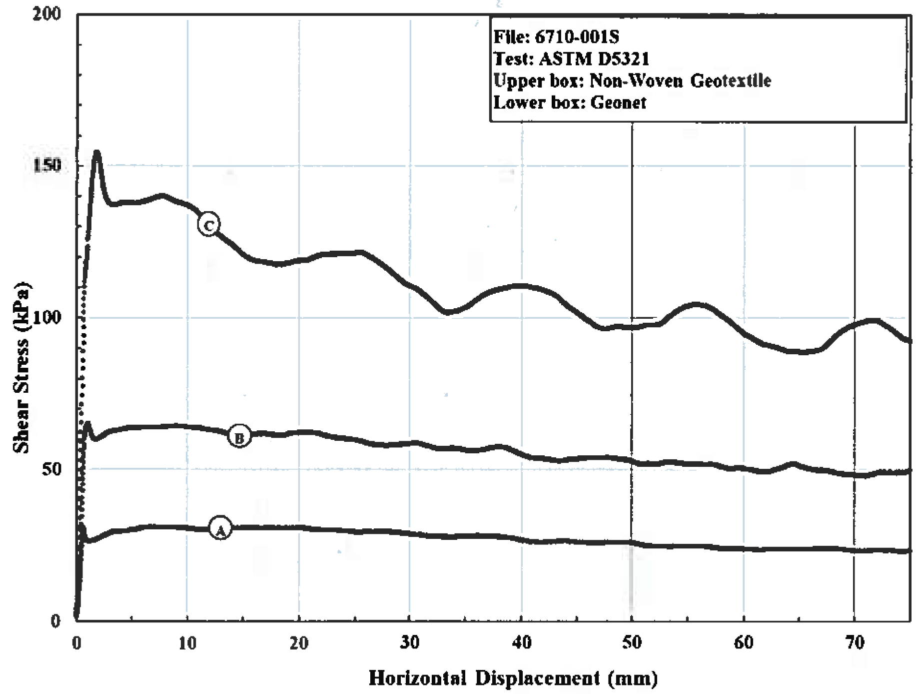
Date: February 14, 2024

***** Any question regarding this report or its authenticity? Please contact Omar Kamla *****

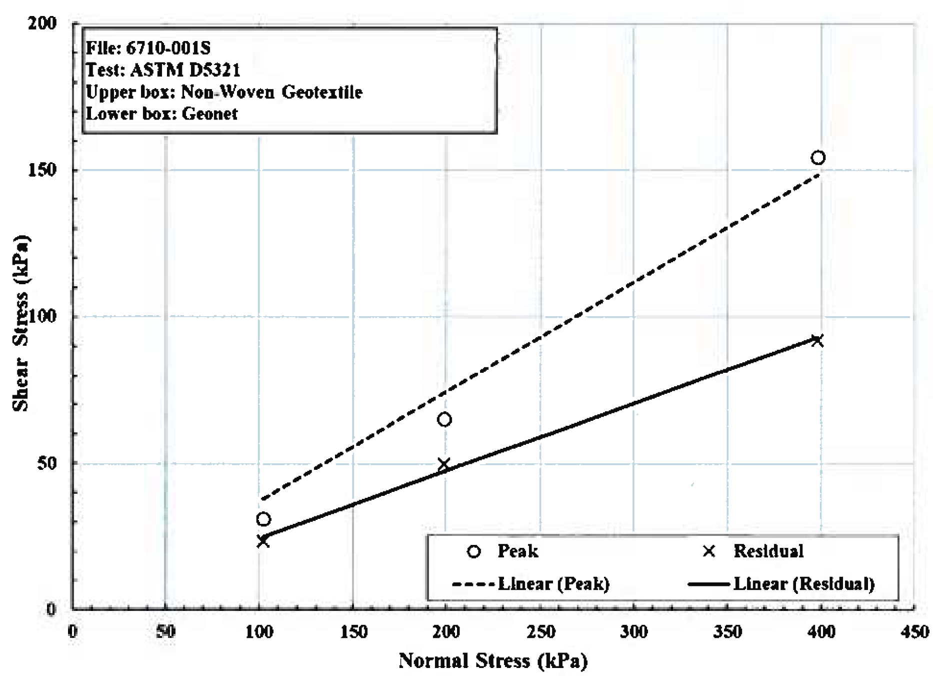
File: 6710-001S

APPENDIX

Graphs



Shear Stress *vs* Horizontal Displacement

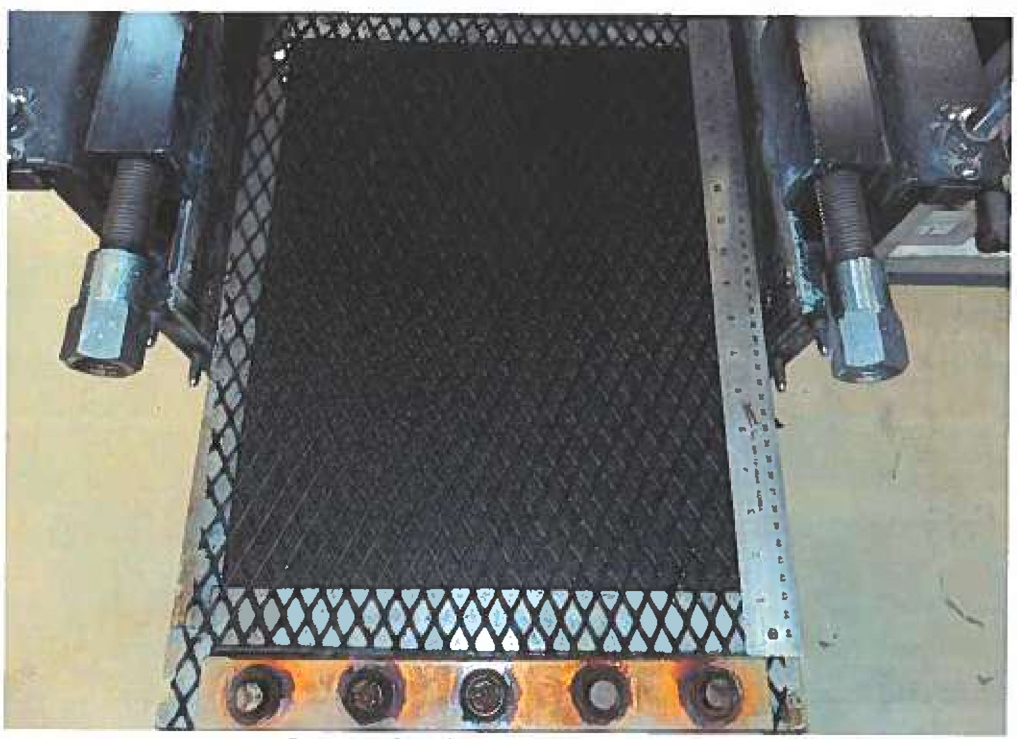


Shear Stress *vs* Normal Stress

File: 6710-001S

Pictures

Non-woven Geotextile after the test – Test at 100kPa



Geonet after the test – Test at 100kPa

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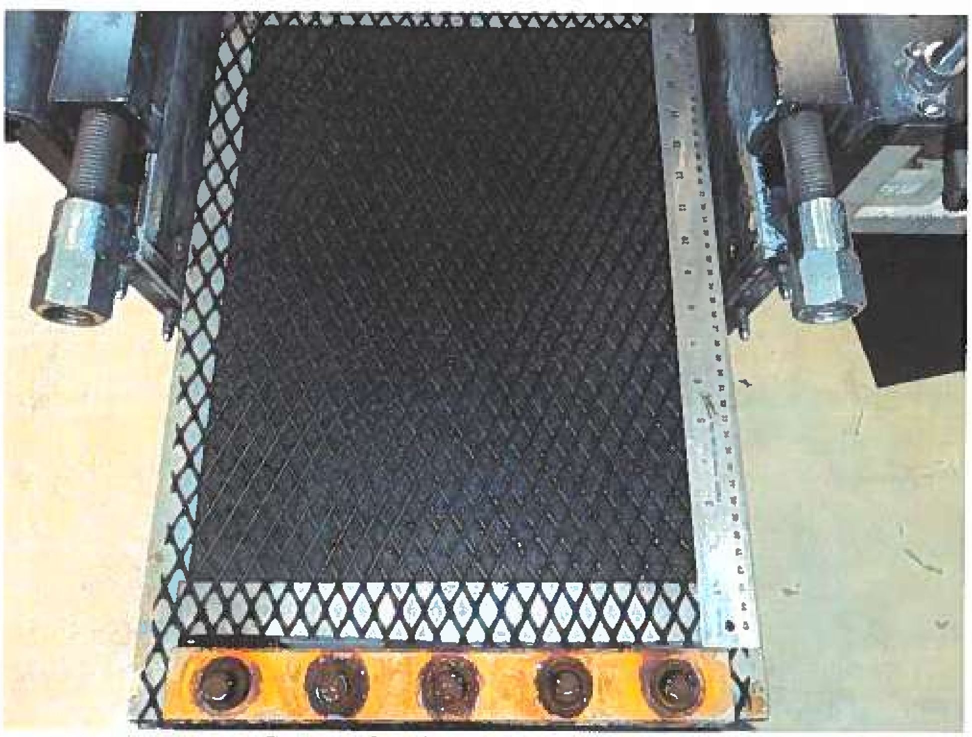
Non-woven Geotextile after the test – Test at 200kPa

Geonet after the test – Test at 200kPa

Non-woven Geotextile after the test – Test at 400kPa


Geonet after the test – Test at 400kPa

CTT

ANALYSIS REPORT
SCC Accreditation No.: 40‡

Mr. Ian MacIntyre
Tetra Tech

Date: February 14, 2024
Report: 6710-001S-3A-en

IDENTIFICATION:	Interface test #3: Geonet Hydranet 220 # GN000131 Vs GCL Bentomat ST #10 Project: 704-ENV.WARC 04415-09 Geonet received on January 09, 2024 Received: January 19, 2024
STANDARD:	
TEST:	Internal and Interface Shear Resistance of Geosynthetic Clay Liner by the Direct Shear Method — ASTM D6243/D6243M-20 Proc. B
TEST CONDITIONS:	Shear surface 304 x 304 mm; Data acquisition period (seconds): 1.20 Hydratation of the GCL: 24 hours under 10 kPa, prior to consolidation ; Flat surfaces grips fixed with 4 bolts + rasp surface in lower box and upper box ; Normal load: Micro-stepper motor Rate of horizontal displacement(mm/min): 1 Tested in machine direction ; Submerged interface ; Testing configuration - Upper box / Lower box: Geonet Hydranet 220 / GCL Bentomat ST#10 (Non-woven side) Date of test: from February 7 to 13, 2024

RESULTS:	Individual Data			Avg.	S.D.	% CV
Normal Compressive Pressure (kPa):	101.5	200.8	399.5			
TESTS RESULTS	:					
Maximum Shear Stress (kPa):	41.9	77.0	180.5			
Residual Shear Stress (kPa):	39.9	72.9	137.0			
Estimated Maximum angle of friction (°):	23					
Estimated Maximum adhesion (kPa):	0.0					
Estimated Residual angle of friction (°):	18					
Estimated Residual adhesion (kPa):	7.1					

REMARKS: - See graphs and pictures in Appendix.

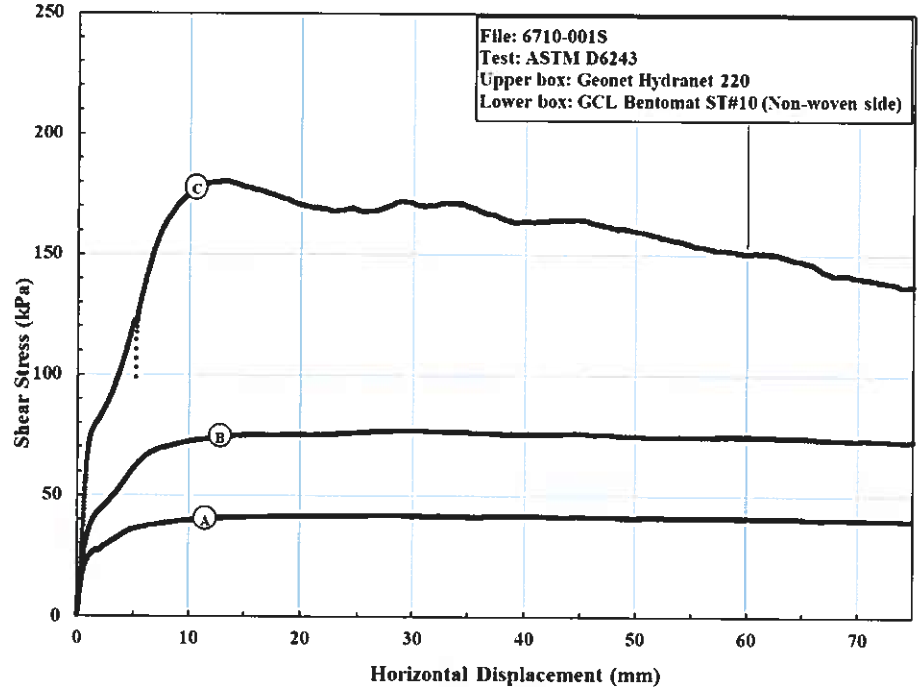
Prepared by: Marlon Bustos, M.Eng. Technician

Approved by: Omar Kamla, Eng. Project Leader

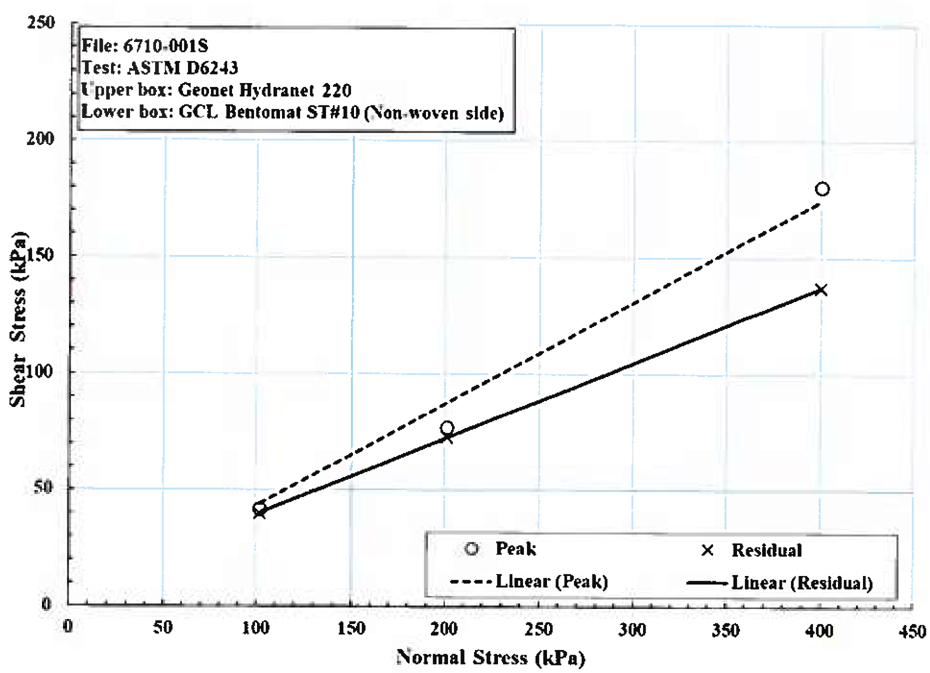
Date: February 14, 2024

***** Any question regarding this report or its authenticity? Please contact Omar Kamla *****

APPENDIX
Graphs



Shear Stress *vs* Horizontal Displacement



Shear Stress *vs* Normal Stress

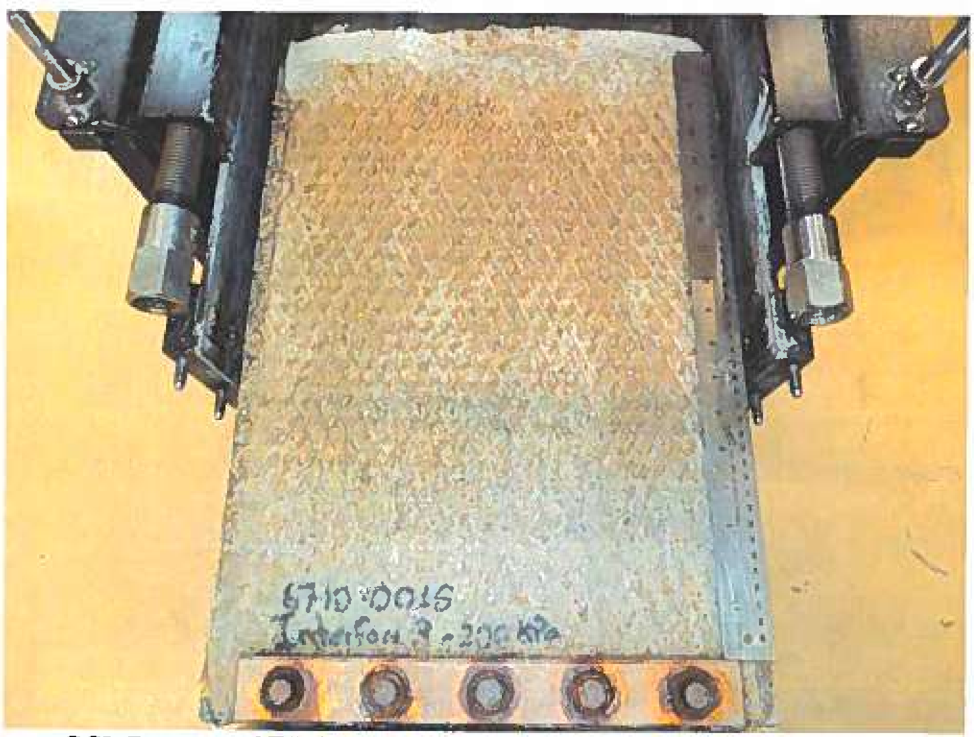
CTT

Pictures

Geonet Hydranet 220 after the test - Test at 100kPa

GCL Bentomat ST#10 (non-woven side) after the test – Test at 100kPa

Geonet Hydranet 220 after the test - Test at 200kPa



GCL Bentomat ST#10 (non-woven side) after the test – Test at 200kPa

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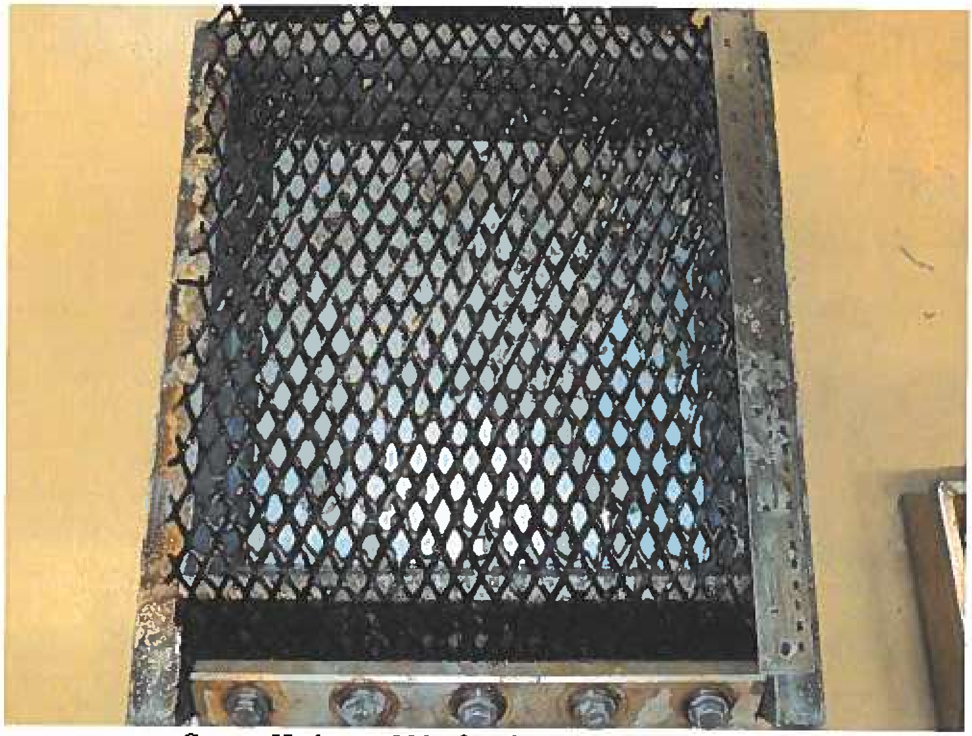

Geonet Hydranet 220 after the test - Test at 400kPa

GCL Bentomat ST#10 (non-woven side) after the test – Test at 400kPa

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ANALYSIS REPORT
SCC Accreditation No.: 40‡

Mr. Ian MacIntyre		Date:	February 19, 2024
Tetra Tech		Report:	6710-001S-4A-en

IDENTIFICATION: Interface test #4: GCL Bentomat ST #10 Vs Drainage blanket (Gravel, coarse soil "Dmax 16mm")
Project: 704-ENV.WARC 04415-09
Gravel received on January 03, 2024
Received: January 19, 2024

STANDARD:

TEST: Internal and Interface Shear Resistance of Geosynthetic Clay Liner by the Direct Shear Method — ASTM D6243/D6243M-20 Proc. C

TEST CONDITIONS:
Shear surface 304 x 304 mm;
Data acquisition period (seconds): 1.20
Hydratation of the GCL: 24 hours under 10 kPa, prior to consolidation ;
Flat surfaces grips fixed with 4 bolts + rasp surface in lower box and upper box ;
Normal load: Micro-Stepper Motor
Rate of horizontal displacement(mm/min): 1
Tested in machine direction ;
Submerged interface ;
Testing configuration - Upper box / Lower box: Drainage Blanket (Gravel) / GCL Bentomat ST #10 (woven side)
Date of test: from February 14 to 16, 2024

RESULTS:	Individual Data			Avg.	S.D.	% CV
Normal Compressive Pressure (kPa):	102.5	203.7	402.3			
PROPERTIES OF THE SOIL	:					
Water content of compaction (%):	6.3	6.5	6.2			
Dry unit weight after compaction (kg/m³):	2050	2060	2050			
Duration of the consolidation (hours):	4	4	4			
TESTS RESULTS	:					
Maximum Shear Stress (kPa):	58.5	131.8	212.0			
Residual Shear Stress (kPa):	23.7	34.8	45.1			
Estimated Maximum angle of friction (°):	26					
Estimated Maximum adhesion (kPa):	16.7					
Estimated Residual angle of friction (°):	3					
Estimated Residual adhesion (kPa):	18.3					

Prepared by: Marlon Bustos, M.Eng. Technician

Approved by: Omar Kamla, Eng. Project Leader

Date: February 19, 2024

***** Any question regarding this report or its authenticity? Please contact Omar Kamla *****

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SAGEOS CTT GROUP

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ANALYSIS REPORT
SCC Accreditation No.: 40‡

Mr. Ian MacIntyre
Tetra Tech

Date: February 19, 2024
Report: 6710-001S-4A-en

REMARKS: - See graphs and pictures in Appendix.

- Consolidation:
100 kPa: 1 hour at 50 kPa, 4 hours at 100 kPa.
200 kPa: 1 hour at 50 kPa, 1 hour at 100 kPa, 4 hours at 200 kPa.
400 kPa: 1 hour at 50 kPa, 1 hour at 100 kPa, 1 hour at 200 kPa, 4 hours at 400 kPa.

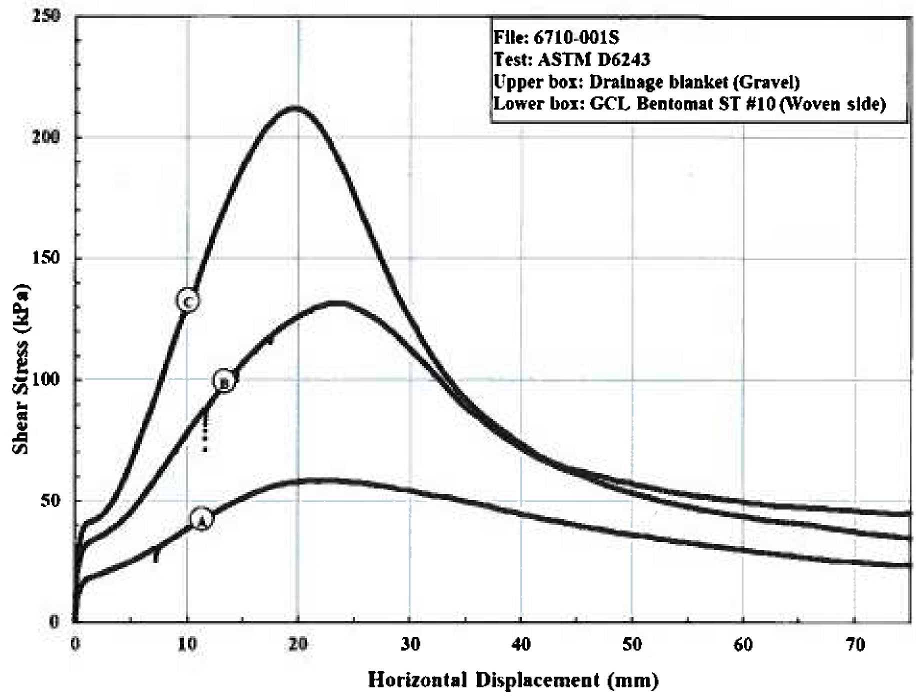
Prepared by: Marlon Bustos, M.Eng.
Technician

Approved by: Omar Kamla, Eng.
Project Leader

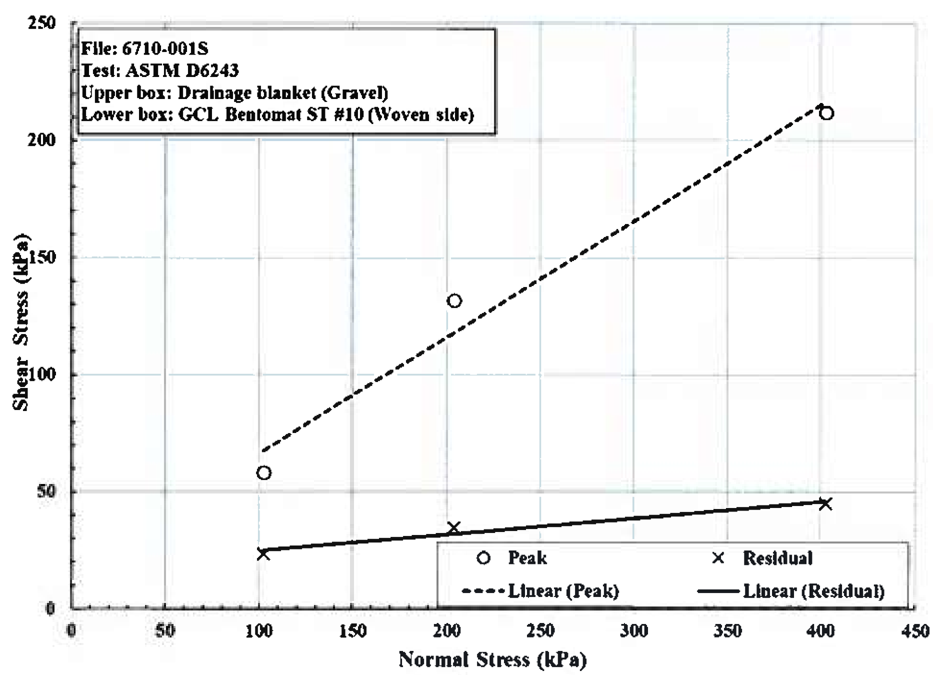
Date: February 19, 2024

***** Any question regarding this report or its authenticity? Please contact Omar Kamla *****

APPENDIX
Graphs



Shear Stress *vs* Horizontal Displacement

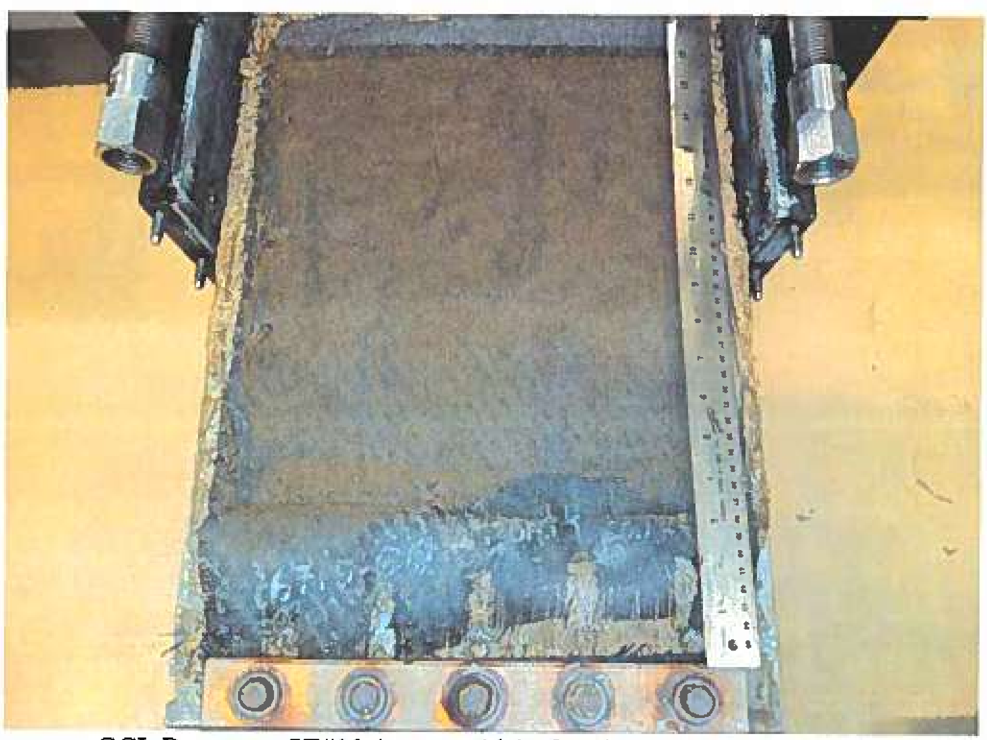


Shear Stress *vs* Normal Stress

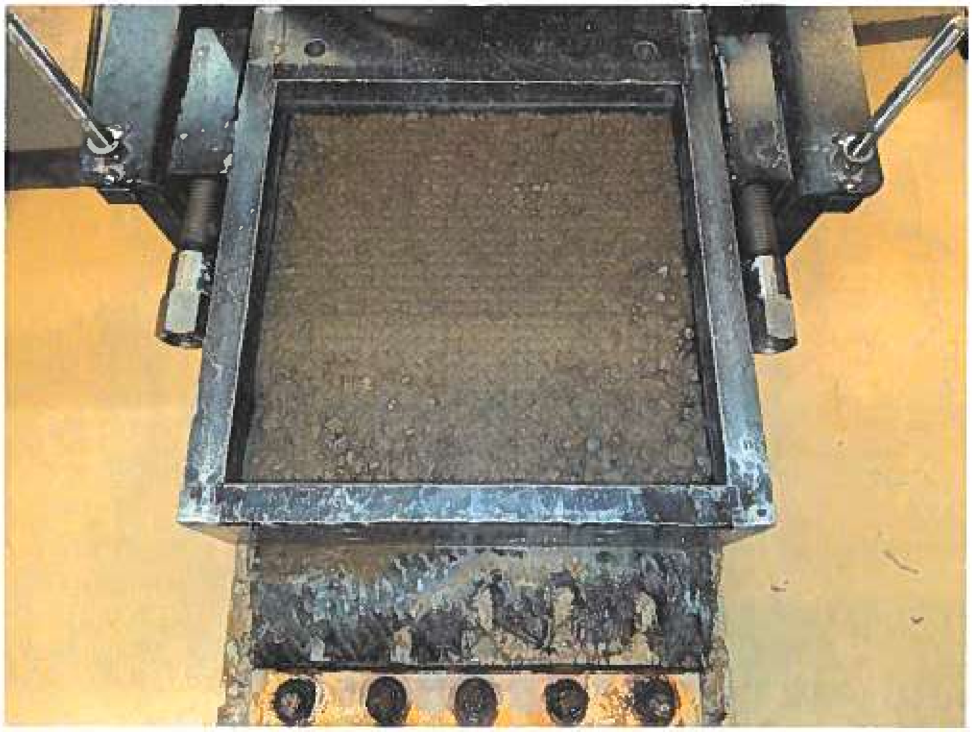
CTT

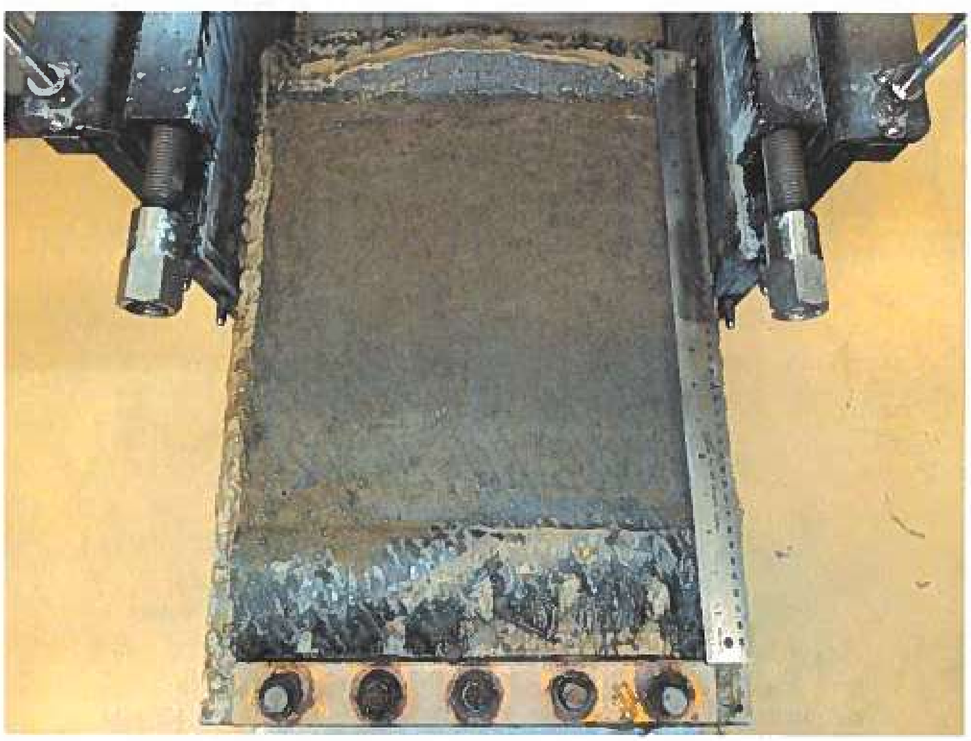
Pictures

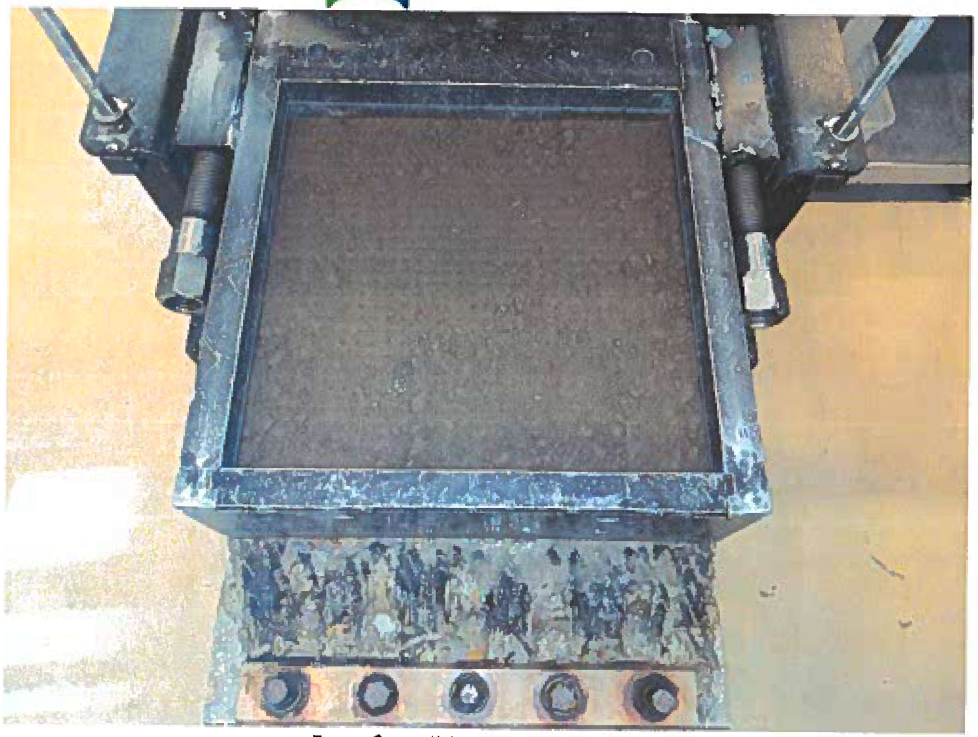
Interface #4 - Test at 100kPa



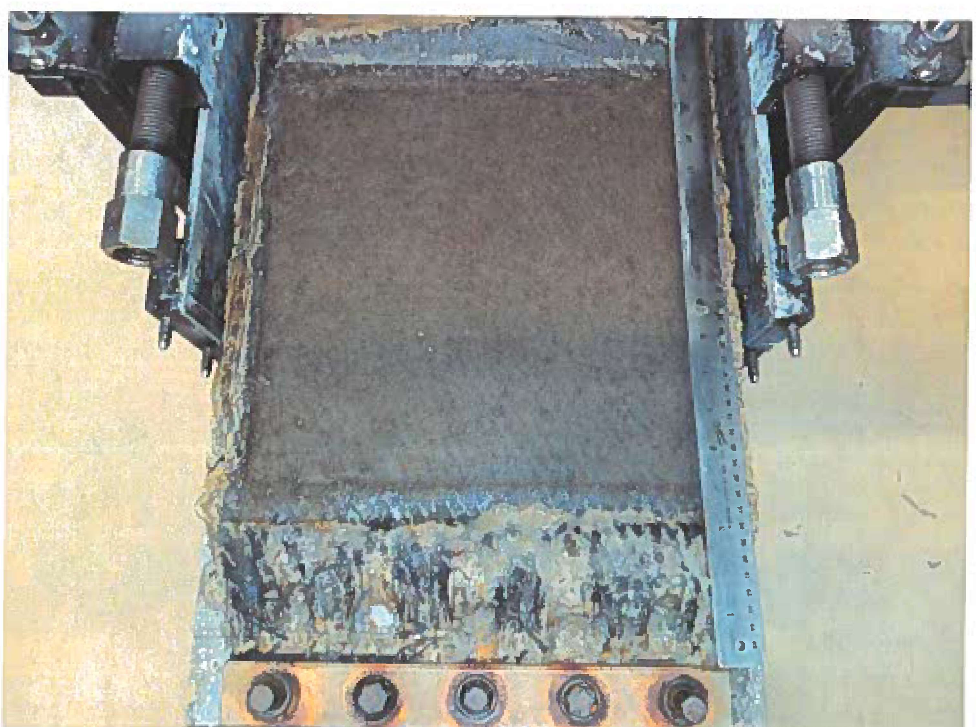
GCL Bentomat ST#10 (woven side) after the test – Test at 100kPa


