APPENDIX A

TETRA TECH'S LIMITATIONS ON USE OF THIS DOCUMENT

LIMITATIONS ON USE OF THIS DOCUMENT

GEOTECHNICAL

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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.

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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

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

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

SITE-SPECIFIC SEISMIC HAZARD ASSESSMENT FOR CANTUNG PROJECT

ONUR SEEMANN CONSULTING, INC.
3378 KINGSLEY PL., VICTORIA, BC V8P 4K1
TEL: 250-882-4393

SEISMIC HAZARD AND GROUND MOTIONS FOR CANTUNG PROJECT

PREPARED BY: TUNA ONUR, PH.D.
10 APRIL 2019
REVISION 4

SEISMIC HAZARD AND GROUND MOTIONS FOR CANTUNG PROJECT

PART 1: EVALUATION OF SEISMIC HAZARD

BACKGROUND AND SCOPE

Tetra Tech Canada requested from Onur Seemann Consulting, Inc. (OSC) a seismic hazard analysis that uses the NBC 2015 hazard models with slight modifications to better reflect the hazard at the CanTung project site. This report outlines the seismic hazard model developed within this scope. The seismic hazard assessment was required as part of Task 005 – Tailings Geotechnical Assessment at the Cantung Mine. Uniform Hazard Spectra (UHS) and hazard deaggregations are provided for return periods specified by Tetra Tech.

REVISIONS

This revision corrects mean and mode magnitudes listed in the report text and Tables 3a-c.

INTRODUCTION

CanTung project site (61.963N, 128.217W) is located at the western edge of the Mackenzie Mountains bordering between Yukon and the Northwest Territories. This region, which is part of the Northern Canadian Cordillera lies between actively deforming major plate boundaries on the Pacific coast and the Stable Craton to the east. Seismic activity generally decreases from the coast to the interior until Mackenzie and Richardson Mountains, but then picks up again along these mountains before dying off along the Cordillera eastern deformation front (Figure 1). Deformation rates follow the same trend, decreasing from 10-50 mm/yr to 0.1-1.0 mm/yr and then increasing again to 1-10 mm/yr along Richardson and Mackenzie Mountains before dropping back down to less than 0.1 mm/yr to the east. Focal mechanisms (Figure 1) generally indicate strike-slip movement in the Richardson Mountains, and thrust and oblique thrust motion in the Mackenzie Mountains. Based on seismicity and GPS data, Mazzotti et al. (2008) postulate that a significant portion (10-30%) of the relative plate motion in this region is taken up by internal shortening, shear and block motion within the Cordillera.

Approximately 150km west of the project site is the Tintina Fault (Figure 1), which is a major right-lateral strike-slip fault, extending from north-central Alaska southeastward to northern British Columbia. Tintina Fault system shows significant dextral motion since the Palaeocene (Zelt et al., 2006). However, present day seismic activity rates are low; and the estimated slip rate of ~0.5 mm/yr (Leonard et al., 2008) suggests that this fault no longer accommodates significant seismic deformation.

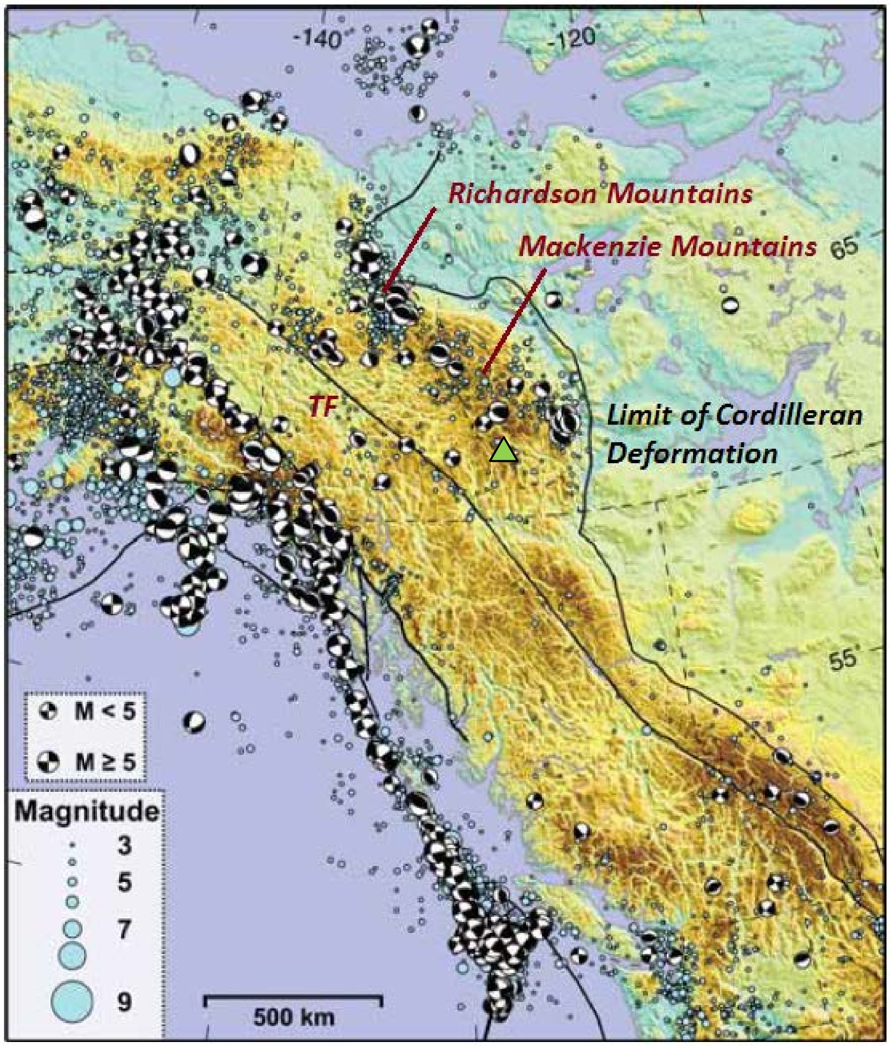

Figure 1. Earthquake activity and focal mechanisms in Western Canada. TF: Tintina Fault. Adapted from Mazzotti et al., (2008). Green triangle indicates the location of the project site.

HAZARD MODEL

Probabilistic seismic hazard assessment (PSHA) for the site was carried out using the Geological Survey Canada (GSC)'s 5th generation hazard model (Adams et al., 2015) implemented in the National Building Code (NBC) of Canada's 2015 Edition, with the following changes:

1. Area sources were modified slightly to introduce a new area source to better reflect the seismic activity rates near the CanTung site.

2. Tintina Fault was added as a fault source to better characterize the long term hazard from this seismic source.

3. Ground motion models were updated to include the NGA West 2 (PEER, 2013) ground motion prediction equations (GMPEs).

OpenQuake (GEM, 2018) software was used for the calculations. Hazard analyses were conducted for Site Class C. GSC's 5th generation hazard model was implemented in OpenQuake (OQ) and checked to confirm that the OQ results were within 5% of GSC's hazard values.

SEISMIC SOURCE CHARACTERIZATION

GSC's 5th generation hazard model (NBC 2015) characterizes the low seismic activity region between the coast and the Mackenzie Mountains by a large area source named "Yukon South (YUS)" (Figure 2). To the east of the YUS, the "Mackenzie Mountains (MKM)" source exhibits significantly more intense seismic activity. Although the CanTung project site is fairly close to the Mackenzie Mountains, it falls inside YUS in the GSC's hazard model. Hence the seismic hazard from the GSC's hazard model for this site is relatively low.

In order to better reflect the seismic activity rates and the associated seismic hazard at the CanTung site, a new area source, "Selwyn Mountains" (SWM) is introduced as part of this project, straddling the YUS and MKM sources (Figure 3). Borders of YUS and MKM are adjusted accordingly, and recurrence for these two GSC source zones is recalculated using their new boundaries.

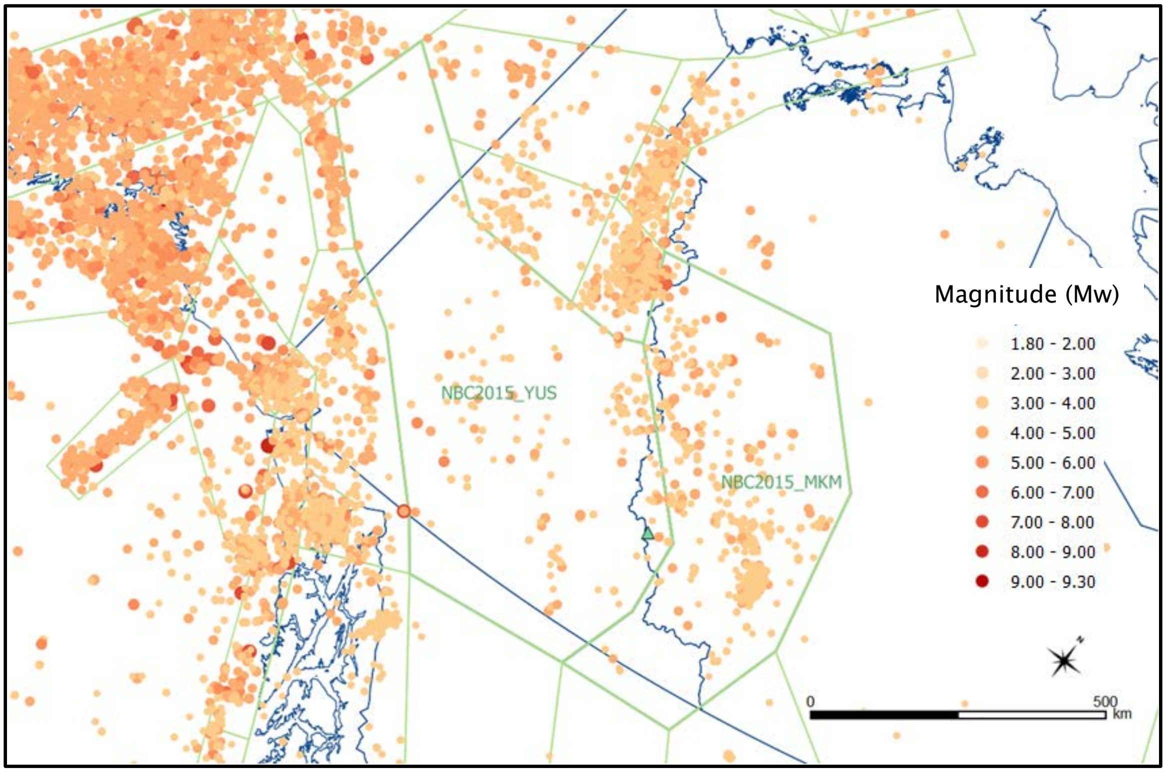

Figure 2. GSC's 5th generation hazard model area source zones overlain with earthquakes in the SHEEF catalogue. Green triangle indicates the location of the project site.