Interface #4 - Test at 200kPa


GCL Bentomat ST#10 (woven side) after the test – Test at 200kPa



Interface #4 - Test at 400kPa



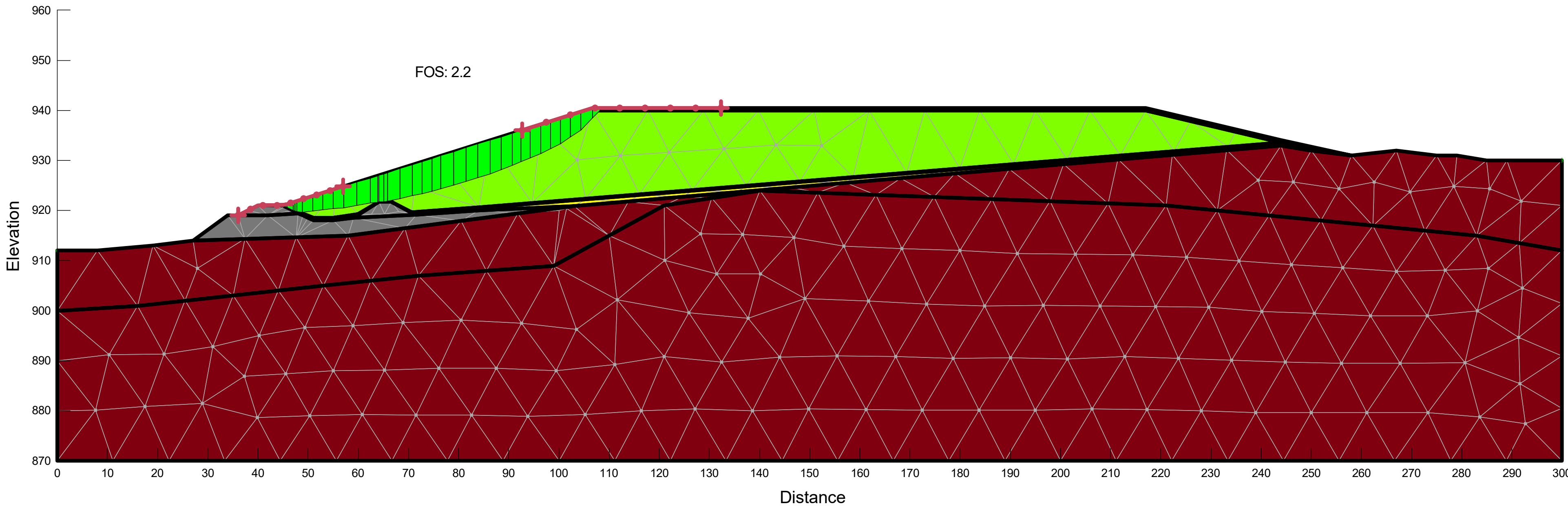
GCL Bentomat ST#10 (woven side) after the test – Test at 400kPa

APPENDIX E

STABILITY ANALYSIS RESULTS

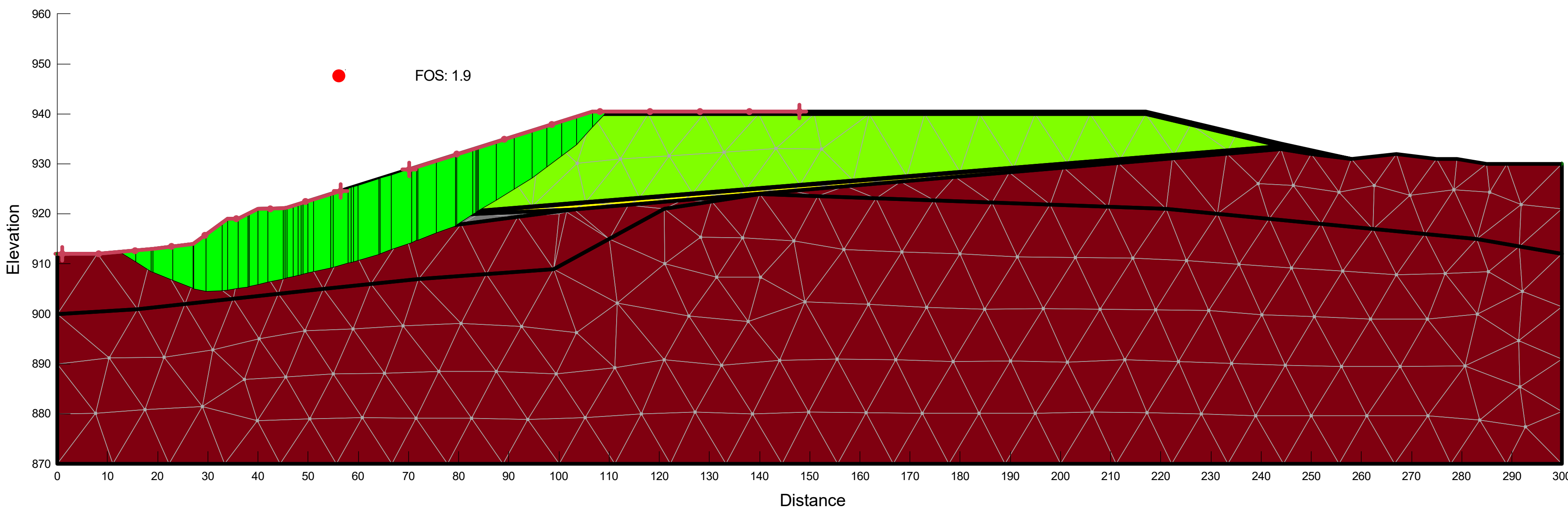
Name: A01 - Fully Frozen - Static Shallow
File Name: WARC04307-02_Section A_3.25-1Tails_Interior Berm_SG4-1-final.gsz
Method: Morgenstern-Price
Minimum Slip Surface Depth: 1 m
Horz Seismic Coef.:
Scale: 1:1,231

Color	Name	Slope Stability Material Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-B (°)
	Foundation Materials	Mohr-Coulomb	20	0	16	0
	Gravel Drainage Blanket	Mohr-Coulomb	24	0	35	0
	Loose Gravel Cover	Mohr-Coulomb	21.1	0	30	0
	Tailings	Mohr-Coulomb	22.5	8	30	0
	Till - Ice Rich	Mohr-Coulomb	11.8	0	30	0
	Waste Rock	Mohr-Coulomb	24	0	40	0



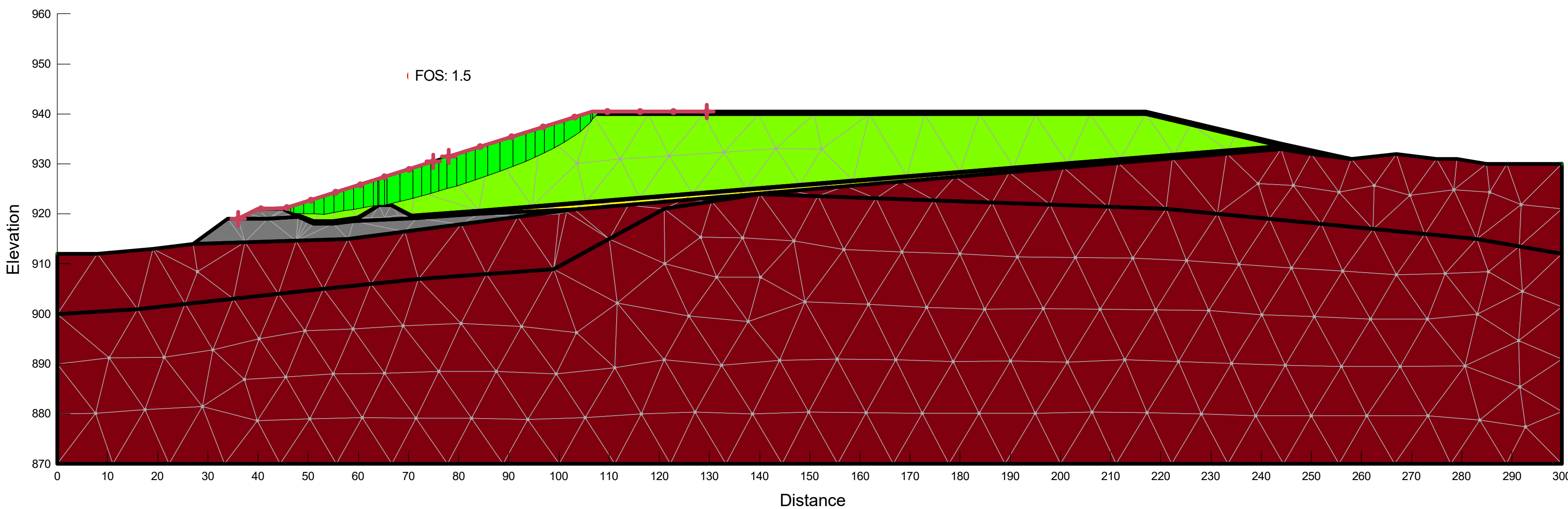
Name: A02 - Fully Frozen - Static Deep
File Name: WARC04307-02_Section A_3.25-1Tails_Interior Berm_SG4-1-final.gsz
Method: Morgenstern-Price
Minimum Slip Surface Depth: 5 m
Horz Seismic Coef.:
Scale: 1:1,231

Color	Name	Slope Stability Material Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-B (°)
Red	Foundation Materials	Mohr-Coulomb	20	0	16	0
Yellow	Gravel Drainage Blanket	Mohr-Coulomb	24	0	35	0
Light blue	Loose Gravel Cover	Mohr-Coulomb	21.1	0	30	0
Light green	Tailings	Mohr-Coulomb	22.5	8	30	0
Dark red	Till - Ice Rich	Mohr-Coulomb	11.8	0	30	0
Grey	Waste Rock	Mohr-Coulomb	24	0	40	0



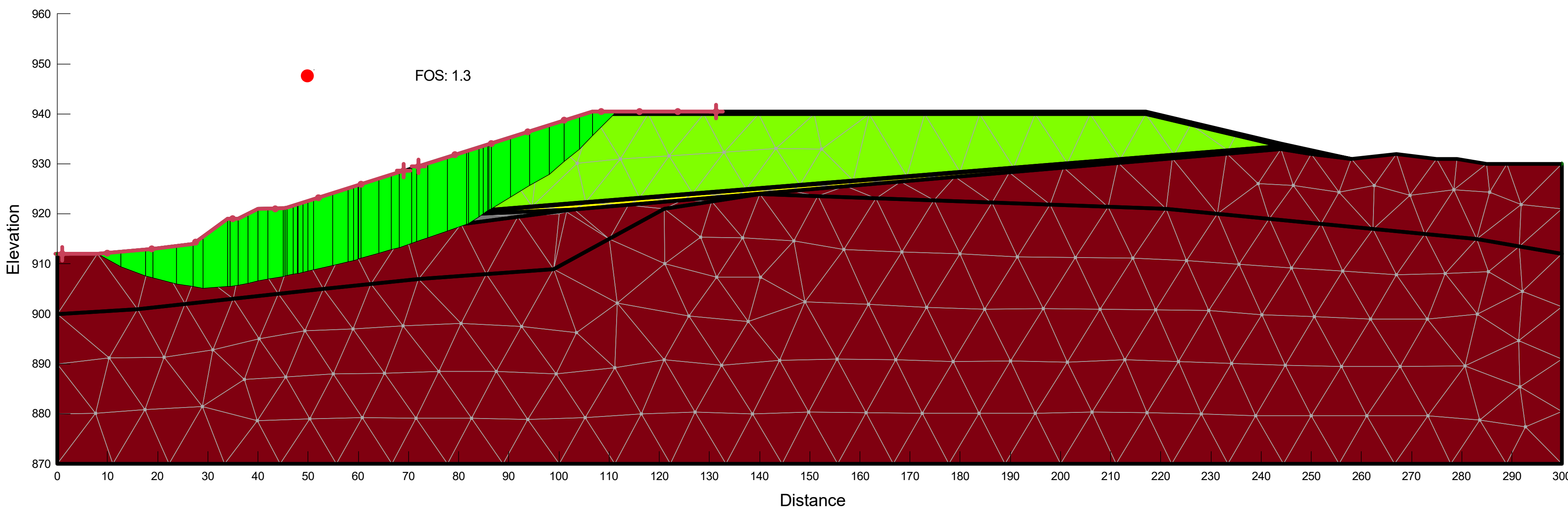
Name: A03 - Fully Frozen - Pseudostatic Shallow
File Name: WARC04307-02_Section A_3.25-1Tails_Interior Berm_SG4-1-final.gsz
Method: Morgenstern-Price
Minimum Slip Surface Depth: 1 m
Horz Seismic Coef.: 0.139
Scale: 1:1,231

Color	Name	Slope Stability Material Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-B (°)
	Foundation Materials	Mohr-Coulomb	20	0	16	0
	Gravel Drainage Blanket	Mohr-Coulomb	24	0	35	0
	Loose Gravel Cover	Mohr-Coulomb	21.1	0	30	0
	Tailings	Mohr-Coulomb	22.5	8	30	0
	Till - Ice Rich	Mohr-Coulomb	11.8	0	30	0
	Waste Rock	Mohr-Coulomb	24	0	40	0



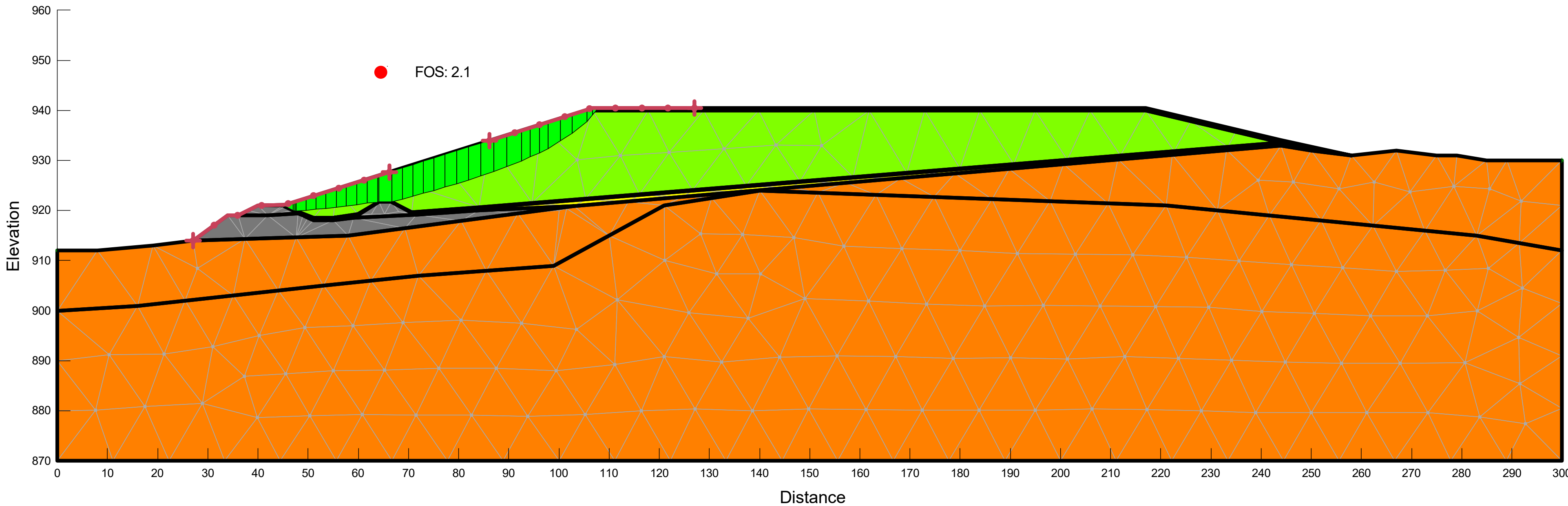
Name: A04 - Fully Frozen - Pseudostatic Deep
File Name: WARC04307-02_Section A_3.25-1Tails_Interior Berm_SG4-1-final.gsz
Method: Morgenstern-Price
Minimum Slip Surface Depth: 5 m
Horz Seismic Coef.: 0.139
Scale: 1:1,231

Color	Name	Slope Stability Material Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-B (°)
	Foundation Materials	Mohr-Coulomb	20	0	16	0
	Gravel Drainage Blanket	Mohr-Coulomb	24	0	35	0
	Loose Gravel Cover	Mohr-Coulomb	21.1	0	30	0
	Tailings	Mohr-Coulomb	22.5	8	30	0
	Till - Ice Rich	Mohr-Coulomb	11.8	0	30	0
	Waste Rock	Mohr-Coulomb	24	0	40	0



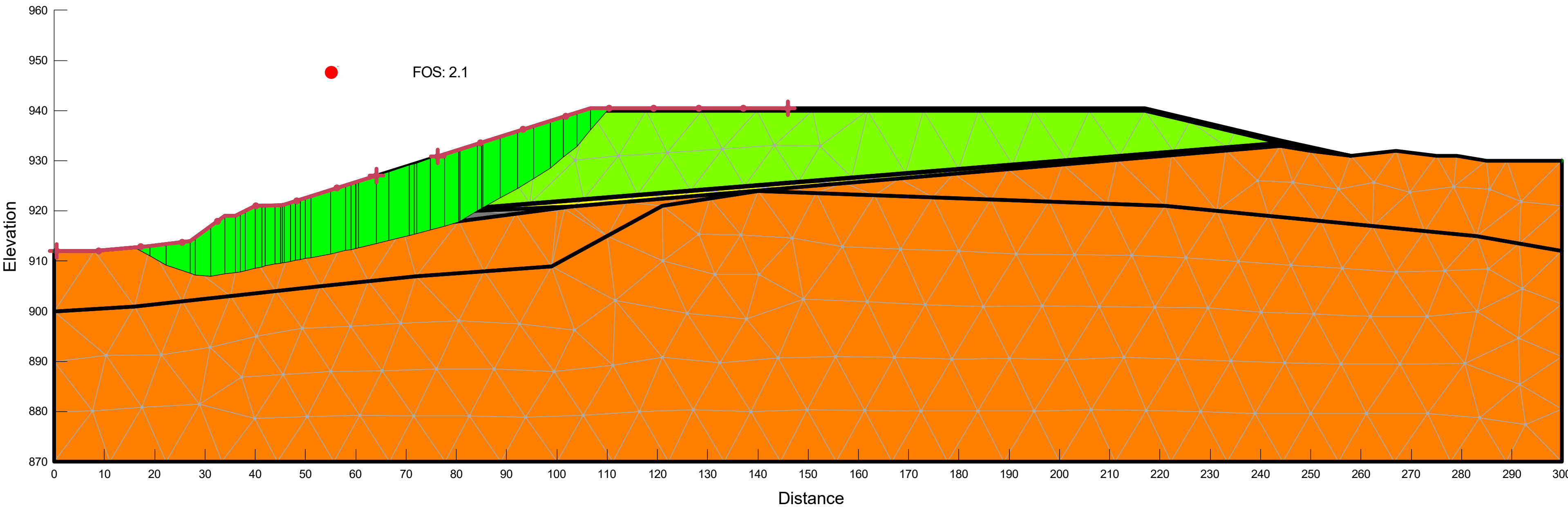
Name: A05 - Fully Thawed - Static Shallow
File Name: WARC04307-02_Section A_3.25-1Tails_Interior Berm_SG4-1-final.gsz
Method: Morgenstern-Price
Minimum Slip Surface Depth: 1 m
Horz Seismic Coef.:
Scale: 1:1,231

Color	Name	Slope Stability Material Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-B (°)
	Foundation Materials	Mohr-Coulomb	20	0	16	0
	Gravel Drainage Blanket	Mohr-Coulomb	24	0	35	0
	Loose Gravel Cover	Mohr-Coulomb	21.1	0	30	0
	Tailings	Mohr-Coulomb	22.5	8	30	0
	Till - Thawed	Mohr-Coulomb	19.1	0	30	0
	Waste Rock	Mohr-Coulomb	24	0	40	0



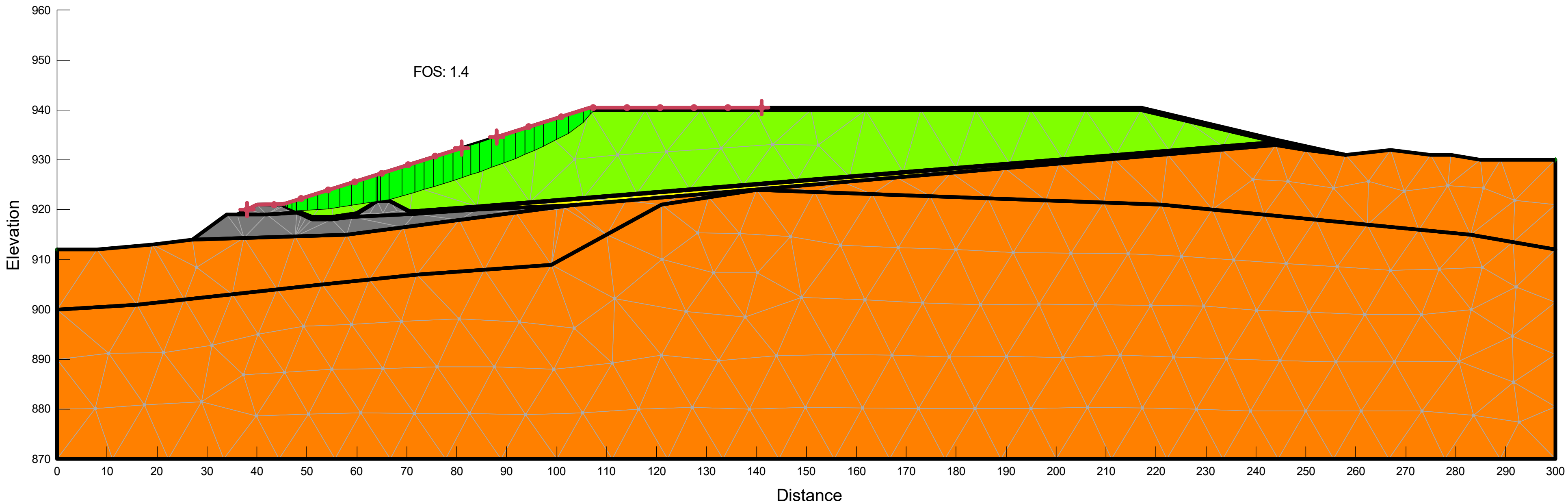
Name: A06 - Fully Thawed - Static Deep
File Name: WARC04307-02_Section A_3.25-1Tails_Interior Berm_SG4-1-final.gsz
Method: Morgenstern-Price
Minimum Slip Surface Depth: 5 m
Horz Seismic Coef.:
Scale: 1:1,231

Color	Name	Slope Stability Material Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-B (°)
Red	Foundation Materials	Mohr-Coulomb	20	0	16	0
Yellow	Gravel Drainage Blanket	Mohr-Coulomb	24	0	35	0
Light blue	Loose Gravel Cover	Mohr-Coulomb	21.1	0	30	0
Green	Tailings	Mohr-Coulomb	22.5	8	30	0
Orange	Till - Thawed	Mohr-Coulomb	19.1	0	30	0
Grey	Waste Rock	Mohr-Coulomb	24	0	40	0



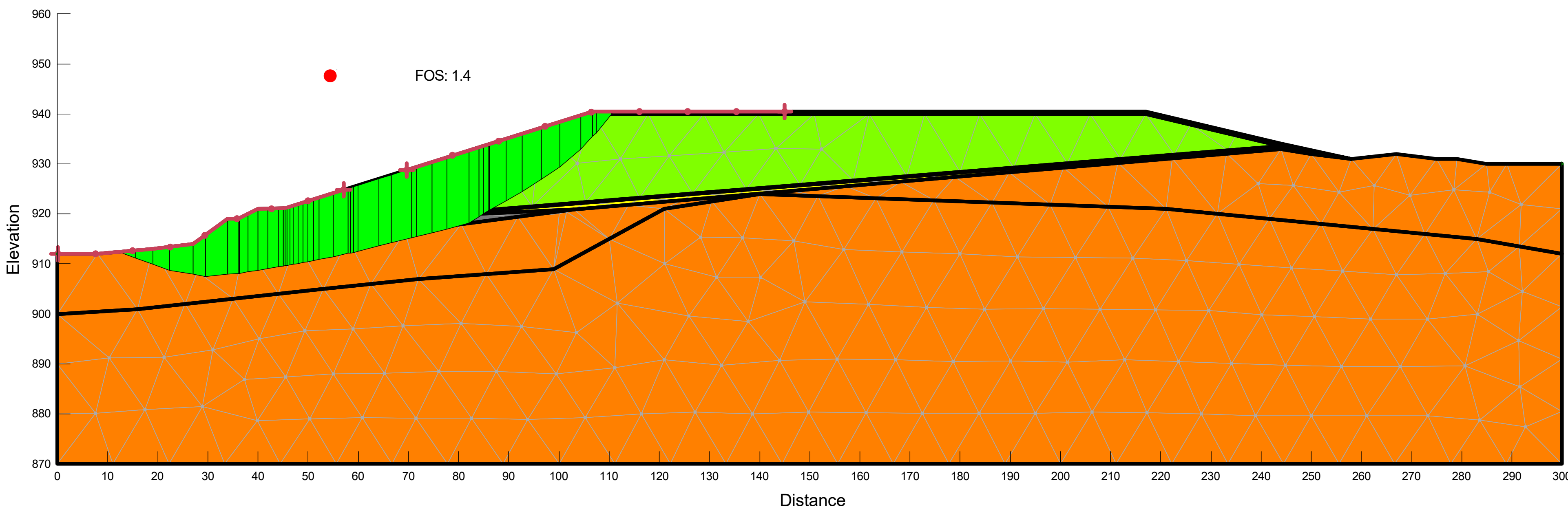
Name: A07 - Fully Thawed - Pseudostatic Shallow
File Name: WARC04307-02_Section A_3.25-1Tails_Interior Berm_SG4-1-final.gsz
Method: Morgenstern-Price
Minimum Slip Surface Depth: 1 m
Horz Seismic Coef.: 0.139
Scale: 1:1,231

Color	Name	Slope Stability Material Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-B (°)
	Foundation Materials	Mohr-Coulomb	20	0	16	0
	Gravel Drainage Blanket	Mohr-Coulomb	24	0	35	0
	Loose Gravel Cover	Mohr-Coulomb	21.1	0	30	0
	Tailings	Mohr-Coulomb	22.5	8	30	0
	Till - Thawed	Mohr-Coulomb	19.1	0	30	0
	Waste Rock	Mohr-Coulomb	24	0	40	0



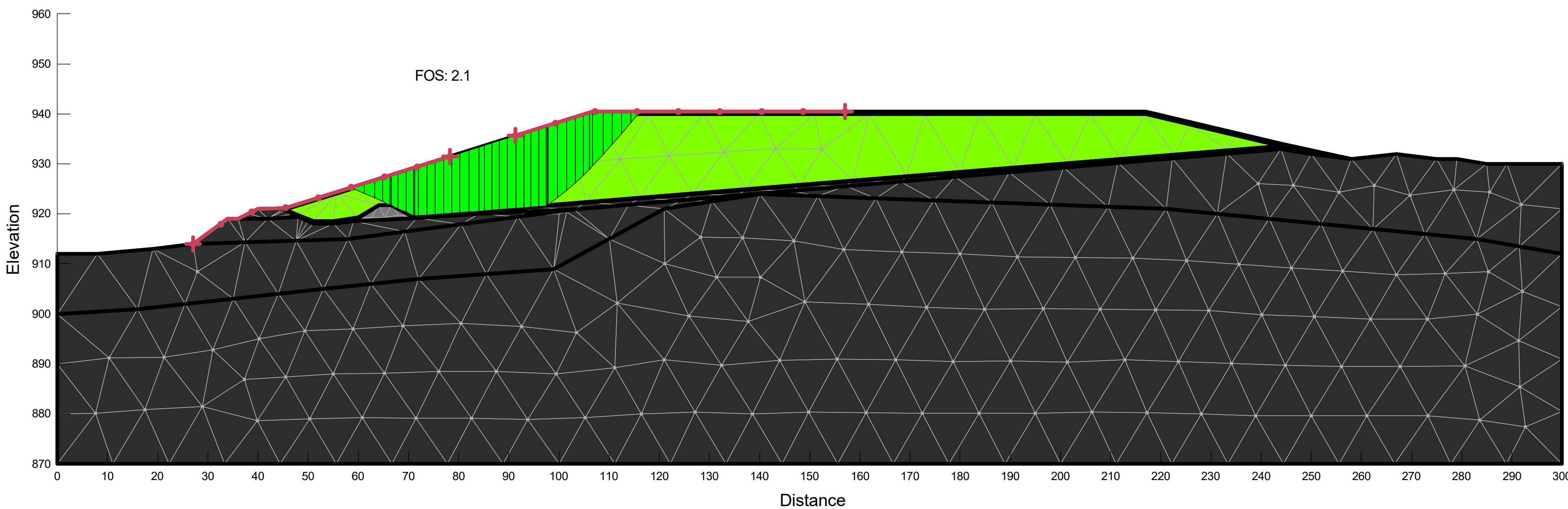
Color	Name	Slope Stability Material Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-B (°)
	Foundation Materials	Mohr-Coulomb	20	0	16	0
	Gravel Drainage Blanket	Mohr-Coulomb	24	0	35	0
	Loose Gravel Cover	Mohr-Coulomb	21.1	0	30	0
	Tailings	Mohr-Coulomb	22.5	8	30	0
	Till - Thawed	Mohr-Coulomb	19.1	0	30	0
	Waste Rock	Mohr-Coulomb	24	0	40	0

Name: A08 - Fully Thawed - Pseudostatic Deep
File Name: WARC04307-02_Section A_3.25-1Tails_Interior Berm_SG4-1-final.gsz
Method: Morgenstern-Price
Minimum Slip Surface Depth: 5 m
Horz Seismic Coef.: 0.139
Scale: 1:1,231



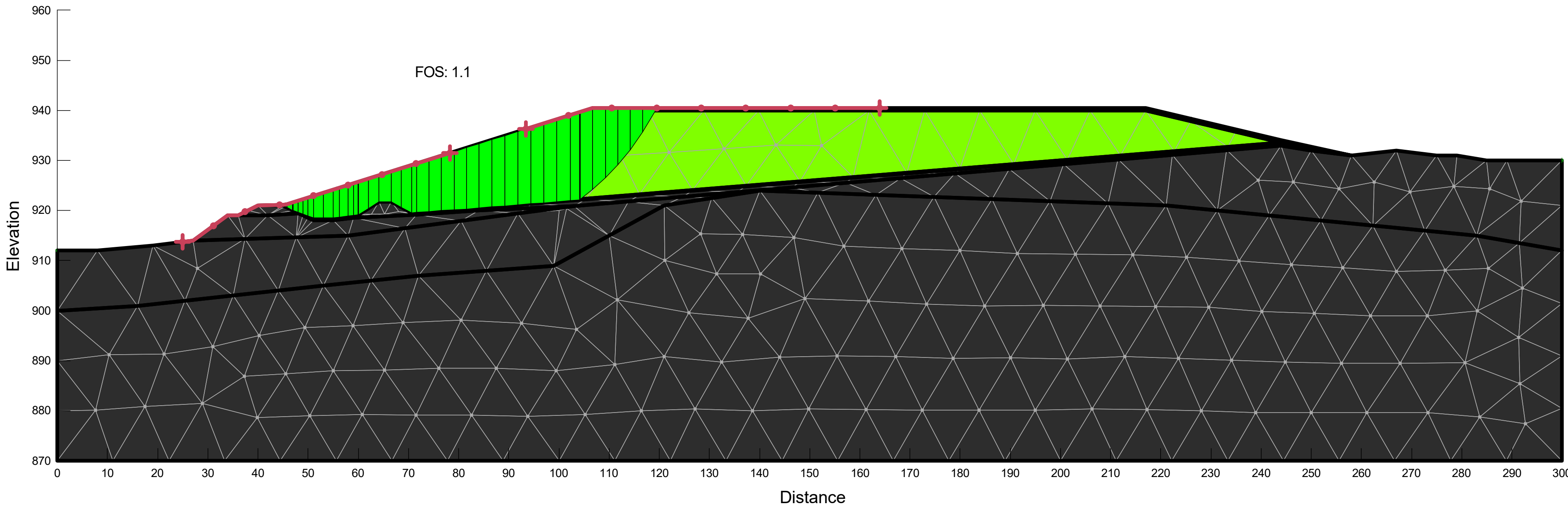
Name: A09 - Foundation Analysis - Static Deep
File Name: WARC04307-02_Section A_3.25-1Tails_Interior Berm_SG4-1-final.gsz
Method: Morgenstern-Price
Minimum Slip Surface Depth: 10 m
Horz Seismic Coef.:
Scale: 1:1,231

Color	Name	Slope Stability Material Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-B (°)
	Bedrock	Bedrock (Impenetrable)				
	Foundation Materials	Mohr-Coulomb	20	0	16	0
	Gravel Drainage Blanket	Mohr-Coulomb	24	0	35	0
	Loose Gravel Cover	Mohr-Coulomb	21.1	0	30	0
	Tailings	Mohr-Coulomb	22.5	8	30	0
	Waste Rock	Mohr-Coulomb	24	0	40	0



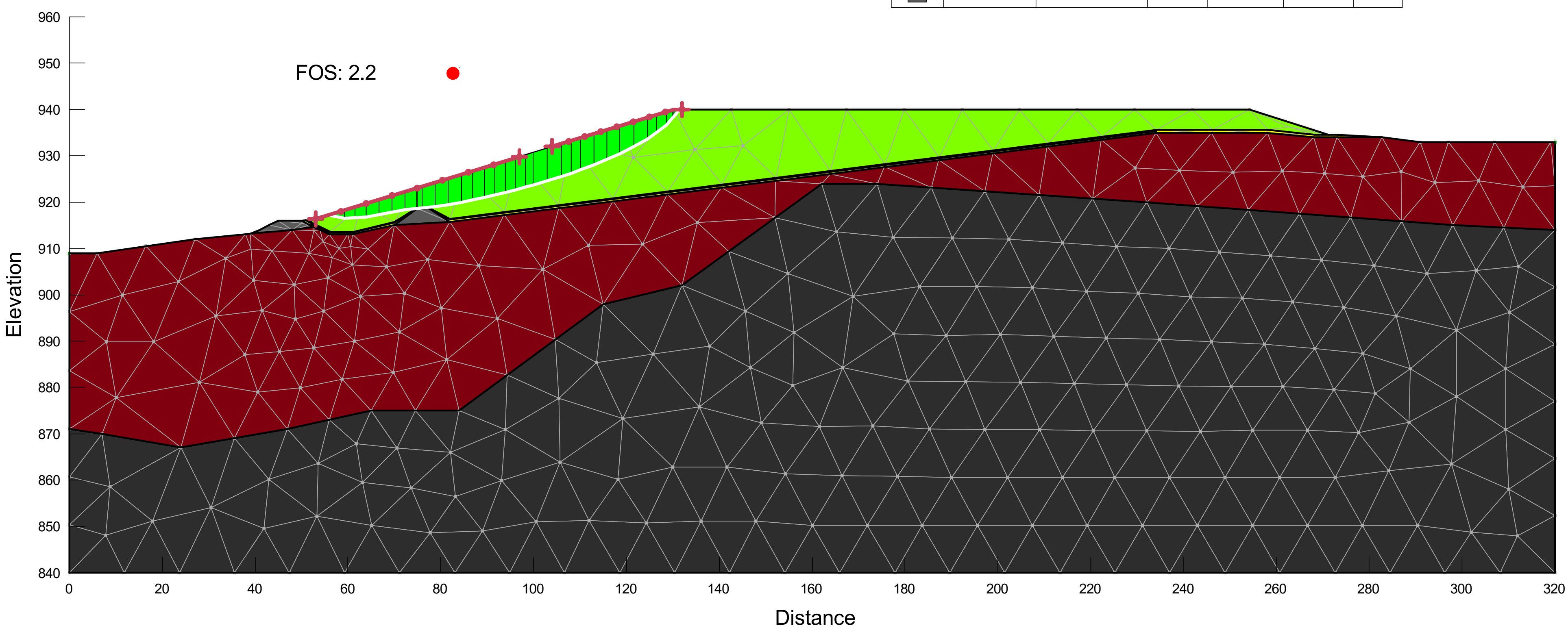
Name: A10 - Foundation Analysis - Pseudostatic Deep
File Name: WARC04307-02_Section A_3.25-1Tails_Interior Berm_SG4-1-final.gsz
Method: Morgenstern-Price
Minimum Slip Surface Depth: 10 m
Horz Seismic Coef.: 0.139
Scale: 1:1,231

Color	Name	Slope Stability Material Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-B (°)
	Bedrock	Bedrock (Impenetrable)				
	Foundation Materials	Mohr-Coulomb	20	0	16	0
	Loose Gravel Cover	Mohr-Coulomb	21.1	0	30	0
	Tailings	Mohr-Coulomb	22.5	8	30	0



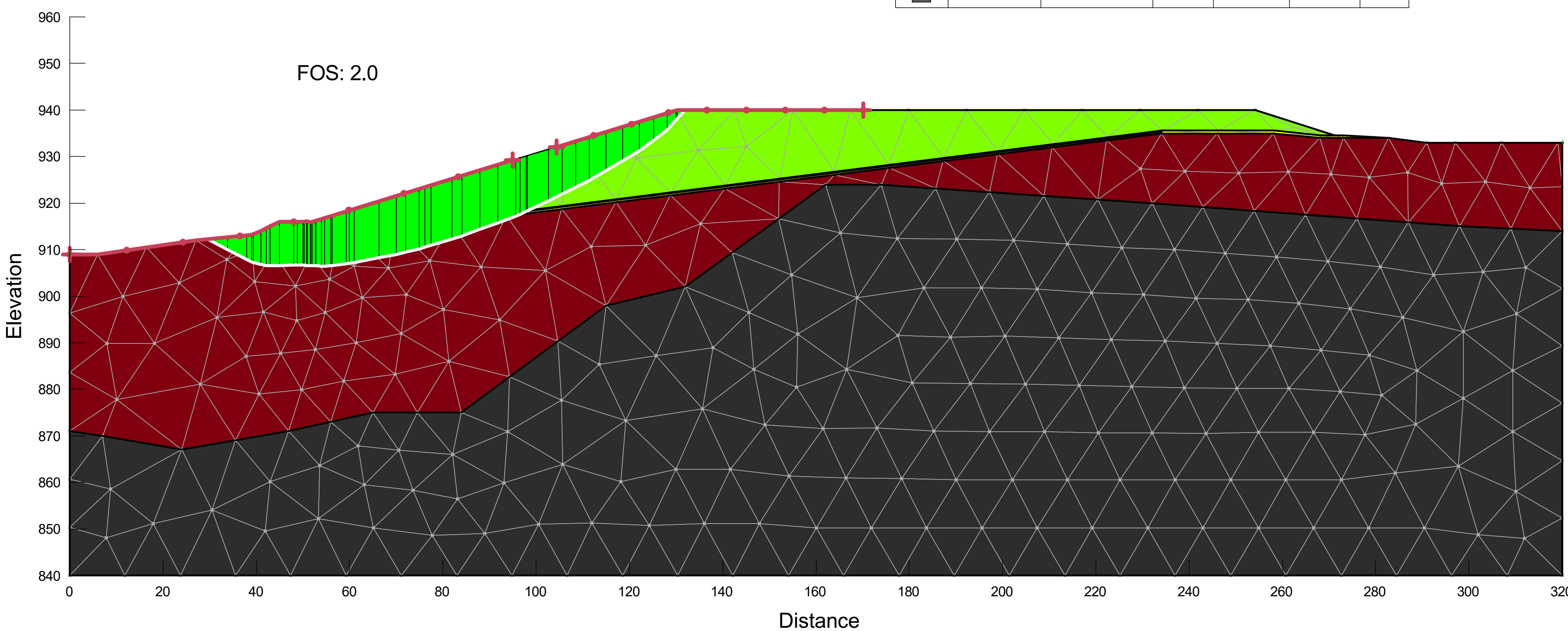
Color	Name	Slope Stability Material Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-B (°)
	Bedrock	Bedrock (Impenetrable)				
	Foundation Materials	Mohr-Coulomb	20	0	16	0
	Gravel Drainage Blanket	Mohr-Coulomb	24	0	35	0
	Tailings	Mohr-Coulomb	22.5	8	30	0
	Till - Ice Rich	Mohr-Coulomb	11.8	0	30	0
	Waste Rock	Mohr-Coulomb	24	0	40	0

Name: B01 - Fully Frozen - Static Shallow
File Name: WARC04307-02_Section B_3.25-1Tails_Interior Berm_SG4-1.gsz
Method: Morgenstern-Price
Minimum Slip Surface Depth: 1 m
Horz Seismic Coef.:



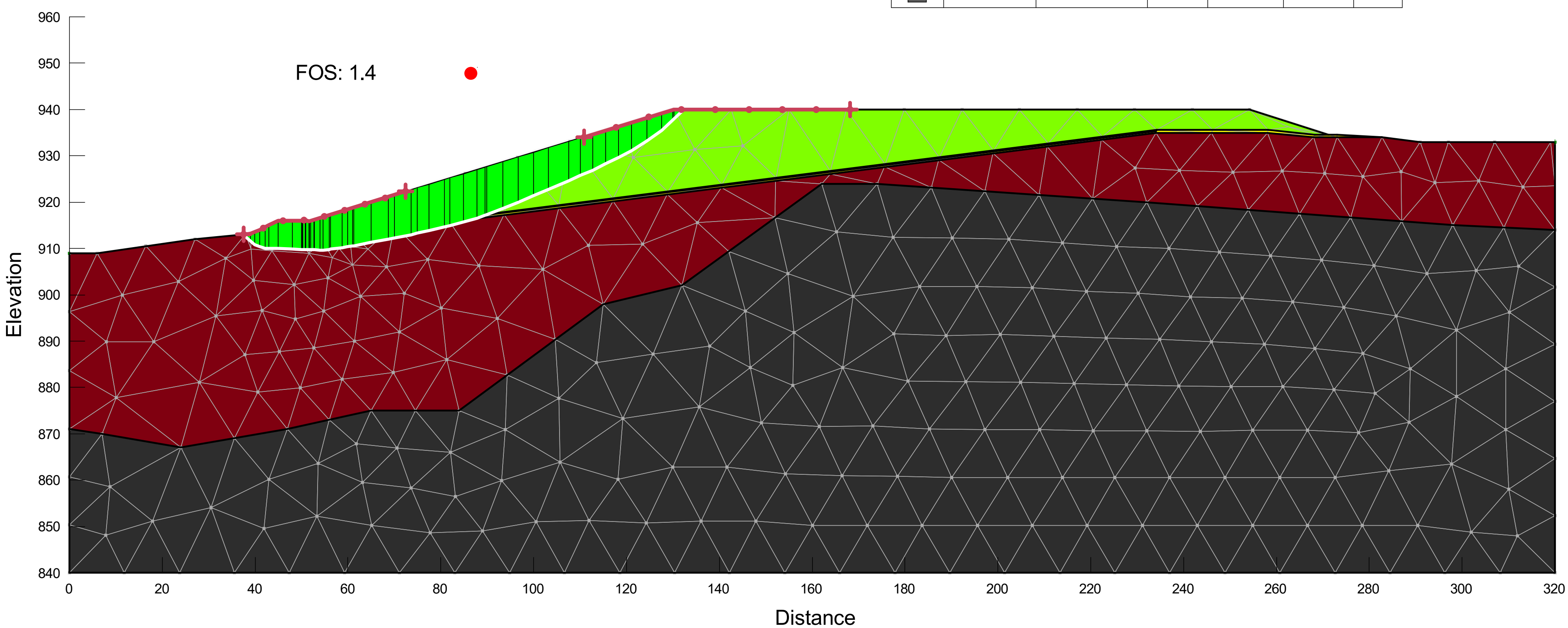
Name: B02 - Fully Frozen - Static Deep
File Name: WARC04307-02_Section B_3.25-1Tails_Interior Berm_SG4-1.gsz
Method: Morgenstern-Price
Minimum Slip Surface Depth: 5 m
Horz Seismic Coef.:

Color	Name	Slope Stability Material Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-B (°)
	Bedrock	Bedrock (Impenetrable)				
	Foundation Materials	Mohr-Coulomb	20	0	16	0
	Gravel Drainage Blanket	Mohr-Coulomb	24	0	35	0
	Tailings	Mohr-Coulomb	22.5	8	30	0
	Till - Ice Rich	Mohr-Coulomb	11.8	0	30	0
	Waste Rock	Mohr-Coulomb	24	0	40	0



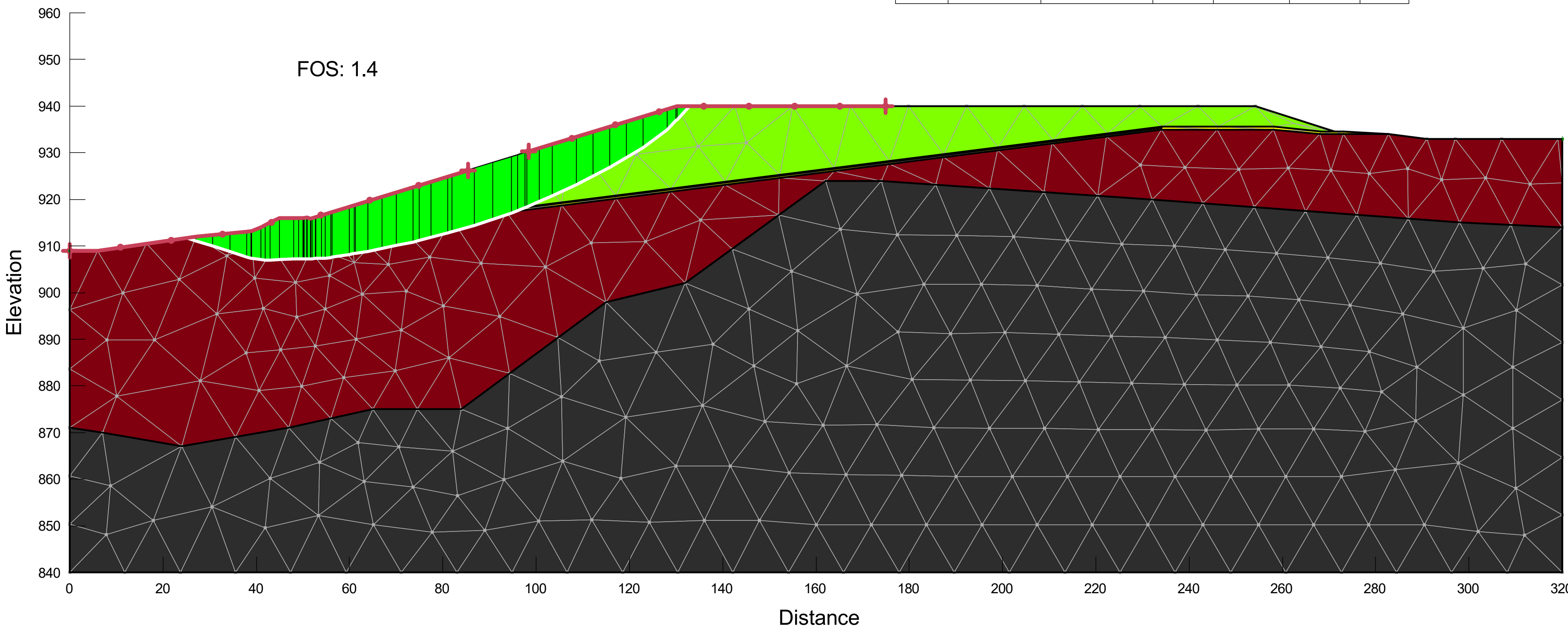
Color	Name	Slope Stability Material Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-B (°)
(dark grey)	Bedrock	Bedrock (Impenetrable)				
(red)	Foundation Materials	Mohr-Coulomb	20	0	16	0
(yellow)	Gravel Drainage Blanket	Mohr-Coulomb	24	0	35	0
(light green)	Tailings	Mohr-Coulomb	22.5	8	30	0
(dark red)	Till - Ice Rich	Mohr-Coulomb	11.8	0	30	0
(grey)	Waste Rock	Mohr-Coulomb	24	0	40	0

Name: B03 - Fully Frozen - Pseudostatic Shallow
File Name: WARC04307-02_Section B_3.25-1Tails_Interior Berm_SG4-1.gsz
Method: Morgenstern-Price
Minimum Slip Surface Depth: 1 m
Horz Seismic Coef.: 0.139



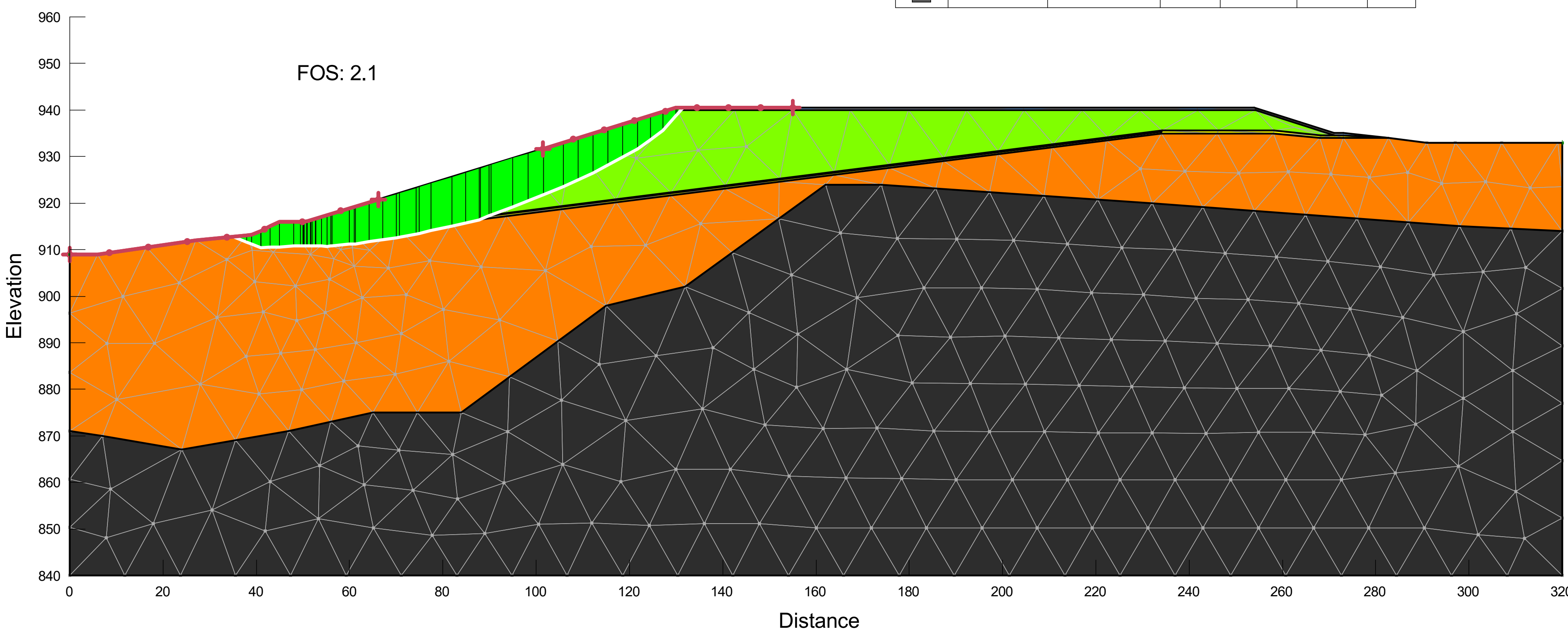
Color	Name	Slope Stability Material Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-B (°)
	Bedrock	Bedrock (Impenetrable)				
	Foundation Materials	Mohr-Coulomb	20	0	16	0
	Gravel Drainage Blanket	Mohr-Coulomb	24	0	35	0
	Tailings	Mohr-Coulomb	22.5	8	30	0
	Till - Ice Rich	Mohr-Coulomb	11.8	0	30	0
	Waste Rock	Mohr-Coulomb	24	0	40	0

Name: B04 - Fully Frozen - Pseudostatic Deep
File Name: WARC04307-02_Section B_3.25-1Tails_Interior Berm_SG4-1.gsz
Method: Morgenstern-Price
Minimum Slip Surface Depth: 5 m
Horz Seismic Coef.: 0.139



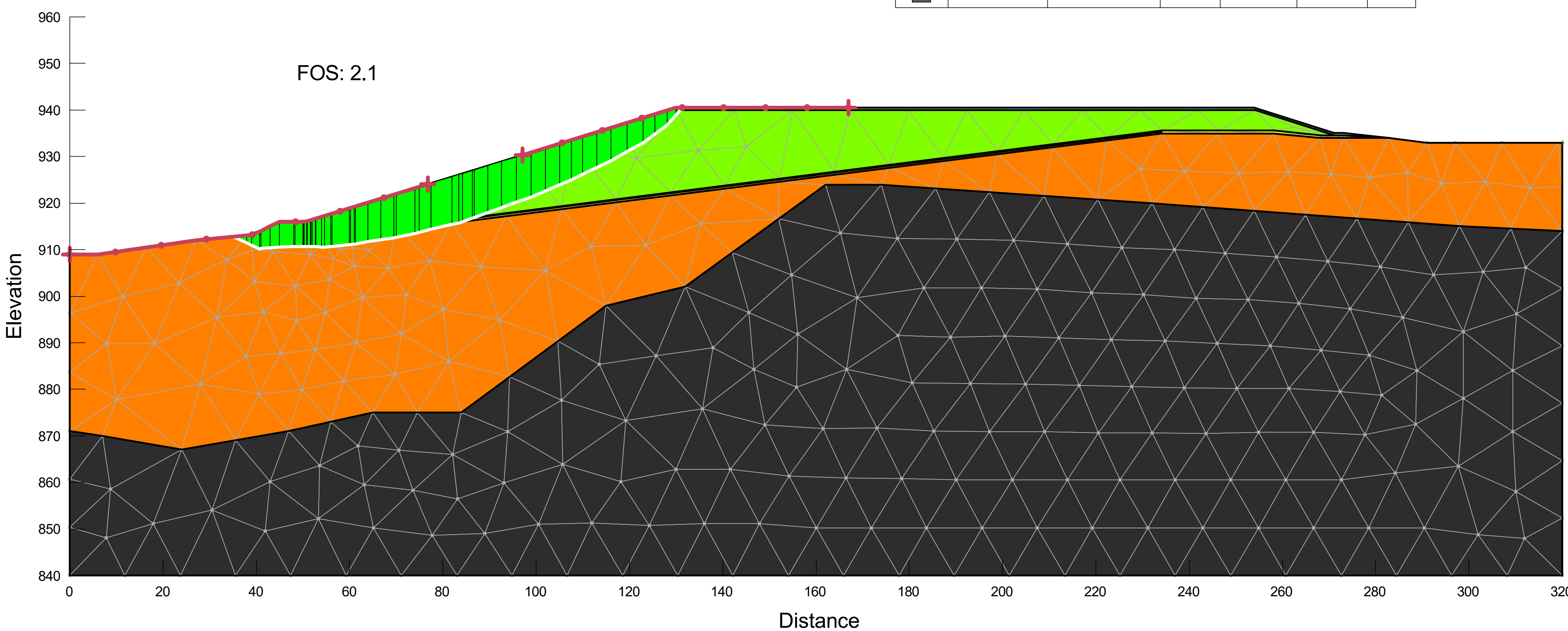
Color	Name	Slope Stability Material Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-B (°)
	Bedrock	Bedrock (Impenetrable)				
	Foundation Materials	Mohr-Coulomb	20	0	16	0
	Gravel Drainage Blanket	Mohr-Coulomb	24	0	35	0
	Loose Gravel Cover	Mohr-Coulomb	21.1	0	30	0
	Tailings	Mohr-Coulomb	22.5	8	30	0
	Till - Thawed	Mohr-Coulomb	19.1	0	30	0
	Waste Rock	Mohr-Coulomb	24	0	40	0

Name: B05 - Fully Thawed - Static Shallow
File Name: WARC04307-02_Section B_3.25-1Tails_Interior Berm_SG4-1.gsz
Method: Morgenstern-Price
Minimum Slip Surface Depth: 1 m
Horz Seismic Coef.:



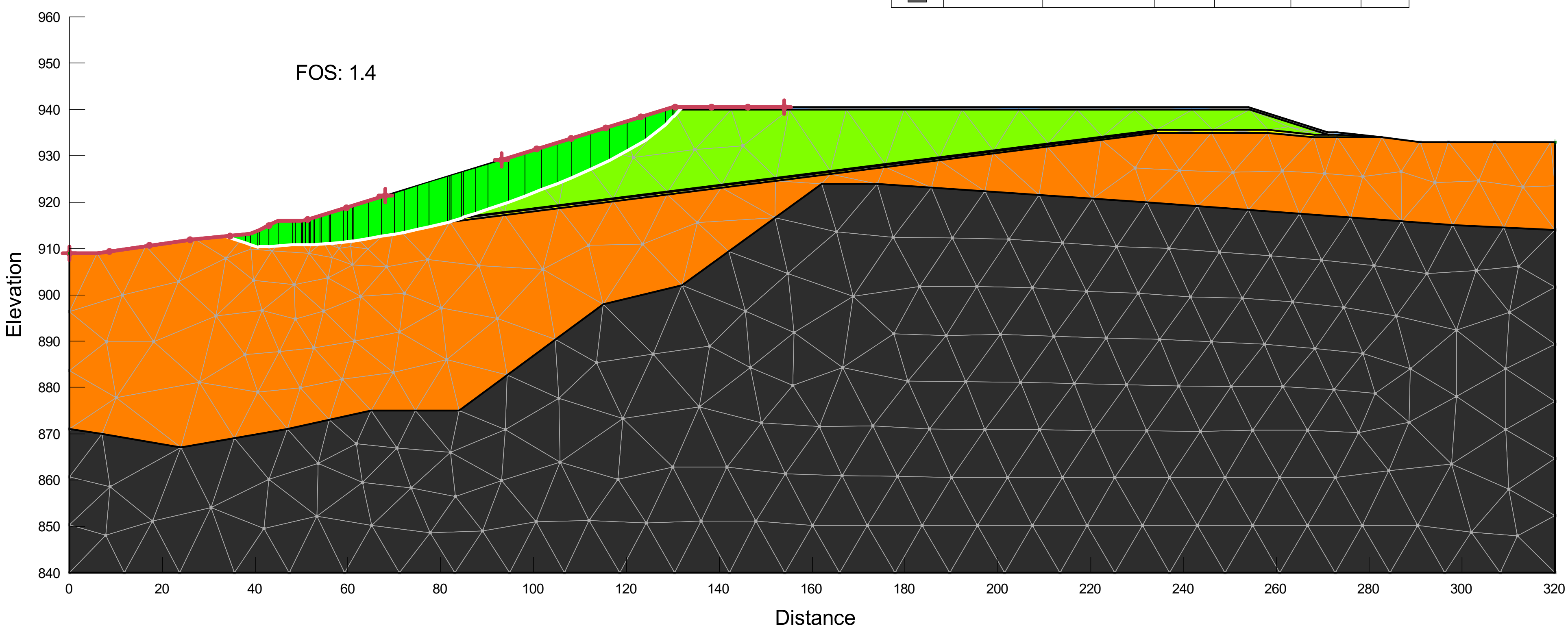
Color	Name	Slope Stability Material Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-B (°)
	Bedrock	Bedrock (Impenetrable)				
	Foundation Materials	Mohr-Coulomb	20	0	16	0
	Gravel Drainage Blanket	Mohr-Coulomb	24	0	35	0
	Loose Gravel Cover	Mohr-Coulomb	21.1	0	30	0
	Tailings	Mohr-Coulomb	22.5	8	30	0
	Till - Thawed	Mohr-Coulomb	19.1	0	30	0
	Waste Rock	Mohr-Coulomb	24	0	40	0

Name: B06 - Fully Thawed - Static Deep
File Name: WARC04307-02_Section B_3.25-1Tails_Interior Berm_SG4-1.gsz
Method: Morgenstern-Price
Minimum Slip Surface Depth: 5 m
Horz Seismic Coef.:



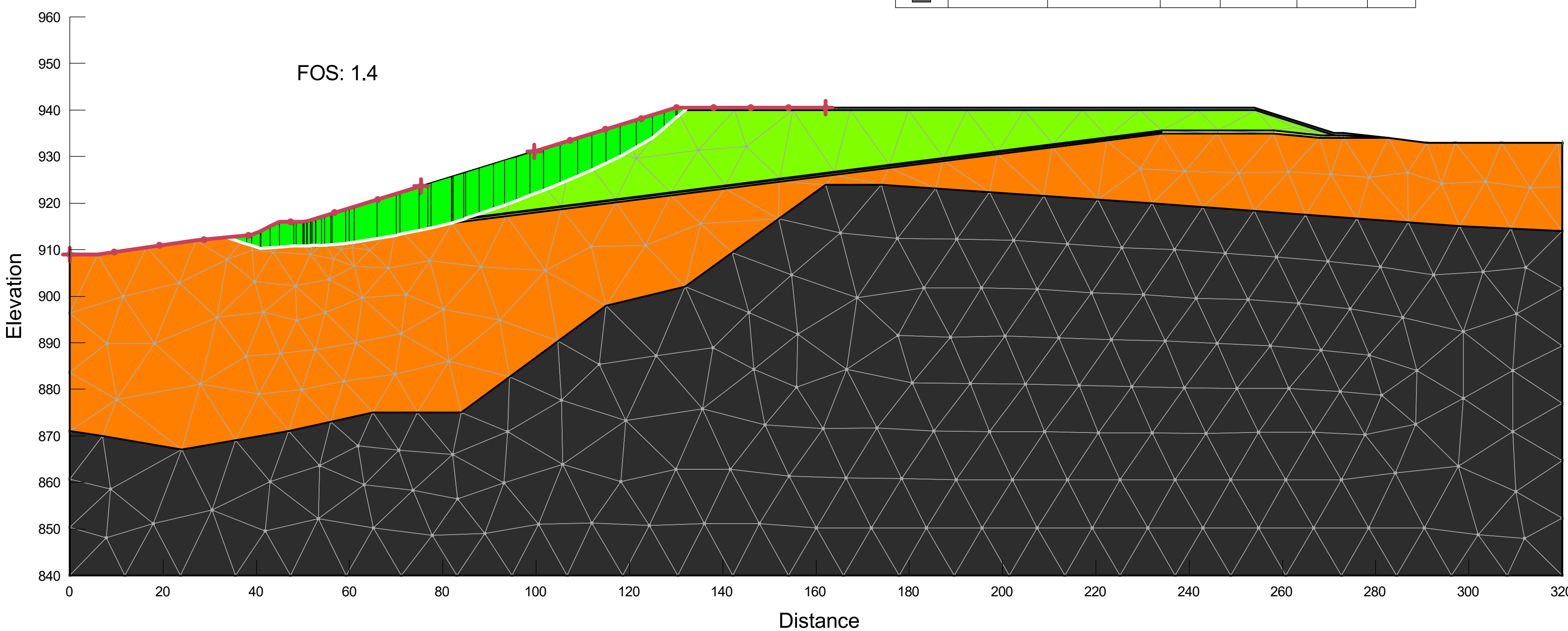
Color	Name	Slope Stability Material Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-B (°)
	Bedrock	Bedrock (Impenetrable)				
	Foundation Materials	Mohr-Coulomb	20	0	16	0
	Gravel Drainage Blanket	Mohr-Coulomb	24	0	35	0
	Loose Gravel Cover	Mohr-Coulomb	21.1	0	30	0
	Tailings	Mohr-Coulomb	22.5	8	30	0
	Till - Thawed	Mohr-Coulomb	19.1	0	30	0
	Waste Rock	Mohr-Coulomb	24	0	40	0

Name: B07 - Fully Thawed - Pseudostatic Shallow
File Name: WARC04307-02_Section B_3.25-1Tails_Interior Berm_SG4-1.gsz
Method: Morgenstern-Price
Minimum Slip Surface Depth: 1 m
Horz Seismic Coef.: 0.139



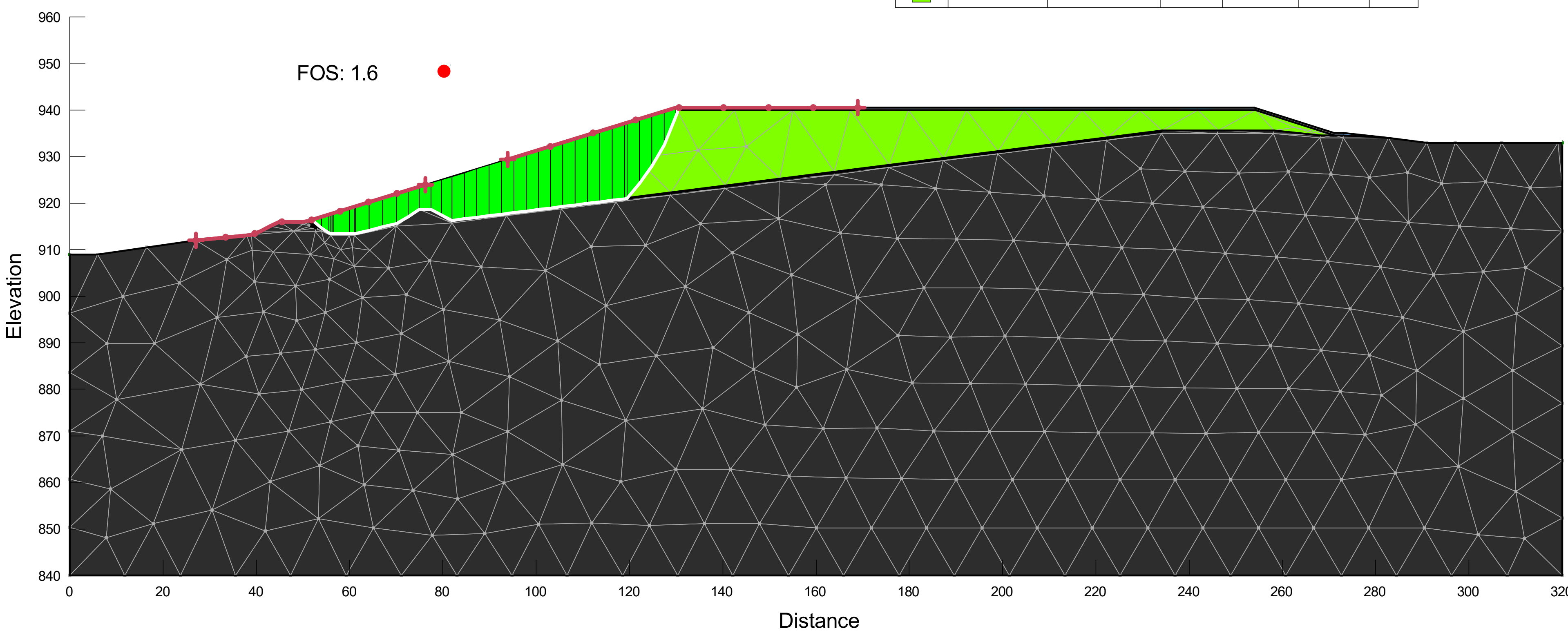
Color	Name	Slope Stability Material Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-B (°)
	Bedrock	Bedrock (Impenetrable)				
	Foundation Materials	Mohr-Coulomb	20	0	16	0
	Gravel Drainage Blanket	Mohr-Coulomb	24	0	35	0
	Loose Gravel Cover	Mohr-Coulomb	21.1	0	30	0
	Tailings	Mohr-Coulomb	22.5	8	30	0
	Till - Thawed	Mohr-Coulomb	19.1	0	30	0
	Waste Rock	Mohr-Coulomb	24	0	40	0

Name: B08 - Fully Thawed - Pseudostatic Deep
File Name: WARC04307-02_Section B_3.25-1Tails_Interior Berm_SG4-1.gsz
Method: Morgenstern-Price
Minimum Slip Surface Depth: 5 m
Horz Seismic Coef.: 0.139



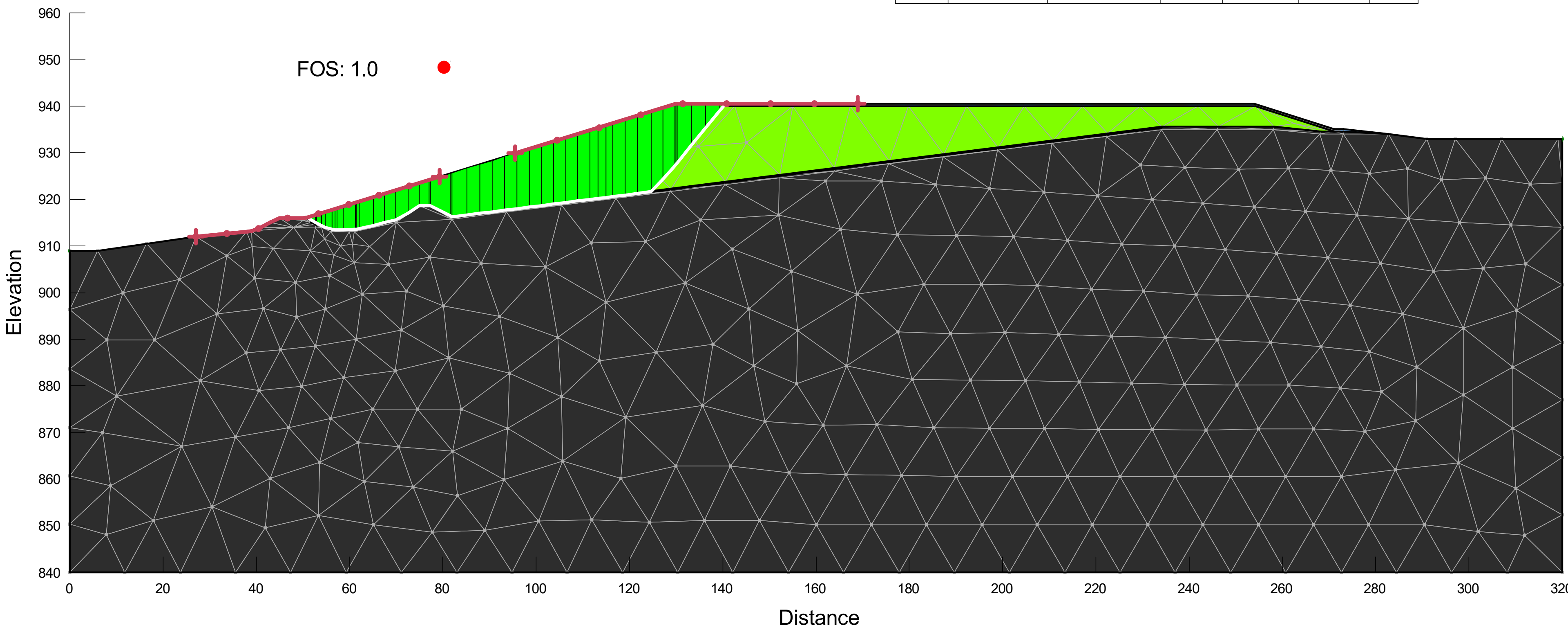
Name: B09 - Foundation Analysis - Static Deep
File Name: WARC04307-02_Section B_3.25-1Tails_Interior Berm_SG4-1.gsz
Method: Morgenstern-Price
Minimum Slip Surface Depth: 10 m
Horz Seismic Coef.:

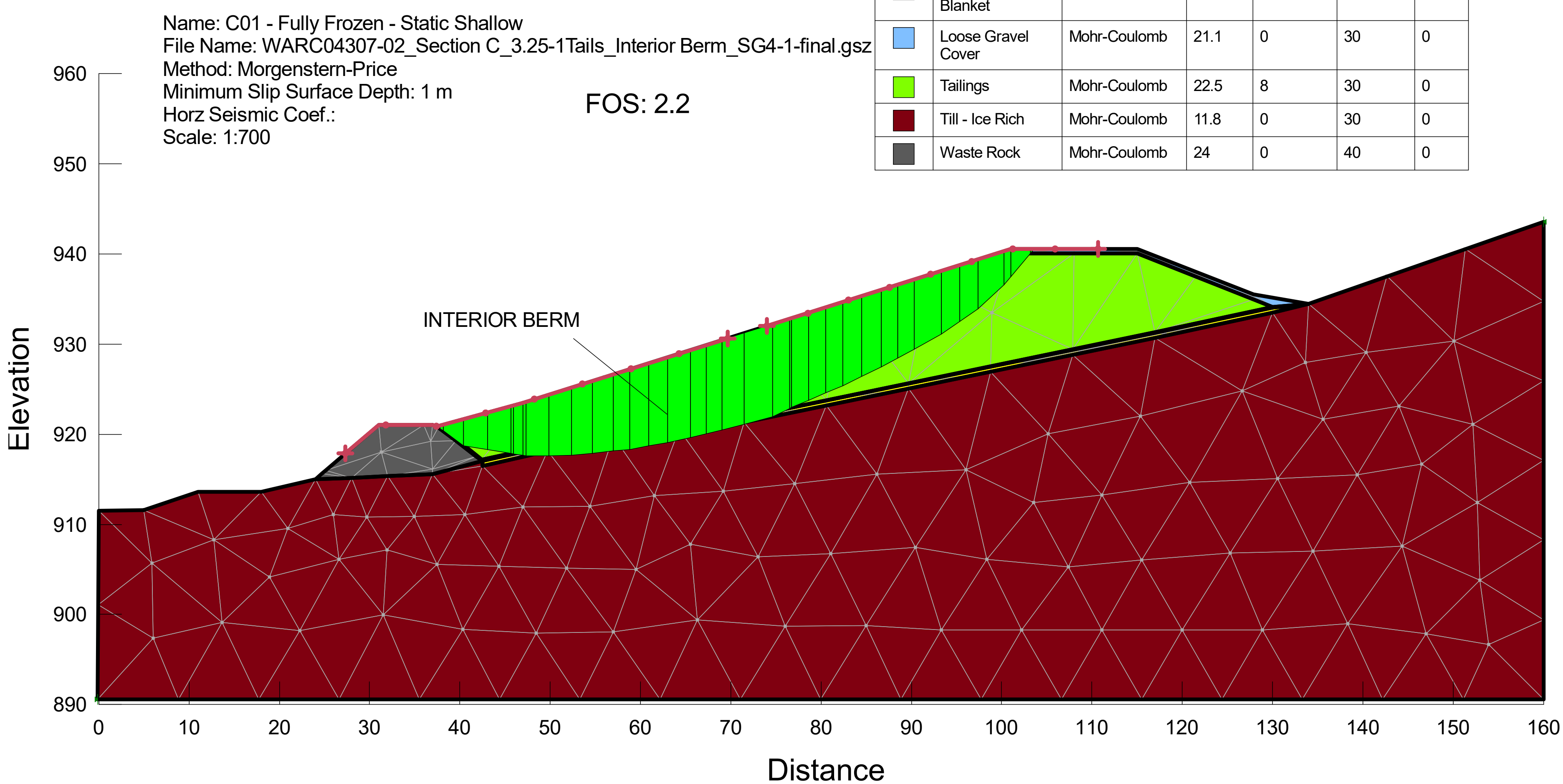
Color	Name	Slope Stability Material Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-B (°)
	Bedrock	Bedrock (Impenetrable)				
	Foundation Materials	Mohr-Coulomb	20	0	16	0
	Loose Gravel Cover	Mohr-Coulomb	21.1	0	30	0
	Tailings	Mohr-Coulomb	22.5	8	30	0



Color	Name	Slope Stability Material Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-B (°)
	Bedrock	Bedrock (Impenetrable)				
	Foundation Materials	Mohr-Coulomb	20	0	16	0
	Loose Gravel Cover	Mohr-Coulomb	21.1	0	30	0
	Tailings	Mohr-Coulomb	22.5	8	30	0

Name: B10 - Foundation Analysis - Pseudostatic Deep
File Name: WARC04307-02_Section B_3.25-1Tails_Interior Berm_SG4-1.gsz
Method: Morgenstern-Price
Minimum Slip Surface Depth: 10 m
Horz Seismic Coef.: 0.139



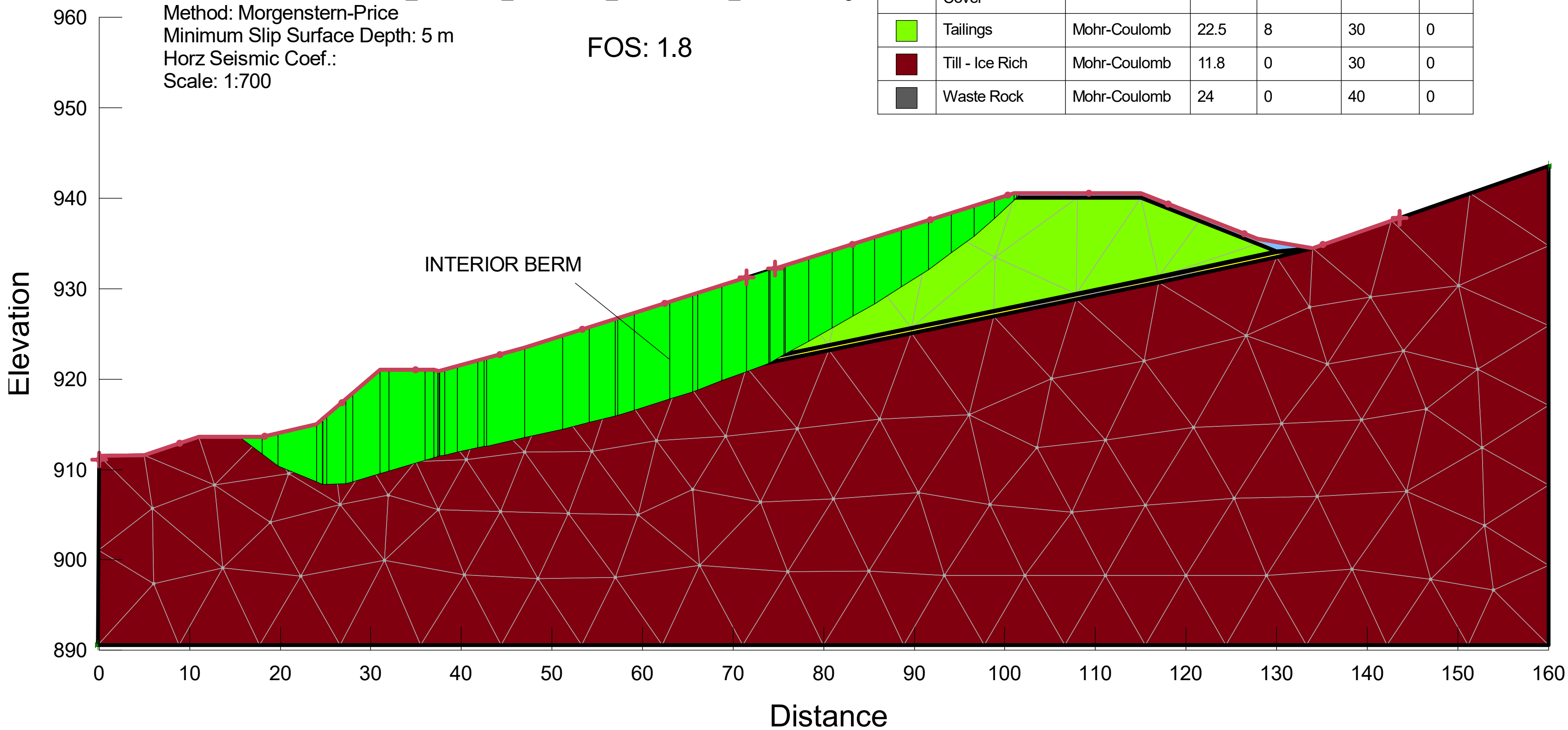


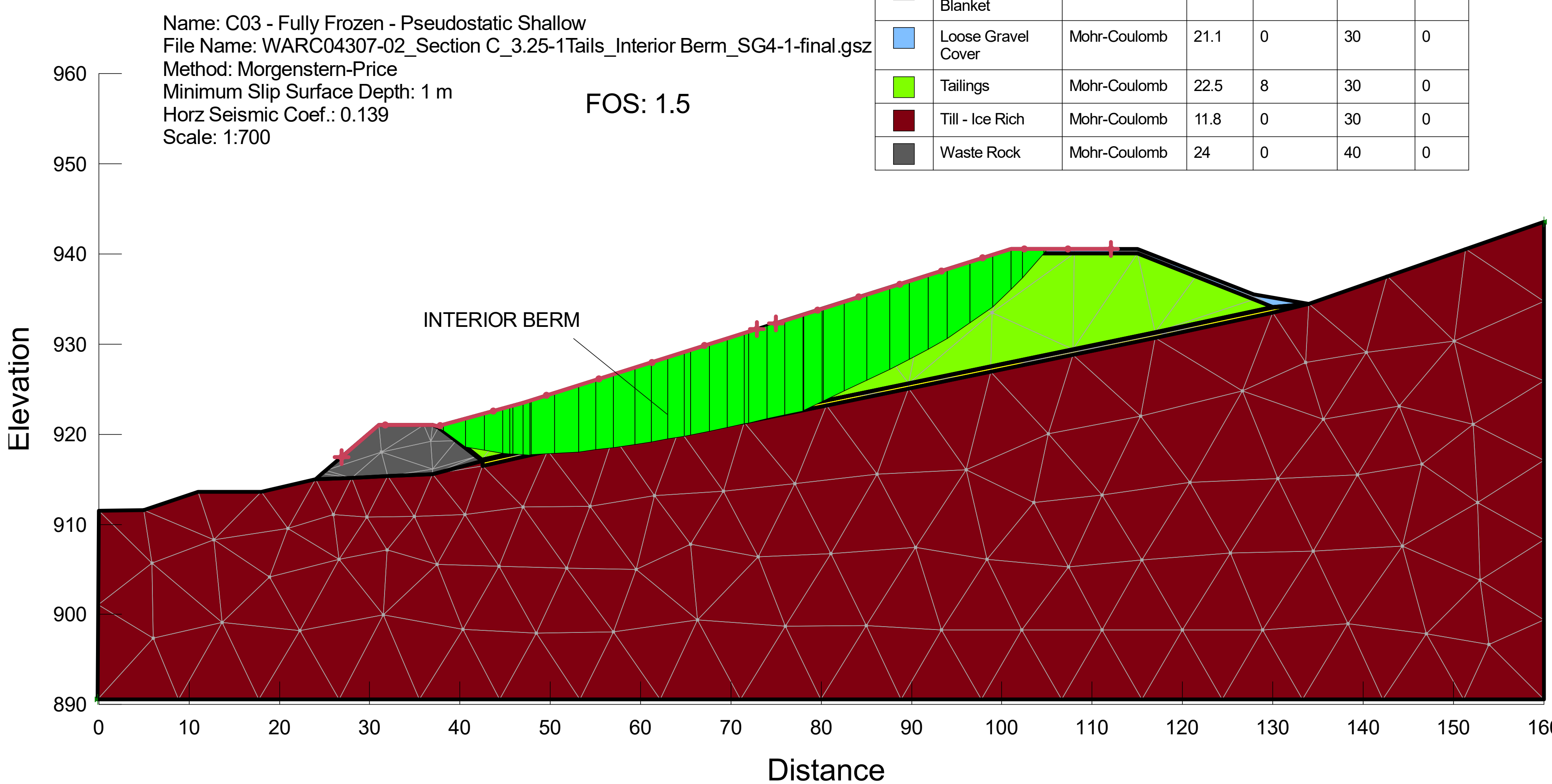
Color	Name	Slope Stability Material Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-B (°)
	Foundation Materials	Mohr-Coulomb	24	0	16	0
	Gravel Drainage Blanket	Mohr-Coulomb	24	0	35	0
	Loose Gravel Cover	Mohr-Coulomb	21.1	0	30	0
	Tailings	Mohr-Coulomb	22.5	8	30	0
	Till - Ice Rich	Mohr-Coulomb	11.8	0	30	0
	Waste Rock	Mohr-Coulomb	24	0	40	0