The seismic recurrence parameters for the adjusted GSC sources (YUS and MKM) and the new area source (SWM) are calculated using the Seismic Hazard Earthquake Epicentre File (SHEEF) catalogue developed by the Geological Survey of Canada (Halchuk et al., 2015) and used in the 5th generation seismic hazard maps. Completeness intervals are adopted from Adams and Halchuk (2003). Bounded Gutenberg-Richter relationship is used to calculate the a- and b-values. This allows consistency of the recurrence parameters with the GSC's original model. The resulting recurrence parameters are given in Table 1 and the bounded Gutenber-Richter curves for the two new sources and the adjusted MKM source are presented in Figure 4.

In addition to the update of the area sources, Tintina Fault is added to the seismic hazard model as a fault source (Figure 3). Geometry and recurrence parameters for Tintina Fault are adopted from Leonard et al. (2008). A minimum magnitude of 5.5 is used for Tintina Fault. It has not experienced any earthquakes larger than Mw5 during instrumental era (since about 1900AD). Smaller magnitude seismic activity is considered in the background area sources. A dip angle of 90^{o} is used for Tintina Fault, consistent with a strike-slip fault. Upper seismogenic depth is set to 0 (surface ruptures are allowed) and lower seismogenic depth is set to 20km, consistent with the rest of GSC's fault source modeling in the region. Wells and Coppersmith (1994) is selected as the magnitude scaling relationship.

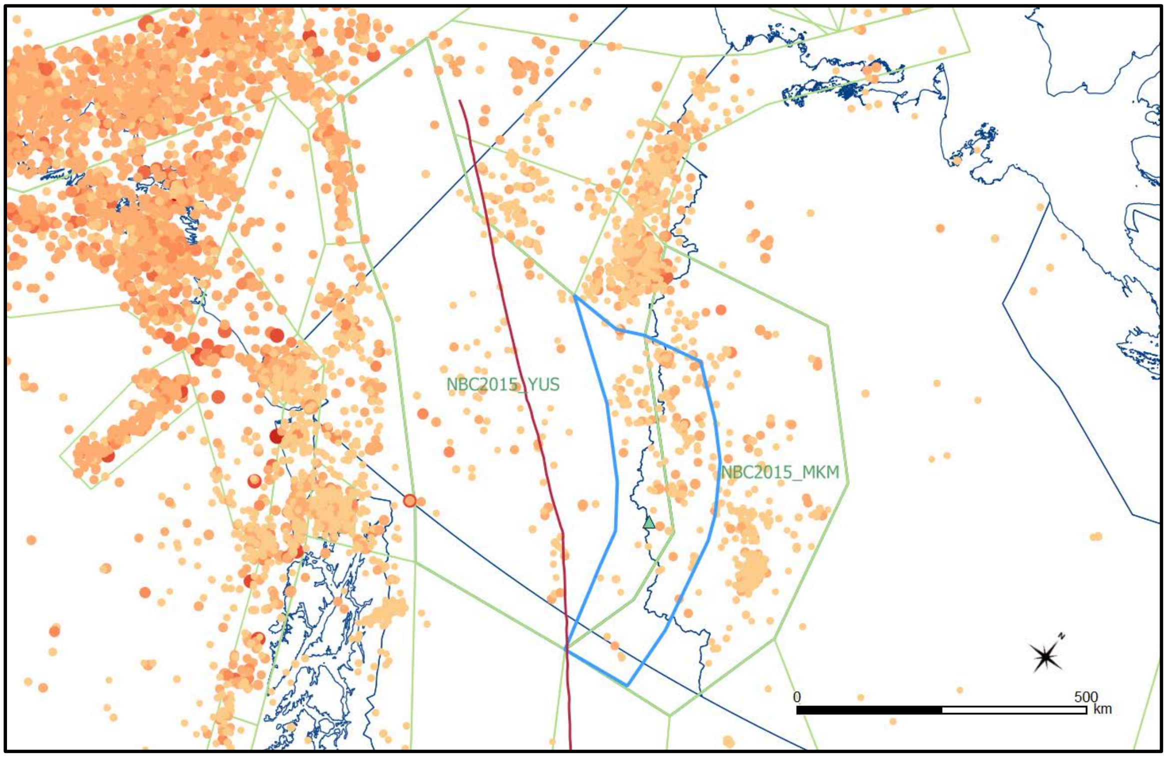

Figure 3. New area source zone (SWM in blue) and newly added Tintina Fault (dark red line).

Table 1. Recurrence parameters for the new and adjusted sources

Source	***G-R b-value***	***G-R a-value***	***Mmax***
Original YUS	0.95	3.67	7.8
Original MKM	0.93	4.22	7.7
New SWM	0.95	3.70	7.8
Adjusted YUS	0.91	3.55	7.8
Adjusted MKM	0.96	4.27	7.8
Tintina Fault	0.84	2.50	8.2

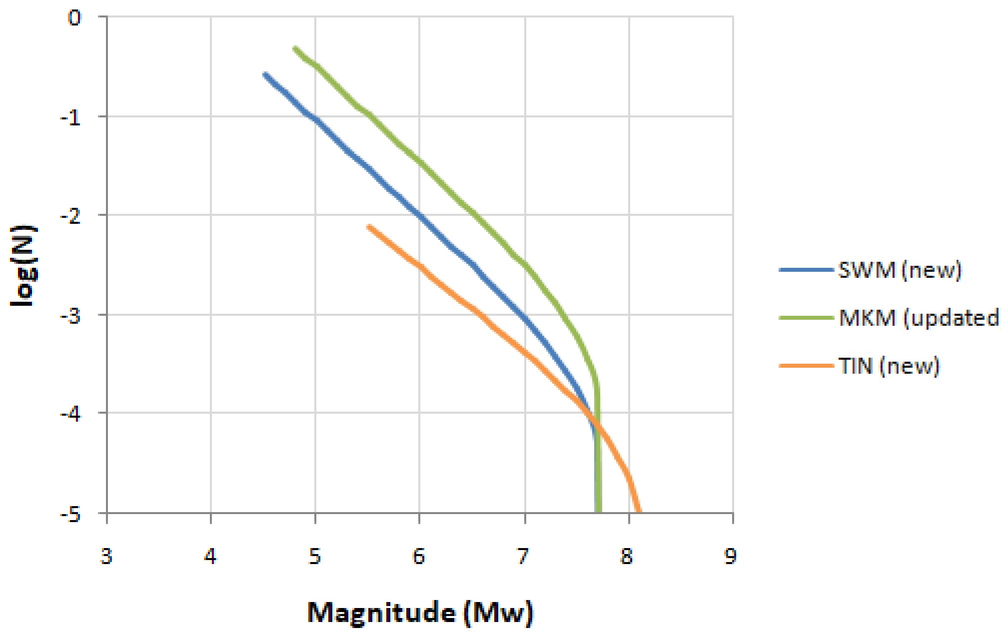

Figure 4. Recurrence relations for the new Selwn Mountains (SWM) area source, the updated Mackenzie Mountains (MKM) area source, and the newly added Tintina Fault (TIN).

GROUND MOTION CHARACTERIZATION

GSC's 5th generation hazard model (NBC 2015) uses GMPEs described by Atkinson and Adams (2013). At the time these GMPEs were selected and implemented, NGA West 2 (PEER, 2013) relationships had not yet been released. In order to reflect the more recent GMPEs in this hazard project, Atkinson and Adams (2013) implementation is weighted 50-50 against the four NGA West 2 GMPEs for shallow crustal earthquakes. Atkinson and Adams (2013) implementation (including the weights) is retained because its treatment of epistemic uncertainty is more robust than simply using the NGA West 2 GMPEs without consideration of additional epistemic uncertainty. GMPEs for other types of sources (e.g. subduction zone earthquakes) are left unchanged as they do not significantly affect seismic hazard at the CanTung site.

Figure 5a presents the Atkinson and Adams (2013) implementation of three GMPEs for crustal earthquakes, i.e. the central (solid line), upper (dashed line) and lower (dashed line), for magnitude 5.0, 6.0, 7.0 and 8.0, and distances (Rjb: closest distance to the surface projection of rupture) 5km, 20km, 50km, and 100km. Similarly, for the same magnitude and distance values, the four new NGA West 2 GMPEs are presented in Figure 5b, where the blue line is Abrahamson et al. (2014), green line Boore et al. (2014), red line Campbell and Bozorgnia (2014), and cyan line Chiou and Youngs (2014).

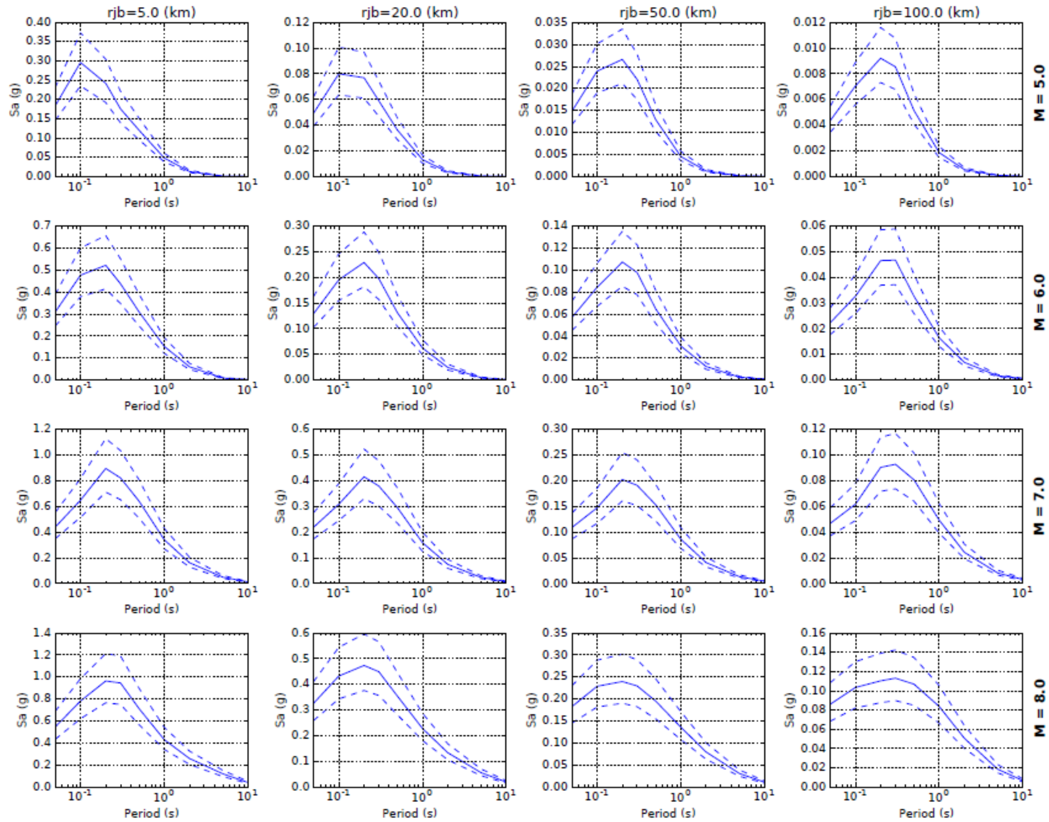

Figure 5a. NBC 2015 crustal GMPEs used in the hazard analyses.