Color	Name	Slope Stability Material Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-B (°)
	Foundation Materials	Mohr-Coulomb	24	0	16	0
	Gravel Drainage Blanket	Mohr-Coulomb	24	0	35	0
	Loose Gravel Cover	Mohr-Coulomb	21.1	0	30	0
	Tailings	Mohr-Coulomb	22.5	8	30	0
	Till - Ice Rich	Mohr-Coulomb	11.8	0	30	0
	Waste Rock	Mohr-Coulomb	24	0	40	0

Name: C02 - Fully Frozen - Static Deep
File Name: WARC04307-02_Section C_3.25-1Tails_Interior Berm_SG4-1-final.gsz
Method: Morgenstern-Price
Minimum Slip Surface Depth: 5 m
Horz Seismic Coef.:
Scale: 1:700

FOS: 1.8

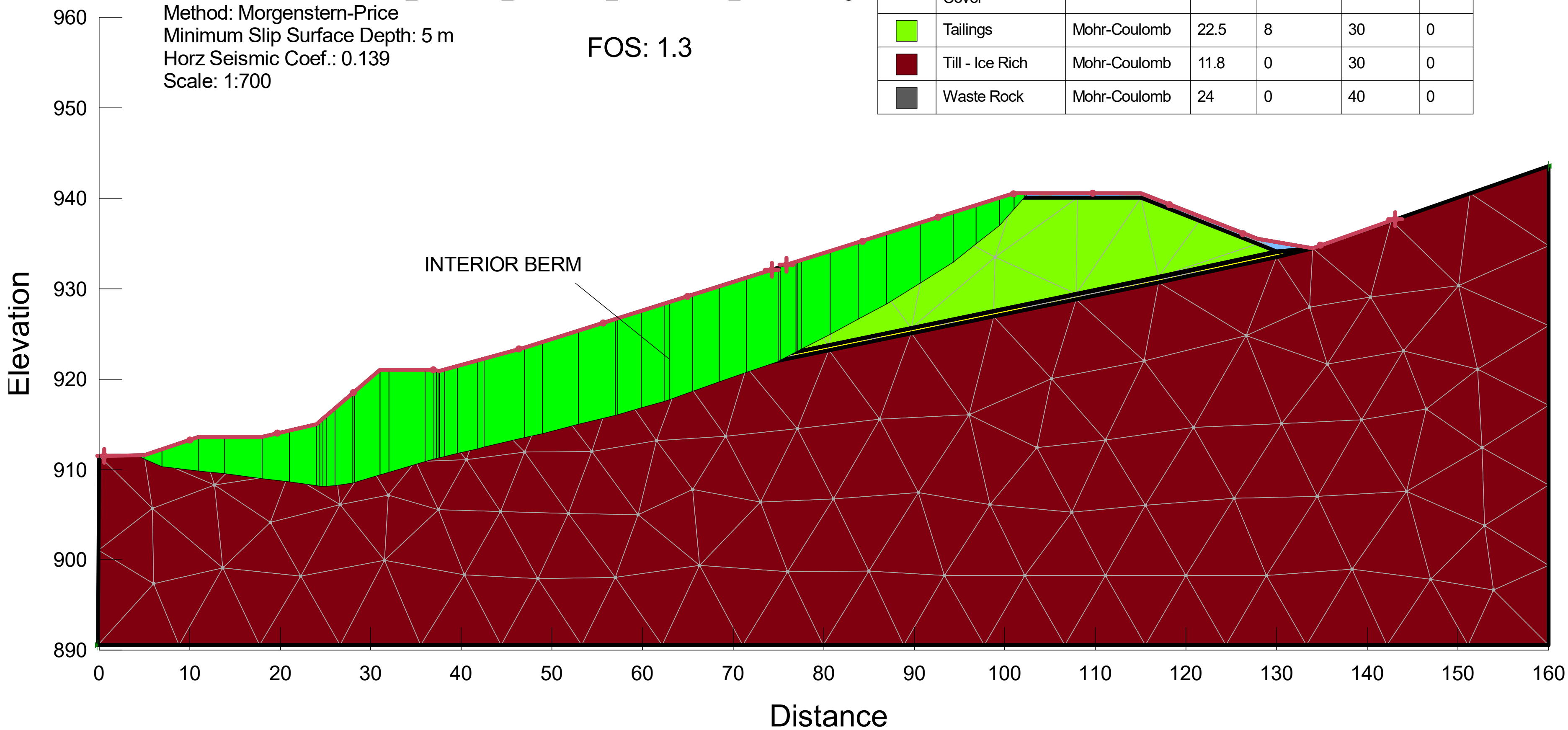




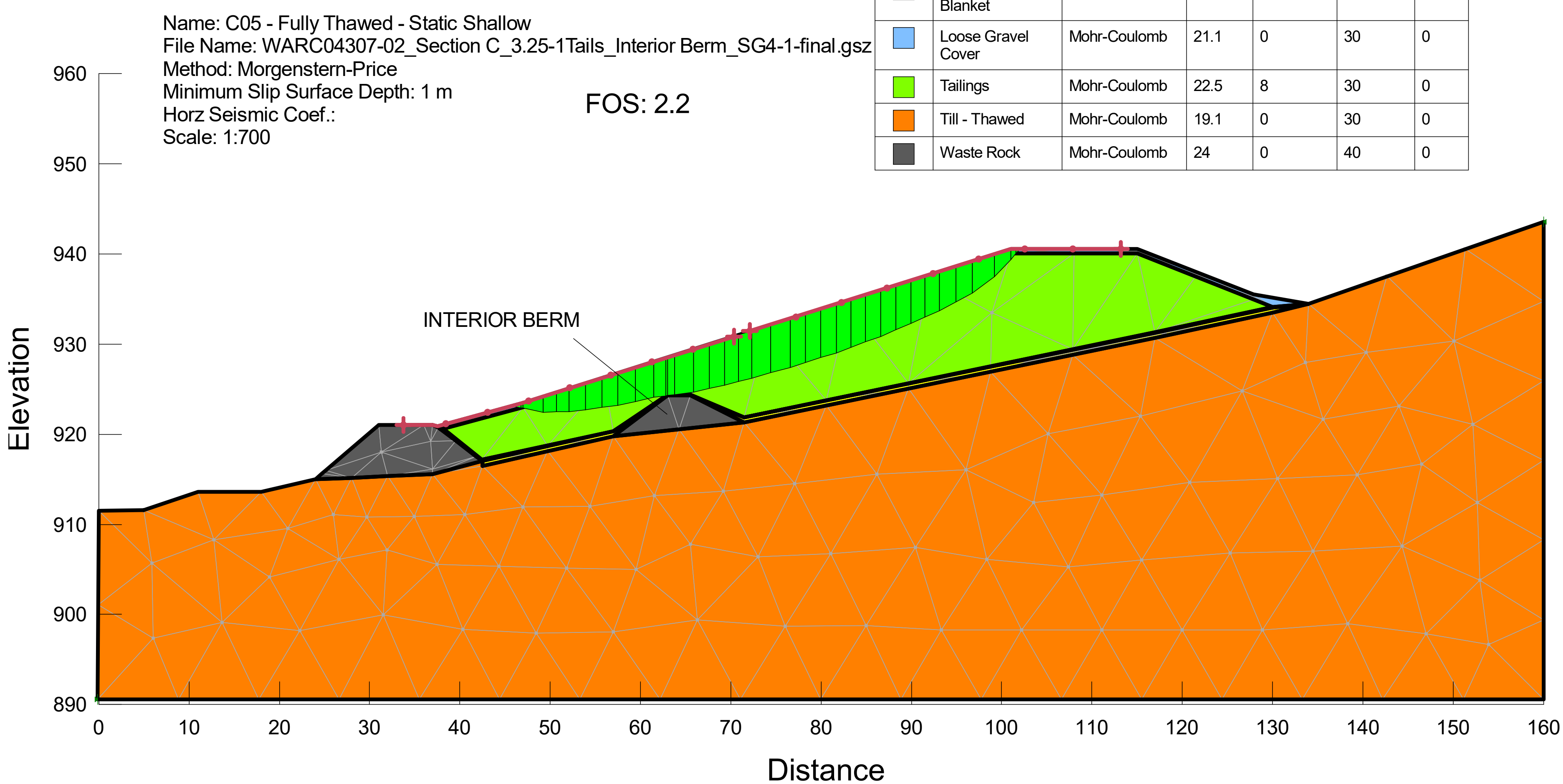
Color	Name	Slope Stability Material Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-B (°)
	Foundation Materials	Mohr-Coulomb	24	0	16	0
	Gravel Drainage Blanket	Mohr-Coulomb	24	0	35	0
	Loose Gravel Cover	Mohr-Coulomb	21.1	0	30	0
	Tailings	Mohr-Coulomb	22.5	8	30	0
	Till - Ice Rich	Mohr-Coulomb	11.8	0	30	0
	Waste Rock	Mohr-Coulomb	24	0	40	0

Color	Name	Slope Stability Material Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-B (°)
Red	Foundation Materials	Mohr-Coulomb	24	0	16	0
Yellow	Gravel Drainage Blanket	Mohr-Coulomb	24	0	35	0
Light blue	Loose Gravel Cover	Mohr-Coulomb	21.1	0	30	0
Green	Tailings	Mohr-Coulomb	22.5	8	30	0
Dark red	Till - Ice Rich	Mohr-Coulomb	11.8	0	30	0
Grey	Waste Rock	Mohr-Coulomb	24	0	40	0

Name: C04 - Fully Frozen - Pseudostatic Deep
File Name: WARC04307-02_Section C_3.25-1Tails_Interior Berm_SG4-1-final.gsz
Method: Morgenstern-Price
Minimum Slip Surface Depth: 5 m
Horz Seismic Coef.: 0.139
Scale: 1:700



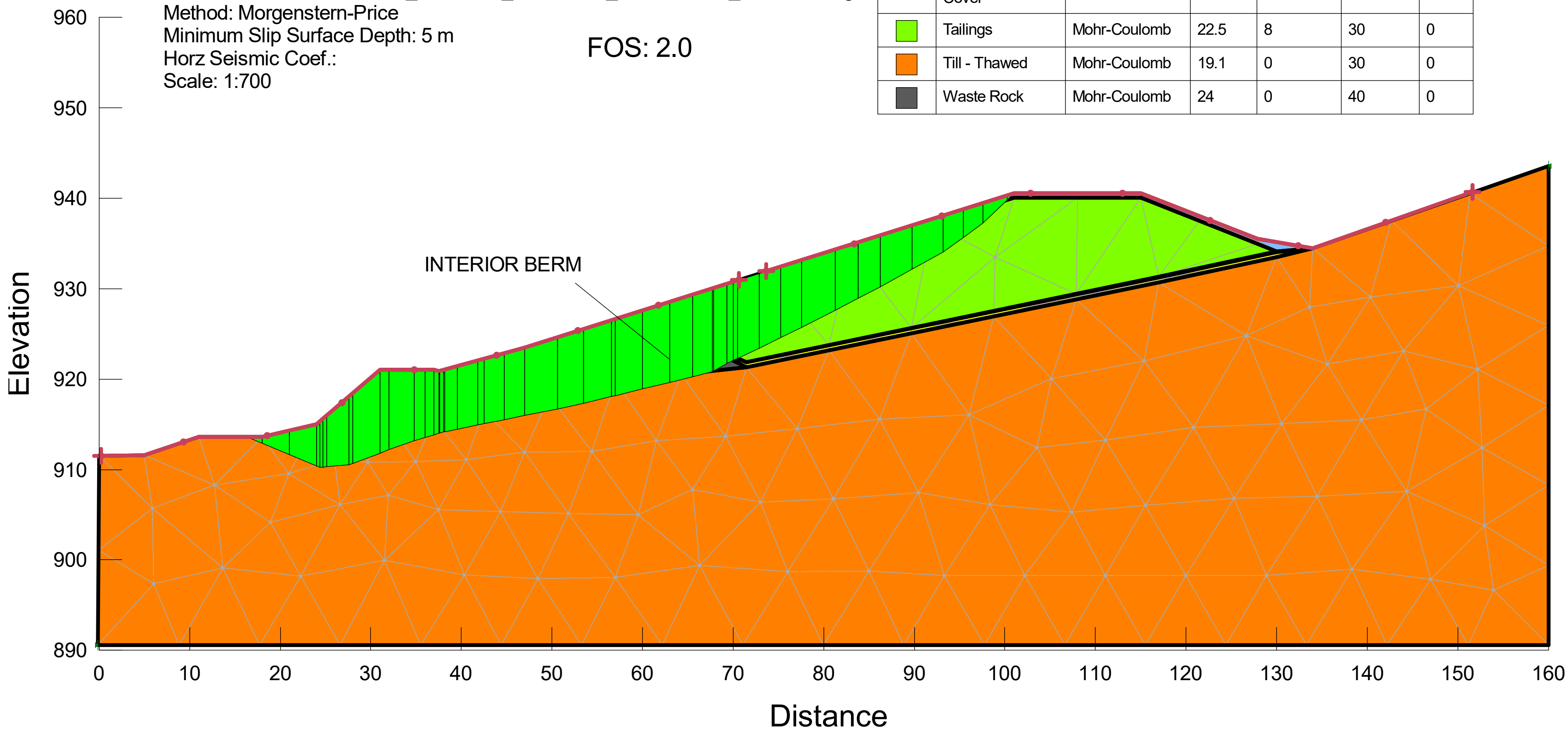
Color	Name	Slope Stability Material Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-B (°)
Red	Foundation Materials	Mohr-Coulomb	24	0	16	0
Yellow	Gravel Drainage Blanket	Mohr-Coulomb	24	0	35	0
Light blue	Loose Gravel Cover	Mohr-Coulomb	21.1	0	30	0
Green	Tailings	Mohr-Coulomb	22.5	8	30	0
Orange	Till - Thawed	Mohr-Coulomb	19.1	0	30	0
Dark grey	Waste Rock	Mohr-Coulomb	24	0	40	0



Color	Name	Slope Stability Material Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-B (°)
(red)	Foundation Materials	Mohr-Coulomb	24	0	16	0
(yellow)	Gravel Drainage Blanket	Mohr-Coulomb	24	0	35	0
(light blue)	Loose Gravel Cover	Mohr-Coulomb	21.1	0	30	0
(green)	Tailings	Mohr-Coulomb	22.5	8	30	0
(orange)	Till - Thawed	Mohr-Coulomb	19.1	0	30	0
(grey)	Waste Rock	Mohr-Coulomb	24	0	40	0

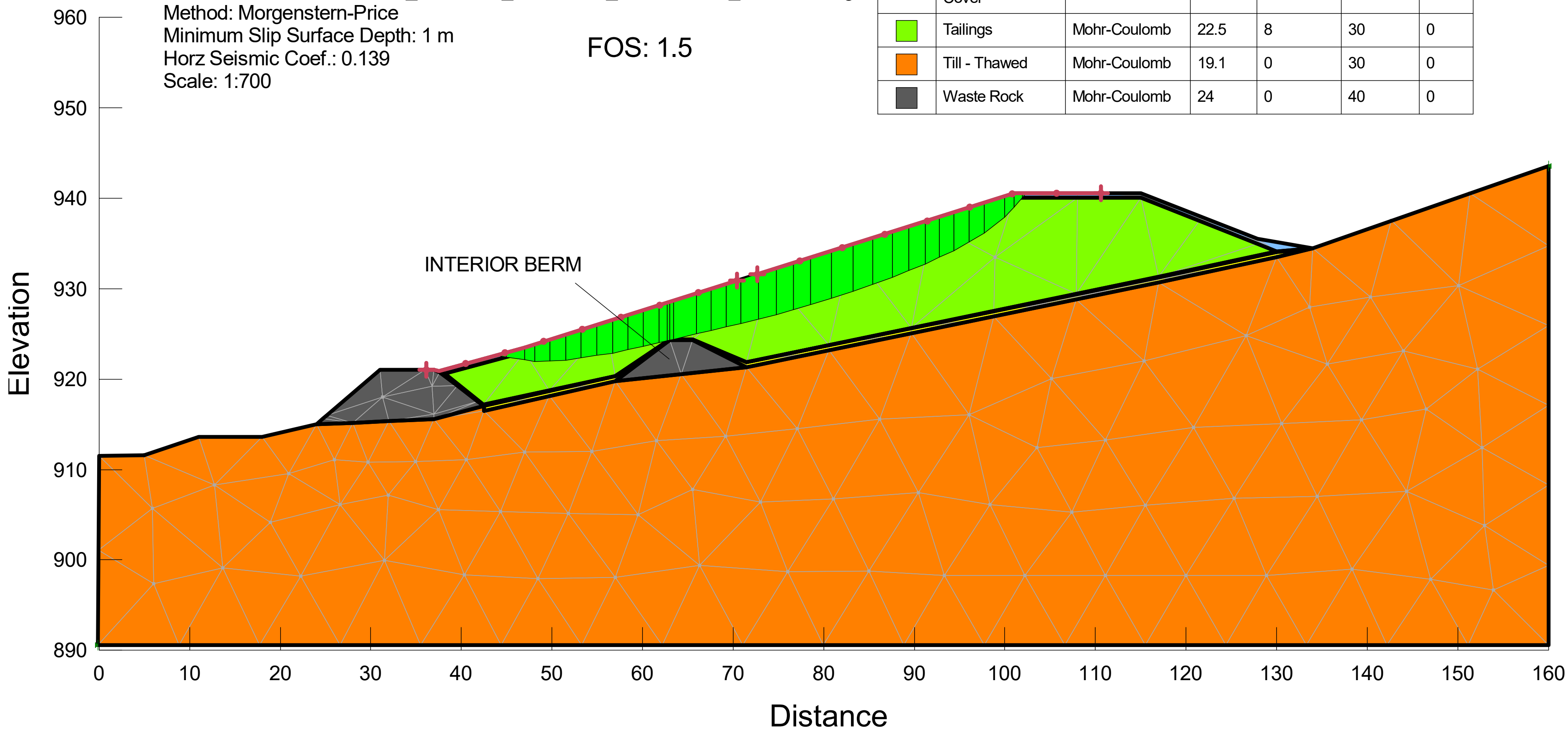
Name: C06 - Fully Thawed - Static Deep
File Name: WARC04307-02_Section C_3.25-1Tails_Interior Berm_SG4-1-final.gsz
Method: Morgenstern-Price
Minimum Slip Surface Depth: 5 m
Horz Seismic Coef.:
Scale: 1:700

FOS: 2.0



Color	Name	Slope Stability Material Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-B (°)
(red)	Foundation Materials	Mohr-Coulomb	24	0	16	0
(yellow)	Gravel Drainage Blanket	Mohr-Coulomb	24	0	35	0
(light blue)	Loose Gravel Cover	Mohr-Coulomb	21.1	0	30	0
(green)	Tailings	Mohr-Coulomb	22.5	8	30	0
(orange)	Till - Thawed	Mohr-Coulomb	19.1	0	30	0
(dark grey)	Waste Rock	Mohr-Coulomb	24	0	40	0

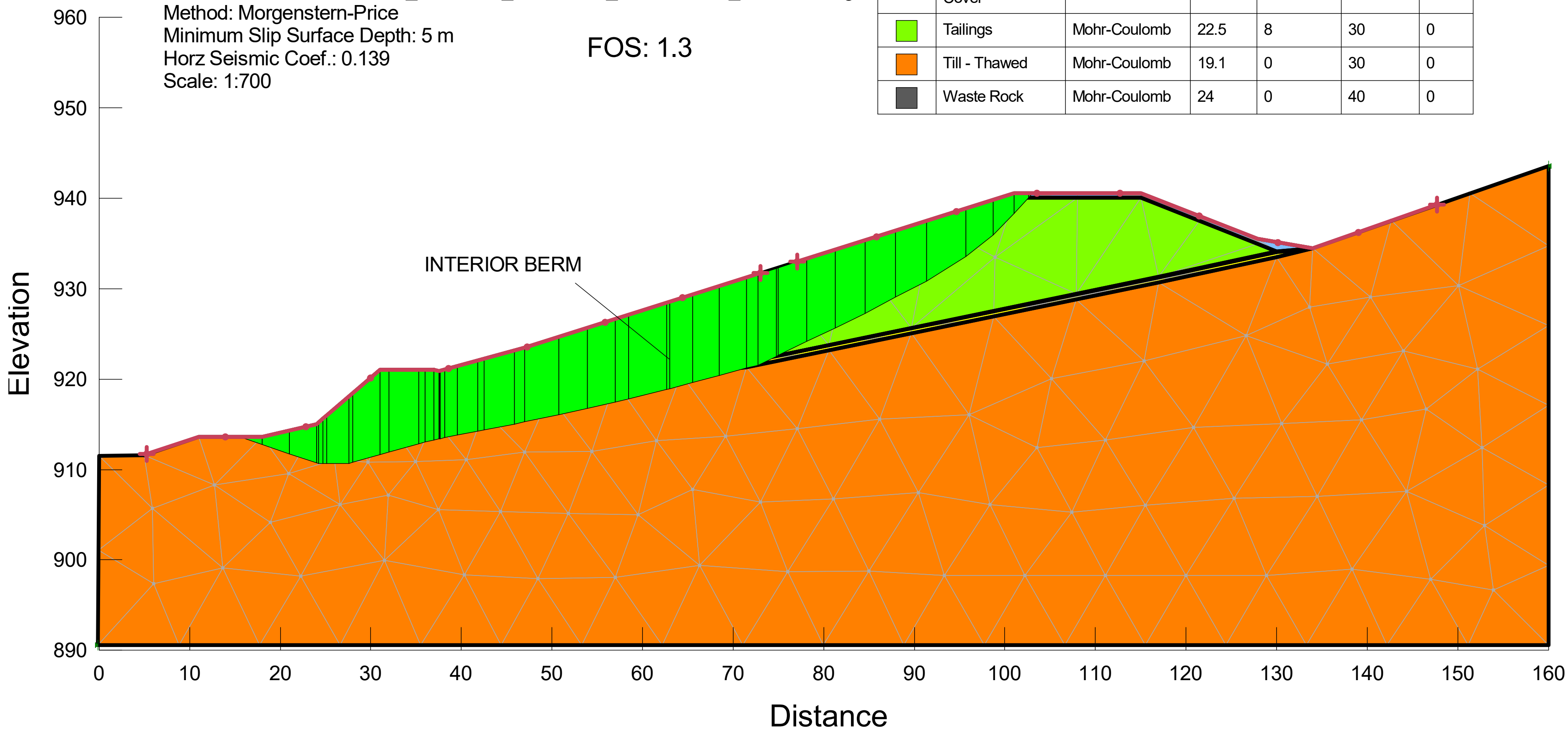
Name: C07 - Fully Thawed - Pseudostatic Shallow
File Name: WARC04307-02_Section C_3.25-1Tails_Interior Berm_SG4-1-final.gsz
Method: Morgenstern-Price
Minimum Slip Surface Depth: 1 m
Horz Seismic Coef.: 0.139
Scale: 1:700



Color	Name	Slope Stability Material Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-B (°)
	Foundation Materials	Mohr-Coulomb	24	0	16	0
	Gravel Drainage Blanket	Mohr-Coulomb	24	0	35	0
	Loose Gravel Cover	Mohr-Coulomb	21.1	0	30	0
	Tailings	Mohr-Coulomb	22.5	8	30	0
	Till - Thawed	Mohr-Coulomb	19.1	0	30	0
	Waste Rock	Mohr-Coulomb	24	0	40	0

Name: C08 - Fully Thawed - Pseudostatic Deep
File Name: WARC04307-02_Section C_3.25-1Tails_Interior Berm_SG4-1-final.gsz
Method: Morgenstern-Price
Minimum Slip Surface Depth: 5 m
Horz Seismic Coef.: 0.139
Scale: 1:700

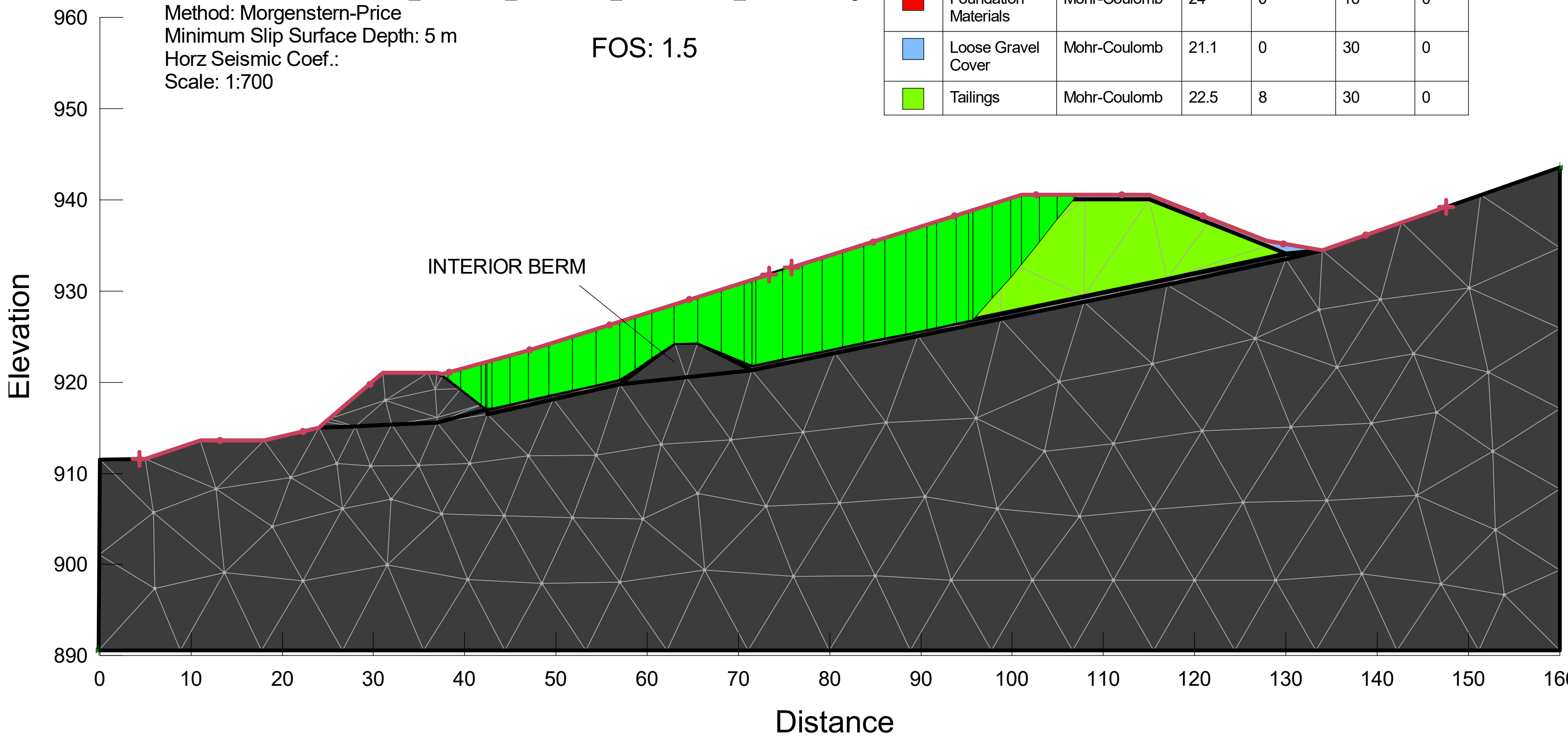
FOS: 1.3



Name: C09 - Foundation Analysis - Static Deep
File Name: WARC04307-02_Section C_3.25-1Tails_Interior Berm_SG4-1-final.gsz
Method: Morgenstern-Price
Minimum Slip Surface Depth: 5 m
Horz Seismic Coef.:
Scale: 1:700

FOS: 1.5

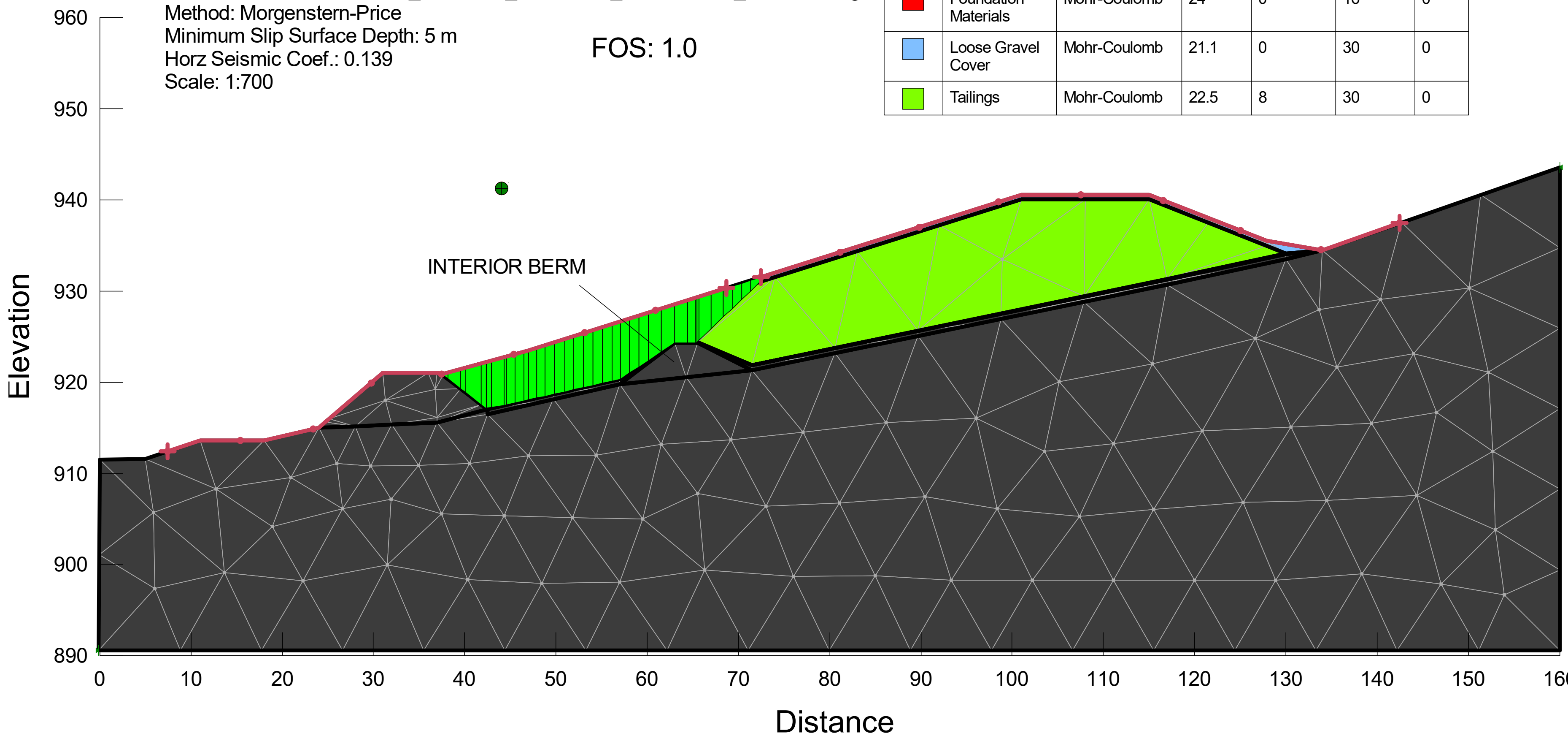
Color	Name	Slope Stability Material Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-B (°)
	Bedrock	Bedrock (Impenetrable)				
	Foundation Materials	Mohr-Coulomb	24	0	16	0
	Loose Gravel Cover	Mohr-Coulomb	21.1	0	30	0
	Tailings	Mohr-Coulomb	22.5	8	30	0



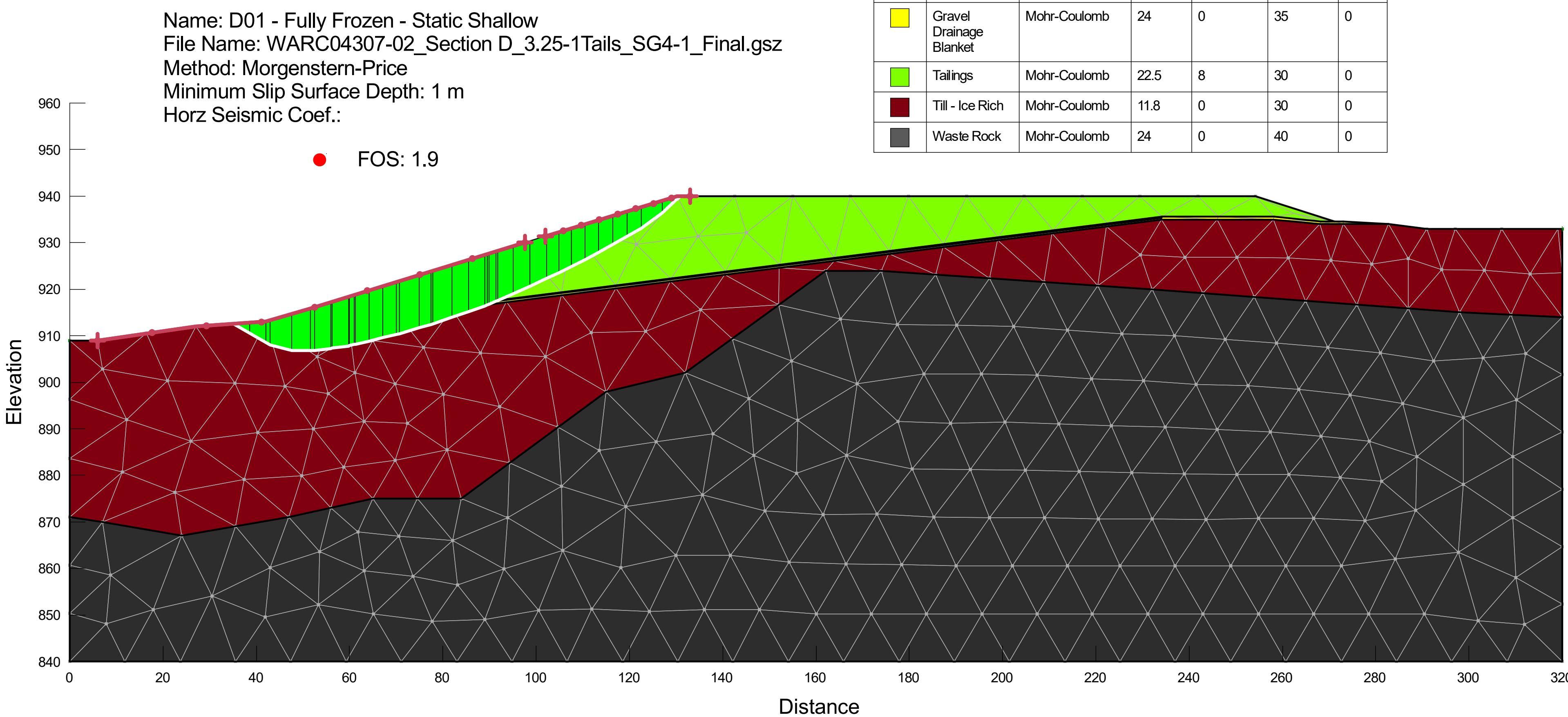
Name: C10 - Foundation Analysis - Pseudostatic Deep
File Name: WARC04307-02_Section C_3.25-1Tails_Interior Berm_SG4-1-final.gsz
Method: Morgenstern-Price
Minimum Slip Surface Depth: 5 m
Horz Seismic Coef.: 0.139
Scale: 1:700

FOS: 1.0

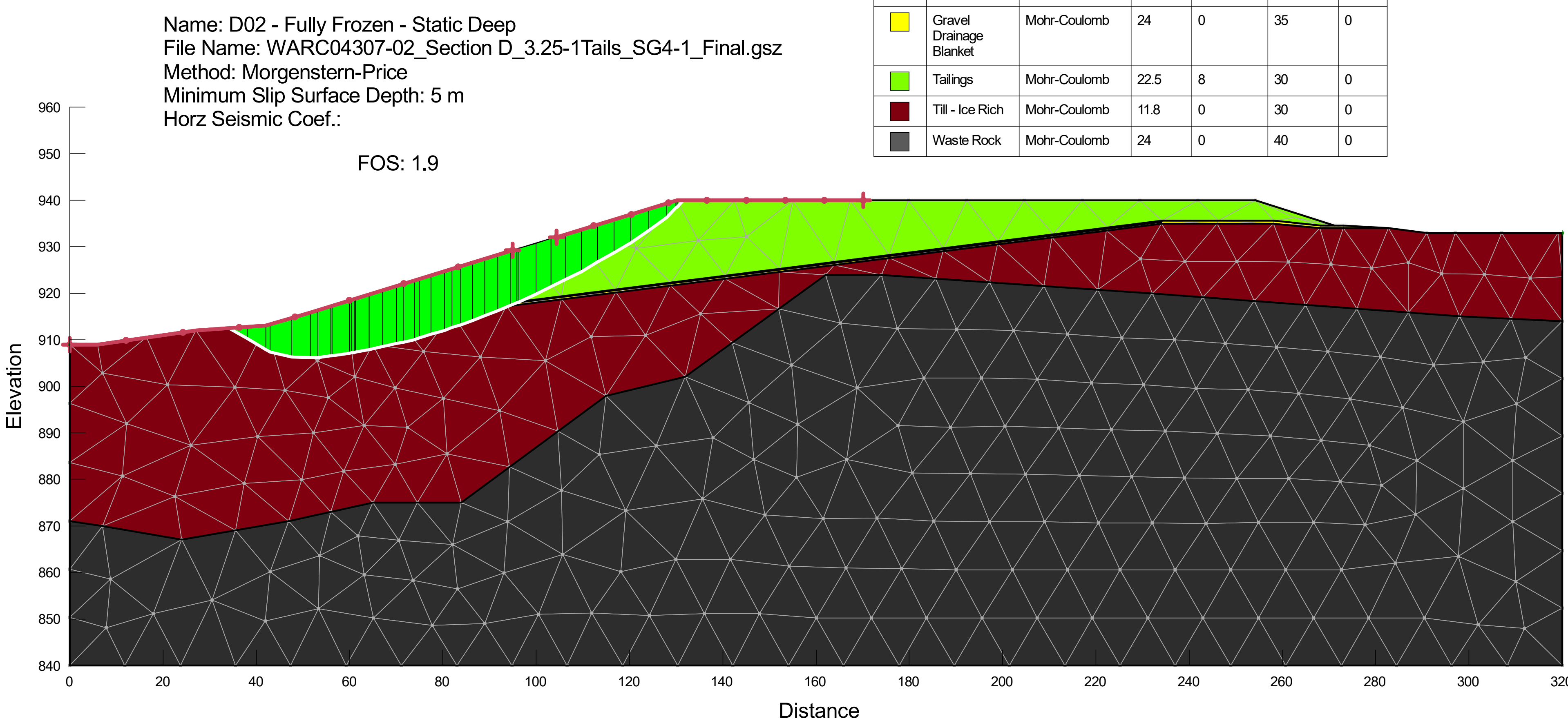
Color	Name	Slope Stability Material Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-B (°)
	Bedrock	Bedrock (Impenetrable)				
	Foundation Materials	Mohr-Coulomb	24	0	16	0
	Loose Gravel Cover	Mohr-Coulomb	21.1	0	30	0
	Tailings	Mohr-Coulomb	22.5	8	30	0