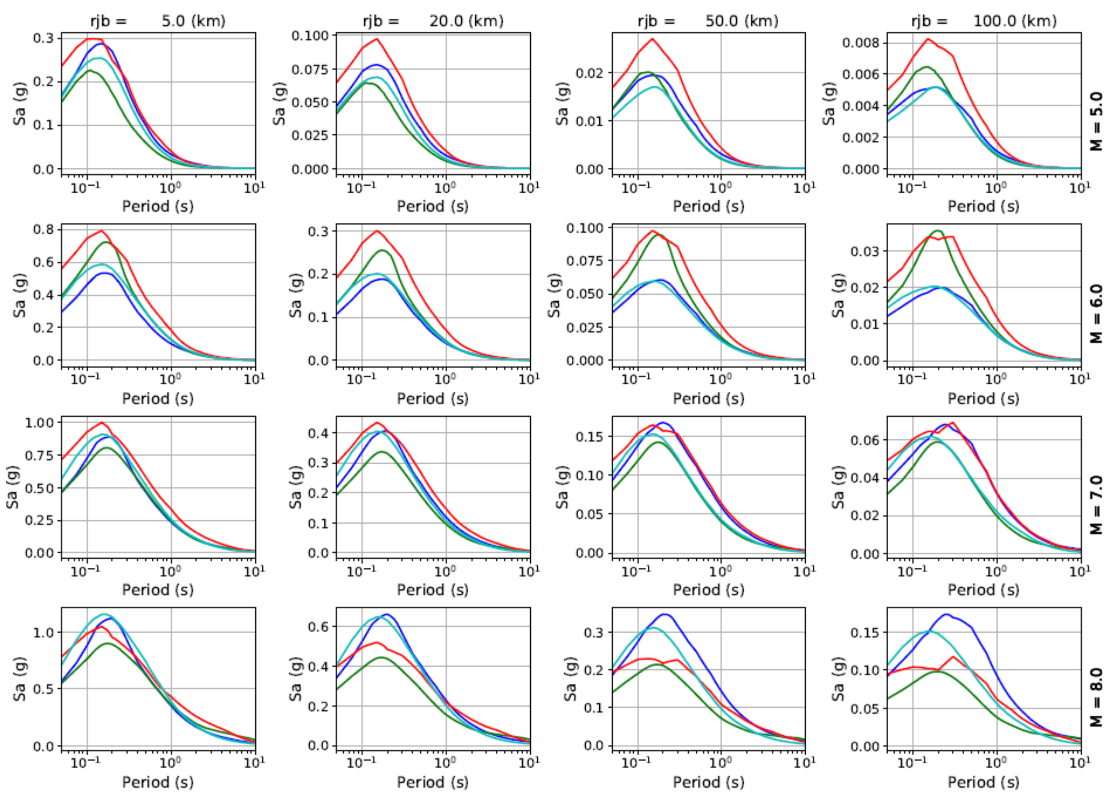

Figure 5b. NGA West 2 crustal GMPEs used in the hazard analyses.

Table 2 and Figure 6 present uniform hazard spectra (UHS) for the CanTung site at three return periods, 475 years, 2,475 years, and 4,975 years. For comparison, GSC's 4th generation (NBC 2010) and 5th generation (NBC 2015) model results are also shown as well as OpenQuake implementation of GSC's 5th generation hazard model (NBC 2015 OQ) at the return periods they are available.

Table 2a. UHS for 475-year return period (10% chance of exceedance in 50 years)

Period	***NBC 2010 SA (g)***	***NBC 2015 GSC SA (g)***	***NBC 2015 OQ SA (g)***	***NEW MODEL SA (g)***
PGA	0.139	0.066	0.065	0.094
0.2	0.271	0.150	0.148	0.209
0.5	0.161	0.115	0.113	0.126
1	0.079	0.071	0.070	0.065
2	0.044	0.036	0.035	0.029
5	N/A	0.012	0.012	0.0083
10	N/A	0.0046	0.0047	0.0033

Table 2b. UHS for 2,475-year return period (2% chance of exceedance in 50 years)

Period	***NBC 2010 SA (g)***	***NBC 2015 GSC SA (g)***	***NBC 2015 OQ SA (g)***	***NEW MODEL SA (g)***
PGA	0.245	0.157	0.149	0.210
0.2	0.509	0.334	0.321	0.466
0.5	0.313	0.244	0.236	0.279
1	0.158	0.146	0.146	0.142
2	0.087	0.071	0.071	0.061
5	N/A	0.024	0.024	0.018
10	N/A	0.0092	0.0093	0.0069

Table 2c. UHS for 4,975-year return period (1% chance of exceedance in 50 years)

UHS	***PGA***	***SA(0.2s)***	***SA(0.5s)***	***SA(1.0s)***	***SA(2.0s)***	***SA(5.0s)***	***SA(10s)***
NEW MODEL SA (g)	0.277	0.620	0.374	0.192	0.081	0.024	0.0092

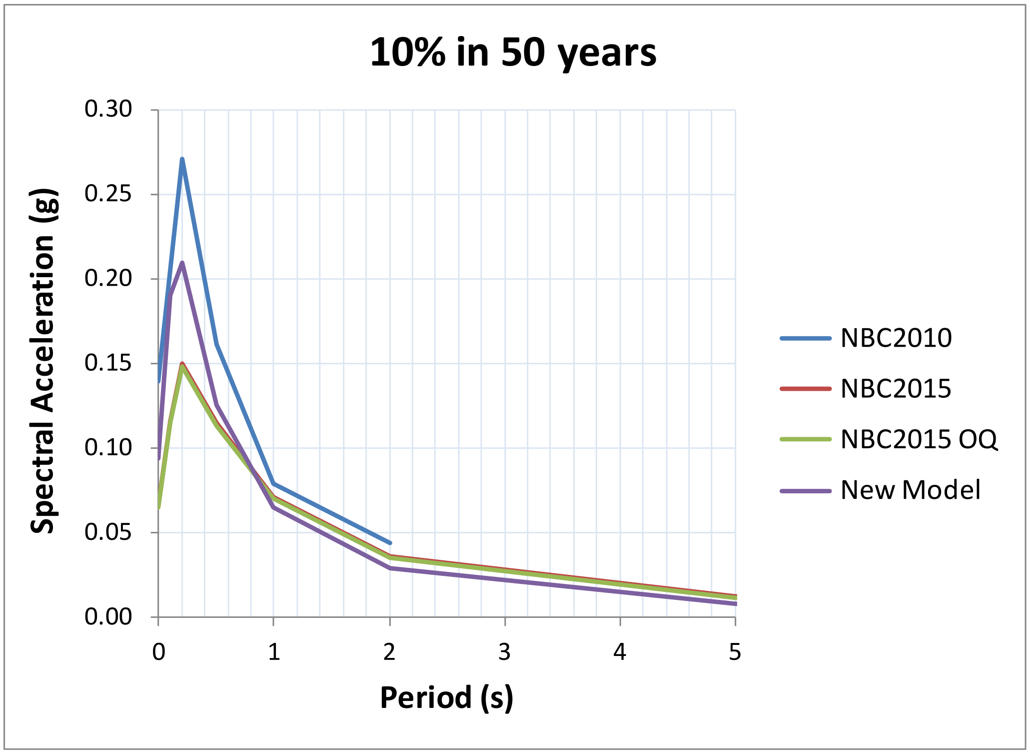

Figure 6a. UHS for 475-year return period (10% chance of exceedance in 50 years).

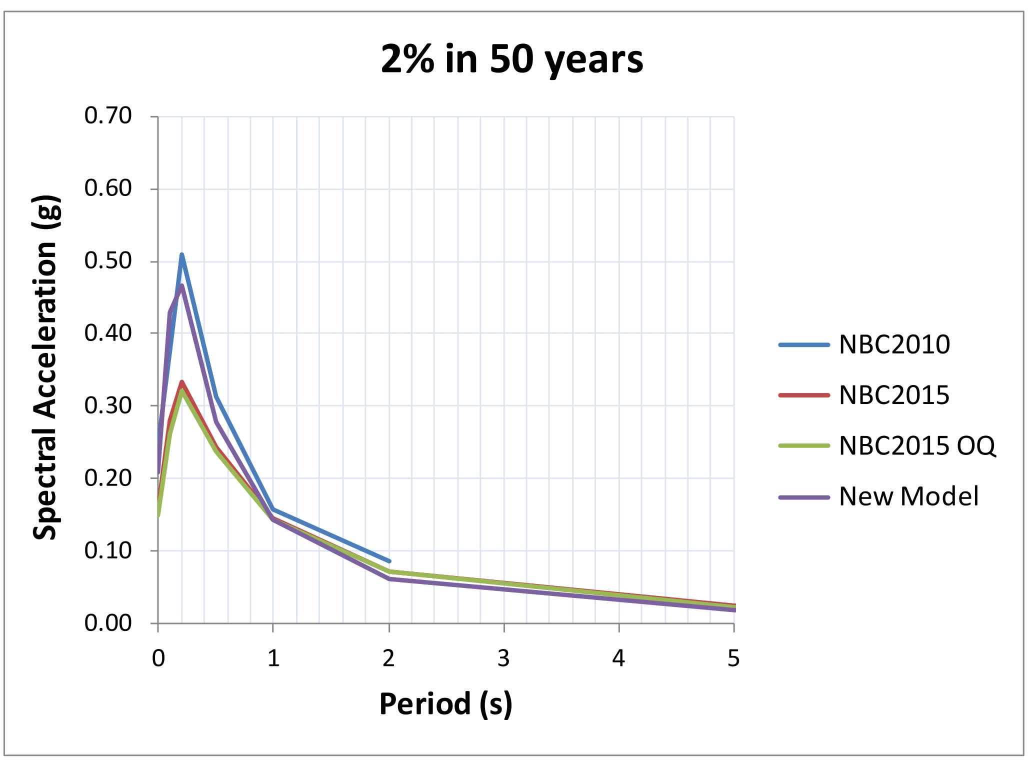

Figure 6b. UHS for 2,475-year return period (2% chance of exceedance in 50 years)