Color	Name	Slope Stability Material Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-B (°)
	Bedrock	Bedrock (Impenetrable)				
	Foundation Materials	Mohr-Coulomb	20	0	16	0
	Gravel Drainage Blanket	Mohr-Coulomb	24	0	35	0
	Tailings	Mohr-Coulomb	22.5	8	30	0
	Till - Ice Rich	Mohr-Coulomb	11.8	0	30	0
	Waste Rock	Mohr-Coulomb	24	0	40	0

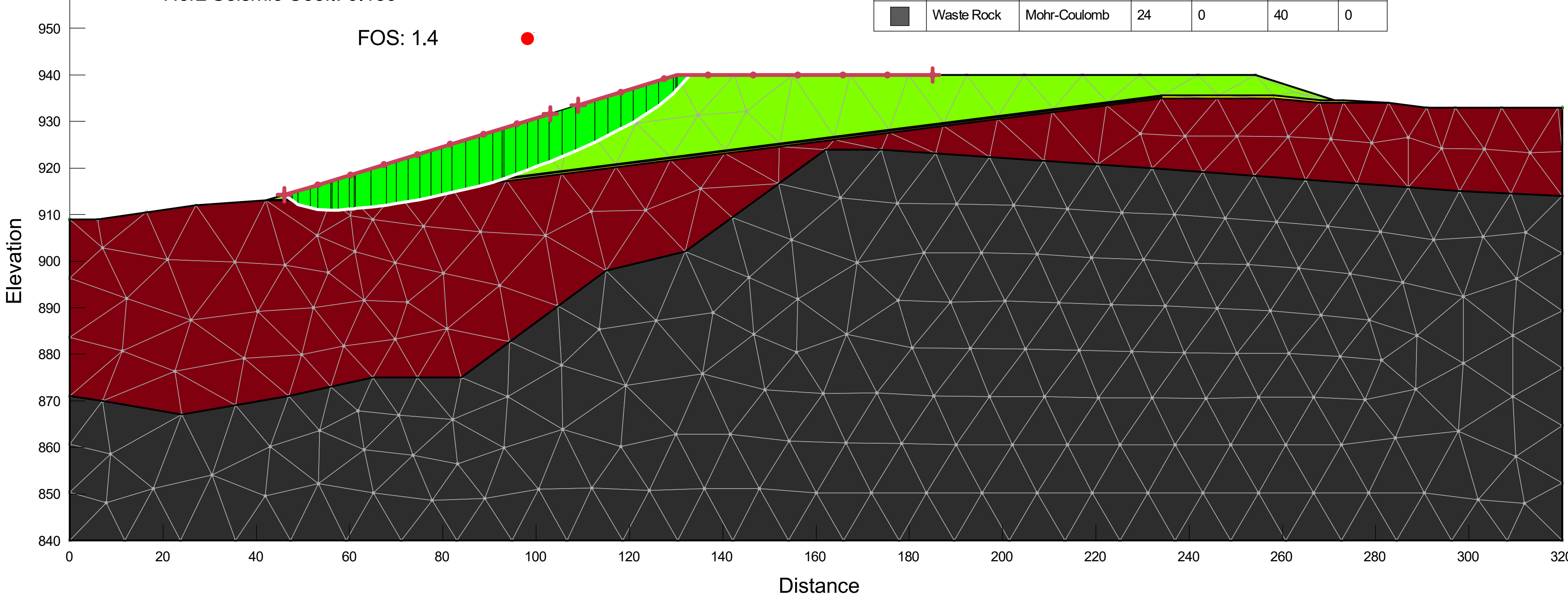


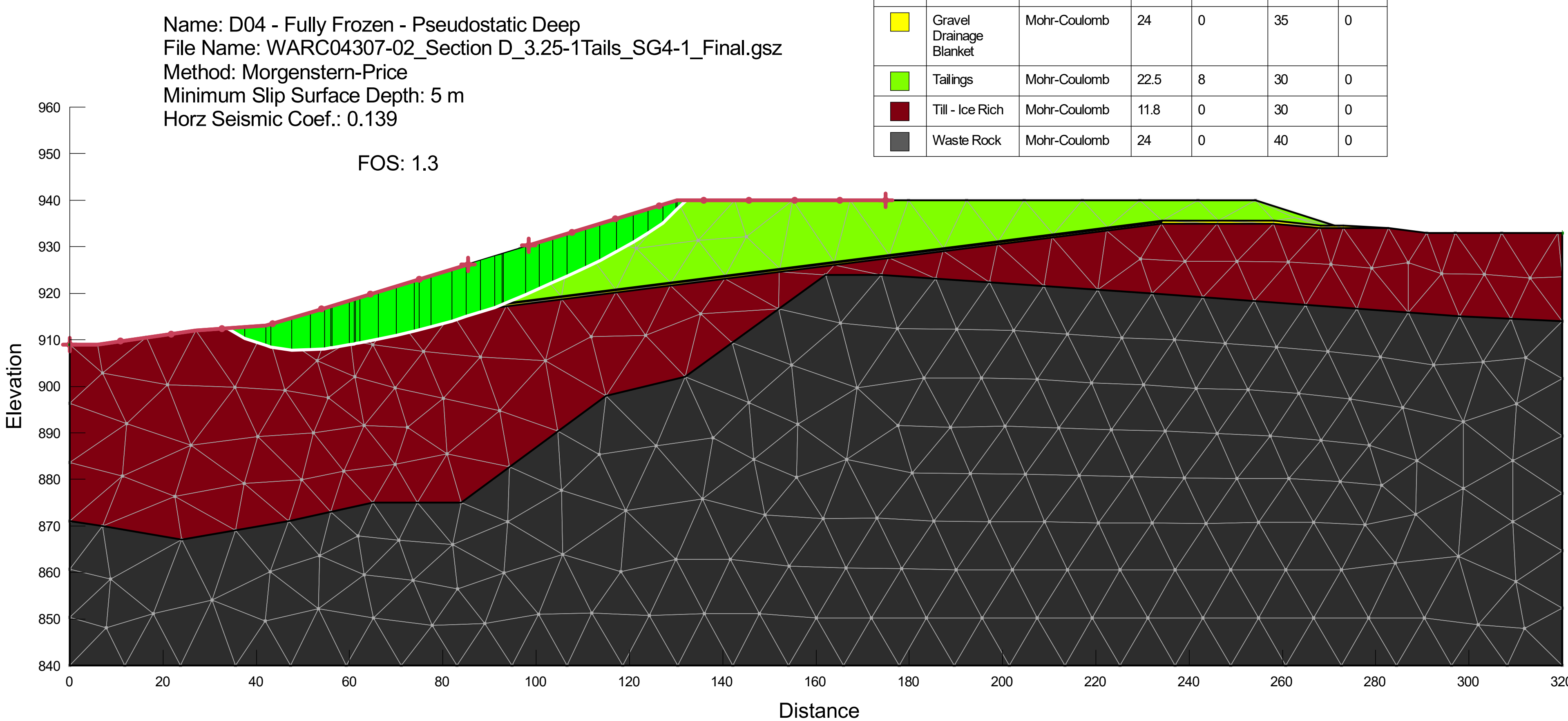
Color	Name	Slope Stability Material Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-B (°)
	Bedrock	Bedrock (Impenetrable)				
	Foundation Materials	Mohr-Coulomb	20	0	16	0
	Gravel Drainage Blanket	Mohr-Coulomb	24	0	35	0
	Tailings	Mohr-Coulomb	22.5	8	30	0
	Till - Ice Rich	Mohr-Coulomb	11.8	0	30	0
	Waste Rock	Mohr-Coulomb	24	0	40	0



Name: D03 - Fully Frozen - Pseudostatic Shallow
File Name: WARC04307-02_Section D_3.25-1Tails_SG4-1_Final.gsz
Method: Morgenstern-Price
Minimum Slip Surface Depth: 1 m
Horz Seismic Coef.: 0.139

Color	Name	Slope Stability Material Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-B (°)
	Bedrock	Bedrock (Impenetrable)				
	Foundation Materials	Mohr-Coulomb	20	0	16	0
	Gravel Drainage Blanket	Mohr-Coulomb	24	0	35	0
	Tailings	Mohr-Coulomb	22.5	8	30	0
	Till - Ice Rich	Mohr-Coulomb	11.8	0	30	0
	Waste Rock	Mohr-Coulomb	24	0	40	0

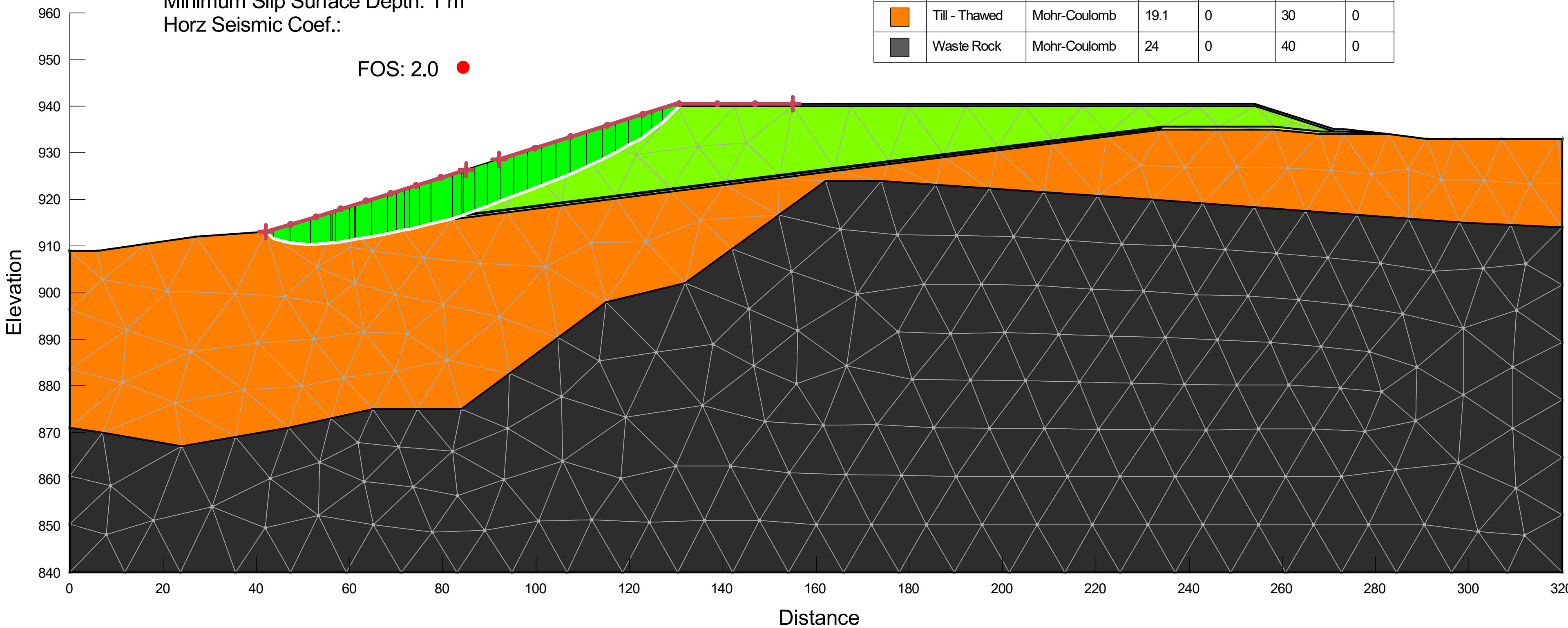




Color	Name	Slope Stability Material Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-B (°)
	Bedrock	Bedrock (Impenetrable)				
	Foundation Materials	Mohr-Coulomb	20	0	16	0
	Gravel Drainage Blanket	Mohr-Coulomb	24	0	35	0
	Tailings	Mohr-Coulomb	22.5	8	30	0
	Till - Ice Rich	Mohr-Coulomb	11.8	0	30	0
	Waste Rock	Mohr-Coulomb	24	0	40	0

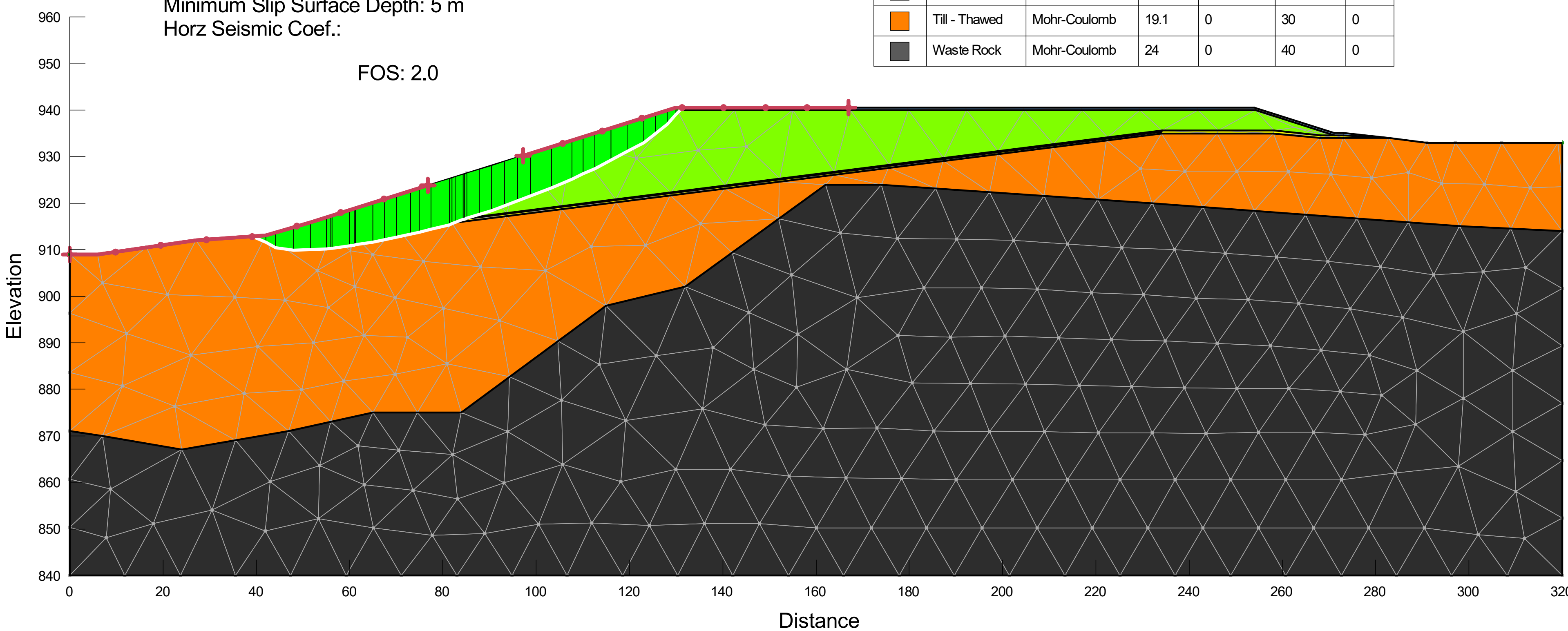
Color	Name	Slope Stability Material Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-B (°)
	Bedrock	Bedrock (Impenetrable)				
	Foundation Materials	Mohr-Coulomb	20	0	16	0
	Gravel Drainage Blanket	Mohr-Coulomb	24	0	35	0
	Loose Gravel Cover	Mohr-Coulomb	21.1	0	30	0
	Tailings	Mohr-Coulomb	22.5	8	30	0
	Till - Thawed	Mohr-Coulomb	19.1	0	30	0
	Waste Rock	Mohr-Coulomb	24	0	40	0

Name: D05 - Fully Thawed - Static Shallow
File Name: WARC04307-02_Section D_3.25-1Tails_SG4-1_Final.gsz
Method: Morgenstern-Price
Minimum Slip Surface Depth: 1 m
Horz Seismic Coef.:



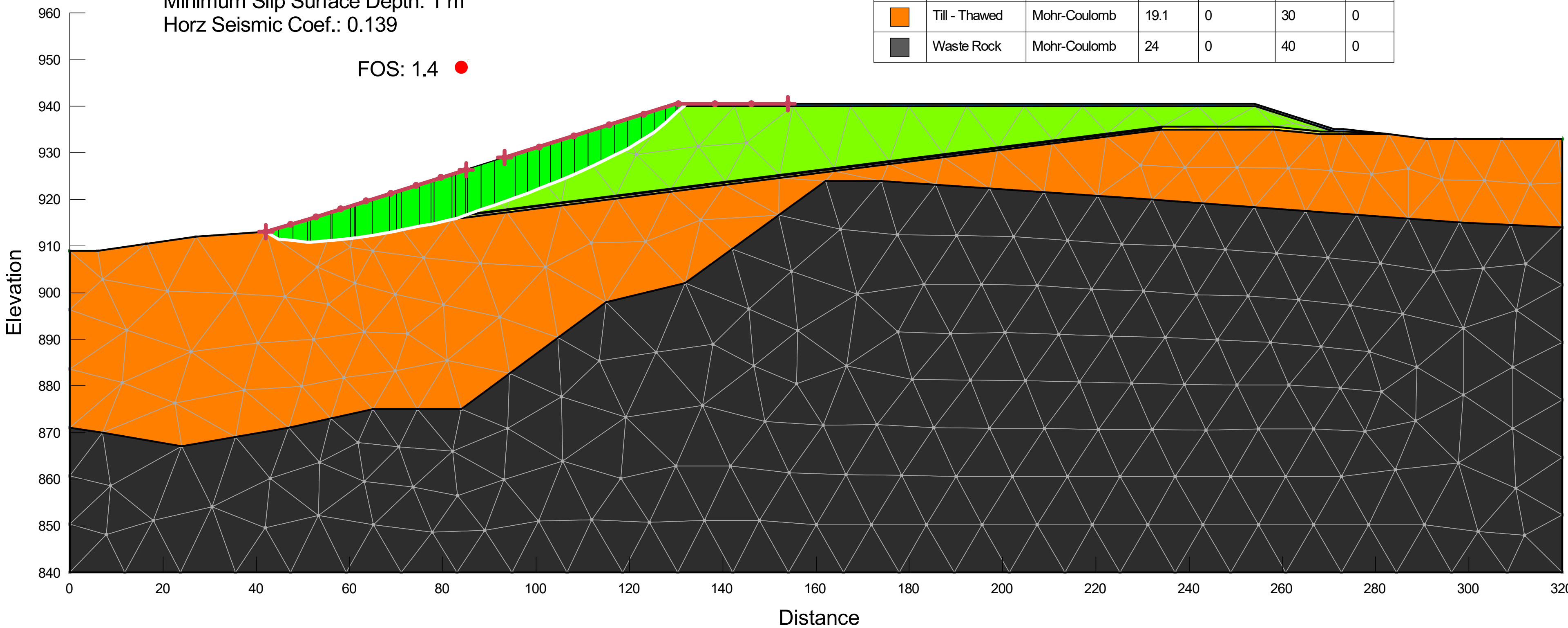
Name: D06 - Fully Thawed - Static Deep
File Name: WARC04307-02_Section D_3.25-1Tails_SG4-1_Final.gsz
Method: Morgenstern-Price
Minimum Slip Surface Depth: 5 m
Horz Seismic Coef.:

Color	Name	Slope Stability Material Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-B (°)
	Bedrock	Bedrock (Impenetrable)				
	Foundation Materials	Mohr-Coulomb	20	0	16	0
	Gravel Drainage Blanket	Mohr-Coulomb	24	0	35	0
	Loose Gravel Cover	Mohr-Coulomb	21.1	0	30	0
	Tailings	Mohr-Coulomb	22.5	8	30	0
	Till - Thawed	Mohr-Coulomb	19.1	0	30	0
	Waste Rock	Mohr-Coulomb	24	0	40	0



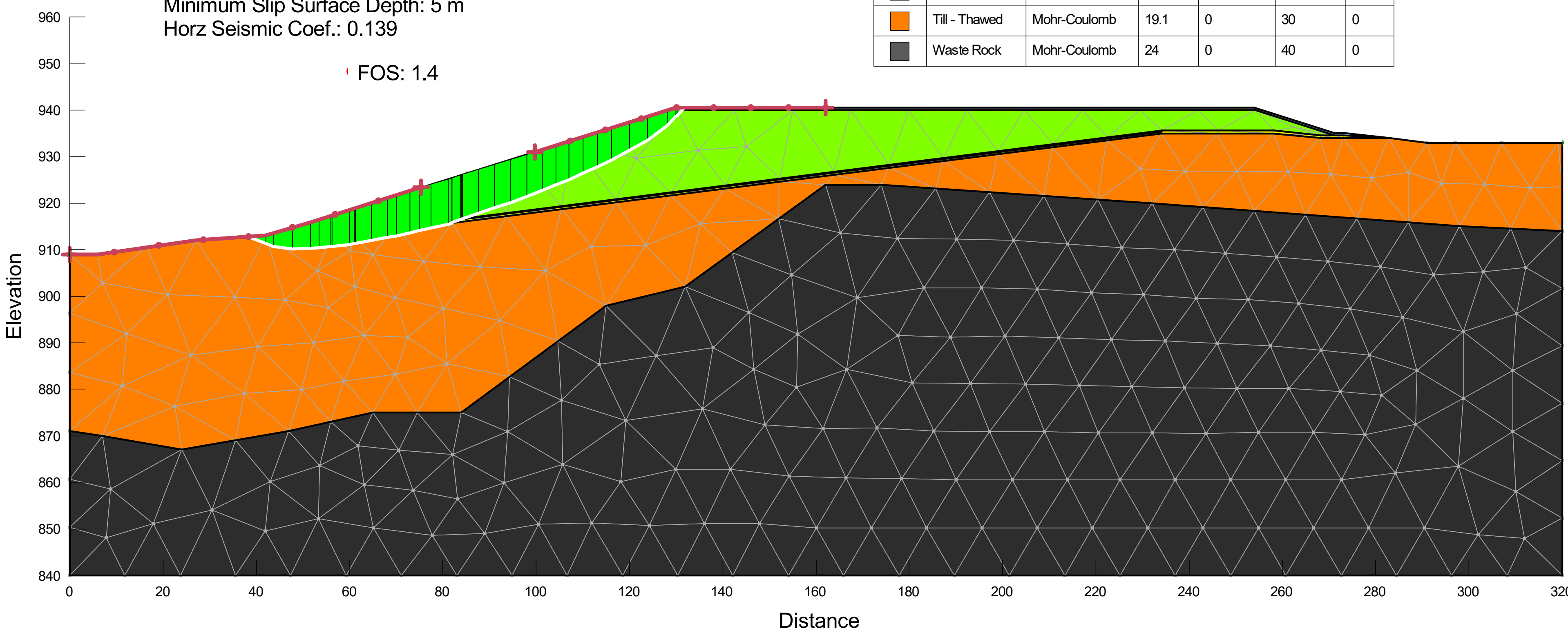
Color	Name	Slope Stability Material Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-B (°)
	Bedrock	Bedrock (Impenetrable)				
	Foundation Materials	Mohr-Coulomb	20	0	16	0
	Gravel Drainage Blanket	Mohr-Coulomb	24	0	35	0
	Loose Gravel Cover	Mohr-Coulomb	21.1	0	30	0
	Tailings	Mohr-Coulomb	22.5	8	30	0
	Till - Thawed	Mohr-Coulomb	19.1	0	30	0
	Waste Rock	Mohr-Coulomb	24	0	40	0

Name: D07 - Fully Thawed - Pseudostatic Shallow
File Name: WARC04307-02_Section D_3.25-1Tails_SG4-1_Final.gsz
Method: Morgenstern-Price
Minimum Slip Surface Depth: 1 m
Horz Seismic Coef.: 0.139



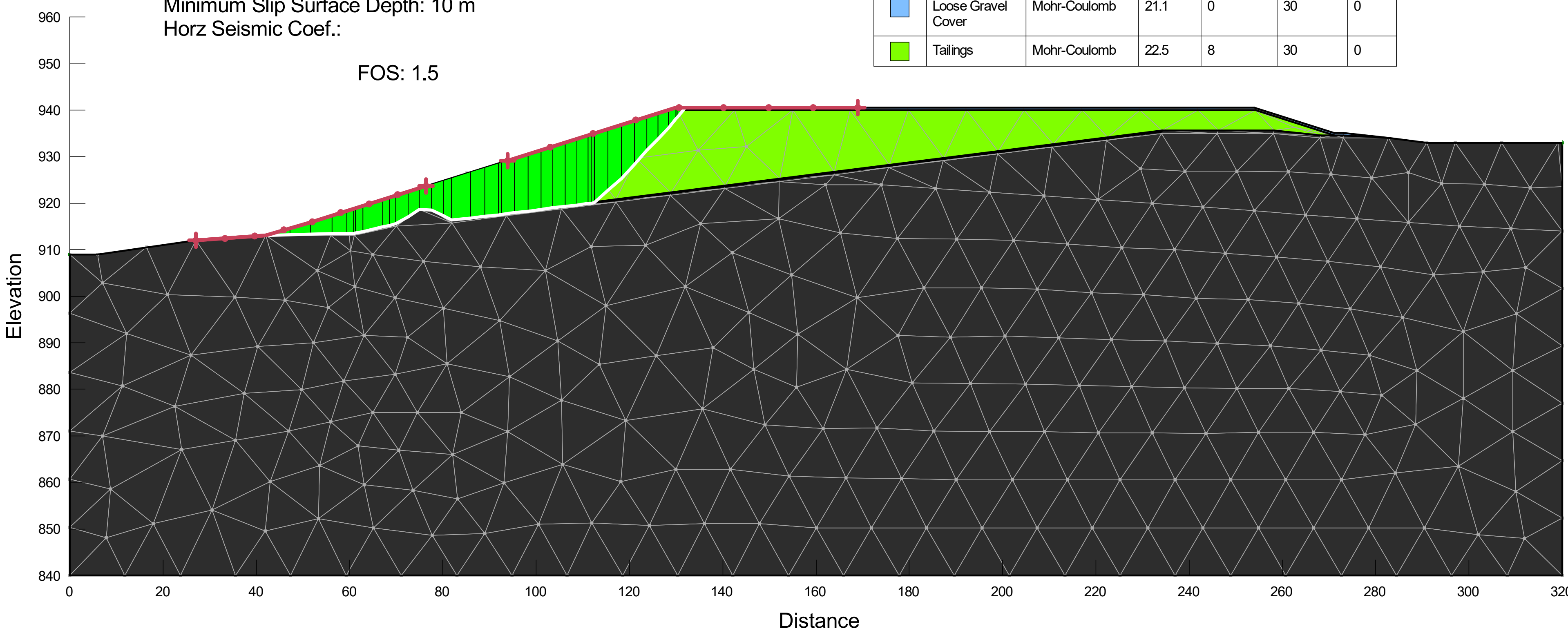
Name: D08 - Fully Thawed - Pseudostatic Deep
File Name: WARC04307-02_Section D_3.25-1Tails_SG4-1_Final.gsz
Method: Morgenstern-Price
Minimum Slip Surface Depth: 5 m
Horz Seismic Coef.: 0.139

Color	Name	Slope Stability Material Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-B (°)
	Bedrock	Bedrock (Impenetrable)				
	Foundation Materials	Mohr-Coulomb	20	0	16	0
	Gravel Drainage Blanket	Mohr-Coulomb	24	0	35	0
	Loose Gravel Cover	Mohr-Coulomb	21.1	0	30	0
	Tailings	Mohr-Coulomb	22.5	8	30	0
	Till - Thawed	Mohr-Coulomb	19.1	0	30	0
	Waste Rock	Mohr-Coulomb	24	0	40	0



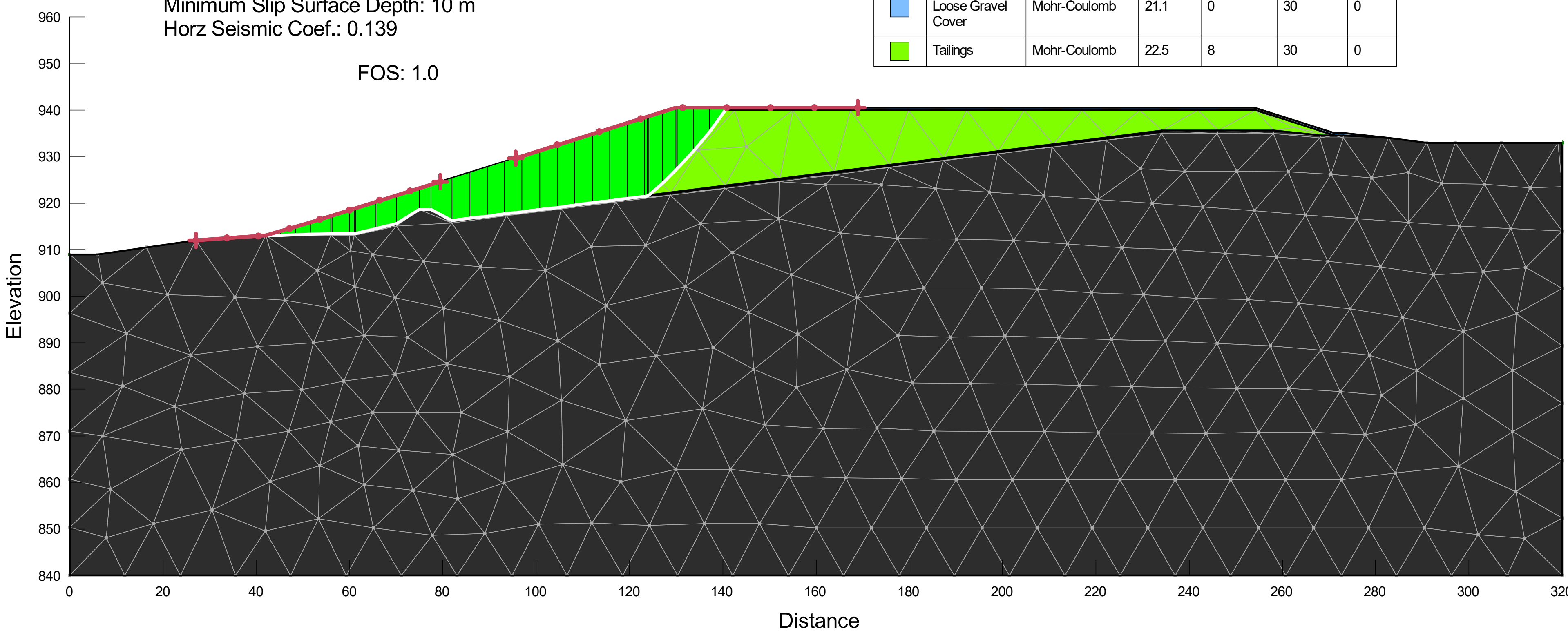
Color	Name	Slope Stability Material Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-B (°)
	Bedrock	Bedrock (Impenetrable)				
	Foundation Materials	Mohr-Coulomb	20	0	16	0
	Loose Gravel Cover	Mohr-Coulomb	21.1	0	30	0
	Tailings	Mohr-Coulomb	22.5	8	30	0

Name: D09 - Foundation Analysis - Static Deep
File Name: WARC04307-02_Section D_3.25-1Tails_SG4-1_Final.gsz
Method: Morgenstern-Price
Minimum Slip Surface Depth: 10 m
Horz Seismic Coef.:



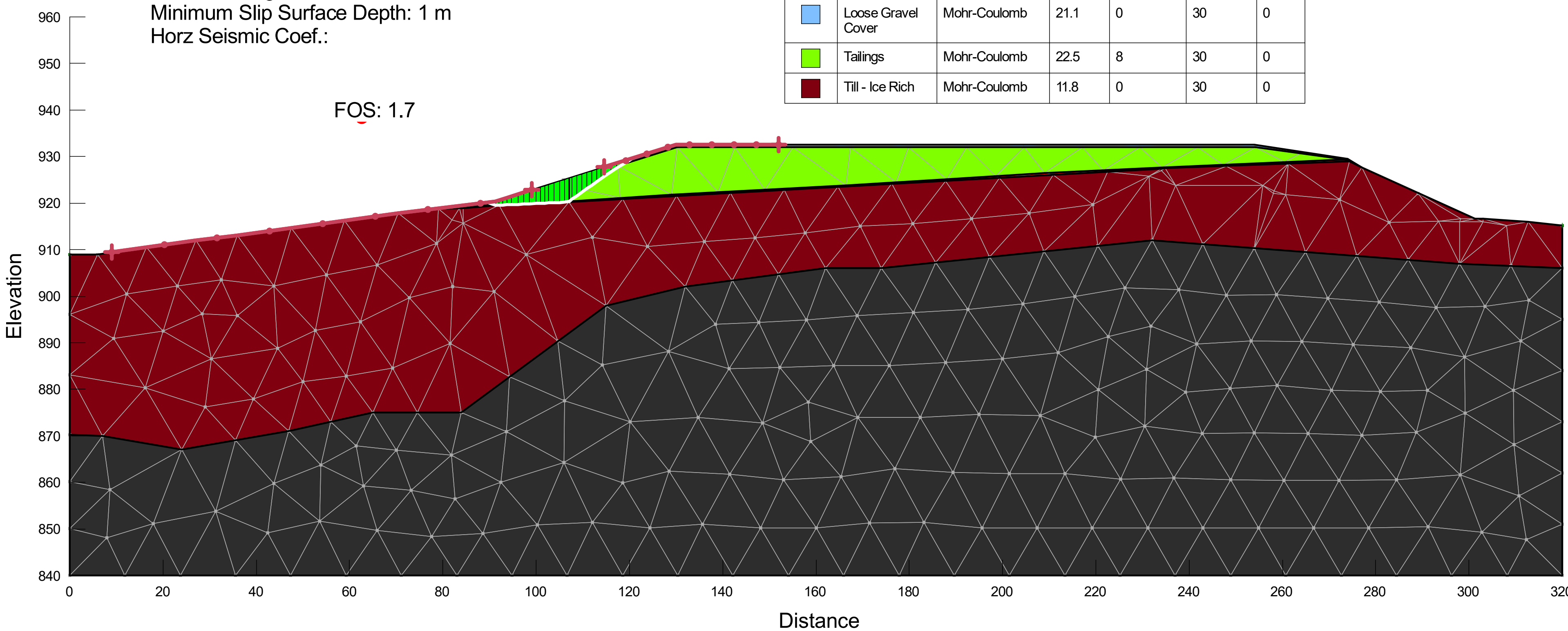
Name: D10 - Foundation Analysis - Pseudostatic Deep
File Name: WARC04307-02_Section D_3.25-1Tails_SG4-1_Final.gsz
Method: Morgenstern-Price
Minimum Slip Surface Depth: 10 m
Horz Seismic Coef.: 0.139

Color	Name	Slope Stability Material Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-B (°)
	Bedrock	Bedrock (Impenetrable)				
	Foundation Materials	Mohr-Coulomb	20	0	16	0
	Loose Gravel Cover	Mohr-Coulomb	21.1	0	30	0
	Tailings	Mohr-Coulomb	22.5	8	30	0



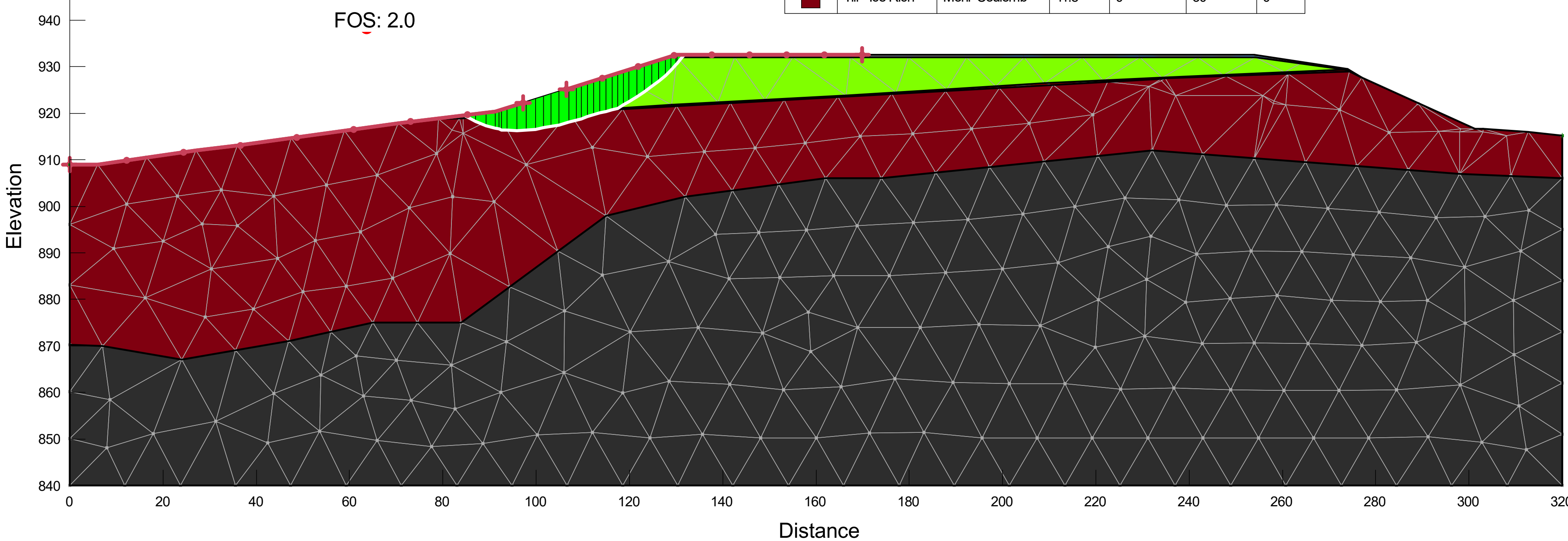
Color	Name	Slope Stability Material Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-B (°)
	Bedrock	Bedrock (Impenetrable)				
	Foundation Materials	Mohr-Coulomb	20	0	16	0
	Loose Gravel Cover	Mohr-Coulomb	21.1	0	30	0
	Tailings	Mohr-Coulomb	22.5	8	30	0
	Till - Ice Rich	Mohr-Coulomb	11.8	0	30	0

Name: E01 - Fully Frozen - Static Shallow
File Name: WARC04307-02_Section E_3.25-10m Tails R1.gsz
Method: Morgenstern-Price
Minimum Slip Surface Depth: 1 m
Horz Seismic Coef.:



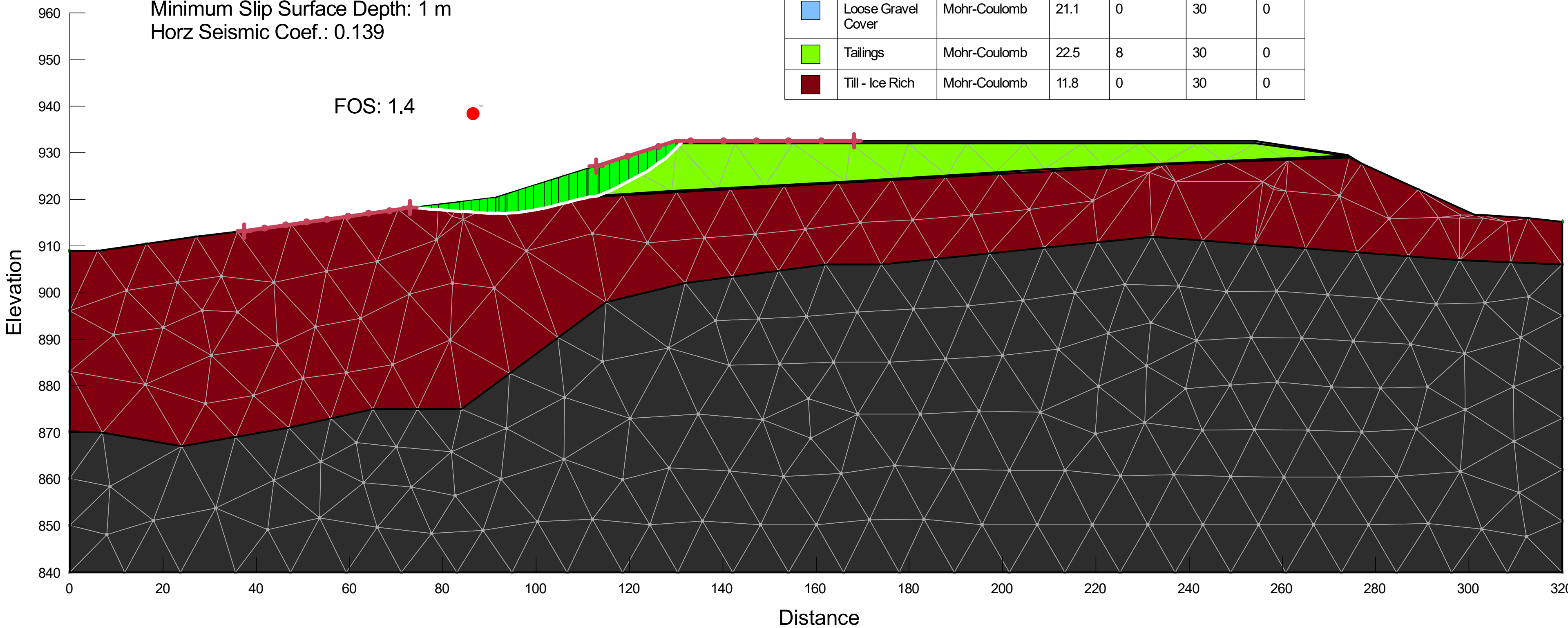
Name: E02 - Fully Frozen - Static Deep
File Name: WARC04307-02_Section E_3.25-10m Tails R1.gsz
Method: Morgenstern-Price
Minimum Slip Surface Depth: 5 m
Horz Seismic Coef.:

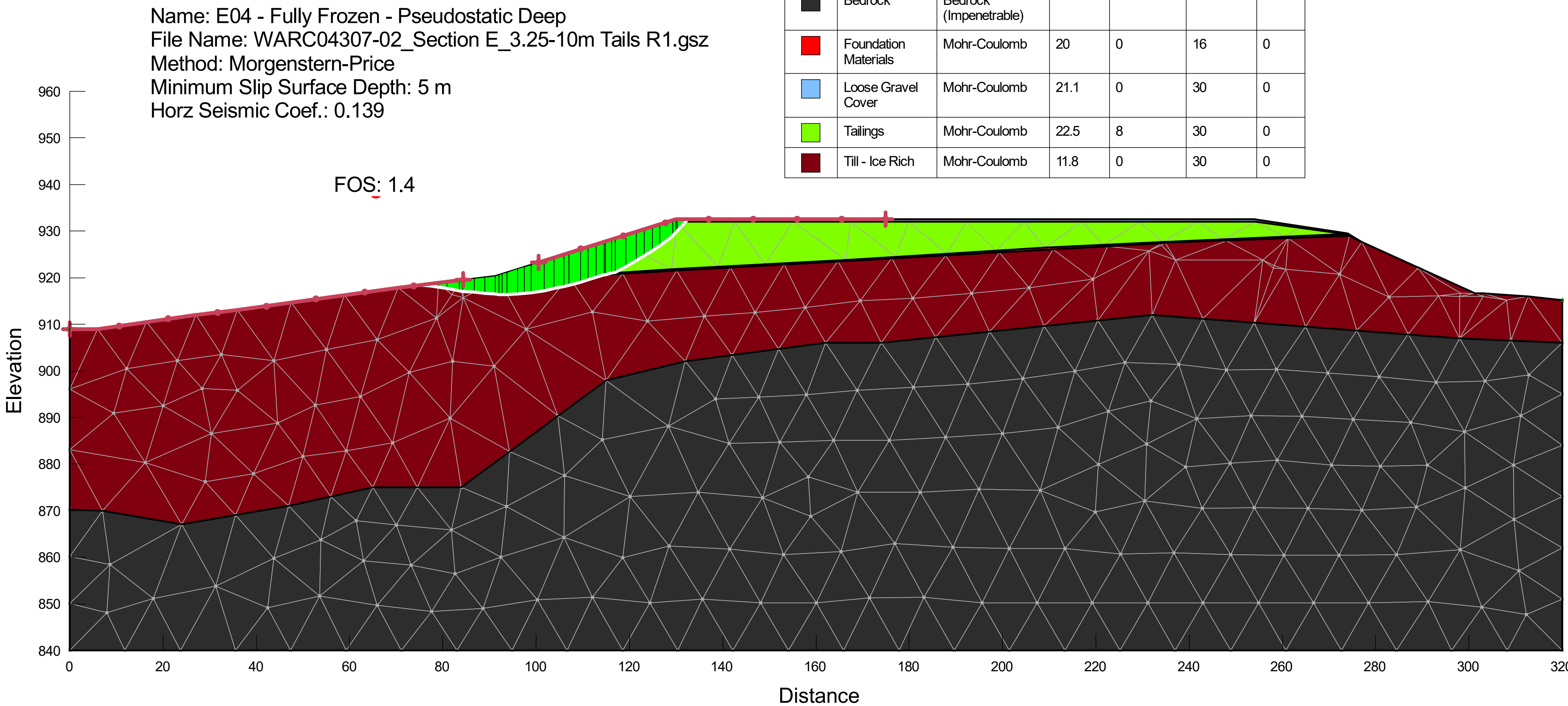
Color	Name	Slope Stability Material Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-B (°)
	Bedrock	Bedrock (Impenetrable)				
	Foundation Materials	Mohr-Coulomb	20	0	16	0
	Loose Gravel Cover	Mohr-Coulomb	21.1	0	30	0
	Tailings	Mohr-Coulomb	22.5	8	30	0
	Till - Ice Rich	Mohr-Coulomb	11.8	0	30	0



Name: E03 - Fully Frozen - Pseudostatic Shallow
File Name: WARC04307-02_Section E_3.25-10m Tails R1.gsz
Method: Morgenstern-Price
Minimum Slip Surface Depth: 1 m
Horz Seismic Coef.: 0.139

Color	Name	Slope Stability Material Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-B (°)
	Bedrock	Bedrock (Impenetrable)				
	Foundation Materials	Mohr-Coulomb	20	0	16	0
	Loose Gravel Cover	Mohr-Coulomb	21.1	0	30	0
	Tailings	Mohr-Coulomb	22.5	8	30	0
	Till - Ice Rich	Mohr-Coulomb	11.8	0	30	0

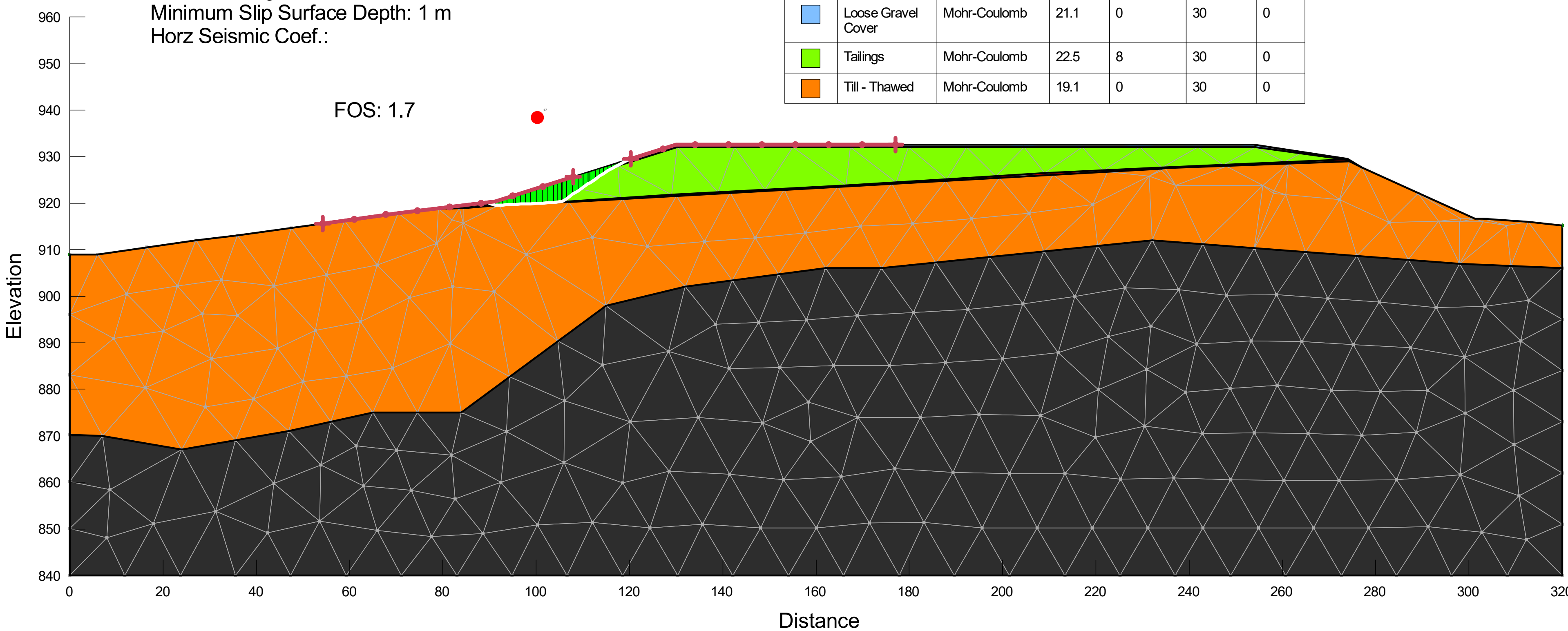


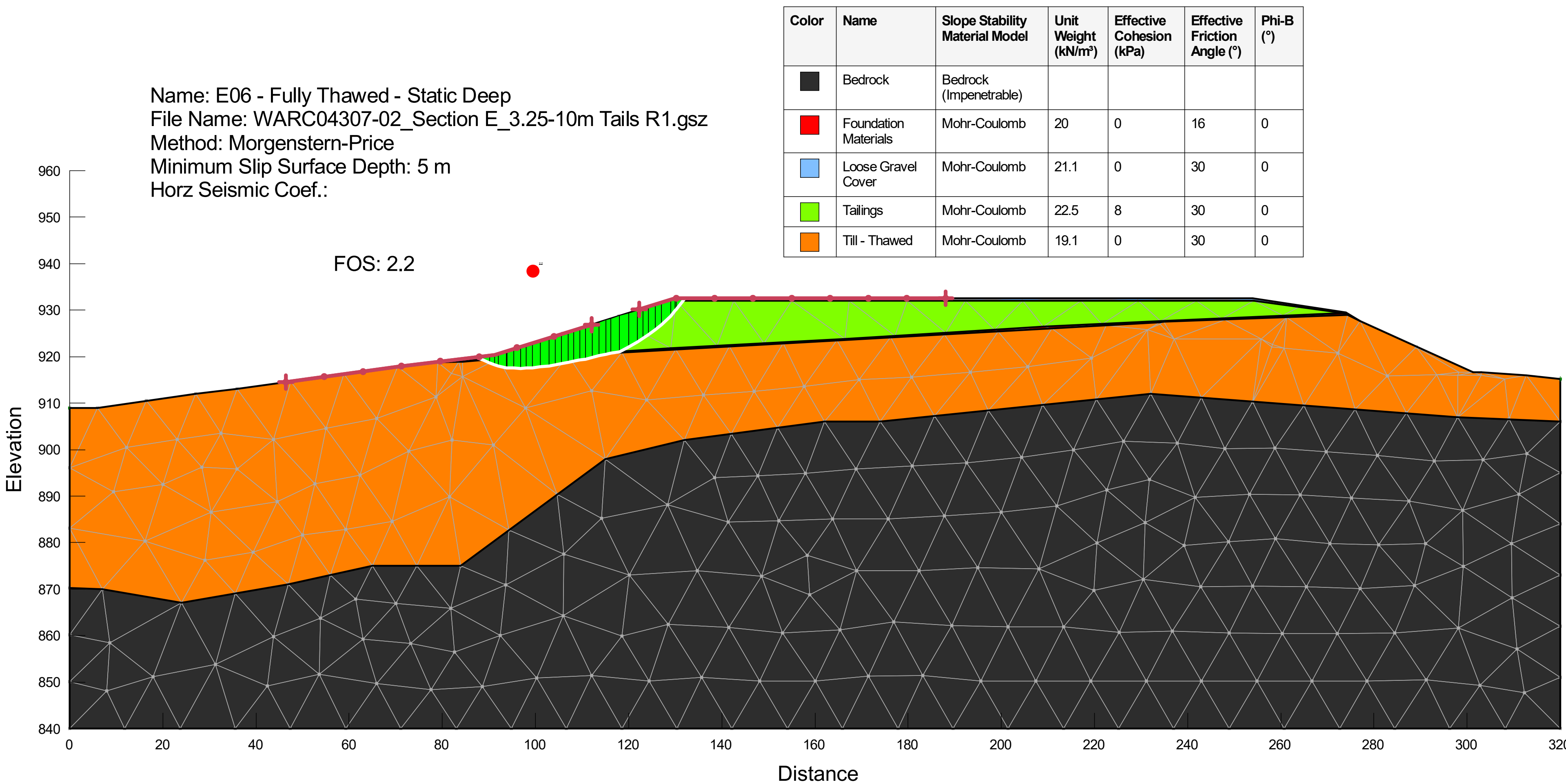


Color	Name	Slope Stability Material Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-B (°)
	Bedrock	Bedrock (Impenetrable)				
	Foundation Materials	Mohr-Coulomb	20	0	16	0
	Loose Gravel Cover	Mohr-Coulomb	21.1	0	30	0
	Tailings	Mohr-Coulomb	22.5	8	30	0
	Till - Ice Rich	Mohr-Coulomb	11.8	0	30	0

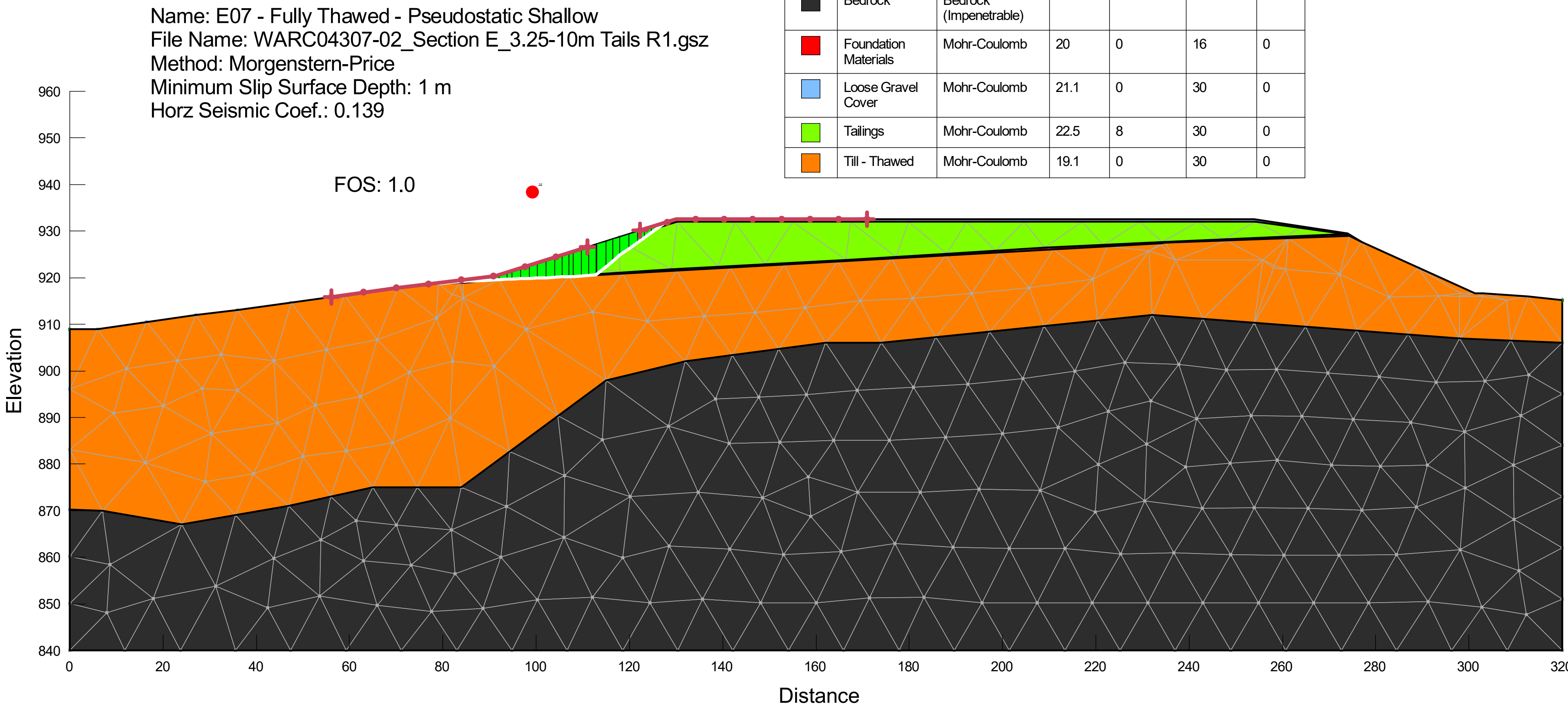
Name: E05 - Fully Thawed - Static Shallow
File Name: WARC04307-02_Section E_3.25-10m Tails R1.gsz
Method: Morgenstern-Price
Minimum Slip Surface Depth: 1 m
Horz Seismic Coef.:

Color	Name	Slope Stability Material Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-B (°)
	Bedrock	Bedrock (Impenetrable)				
	Foundation Materials	Mohr-Coulomb	20	0	16	0
	Loose Gravel Cover	Mohr-Coulomb	21.1	0	30	0
	Tailings	Mohr-Coulomb	22.5	8	30	0
	Till - Thawed	Mohr-Coulomb	19.1	0	30	0





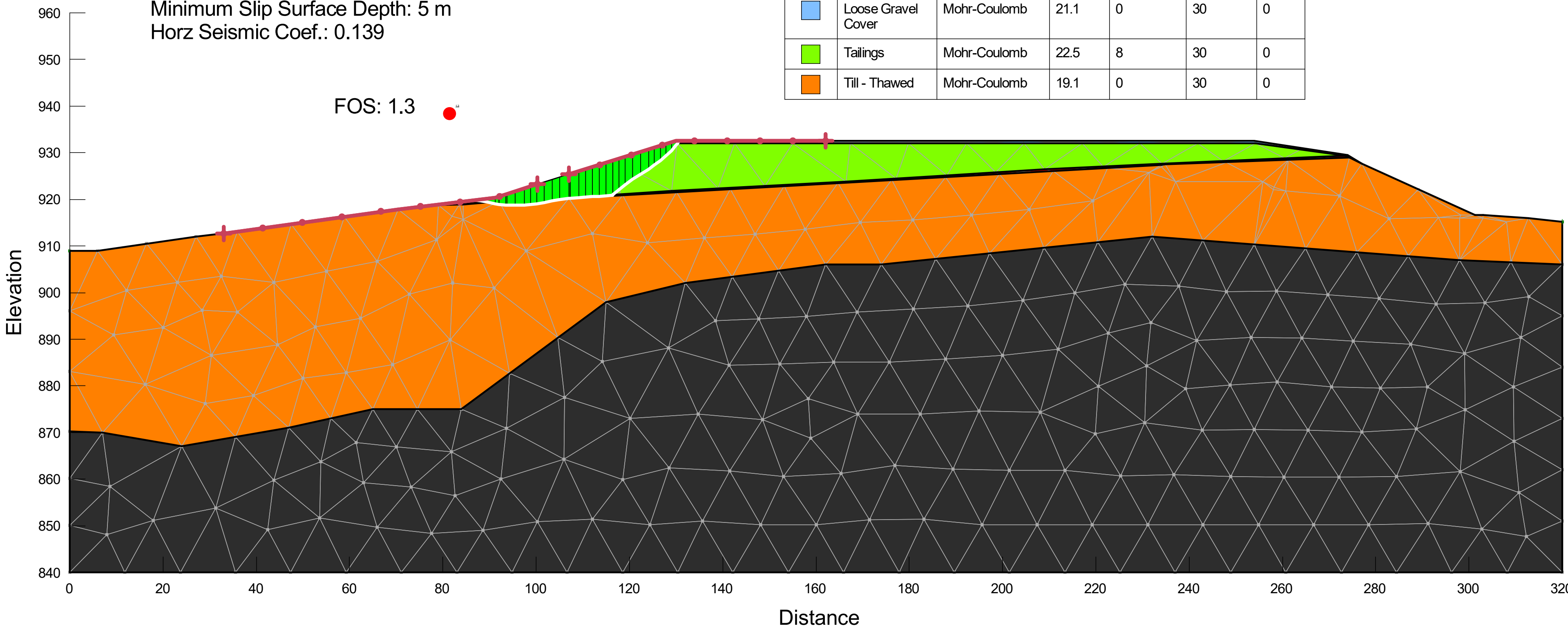
Name: E06 - Fully Thawed - Static Deep
File Name: WARC04307-02_Section E_3.25-10m Tails R1.gsz
Method: Morgenstern-Price
Minimum Slip Surface Depth: 5 m
Horz Seismic Coef.:
FOS: 2.2
Color
Name
Slope Stability Material Model
Unit Weight (kN/m³)
Effective Cohesion (kPa)
Effective Friction Angle (°)
Phi-B (°)
Bedrock
Bedrock (Impenetrable)
Foundation Materials
Mohr-Coulomb
20
0
16
0
Loose Gravel Cover
Mohr-Coulomb
21.1
0
30
0
Tailings
Mohr-Coulomb
22.5
8
30
0
Till - Thawed
Mohr-Coulomb
19.1
0
30
0
Elevation
960
950
940
930
920
910
900
890
880
870
860
850
840
Distance
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
320



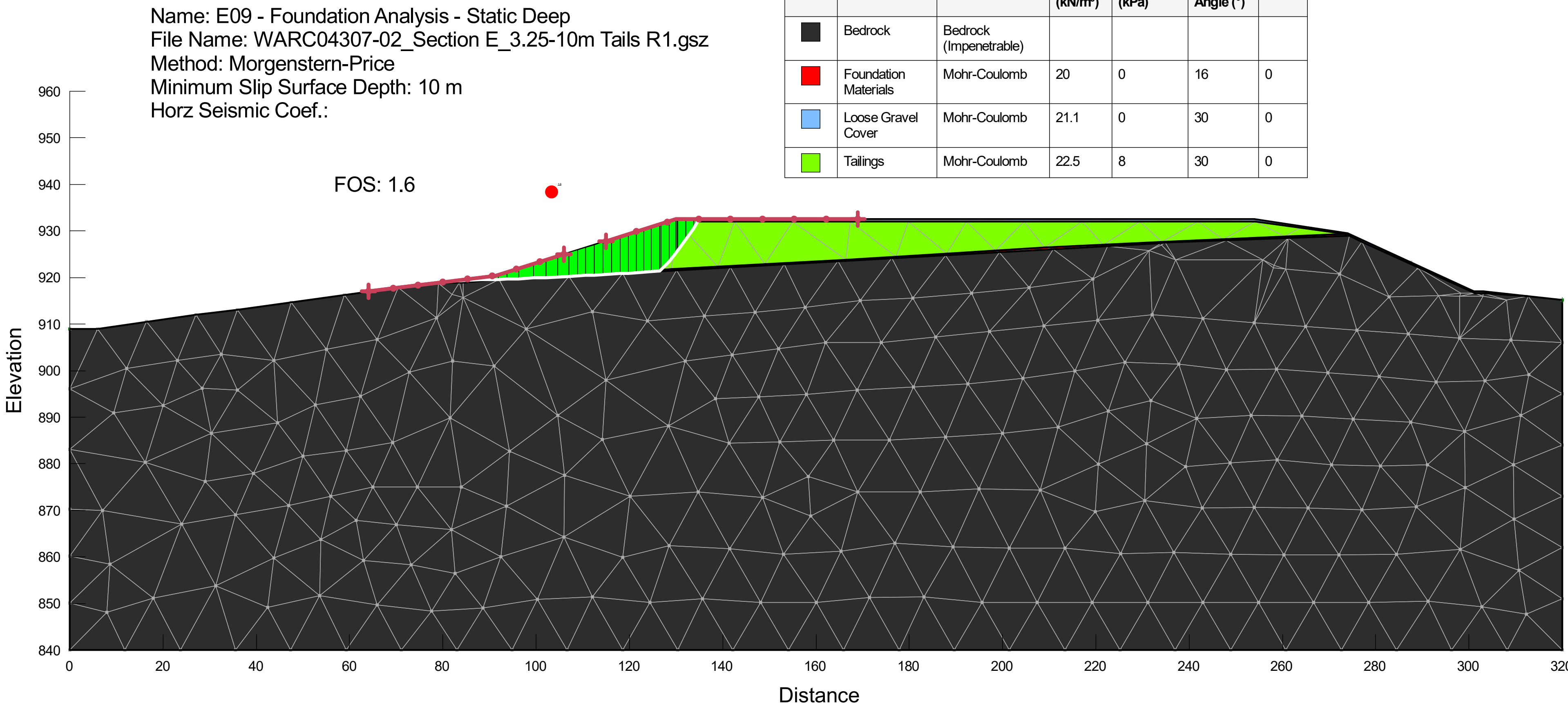
Color	Name	Slope Stability Material Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-B (°)
	Bedrock	Bedrock (Impenetrable)				
	Foundation Materials	Mohr-Coulomb	20	0	16	0
	Loose Gravel Cover	Mohr-Coulomb	21.1	0	30	0
	Tailings	Mohr-Coulomb	22.5	8	30	0
	Till - Thawed	Mohr-Coulomb	19.1	0	30	0

Color	Name	Slope Stability Material Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-B (°)
	Bedrock	Bedrock (Impenetrable)				
	Foundation Materials	Mohr-Coulomb	20	0	16	0
	Loose Gravel Cover	Mohr-Coulomb	21.1	0	30	0
	Tailings	Mohr-Coulomb	22.5	8	30	0
	Till - Thawed	Mohr-Coulomb	19.1	0	30	0

Name: E08 - Fully Thawed - Pseudostatic Deep
File Name: WARC04307-02_Section E_3.25-10m Tails R1.gsz
Method: Morgenstern-Price
Minimum Slip Surface Depth: 5 m
Horz Seismic Coef.: 0.139

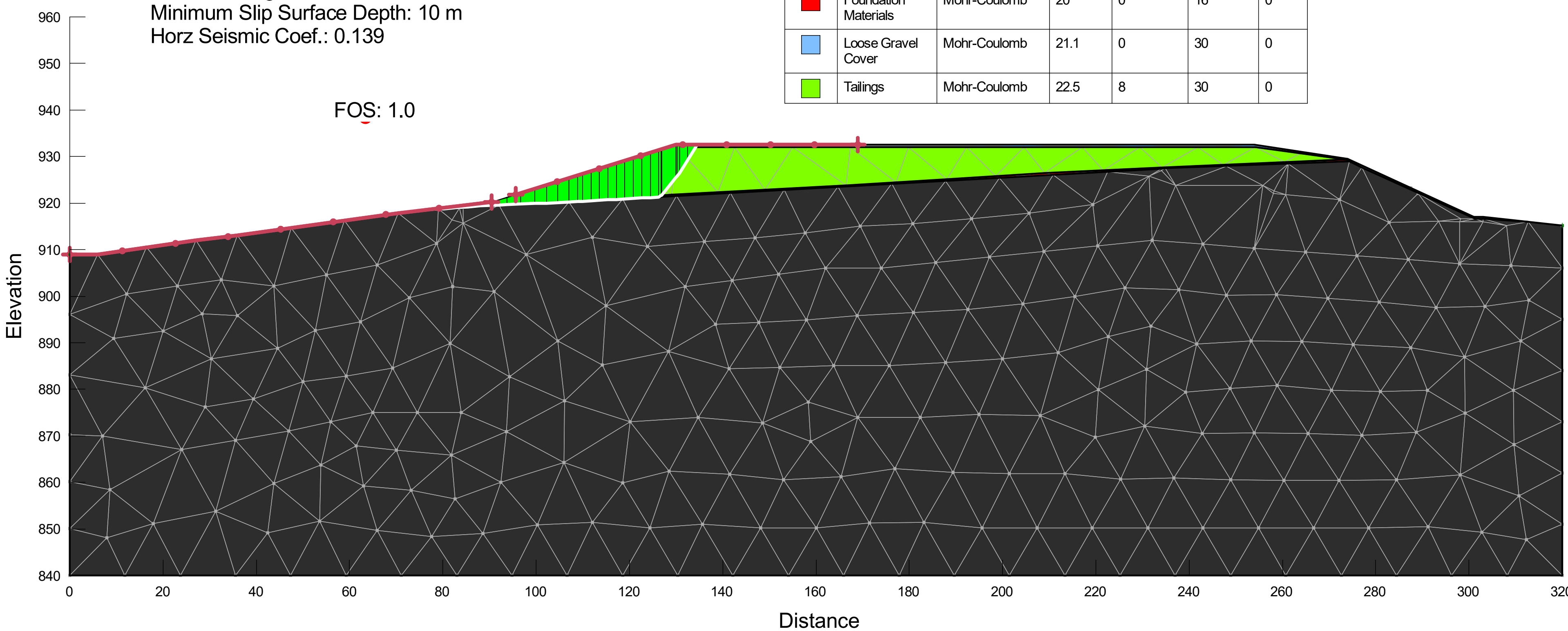


Color	Name	Slope Stability Material Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-B (°)
	Bedrock	Bedrock (Impenetrable)				
	Foundation Materials	Mohr-Coulomb	20	0	16	0
	Loose Gravel Cover	Mohr-Coulomb	21.1	0	30	0
	Tailings	Mohr-Coulomb	22.5	8	30	0



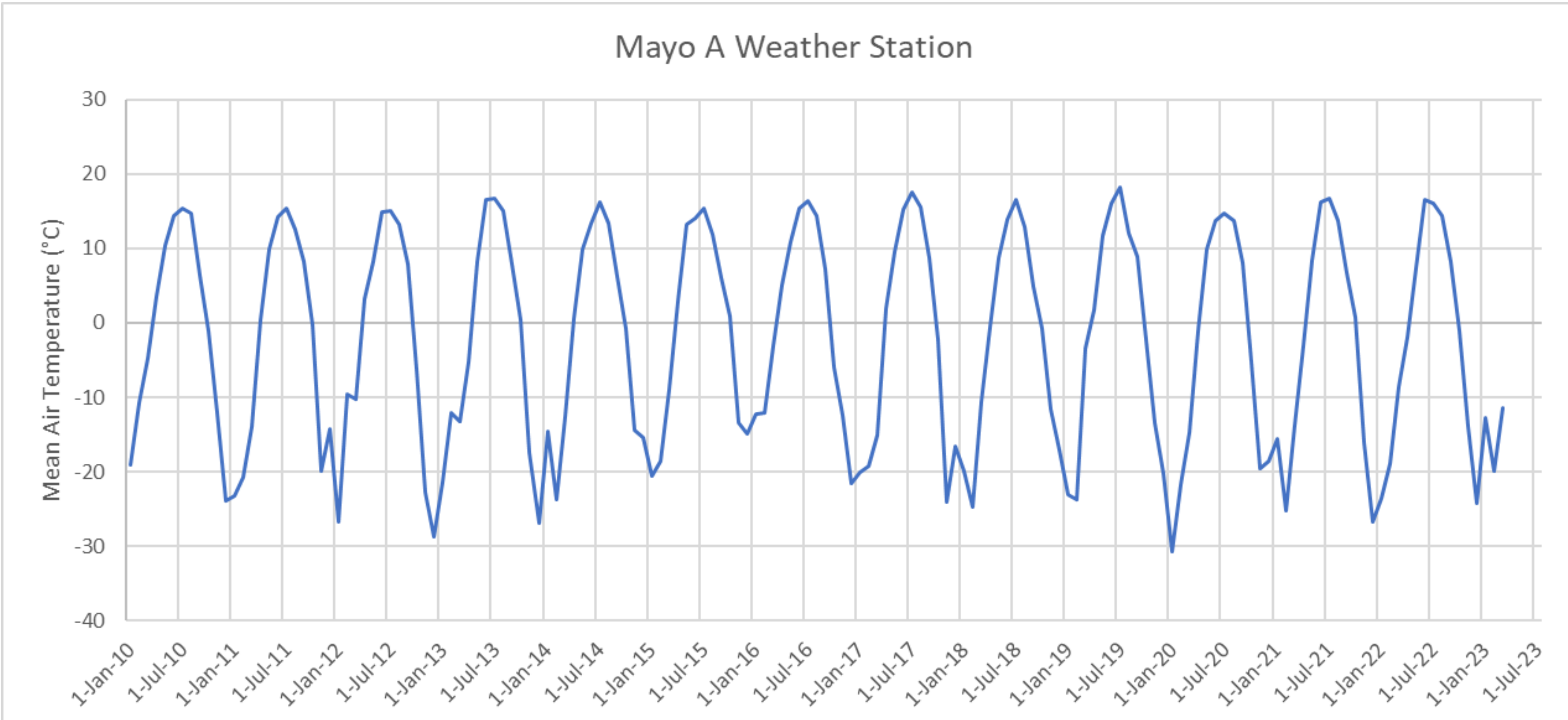
Name: E10 - Foundation Analysis - Pseudostatic Deep
File Name: WARC04307-02_Section E_3.25-10m Tails R1.gsz
Method: Morgenstern-Price
Minimum Slip Surface Depth: 10 m
Horz Seismic Coef.: 0.139

Color	Name	Slope Stability Material Model	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)	Phi-B (°)
	Bedrock	Bedrock (Impenetrable)				
	Foundation Materials	Mohr-Coulomb	20	0	16	0
	Loose Gravel Cover	Mohr-Coulomb	21.1	0	30	0
	Tailings	Mohr-Coulomb	22.5	8	30	0



APPENDIX F

GEOTHERMAL MODEL FIGURES



LEGEND

NOTES

CLIENT

Hecla
MINING COMPANY

TETRA TECH

STATUS
ISSUED FOR USE

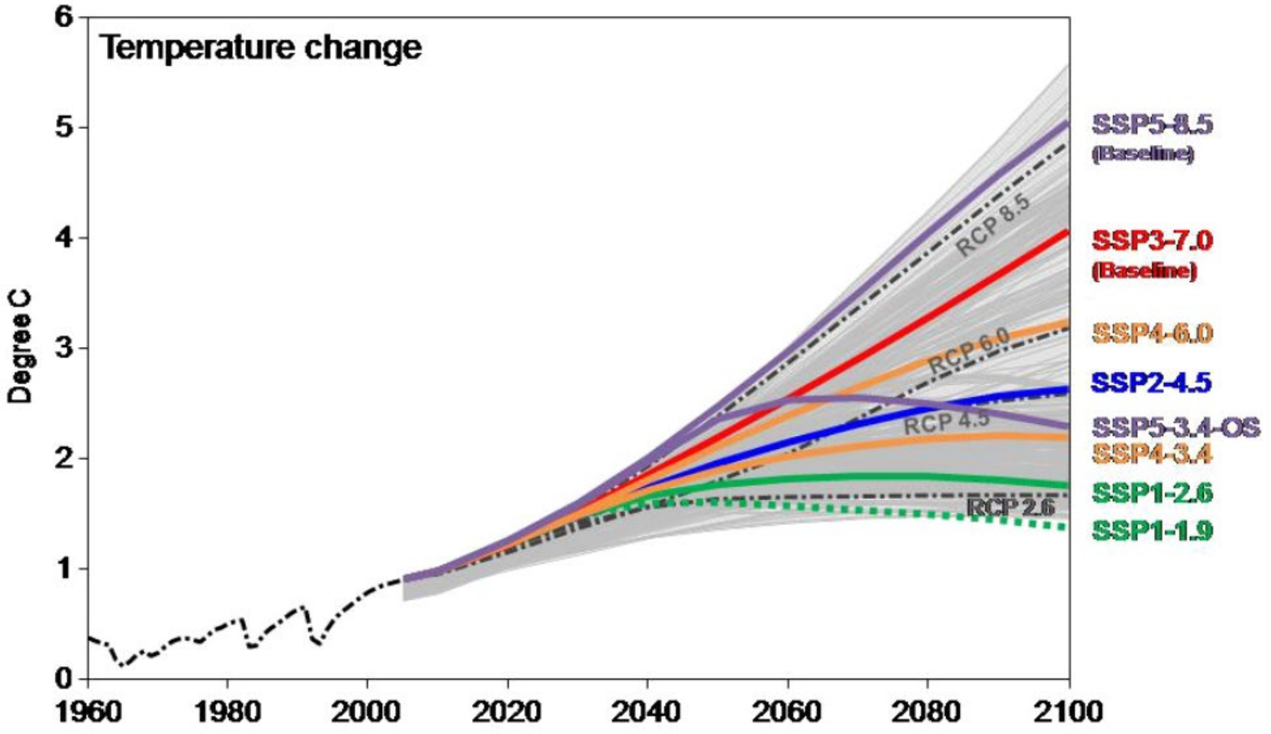
DETAILED DESIGN – PHASE 2 DRY STACK TAILINGS FACILITY
KENO HILL DISTRICT MILL SITE, YUKON

Mean Monthly Air Temperatures from Mayo A Weather Station (January 2010 to April 2023)

PROJECT NO.	DWN	CKD	APVD	REV
ENG.WARC04307-01	EDG	IM	RT	A

OFFICE	DATE
WHITEHORSE	JUNE 2023

Figure F-1



Source: Riahi et al, 2016

LEGEND

NOTES

STATUS
ISSUED FOR USE

CLIENT

Hecla MINING COMPANY

TETRA TECH

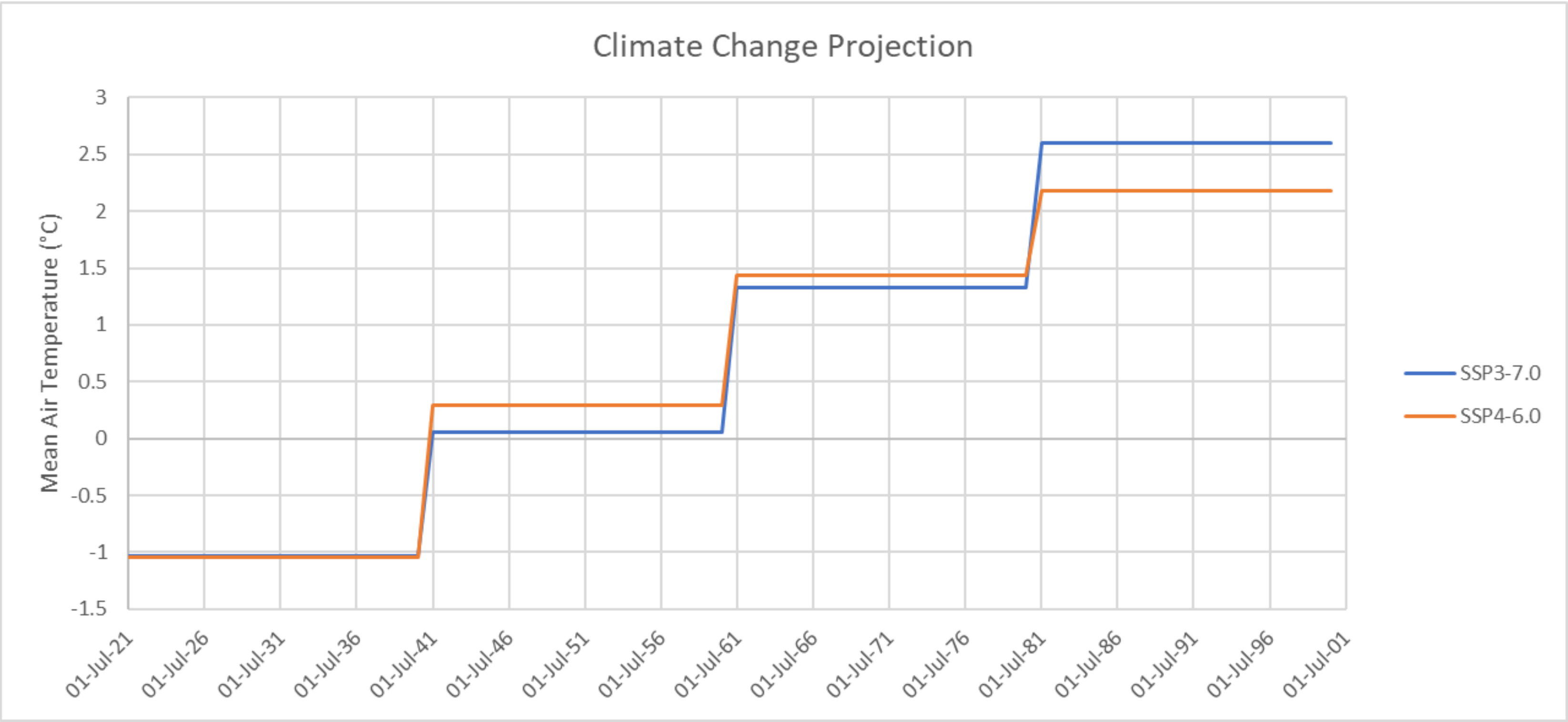
DETAILED DESIGN – PHASE 2 DRY STACK TAILINGS FACILITY
KENO HILL DISTRICT MILL SITE, YUKON