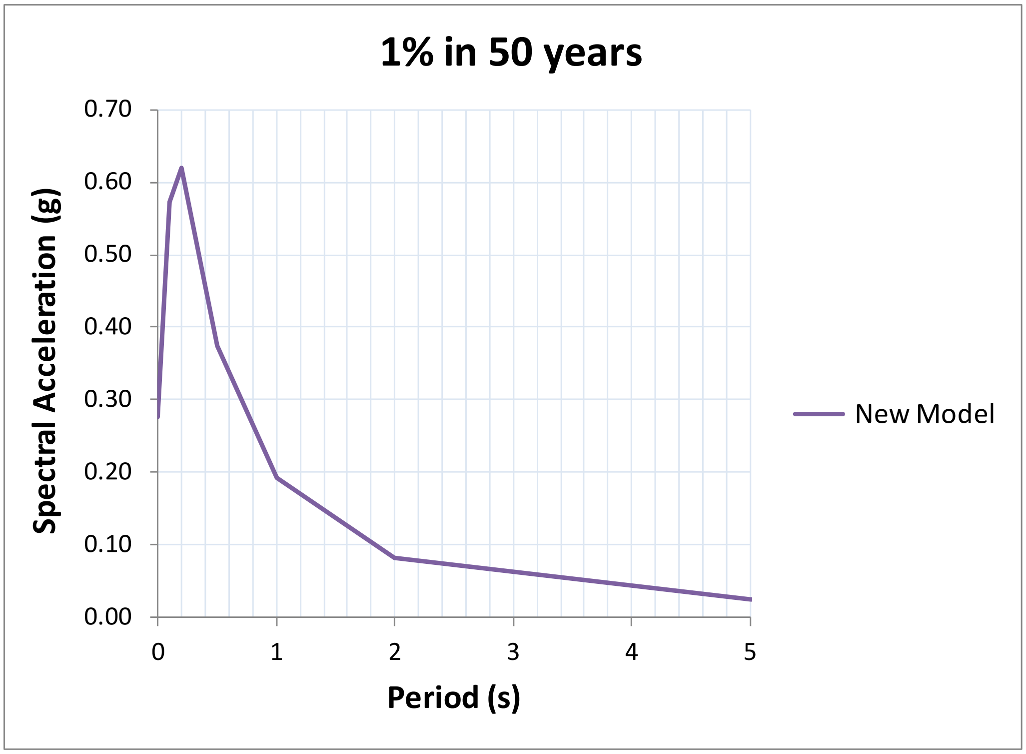

Figure 6c. UHS for 4,975-year return period (1% chance of exceedance in 50 years)

Deaggregations are presented in Table 3 and Figure 7 for PGA, SA(0.2s) and SA(1.0s) at the 2,475-year return period. The deaggregations are in terms of per mil contributions in Table 3 and per cent contributions in Figure 7.

Mean magnitudes and distances for PGA, SA(0.2s), and SA(1.0s) are {Mw5.8, 21km}, {Mw5.9, 23km}, and {Mw6.5, 53km}, respectively. Mode magnitudes and distances are {Mw5.0, 10km}, {Mw5.3, 10km}, and {Mw6.3, 30km} for PGA, SA(0.2s), and SA(1.0s), respectively.

The largest contributor to hazard is generally the nearby small earthquakes, particularly for short periods. Contributions to hazard shift to larger magnitudes and distances as the period goes longer to 1.0s.

Table 3a. Per mil contributions by magnitude (Mw) and distance (km) for PGA at 2,475-year return period (2% chance of exceedance in 50 years). Mode magnitude: 5.05. Mode distance: 10km. Mean magnitude: 5.80. Mean distance: 21km.

	Dist																			
Mag	10	30	50	70	90	110	130	150	170	190	210	230	250	270	290	310	330	350	370	390
4.55	31	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4.65	33	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4.75	34	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4.85	35	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4.95	37	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5.05	37	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5.15	37	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5.25	36	9	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5.35	35	10	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5.45	34	12	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5.55	32	13	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5.65	29	14	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5.75	26	14	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5.85	23	14	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5.95	21	14	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6.05	18	14	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6.15	16	14	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6.25	14	14	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6.35	12	14	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6.45	11	13	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6.55	9	12	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6.65	8	12	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6.75	7	11	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6.85	5	9	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6.95	5	8	4	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7.05	4	7	4	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7.15	3	6	4	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7.25	3	5	4	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7.35	2	5	3	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7.45	2	4	3	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7.55	1	3	3	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7.65	1	3	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7.75	1	3	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7.85	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7.95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8.05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8.15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 3b. Per mil contributions by magnitude (Mw) and distance (km) for SA(0.2s) at 2,475-year return period (2% chance of exceedance in 50 years). Mode magnitude: 5.35. Mode distance: 10km. Mean magnitude: 5.90. Mean distance: 23km.

	Dist																			
Mag	10	30	50	70	90	110	130	150	170	190	210	230	250	270	290	310	330	350	370	390
4.55	17	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4.65	20	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4.75	23	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4.85	26	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4.95	29	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5.05	31	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5.15	32	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5.25	32	9	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5.35	33	10	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5.45	32	12	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5.55	31	14	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5.65	30	16	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5.75	28	17	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5.85	25	19	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5.95	23	19	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6.05	20	19	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6.15	18	19	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6.25	16	18	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6.35	14	17	6	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6.45	12	16	6	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6.55	10	15	6	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6.65	8	14	6	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6.75	7	12	6	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6.85	6	11	5	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6.95	5	9	5	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7.05	4	7	4	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7.15	3	6	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7.25	3	5	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7.35	2	4	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7.45	2	4	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7.55	1	3	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7.65	1	3	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7.75	1	2	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7.85	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7.95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8.05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8.15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 3c. Per mil contributions by magnitude (Mw) and distance (km) for SA(1.0s) at 2,475-year return period (2% chance of exceedance in 50 years). Mode magnitude: 6.35. Mode distance: 30km. Mean magnitude: 6.54. Mean distance: 53km.

	Dist																			
Mag	10	30	50	70	90	110	130	150	170	190	210	230	250	270	290	310	330	350	370	390
4.55	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4.65	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4.75	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4.85	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4.95	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5.05	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5.15	8	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5.25	10	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5.35	13	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5.45	15	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5.55	17	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5.65	18	7	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5.75	18	9	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5.85	18	12	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5.95	18	14	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6.05	17	16	5	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6.15	16	18	7	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6.25	15	19	8	3	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6.35	13	19	10	4	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
6.45	12	19	11	5	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
6.55	10	18	11	6	3	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0
6.65	9	17	12	6	4	2	1	1	1	0	0	0	0	0	0	0	0	0	0	0
6.75	7	16	12	7	4	3	2	1	1	0	0	0	0	0	0	0	0	0	0	0
6.85	6	14	11	7	4	3	2	1	1	1	0	0	0	0	0	0	0	0	0	0
6.95	5	12	10	6	4	3	2	2	1	1	0	0	0	0	0	0	0	0	0	0
7.05	4	10	9	6	4	3	2	2	1	1	0	0	0	0	0	0	0	0	0	0
7.15	3	9	8	6	4	3	2	2	1	1	1	0	0	0	0	0	0	0	0	0
7.25	3	7	7	5	4	3	2	2	1	1	1	0	0	0	0	0	0	0	0	0
7.35	2	6	6	5	4	3	2	2	2	1	1	1	0	0	0	0	0	0	0	0
7.45	2	5	5	4	3	3	2	2	2	1	1	1	0	0	0	0	0	0	0	0
7.55	2	4	5	4	3	3	2	2	2	1	1	1	1	0	0	0	0	0	0	0
7.65	1	4	4	4	3	3	2	2	2	1	1	1	1	0	0	0	0	0	0	0
7.75	1	3	4	3	2	2	1	1	1	0	0	0	0	0	0	0	0	0	0	0
7.85	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
7.95	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
8.05	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
8.15	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
8.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

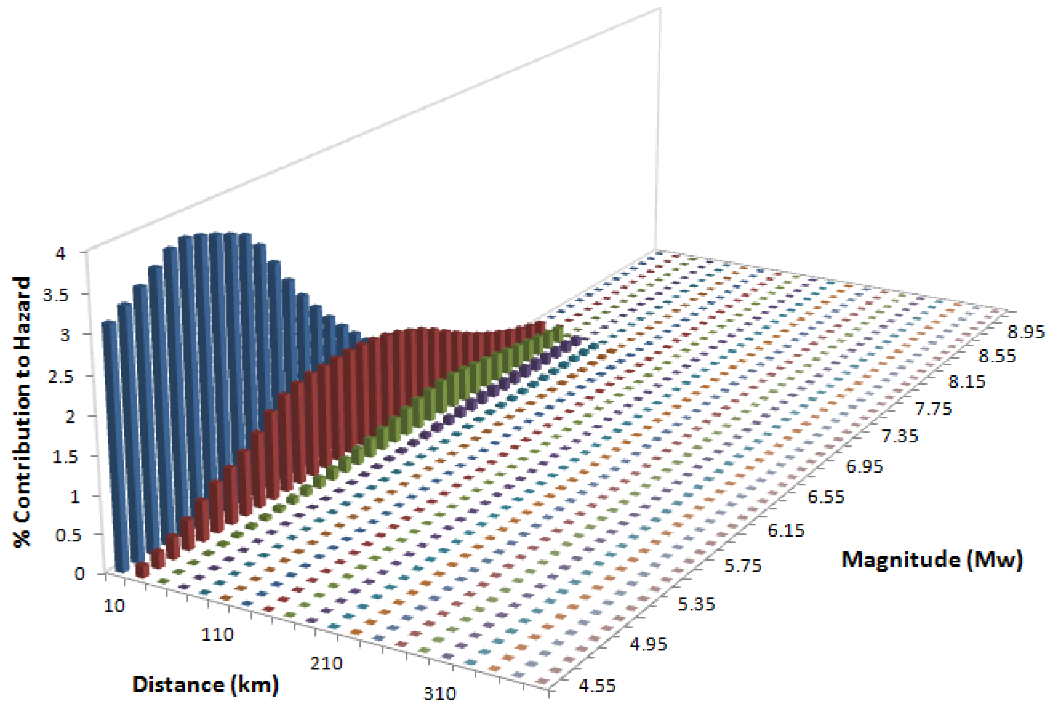

Figure 7a. Per cent contribution by magnitude and distance for PGA at 2,475-year return period (2% chance of exceedance in 50 years). Mode magnitude: 5.05. Mode distance: 10km. Mean magnitude: 5.80. Mean distance: 21km.