Comparison of Temperature Change for CMIP6 Climate Scenarios

PROJECT NO.	DWN	CKD	APVD	REV
ENG.WARC04307-01	EDG	IM	RT	A

OFFICE	DATE
WHITEHORSE	JUNE 2023

Figure F-2



LEGEND

NOTES

CLIENT

Hecla MINING COMPANY

TETRA TECH

DETAILED DESIGN – PHASE 2 DRY STACK TAILINGS FACILITY
KENO HILL DISTRICT MILL SITE, YUKON

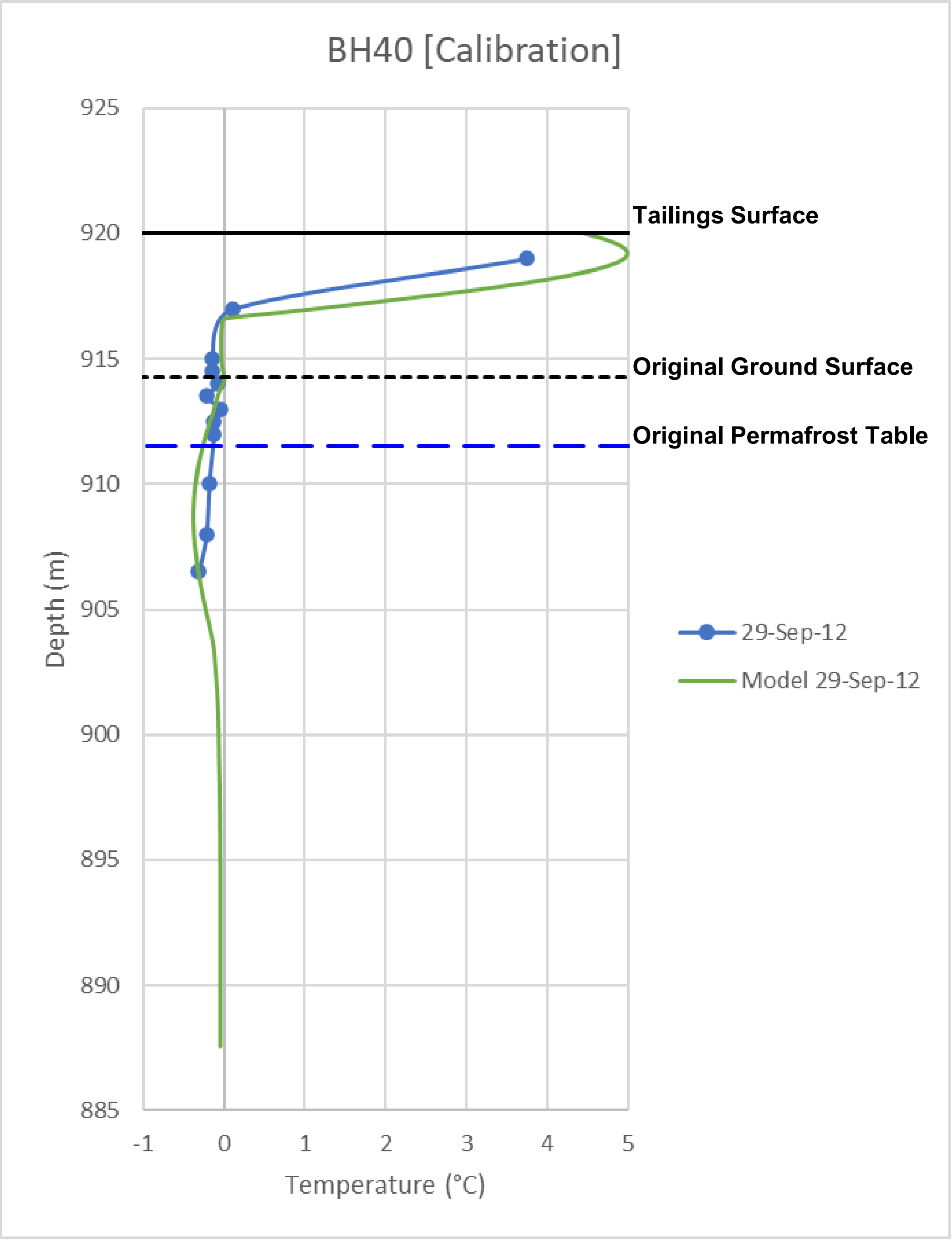
Mean Annual Temperature for SSP3-7.0 and SSP4-6.0

PROJECT NO.	DWN	CKD	APVD	REV
ENG.WARC04307-01	EDG	IM	RT	A

OFFICE	DATE
WHITEHORSE	JUNE 2023

STATUS
ISSUED FOR USE

Figure F-3



LEGEND

NOTES

CLIENT

Hecla MINING COMPANY

TETRA TECH

DETAILED DESIGN – PHASE 2 DRY STACK TAILINGS FACILITY
KENO HILL DISTRICT MILL SITE, YUKON

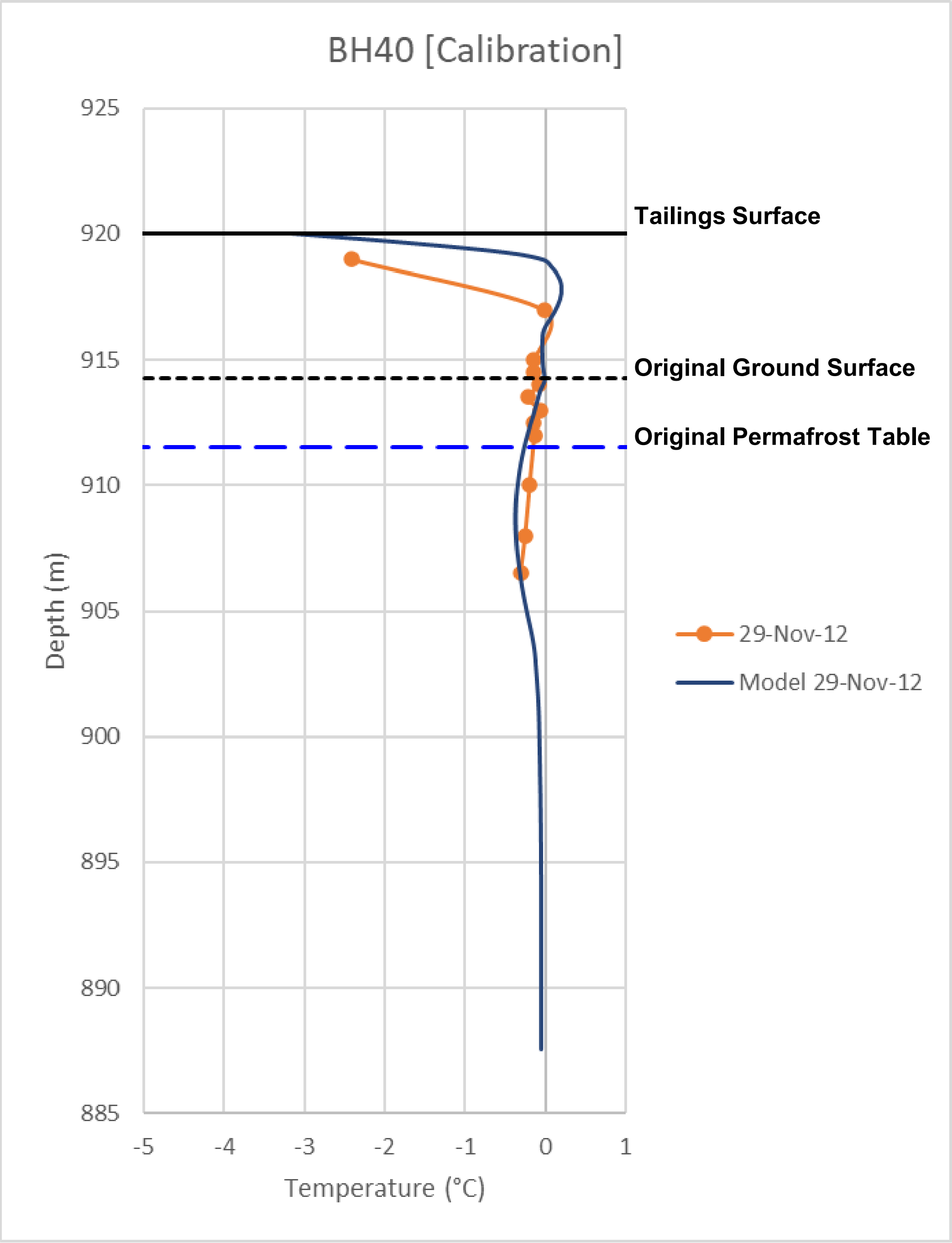
Model Calibration at BH-40: September 2012

PROJECT NO.	DWN	CKD	APVD	REV
ENG.WARC04307-01	EDG	IM	RT	A

OFFICE	DATE
WHITEHORSE	JUNE 2023

Figure F-4

STATUS
ISSUED FOR USE



LEGEND

NOTES

CLIENT

HECLA MINING COMPANY

TETRA TECH

DETAILED DESIGN – PHASE 2 DRY STACK TAILINGS FACILITY
KENO HILL DISTRICT MILL SITE, YUKON

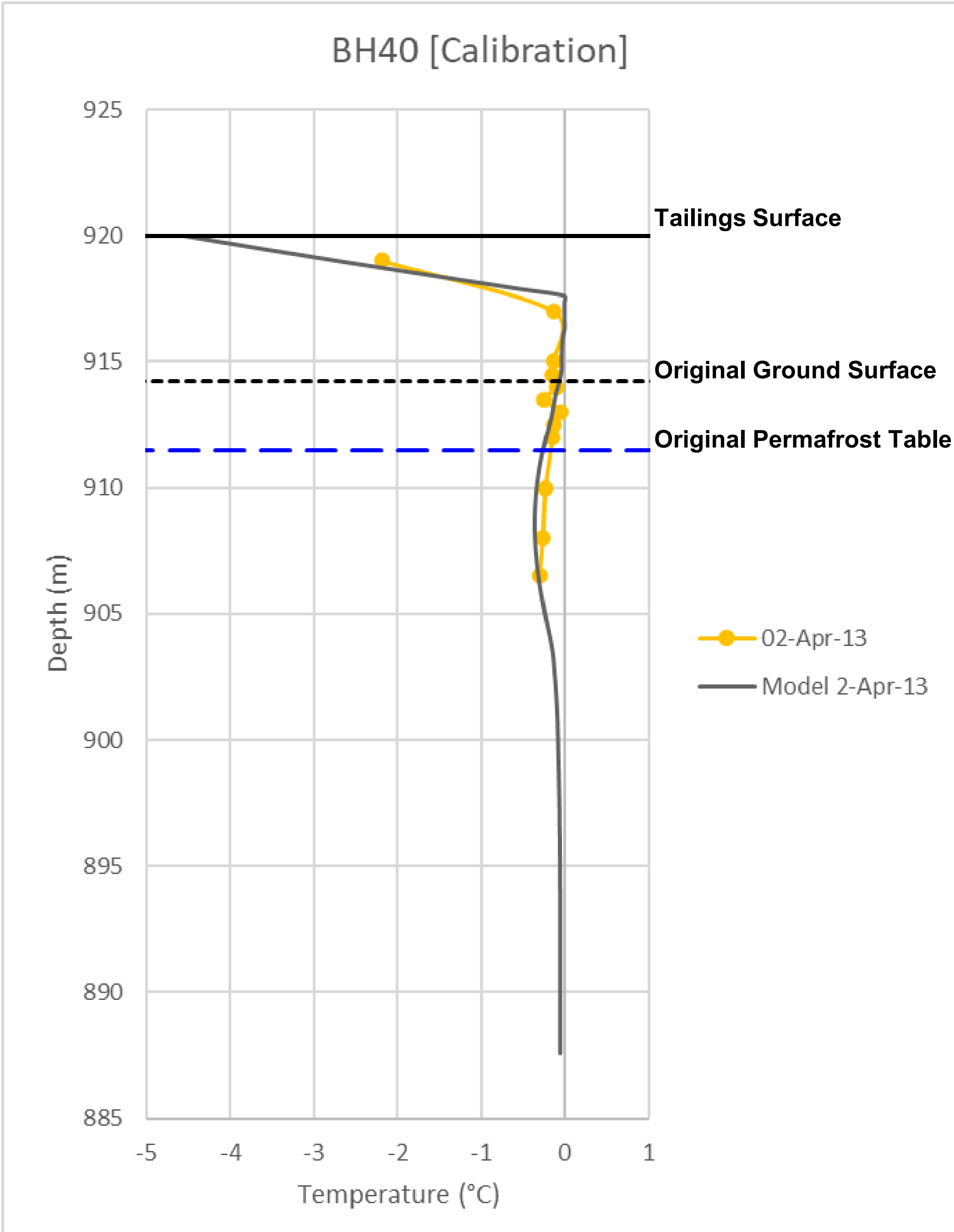
Model Calibration at BH-40: November 2012

PROJECT NO.	DWN	CKD	APVD	REV
ENG.WARC04307-01	EDG	IM	RT	A

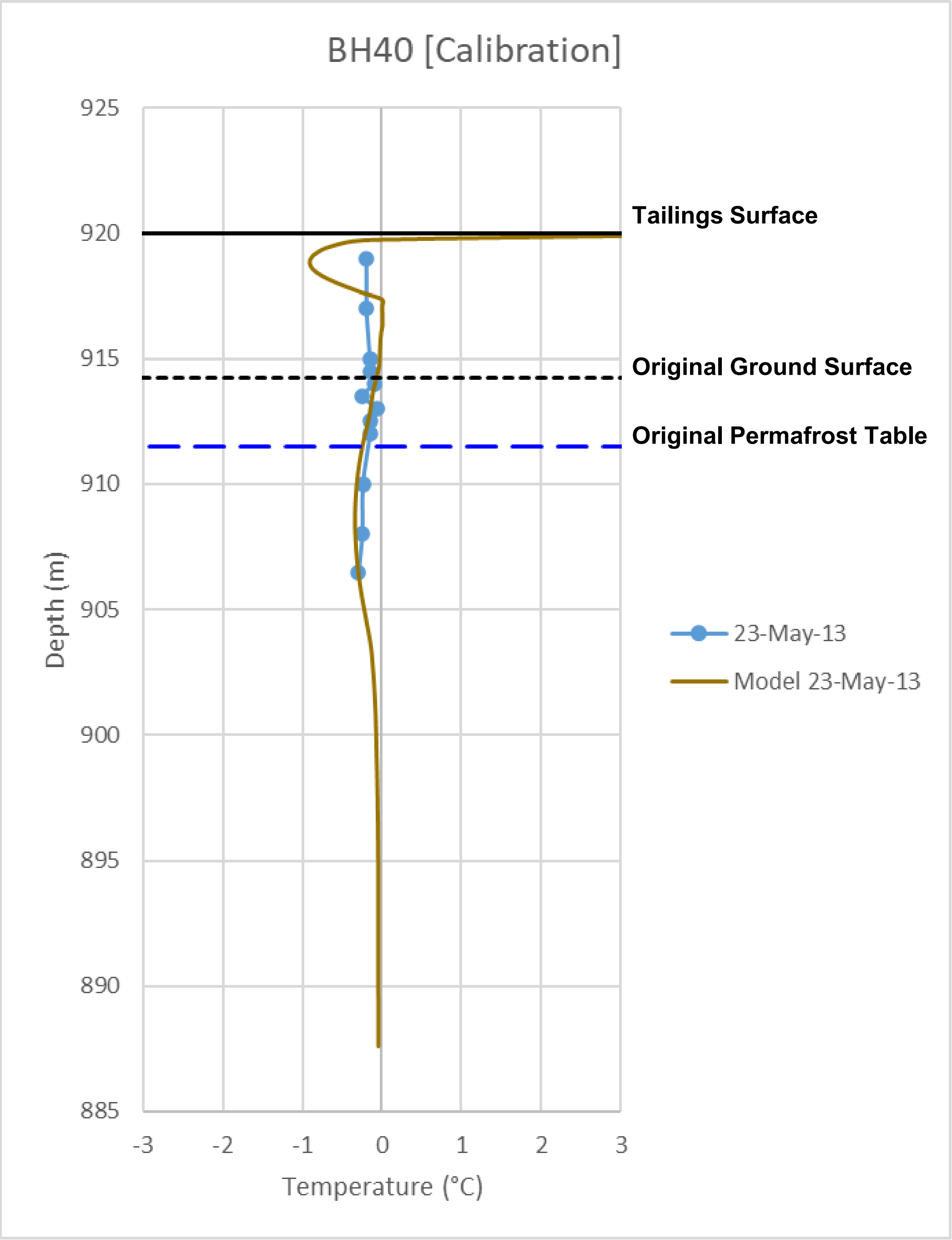
OFFICE	DATE
WHITEHORSE	JUNE 2023

Figure F-5

STATUS
ISSUED FOR USE



LEGEND	NOTES	CLIENT	DETAILED DESIGN – PHASE 2 DRY STACK TAILINGS FACILITY KENO HILL DISTRICT MILL SITE, YUKON
		Hecla MINING COMPANY	Model Calibration at BH-40: April 2013
	STATUS ISSUED FOR USE	TETRA TECH	PROJECT NO. ENG.WARC04307-01; DWN EDG; CKD IM; APVD RT; REV A; OFFICE WHITEHORSE; DATE JUNE 2023; Figure F-6



LEGEND

NOTES

CLIENT

Hecla MINING COMPANY

TETRA TECH

DETAILED DESIGN – PHASE 2 DRY STACK TAILINGS FACILITY
KENO HILL DISTRICT MILL SITE, YUKON

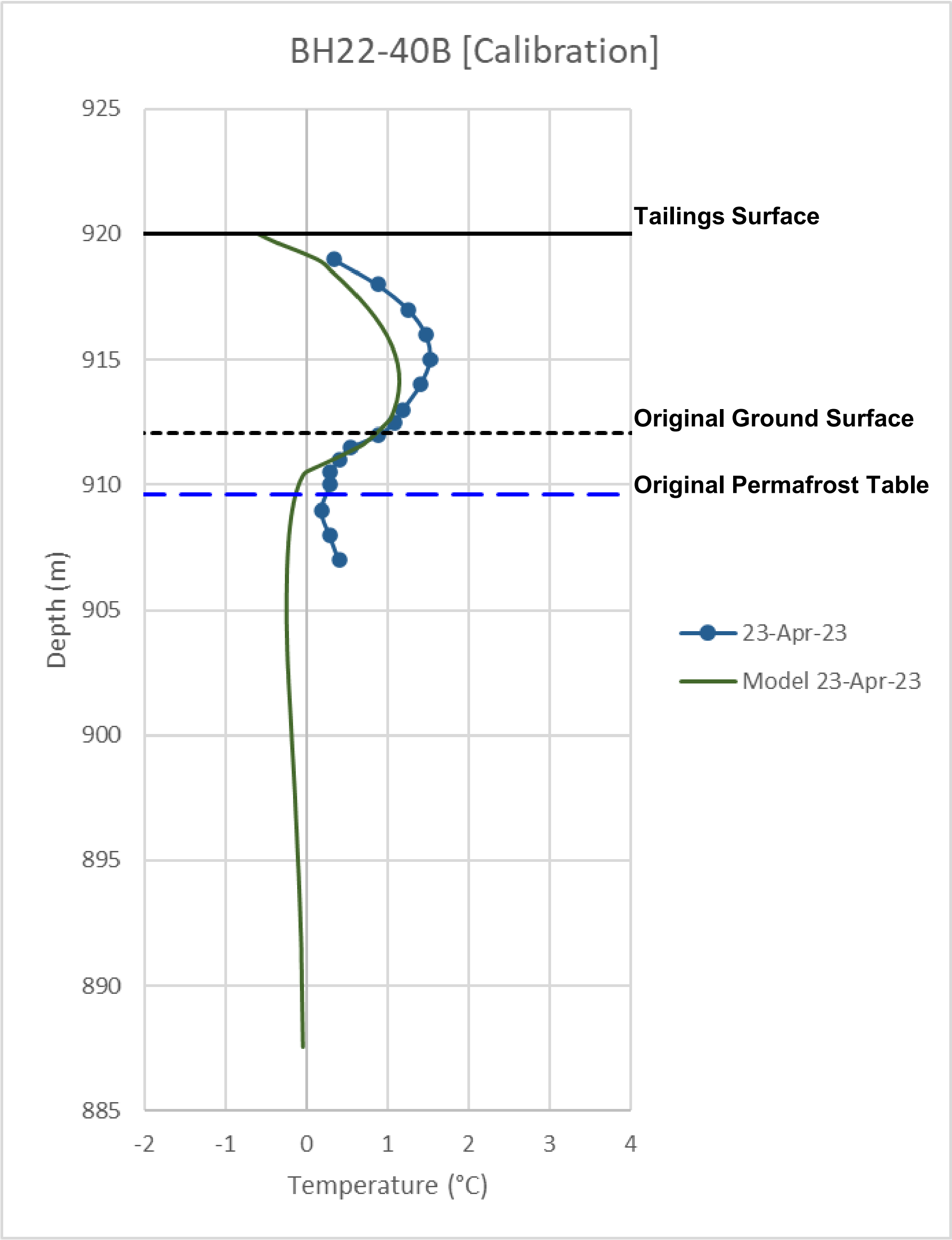
Model Calibration at BH-40: May 2013

PROJECT NO.	DWN	CKD	APVD	REV
ENG.WARC04307-01	EDG	IM	RT	A

OFFICE	DATE
WHITEHORSE	JUNE 2023

Figure F-7

STATUS
ISSUED FOR USE



LEGEND

NOTES

CLIENT

HECLA MINING COMPANY

TETRA TECH

DETAILED DESIGN – PHASE 2 DRY STACK TAILINGS FACILITY
KENO HILL DISTRICT MILL SITE, YUKON

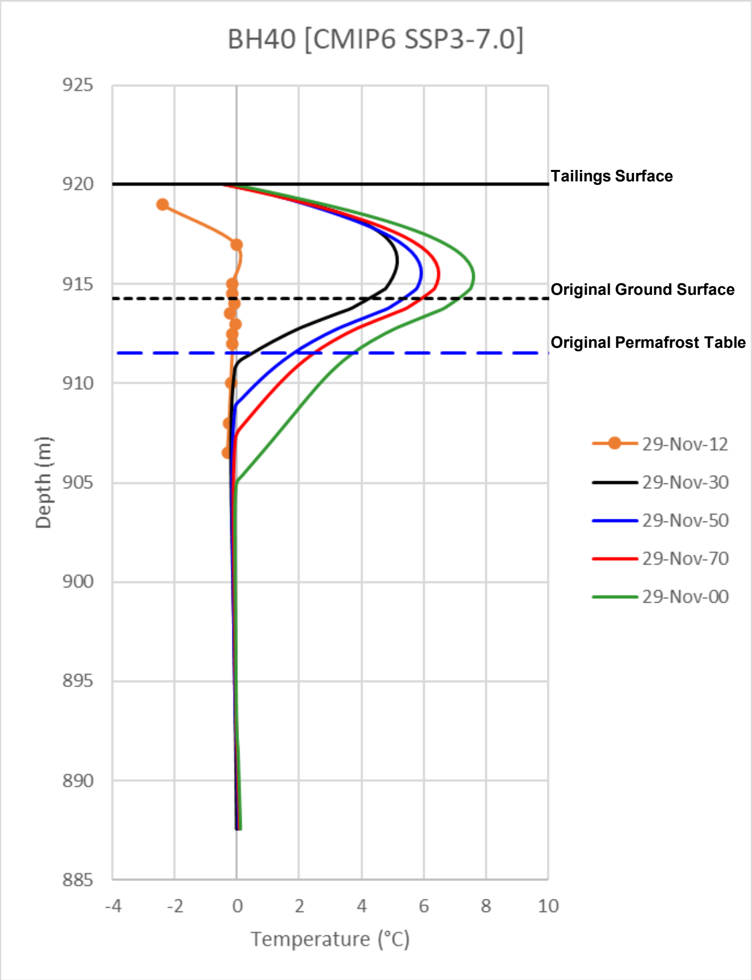
Model Calibration at BH22-40B: April 2023

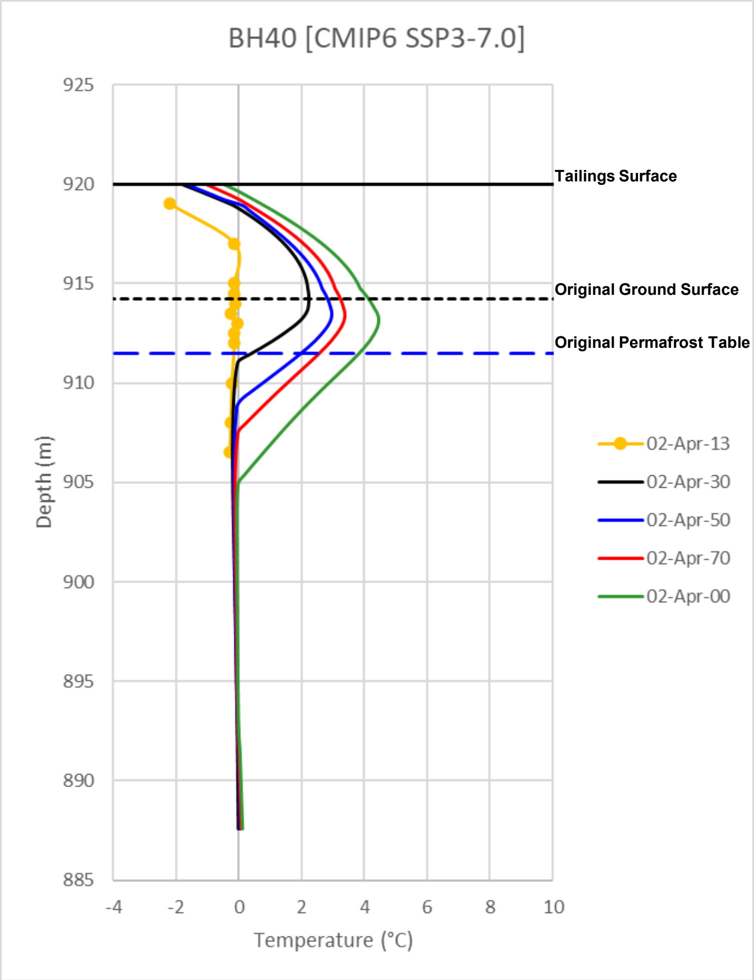
PROJECT NO.	DWN	CKD	APVD	REV
ENG.WARC04307-01	EDG	IM	RT	A

OFFICE	DATE
WHITEHORSE	JUNE 2023

Figure F-8

STATUS
ISSUED FOR USE





LEGEND

NOTES

STATUS
ISSUED FOR USE

CLIENT
Hecla MINING COMPANY

TETRA TECH

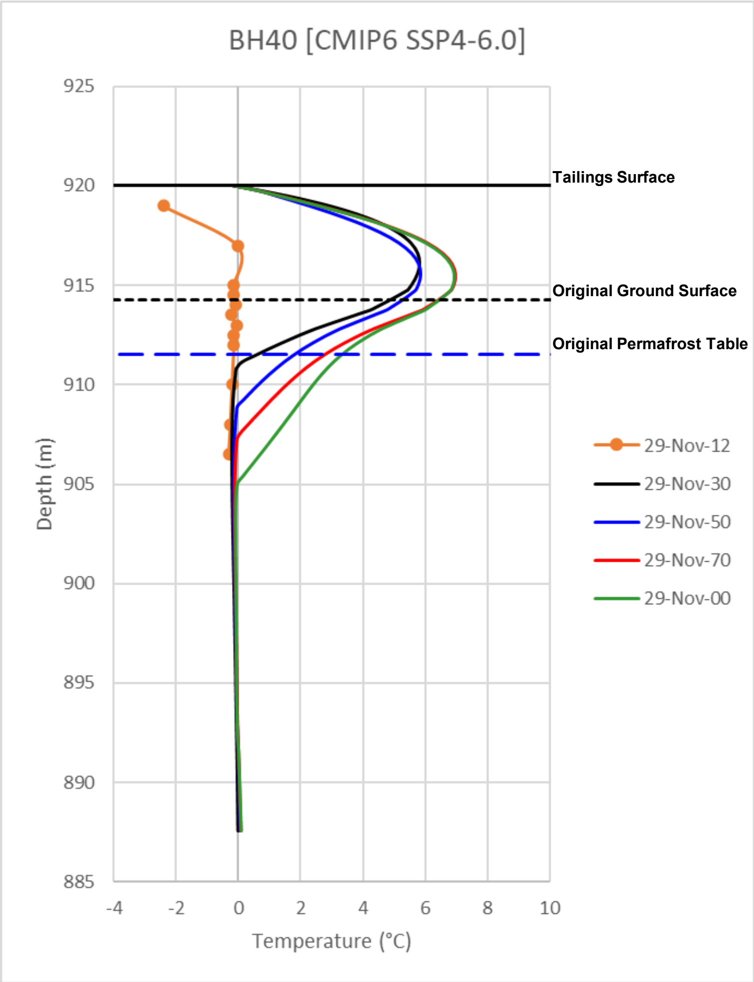
DETAILED DESIGN – PHASE 2 DRY STACK TAILINGS FACILITY
KENO HILL DISTRICT MILL SITE, YUKON

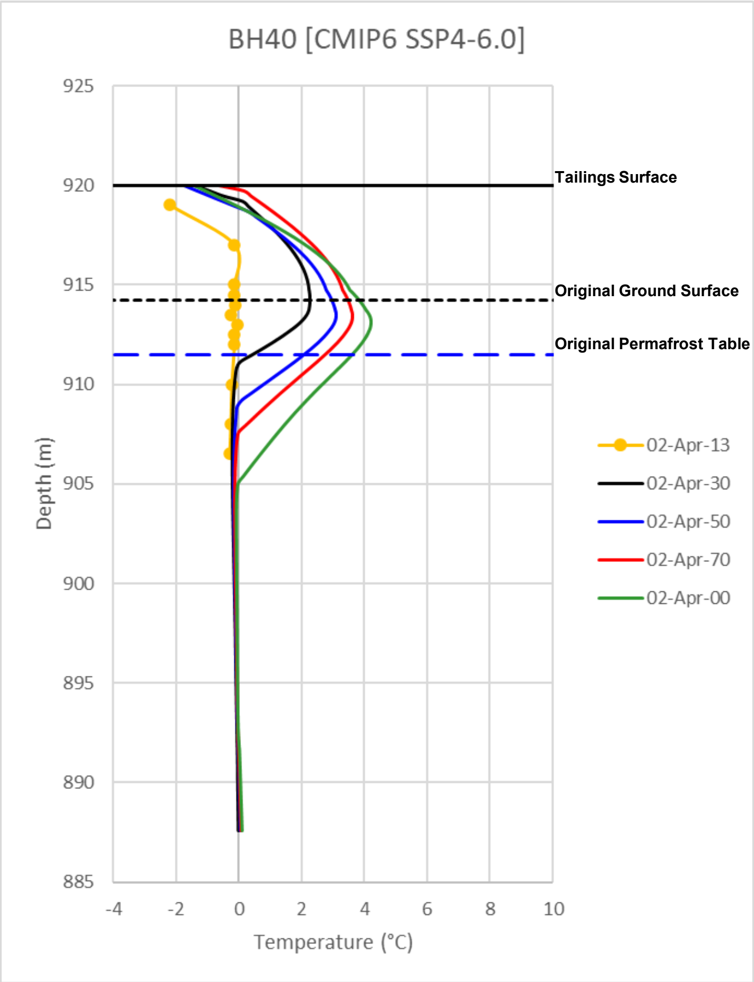
Temperature Projection at BH40 under SSP3-7.0 Climate Scenario

PROJECT NO.	DWN	CKD	APVD	REV
ENG.WARC04307-01	EDG	IM	RT	A

OFFICE	DATE
WHITEHORSE	JUNE 2023

Figure F-9





LEGEND

NOTES

CLIENT

Hecla MINING COMPANY

TETRA TECH

DETAILED DESIGN – PHASE 2 DRY STACK TAILINGS FACILITY
KENO HILL DISTRICT MILL SITE, YUKON

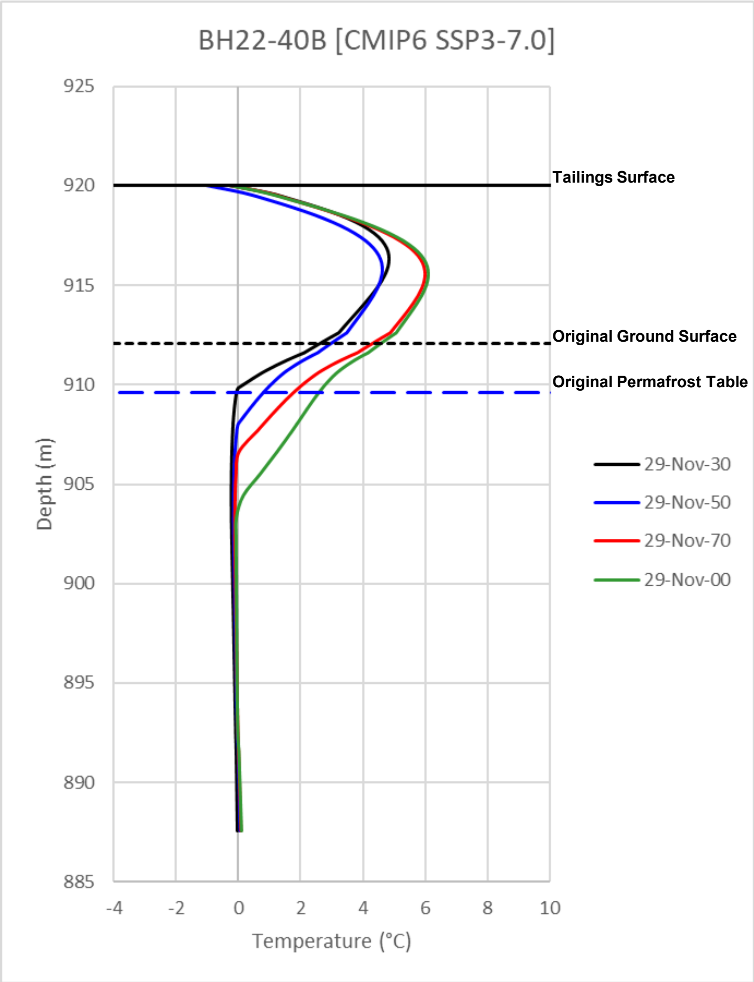
Temperature Projection at BH40 under SSP4-6.0 Climate Scenario

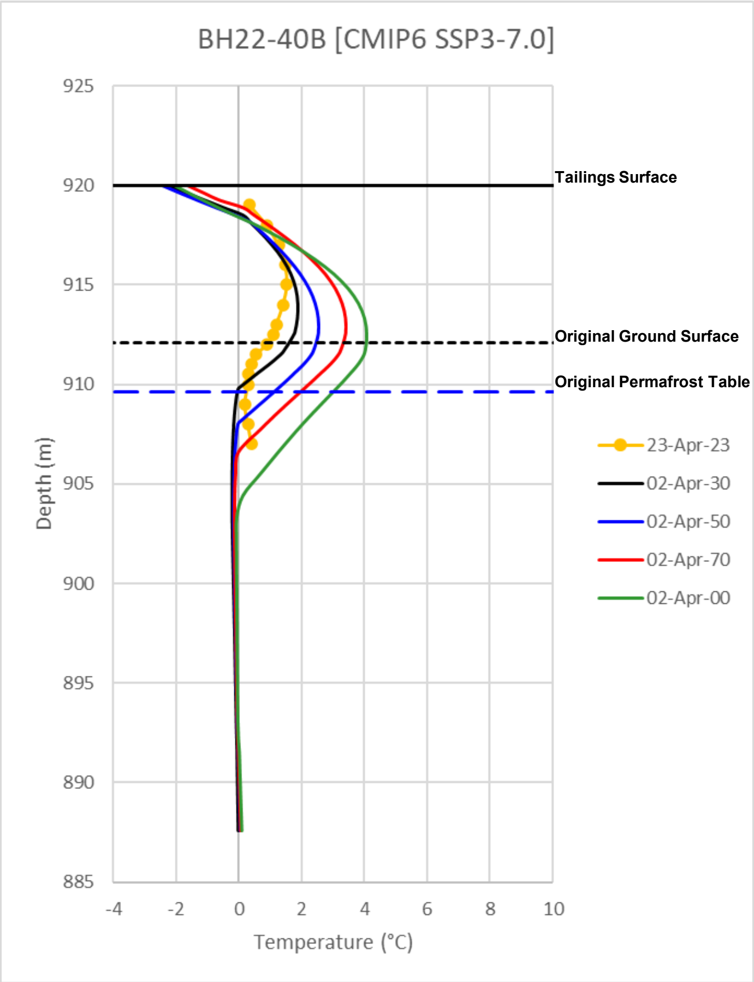
PROJECT NO.	DWN	CKD	APVD	REV
ENG.WARC04307-01	EDG	IM	RT	A

OFFICE	DATE
WHITEHORSE	JUNE 2023

Figure F-10

STATUS
ISSUED FOR USE





LEGEND

NOTES

STATUS
ISSUED FOR USE

CLIENT
Hecla MINING COMPANY

TETRA TECH

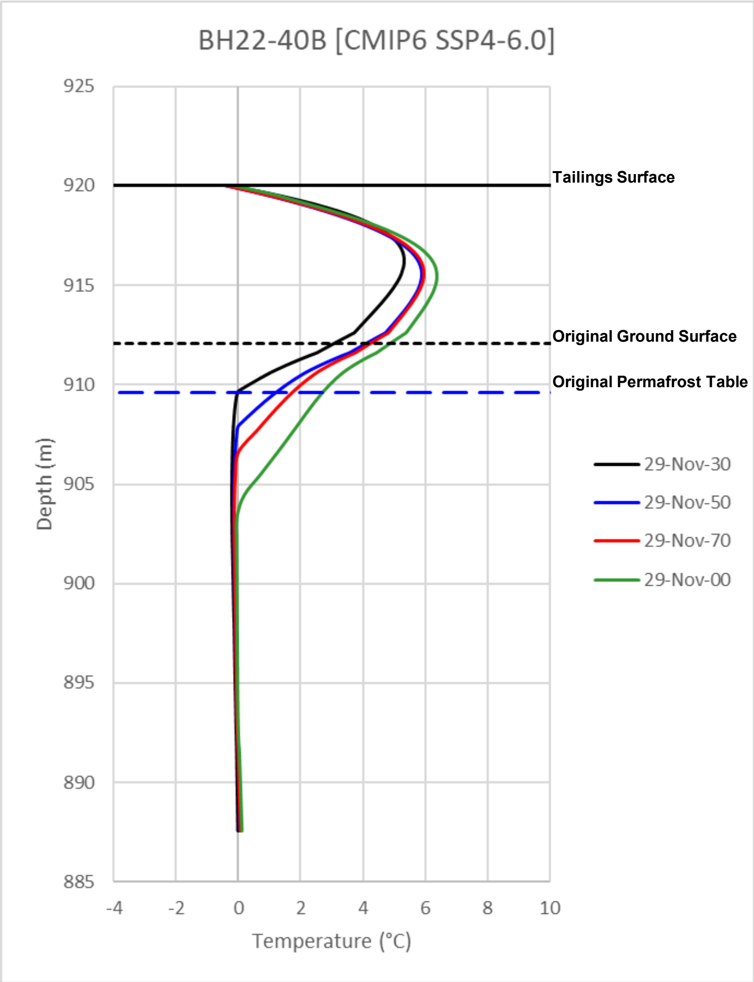
DETAILED DESIGN – PHASE 2 DRY STACK TAILINGS FACILITY
KENO HILL DISTRICT MILL SITE, YUKON