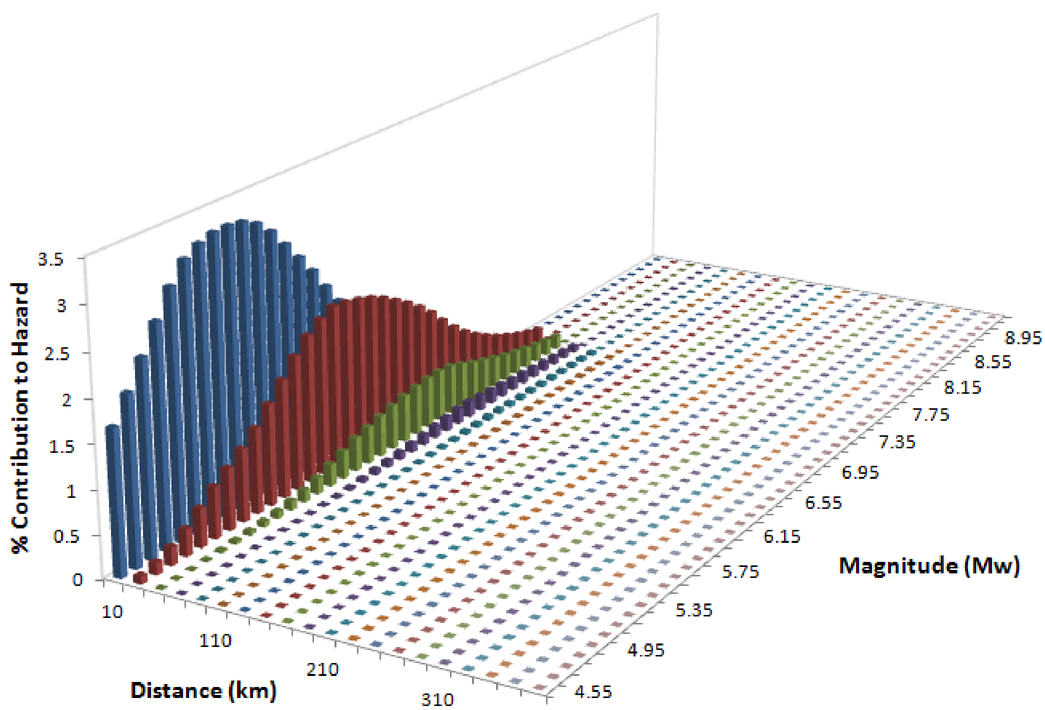

Figure 7b. Per cent contribution by magnitude and distance for SA(0.2s) at 2,475-year return period (2% chance of exceedance in 50 years). Mode magnitude: 5.35. Mode distance: 10km. Mean magnitude: 5.90. Mean distance: 23km.

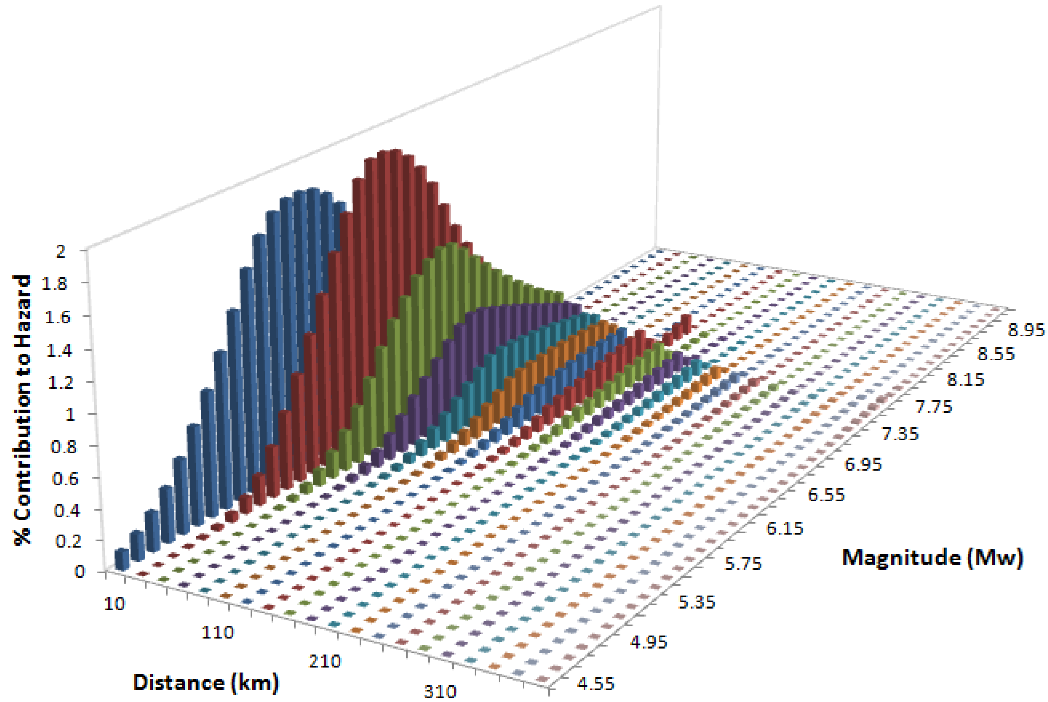

Figure 7c. Per cent contribution by magnitude and distance for SA(1.0s) at 2,475-year return period (2% chance of exceedance in 50 years). Mode magnitude: 6.35. Mode distance: 30km. Mean magnitude: 6.54. Mean distance: 53km.

SENSITIVITY OF RESULTS TO MODEL PARAMETERS

Introduction of the new area source, "Selwyn Mountains", generally increased the hazard at all periods at the project site. Given its low seismic activity rates and large distance to the CanTung site (~150km), adding Tintina Fault to the hazard model did not change the hazard significantly, i.e. no change to short periods, about 0.5% increase in SA(2s), 2% increase in SA(5s) and 4% increase in SA(10s).

Using NGA West 2 GMPEs instead of Atkinson and Adams (2013) for shallow crustal seismicity reduces the calculated long-period hazard by about 25% at 2 second period, and over 30% at 5 and 10 second periods (generally less than 10% difference in all other periods). The hazard model developed for this project equally weighs the NGA West 2 GMPEs with Atkinson and Adams (2013), which brings the long period hazard back up somewhat (by 10% at 5 second period).

CONCLUSIONS

An updated PSHA was carried out for the CanTung project site. Although effort was made to better reflect the seismicity and seismic hazard around the project site, it should be noted that this updated PSHA does not constitute a full site-specific hazard assessment.

The new hazard model uses the GSC's 5^{th} generation hazard model (Adams et al., 2015) implemented in NBC's 2015 Edition as the base model, as required by the project scope document. Three main changes were introduced to better characterize the seismic activity at the site and reflect GMPE updates introduced after the implementation of the GSC's 5^{th} generation hazard model: 1) A new area source was introduced to better reflect the seismic activity rates near the CanTung site, 2) Tintina Fault was added as a fault source to better characterize the long term hazard from this seismic source, and 3) Ground motion characterization was updated to include the NGA West 2 GMPEs.

The resulting hazard (presented in Table 2) is within 10% of the NBC 2015 values for SA(1s) and SA(2s); higher in shorter periods (40% higher for PGA) and lower in longer periods (20% lower for 10s SA). The changes are mainly due to the new area source introduced in order to better capture the seismic activity in the vicinity of the project site and the new GMPE implementation.

Deaggregations presented in Figure 7 indicate that the largest contribution to short period hazard is generally from nearby small earthquakes (Mw<6.0 within 20km of the site). On the other hand, the contribution to long period hazard shifts to earthquakes with larger magnitudes (Mw>6.0) and distances (30~55km).

DISCLAIMER

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PART 2: SUITE OF GROUND MOTION TIME-HISTORIES

SELECTION AND PREPARATION PROCESS

The hazard at the CanTung project site is dominated by shallow crustal earthquake activity. Deaggregations for 2,475-year hazard indicate that the largest contribution to short period hazard is generally from nearby small earthquakes (Mw<6.0 within 20km of the site), while the contribution to long period hazard shifts to earthquakes with larger magnitudes (Mw>6.0) and distances (30~55km). However, the shift is gradual and there is no sharp change by period in contributing magnitudes and distances.

Records from earthquakes of these magnitude and distance ranges were selected from the PEER NGA-West2 database (Table 4). All selected time-histories were recorded on Site Class C. Those records with spectral shapes that are naturally close to the 2,475-year UHS (target spectrum) were most strongly favoured.

Table 4. Selected ground motion time-histories

File Name	***Event***	***Mw***	***Station***	***Rrup (km)***	***Vs30 (m/s)***	***Time step (s)***	***Scale factor***
CT_Crustal01	1979 Imperial Valley	6.5	CPE	15	472	0.01	1.0
CT_Crustal02	1983 Coalinga	6.4	PG3	39	511	0.01	1.2
CT_Crustal03	1983 Coalinga	6.4	SC3	34	565	0.01	1.5
CT_Crustal04	1984 Morgan Hill	6.2	CLS	23	462	0.005	2.5*
CT_Crustal05	1986 Chalfant Valley	5.8	BPL	15	585	0.005	1.5
CT_Crustal06	1987 Whittier Narrows	6.0	SYL	42	440	0.005	3.0
CT_Crustal07	1994 Northridge	6.7	CYP	31	367	0.01	1.3
CT_Crustal08	1994 Northridge	6.7	UCL	22	398	0.02	1.0
CT_Crustal09	1991 Sierra Madre	5.6	LAC	26	365	0.01	2.8
CT_Crustal10	2004 Niigata, Japan	6.6	FKSH21	31	365	0.005	1.0
CT_Crustal11	2004 Niigata, Japan	6.6	NIG016	32	370	0.01	1.8

* In addition to scaling, this record was spectrally modified at six periods

As the significant proportion of earthquakes in the region is caused by compressional tectonics, most of the records were chosen from "reverse" or "reverse oblique" mechanism earthquakes. However, three records from strike-slip earthquakes

(1979 Imperial Valley, 1984 Morgan Hill, 1986 Chalfant Valley) were also included to cover the possibility of this type of earthquake in the region.

Records requiring scale factors more than 3.0 were discarded from the selection. As there are no known major active faults within 10km of the project site, records marked by PEER NGA-West2 database as having pulses were also discarded.

All records were processed by the PEER NGA program, as described in Ancheta et al. (2013). Scaling factors ranging from 1.0 to 3.0 were applied to the records. No spectral matching was applied to the records with the exception of one (CT_Crustal04). This record's spectrum was modified at six periods using the program, RSPMATCH (Al Atik and Abrahamson, 2010). The full set of time-histories and their response spectra are presented in the Appendix.

Each time-history file includes a header indicating time step and units. It should be noted that the records are prepared to be used as a set, and as such, their average response spectrum "matches" the target spectrum, i.e. it does not fall more than 10% below the target spectrum at the period range of 0.1s to 3.5s (Figure 8).

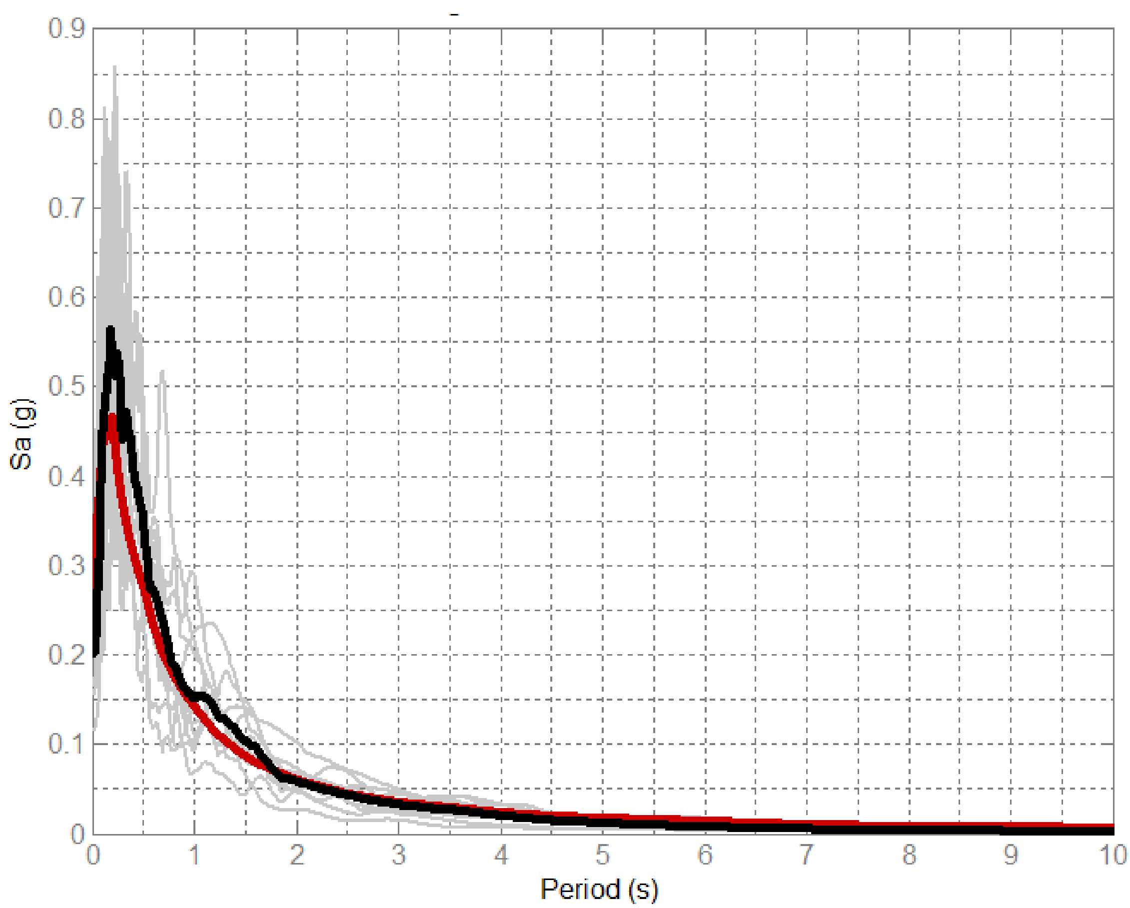

Figure 8a. Comparison of the response spectra of the suite of 11 time-histories (light gray), the average response spectrum (black) and the target spectrum (red), plotted in linear axes

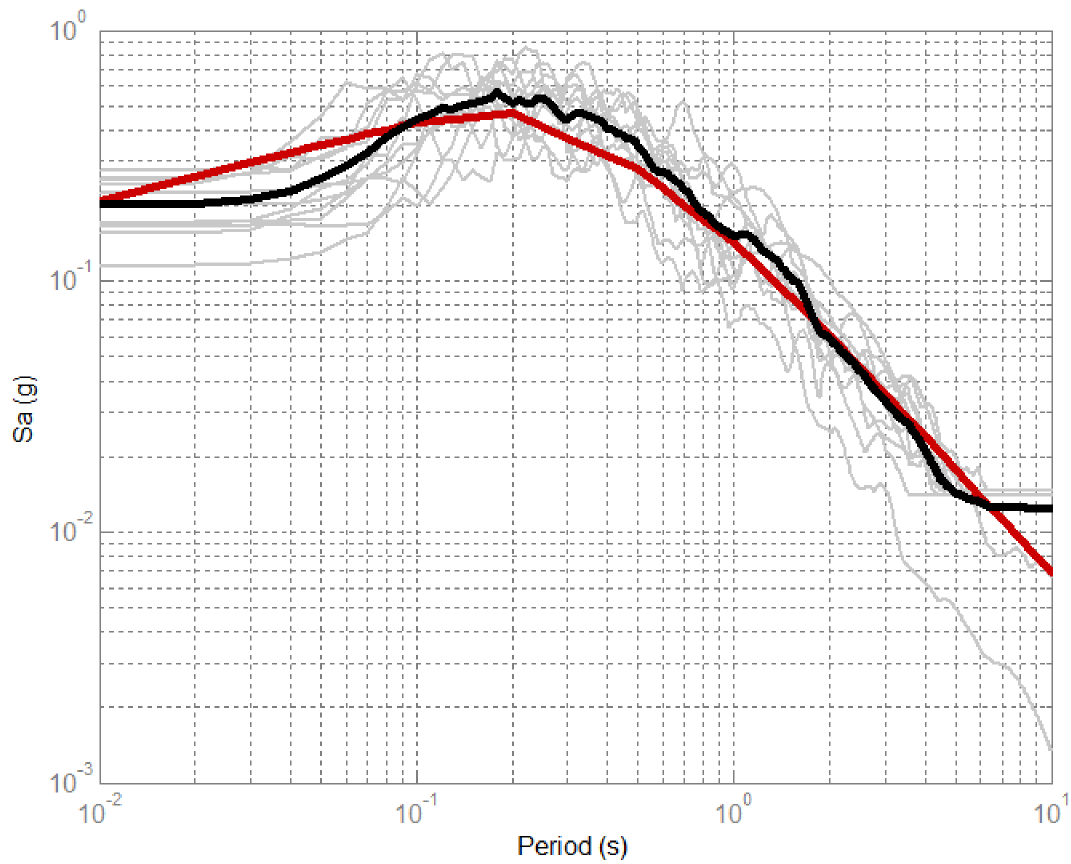

Figure 8b. Comparison of the response spectra of the suite of 11 time-histories (light gray), the average response spectrum (black) and the target spectrum (red), plotted in log-log axes

DISCLAIMER

All information and data provided as part of this report (presented in any form, including any attachments to this report or other email communications) are the author's best estimates on a subject that is susceptible to large uncertainties and varying interpretations. In no event shall Onur Seemann Consulting, Inc. (OSC) and its consultants be liable to any party for direct, indirect, special, incidental, or consequential damages, including injuries, loss of life, loss of property or any form of financial loss, arising out of the use of the information and data described herein.

ACKNOWLEDGEMENTS

This work greatly benefited from the online strong motion database prepared by the Pacific Earthquake Engineering Research Center (PEER).

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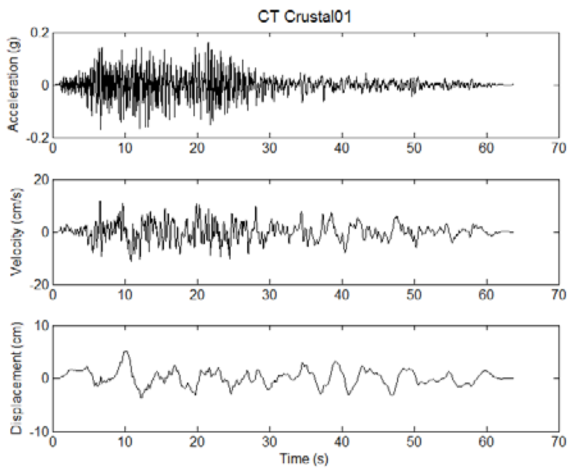
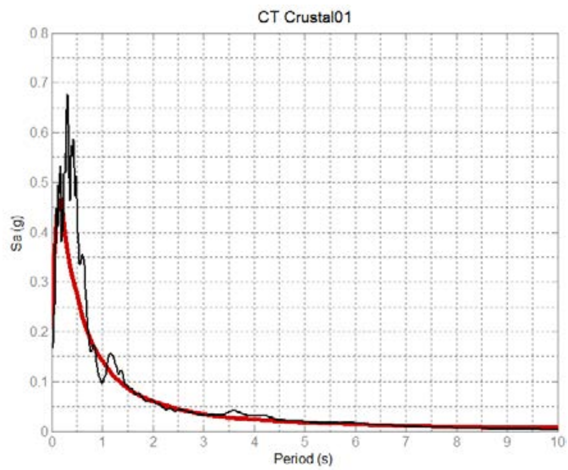
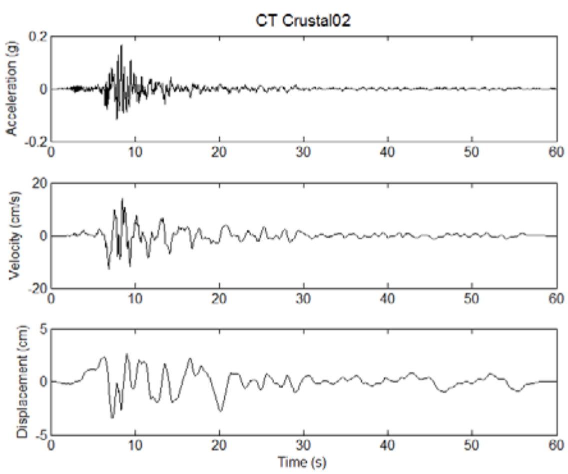
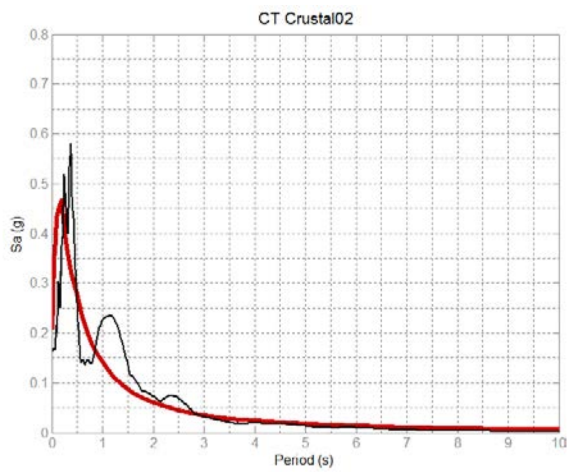
APPENDIX

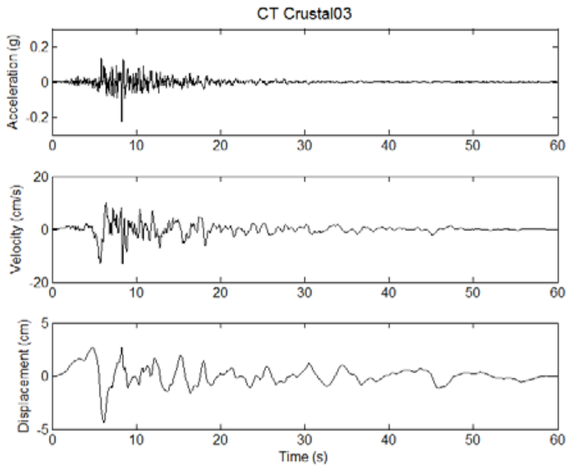
The scaled time-histories and their response spectra are presented below. The target spectrum is plotted in red for comparison. In the Crustal04 plots, the original scaled record is plotted in black and the spectrally modified record is plotted in blue.