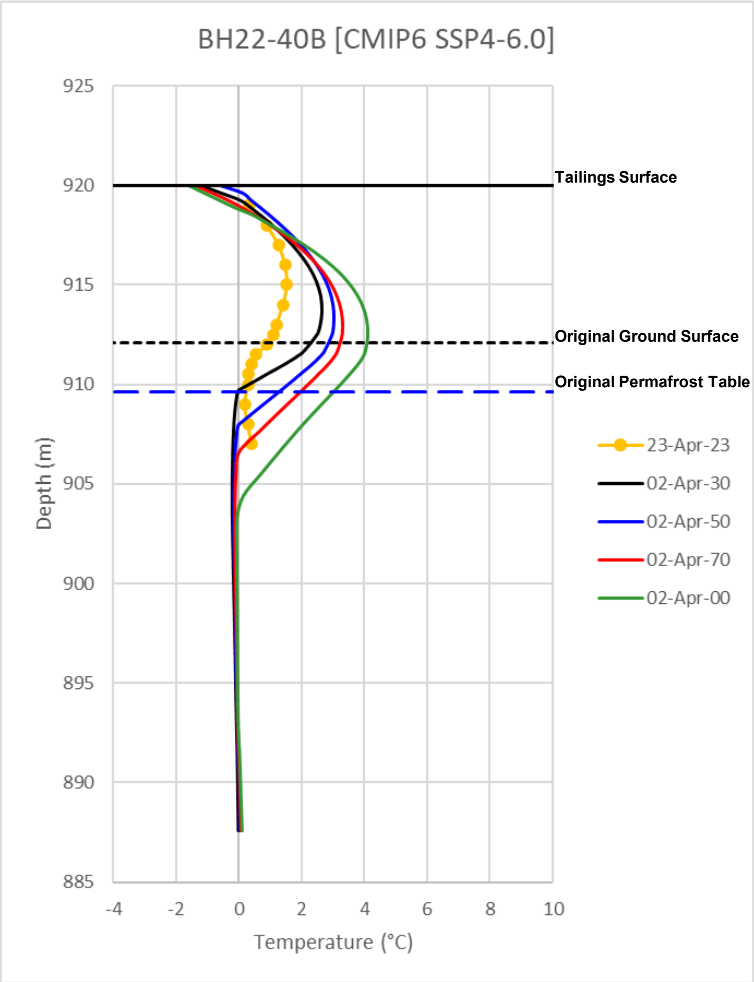
Temperature Projection at BH22-40B under SSP3-7.0 Climate Scenario

PROJECT NO.	DWN	CKD	APVD	REV
ENG.WARC04307-01	EDG	IM	RT	A

OFFICE	DATE
WHITEHORSE	JUNE 2023

Figure F-11





LEGEND

NOTES

STATUS
ISSUED FOR USE

CLIENT

Hecla
MINING COMPANY

TETRA TECH

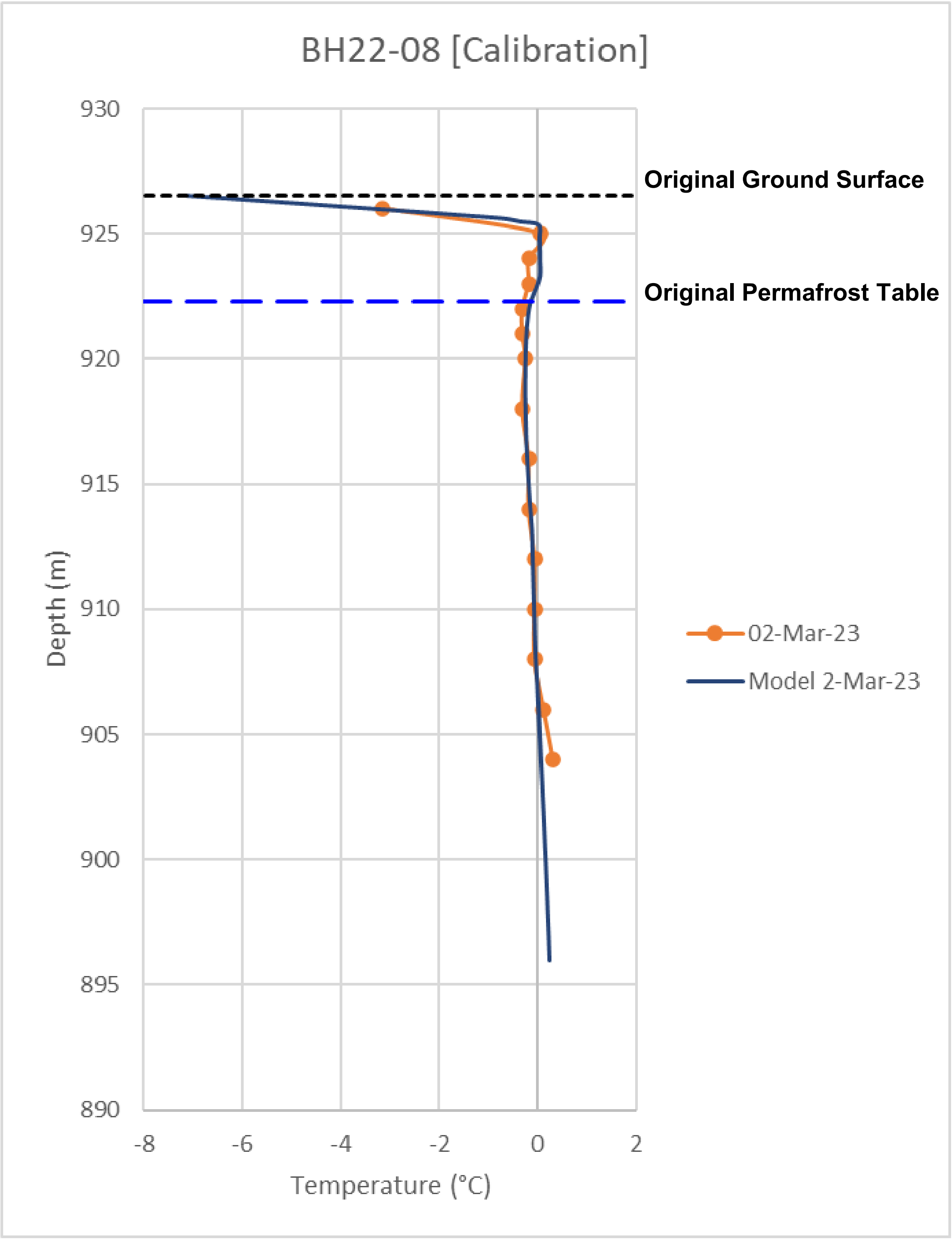
DETAILED DESIGN – PHASE 2 DRY STACK TAILINGS FACILITY
KENO HILL DISTRICT MILL SITE, YUKON

Temperature Projection at BH22-40B under SSP4-6.0 Climate Scenario

PROJECT NO.	DWN	CKD	APVD	REV
ENG.WARC04307-01	EDG	IM	RT	A

OFFICE	DATE
WHITEHORSE	JUNE 2023

Figure F-12



LEGEND

NOTES

CLIENT

Hecla MINING COMPANY

TETRA TECH

DETAILED DESIGN – PHASE 2 DRY STACK TAILINGS FACILITY
KENO HILL DISTRICT MILL SITE, YUKON

Model Calibration at BH22-08: March 2023

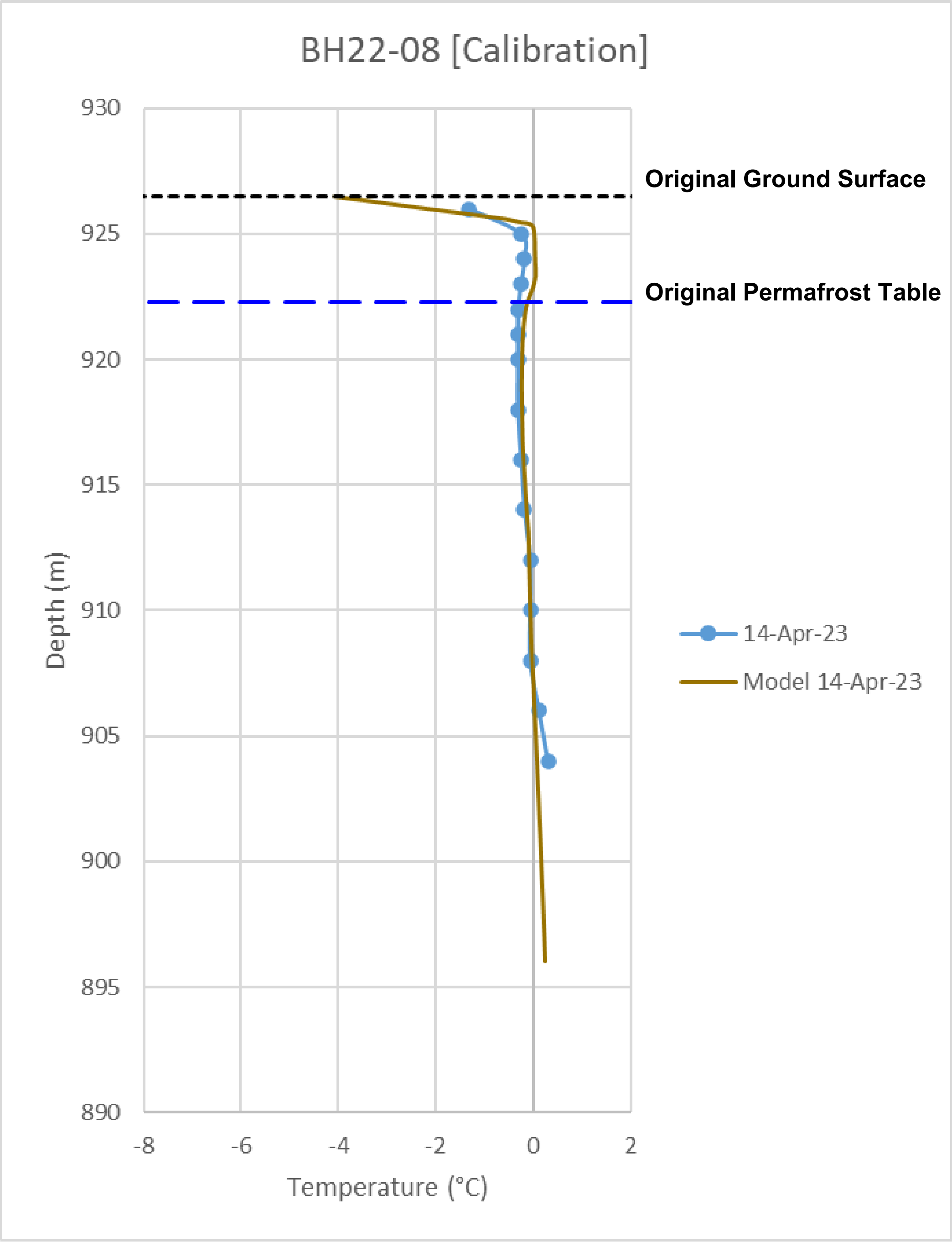
PROJECT NO.	DWN	CKD	APVD	REV
ENG.WARC04307-01	EDG	IM	RT	A

OFFICE: WHITEHORSE

DATE: JUNE 2023

Figure F-13

STATUS
ISSUED FOR USE



LEGEND

NOTES

STATUS
ISSUED FOR USE

CLIENT

Hecla MINING COMPANY

TETRA TECH

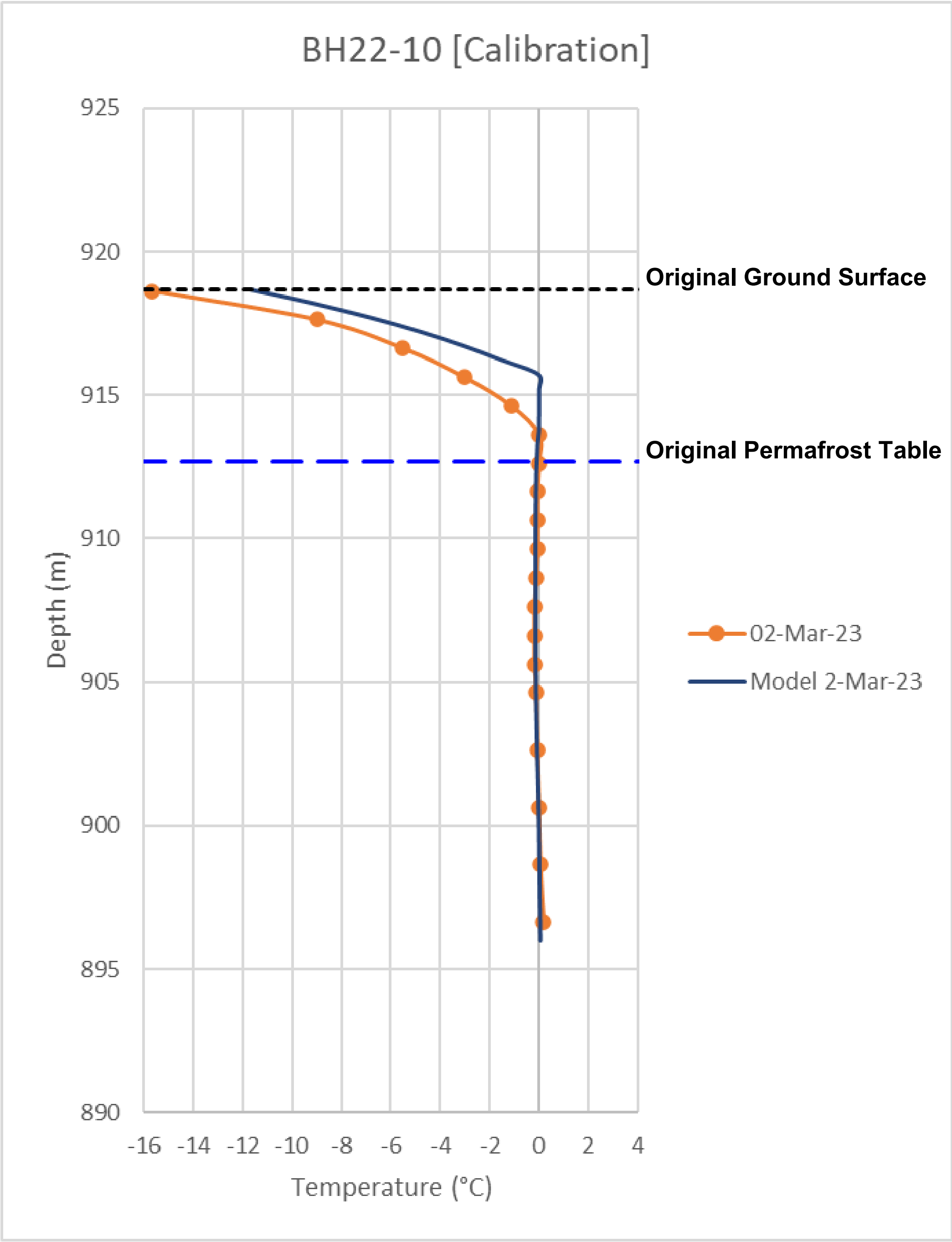
DETAILED DESIGN – PHASE 2 DRY STACK TAILINGS FACILITY
KENO HILL DISTRICT MILL SITE, YUKON

Model Calibration at BH22-08: April 2023

PROJECT NO.	DWN	CKD	APVD	REV
ENG.WARC04307-01	EDG	IM	RT	A

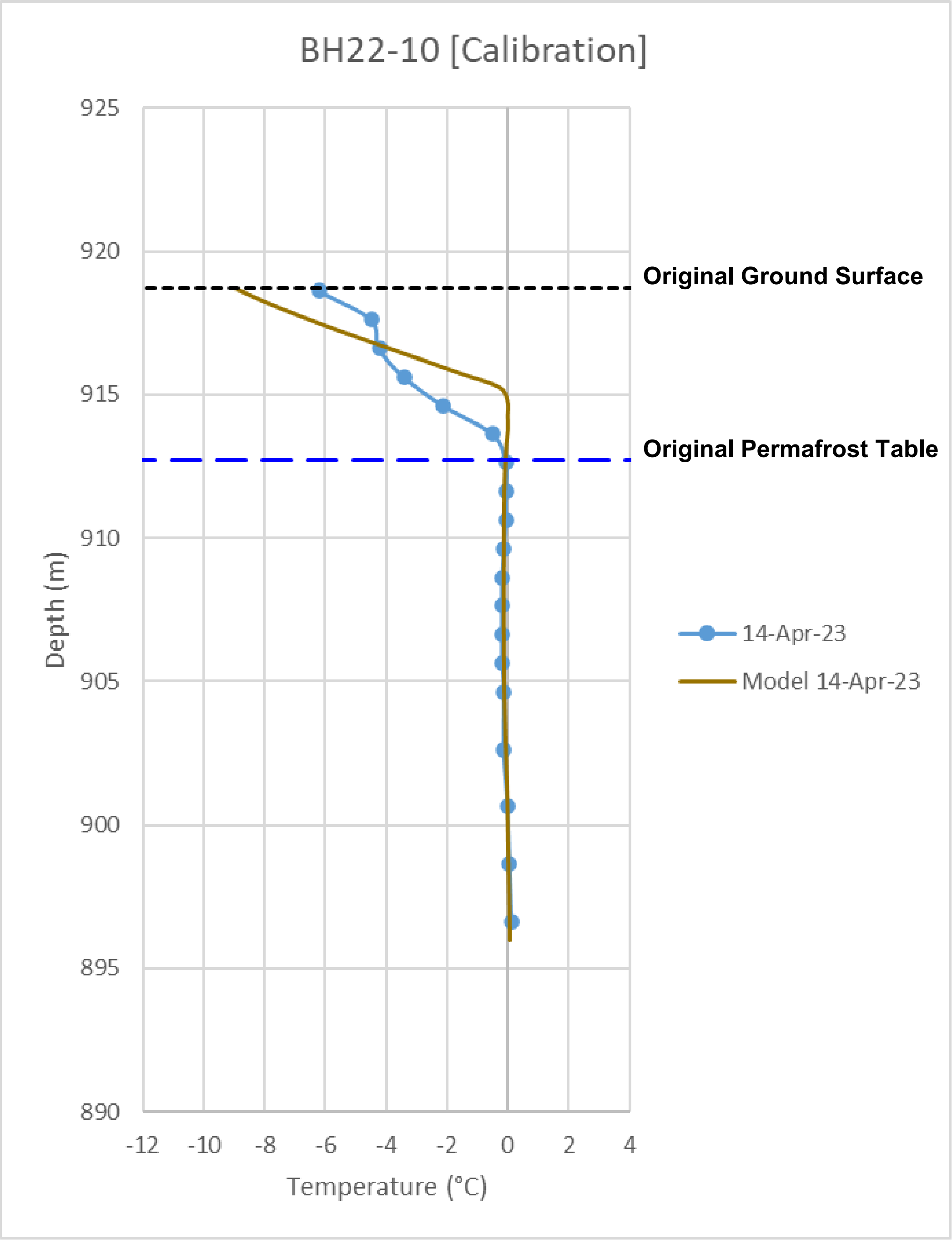
OFFICE	DATE
WHITEHORSE	JUNE 2023

Figure F-14



LEGEND	NOTES	CLIENT	DETAILED DESIGN – PHASE 2 DRY STACK TAILINGS FACILITY KENO HILL DISTRICT MILL SITE, YUKON
		Hecla MINING COMPANY	Model Calibration at BH22-10: March 2023
	STATUS ISSUED FOR USE	TETRA TECH	PROJECT NO. ENG.WARC04307-01; DWN EDG; CKD IM; APVD RT; REV A; OFFICE WHITEHORSE; DATE JUNE 2023

Figure F-15



LEGEND

NOTES

CLIENT

Hecla MINING COMPANY

TETRA TECH

DETAILED DESIGN – PHASE 2 DRY STACK TAILINGS FACILITY
KENO HILL DISTRICT MILL SITE, YUKON

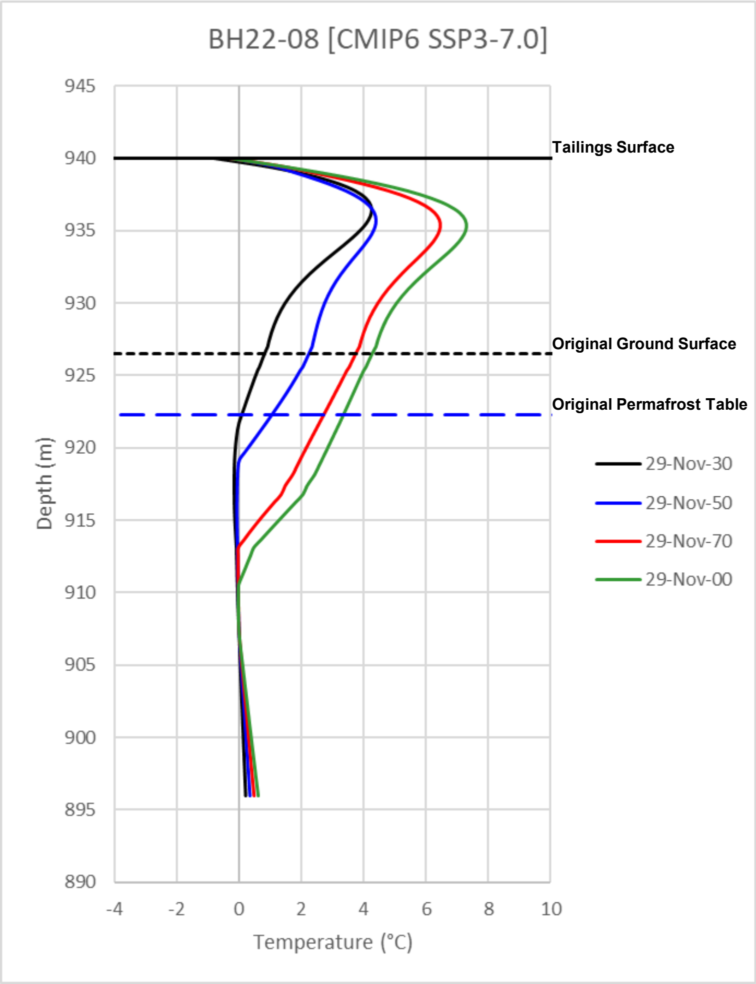
Model Calibration at BH22-10: April 2023

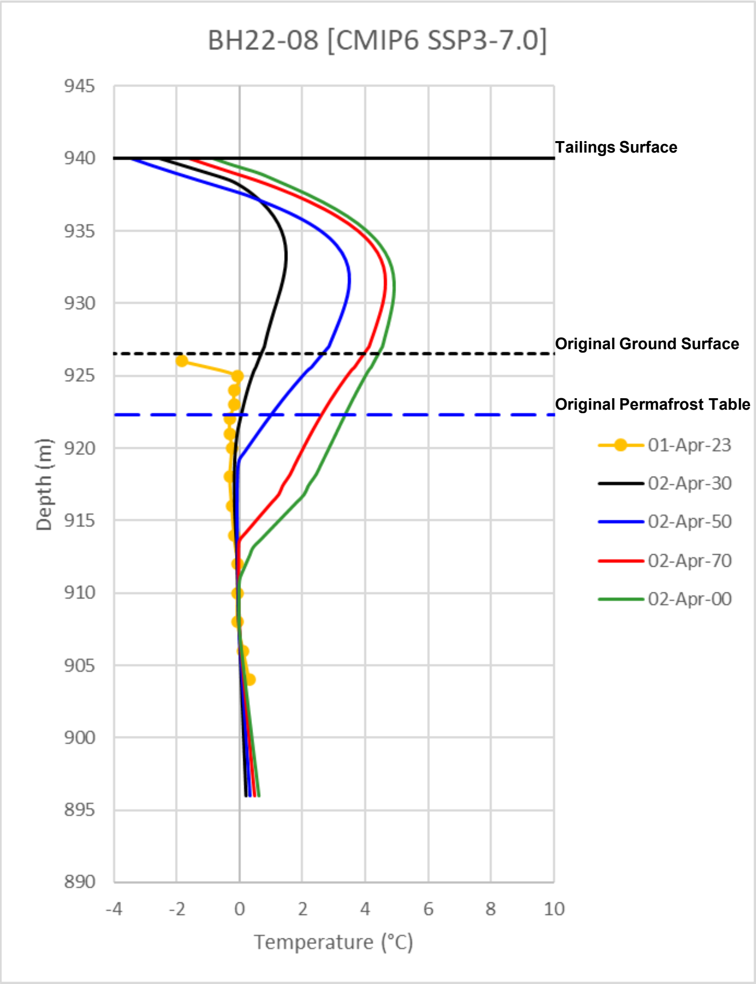
PROJECT NO.	DWN	CKD	APVD	REV
ENG.WARC04307-01	EDG	IM	RT	A

OFFICE	DATE
WHITEHORSE	JUNE 2023

Figure F-16

STATUS
ISSUED FOR USE





LEGEND

NOTES

STATUS
ISSUED FOR USE

CLIENT
Hecla MINING COMPANY

TETRA TECH

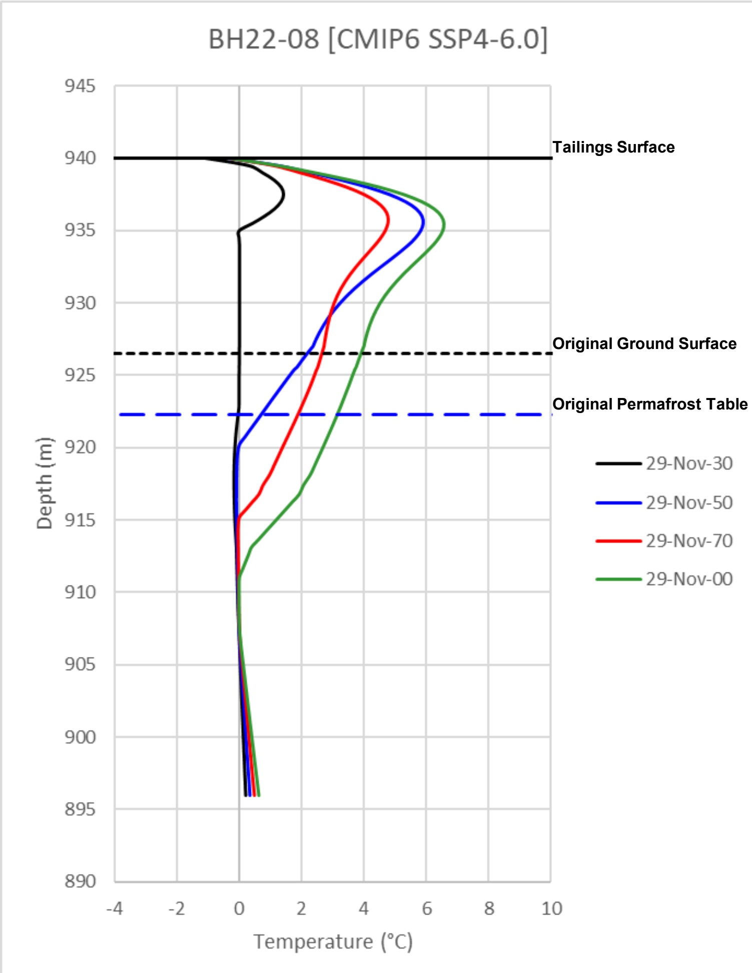
DETAILED DESIGN – PHASE 2 DRY STACK TAILINGS FACILITY
KENO HILL DISTRICT MILL SITE, YUKON

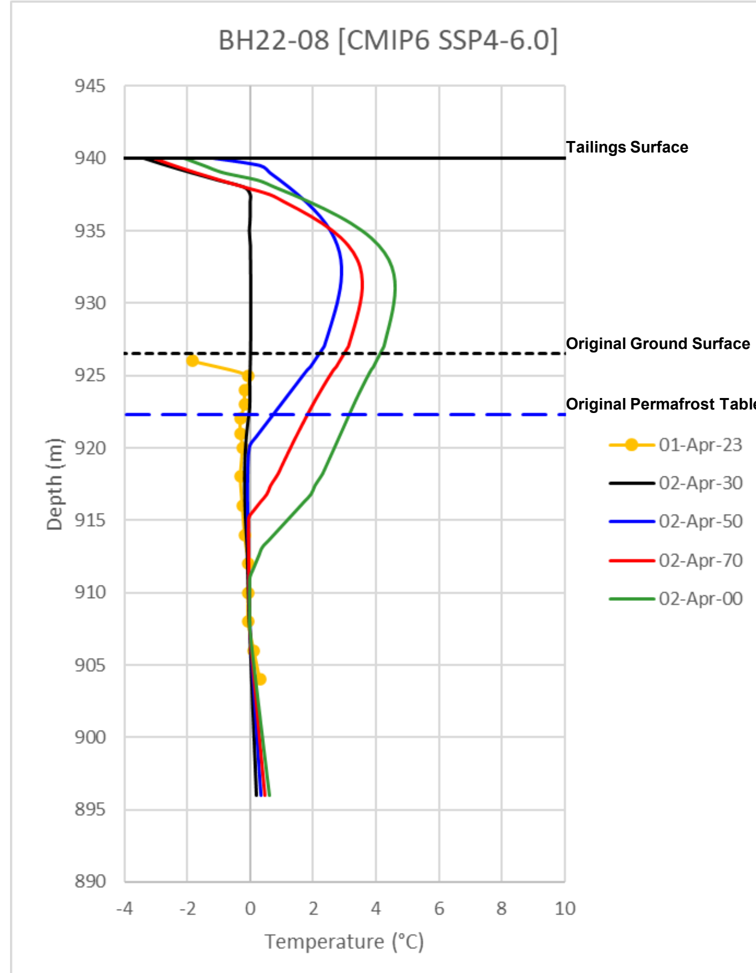
Temperature Projection at BH22-08 under SSP3-7.0 Climate Scenario

PROJECT NO.	DWN	CKD	APVD	REV
ENG.WARC04307-01	EDG	IM	RT	A

OFFICE	DATE
WHITEHORSE	JUNE 2023

Figure F-17





LEGEND

NOTES

STATUS
ISSUED FOR USE

CLIENT
Hecla
MINING COMPANY

TETRA TECH

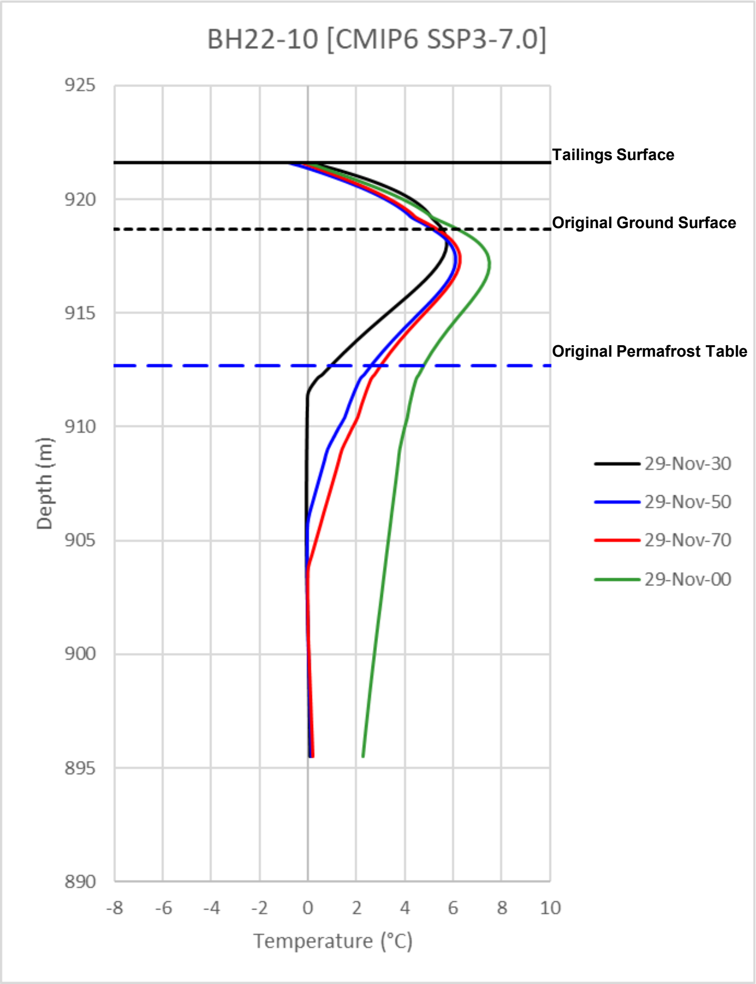
DETAILED DESIGN – PHASE 2 DRY STACK TAILINGS FACILITY
KENO HILL DISTRICT MILL SITE, YUKON

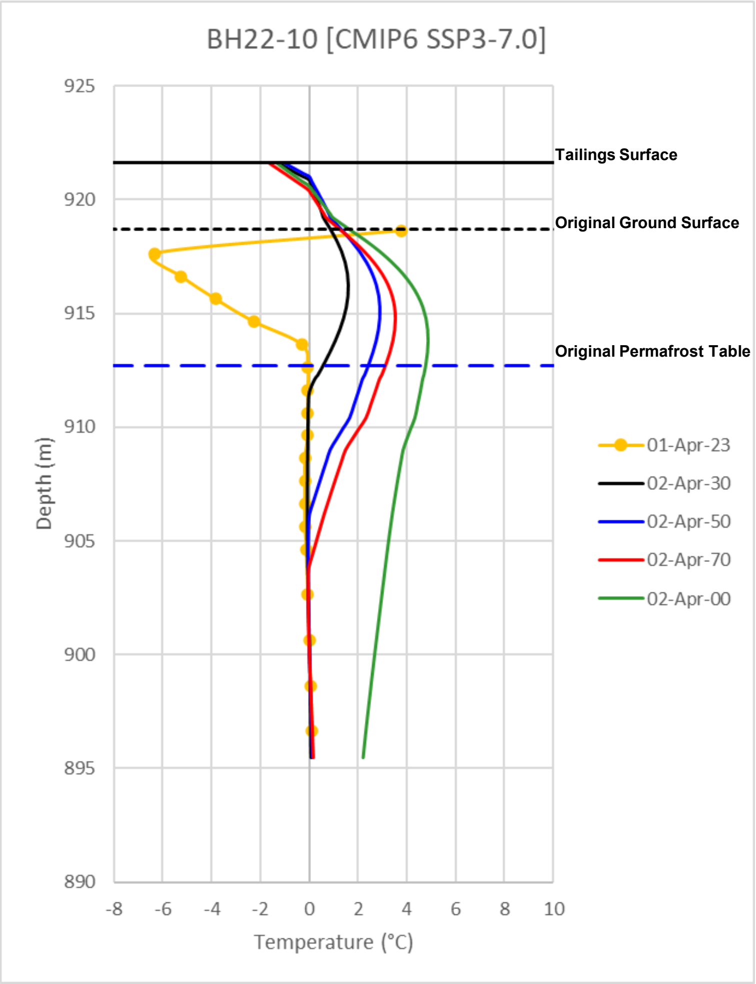
Temperature Projection at BH22-08 under SSP4-6.0 Climate Scenario

PROJECT NO.	DWN	CKD	APVD	REV
ENG.WARC04307-01	EDG	IM	RT	A

OFFICE	DATE
WHITEHORSE	JUNE 2023

Figure F-18





LEGEND

NOTES

STATUS
ISSUED FOR USE

CLIENT
Hecla MINING COMPANY

TETRA TECH

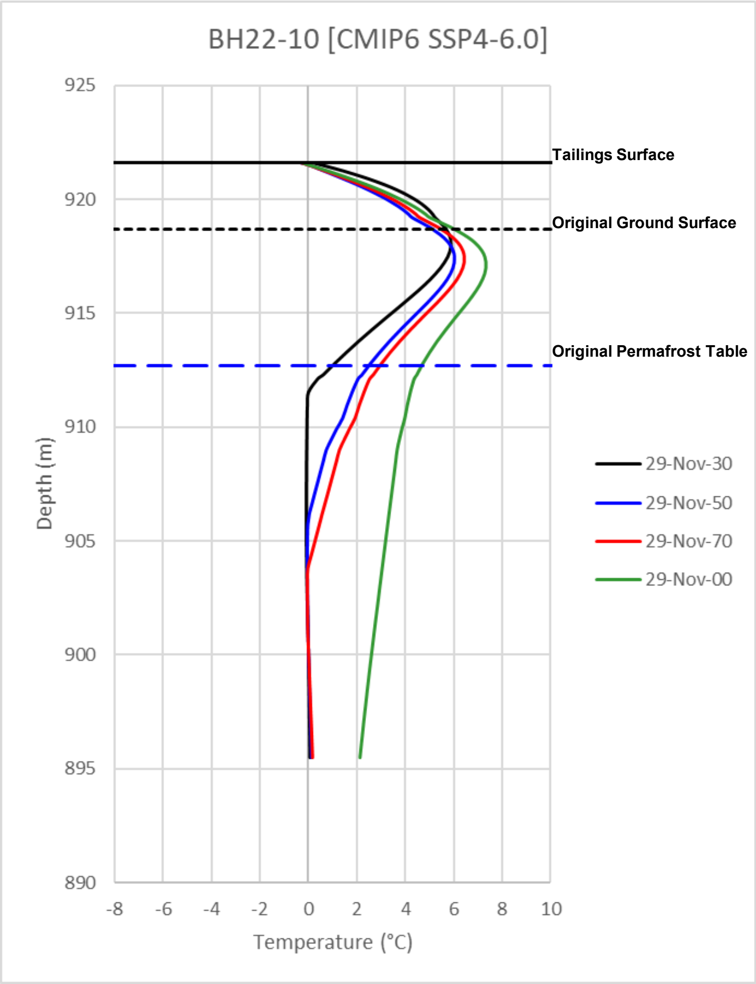
DETAILED DESIGN – PHASE 2 DRY STACK TAILINGS FACILITY
KENO HILL DISTRICT MILL SITE, YUKON

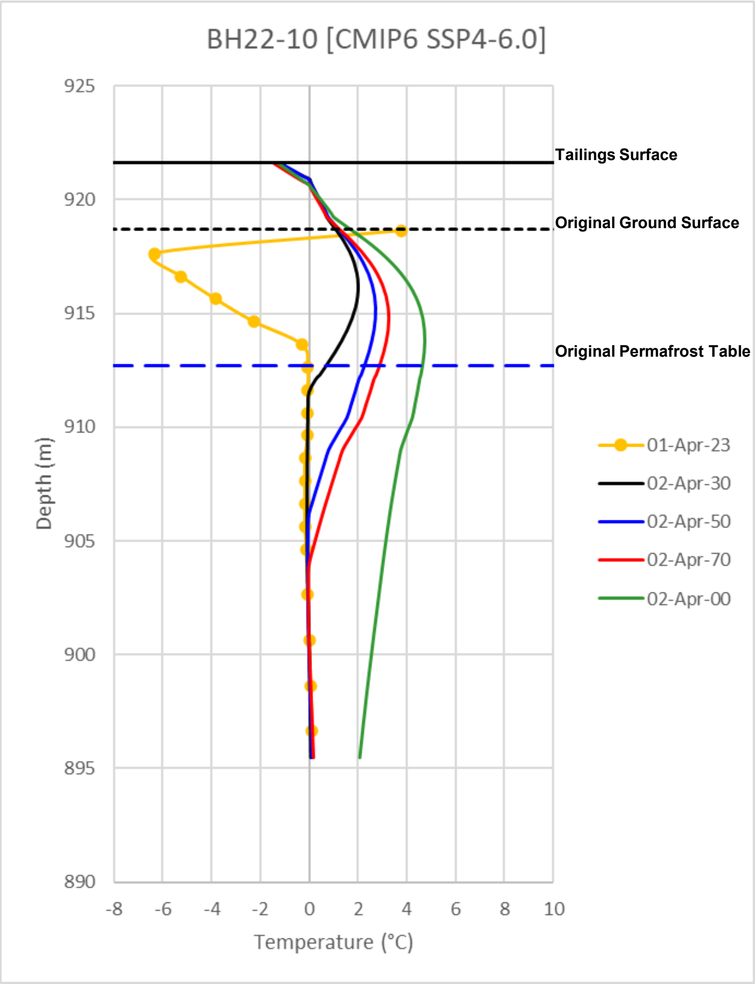
Temperature Projection at BH22-10 under SSP3-7.0 Climate Scenario

PROJECT NO.	DWN	CKD	APVD	REV
ENG.WARC04307-01	EDG	IM	RT	A

OFFICE	DATE
WHITEHORSE	JUNE 2023

Figure F-19





LEGEND

NOTES

STATUS
ISSUED FOR USE

CLIENT
Hecla MINING COMPANY

TETRA TECH

DETAILED DESIGN – PHASE 2 DRY STACK TAILINGS FACILITY
KENO HILL DISTRICT MILL SITE, YUKON

Temperature Projection at BH22-10 under SSP4-6.0 Climate Scenario

PROJECT NO.	DWN	CKD	APVD	REV
ENG.WARC04307-01	EDG	IM	RT	A

OFFICE	DATE
WHITEHORSE	JUNE 2023

Figure F-20