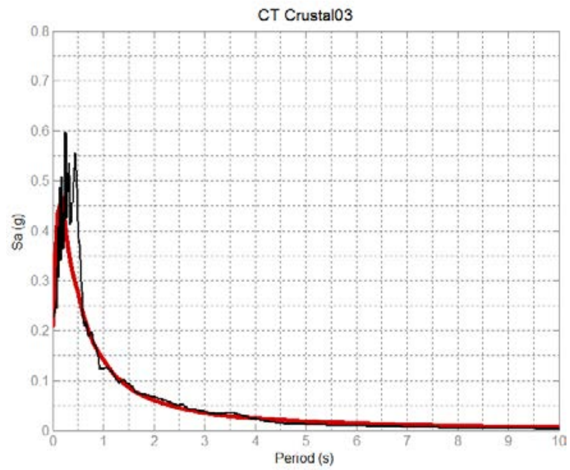


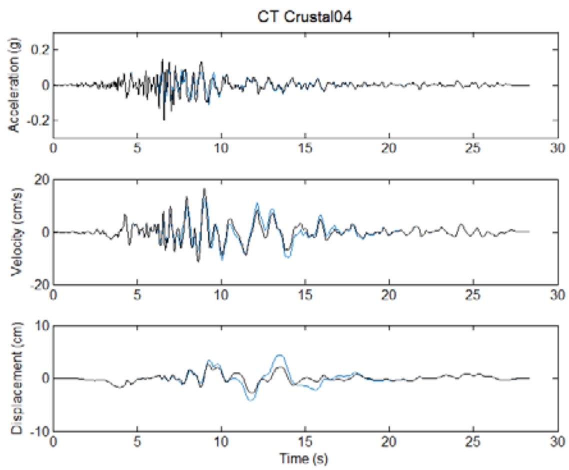


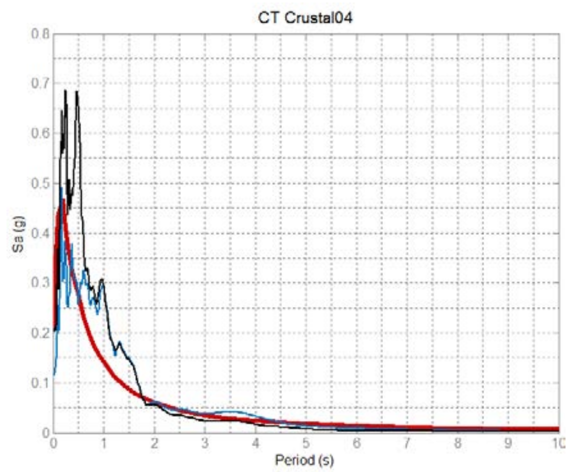


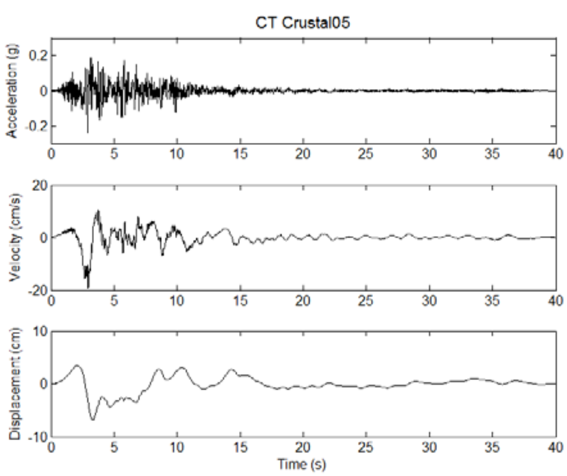


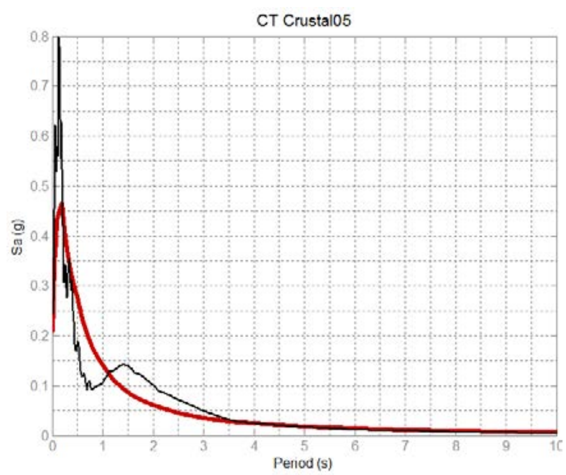

CT Crustal03
Acceleration (g)
Velocity (cm/s)
Displacement (cm)
Time (s)


CT Crustal03
Sa (g)
Period (s)

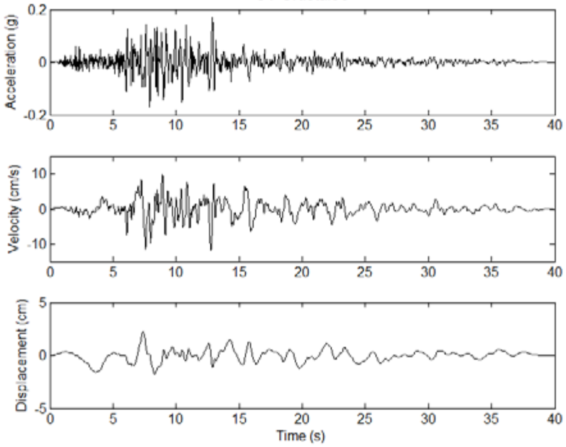

CT Crustal04
Acceleration (g)
Velocity (cm/s)
Displacement (cm)
Time (s)


CT Crustal04
Sa (g)
Period (s)

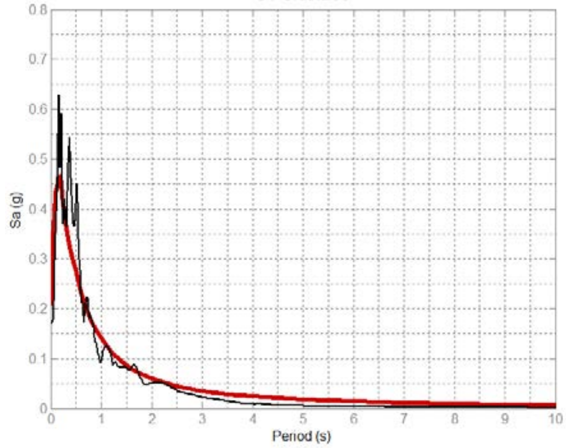

CT Crustal05
Acceleration (g)
Velocity (cm/s)
Displacement (cm)
Time (s)


CT Crustal05
Sa (g)
Period (s)

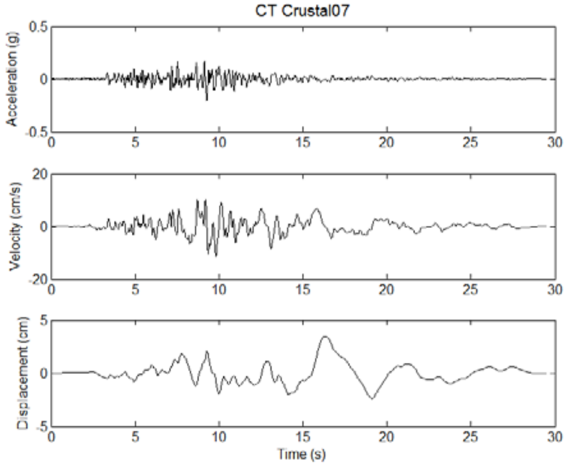
CT Crustal06



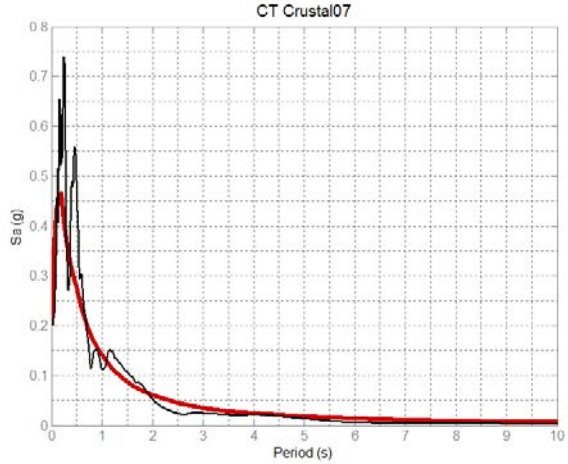
CT Crustal06



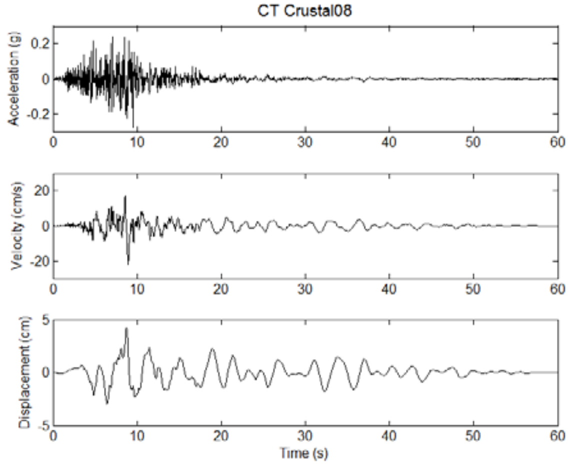
CT Crustal07



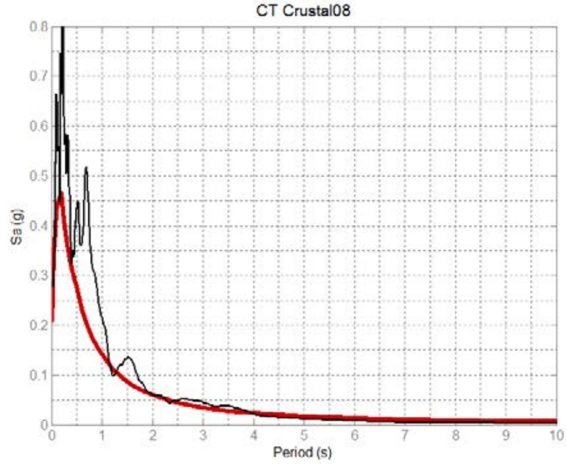
CT Crustal07

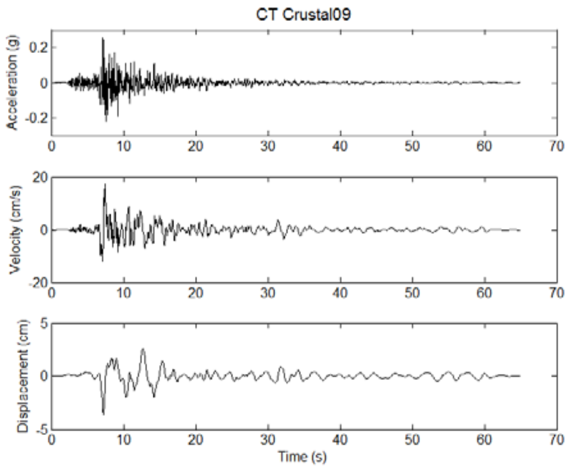


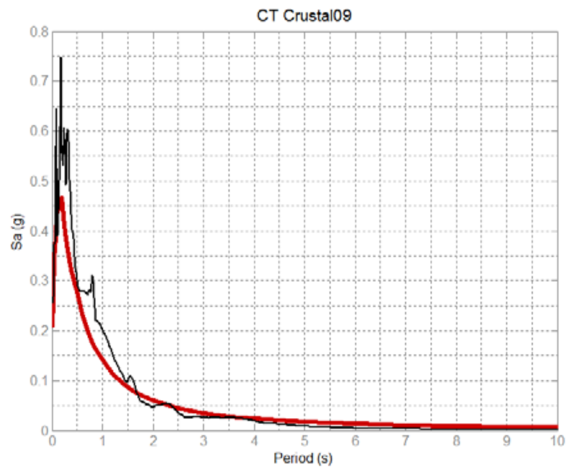
CT Crustal08

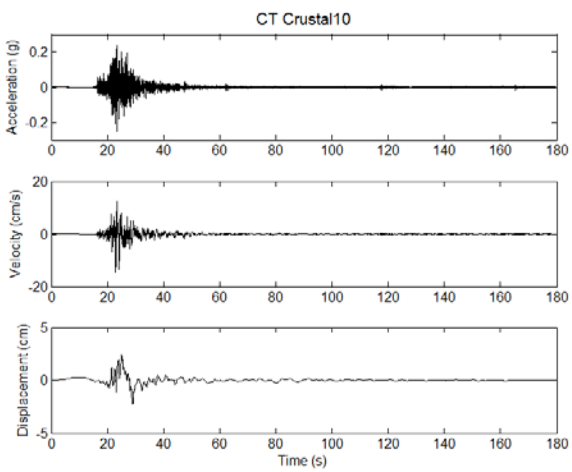


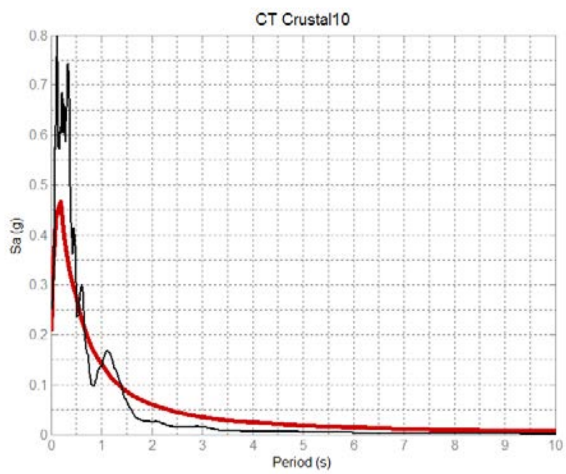
CT Crustal08

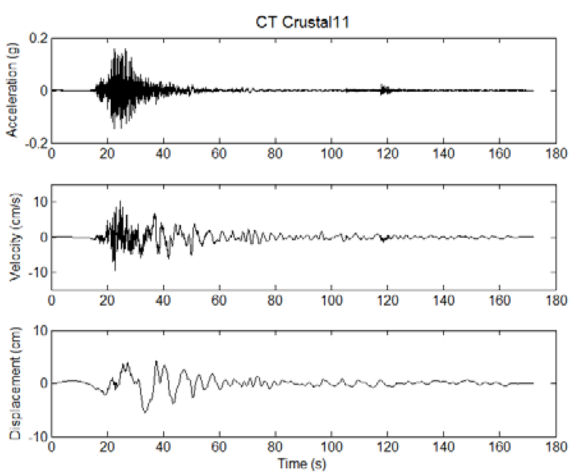


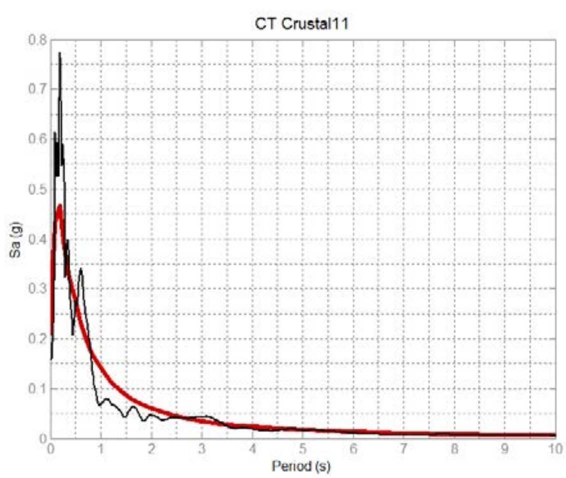

CT Crustal09
Acceleration (g)
Velocity (cm/s)
Displacement (cm)
Time (s)


CT Crustal09
Sa (g)
Period (s)


CT Crustal10
Acceleration (g)
Velocity (cm/s)
Displacement (cm)
Time (s)

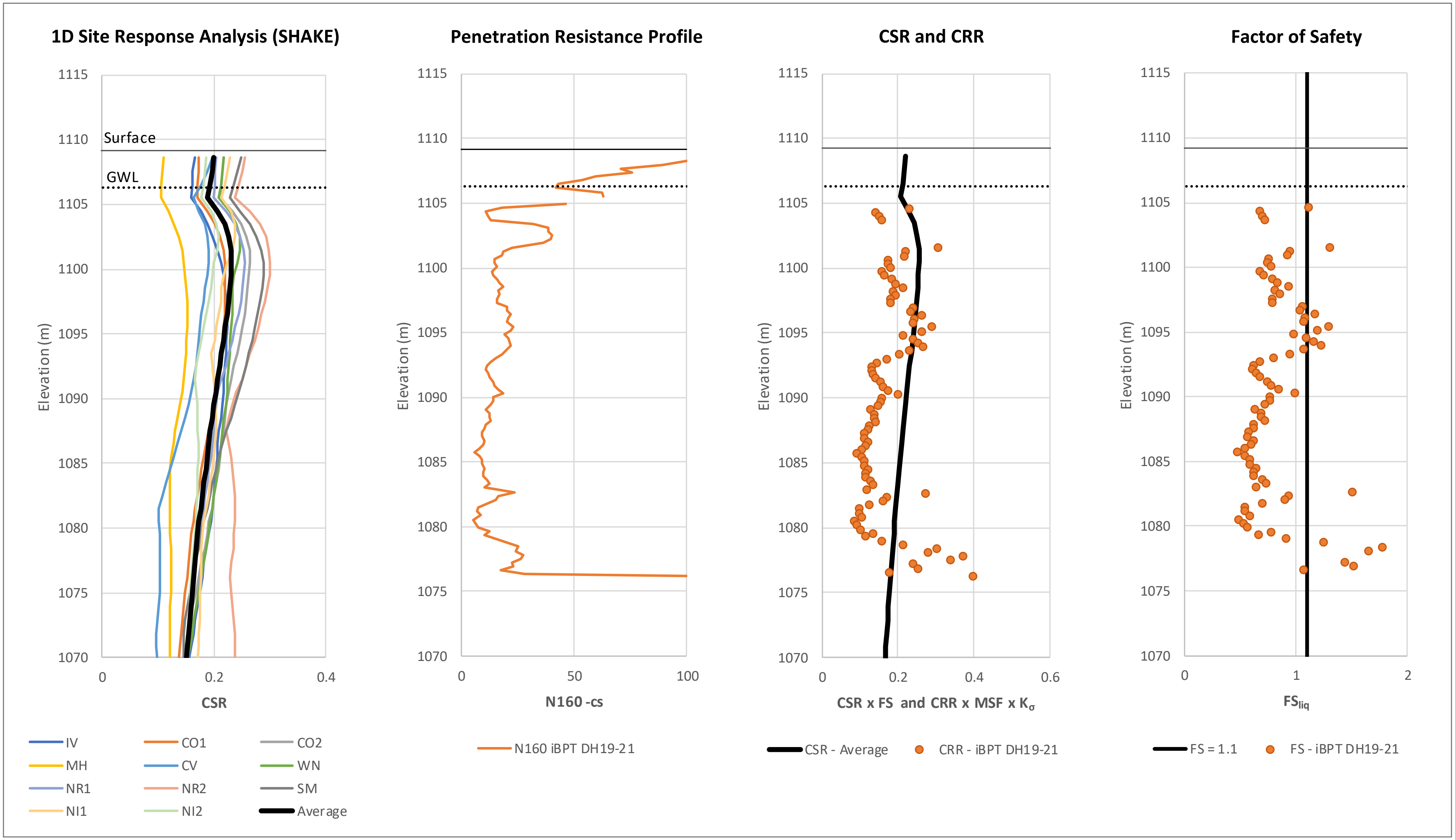

CT Crustal10
Sa (g)
Period (s)


CT Crustal11
Acceleration (g)
Velocity (cm/s)
Displacement (cm)
Time (s)


CT Crustal11
Sa (g)
Period (s)

APPENDIX C

LIQUEFACTION POTENTIAL ASSESSMENT RESULTS



LEGEND

Earthquake Records:
IV: Imperial Valley, 1979
CO1, 2: Coalinga, 1983
MH: Morgan Hill, 1984
CV: Chalfant Valley, 1986
WN: Whittier Narrows, 1987
NR1, 2: Northridge, 1994
SM: Sierra Madre, 1991
NI1, 2: Niigata, Japan, 2004

GWL: Groundwater Level
iBPT: Instrumented Becker Penetration Test
N160-cs: Corrected Penetration Resistance
CSR: Cyclic Stress Ratio
CRR: Cyclic Resistance Ratio
MSF: Magnitude Scaling Factor
Kσ: Overburden Correction Factor
FS_{liq}: Factor of Safety against Liquefaction

NOTES

STATUS
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NORTH AMERICAN TUNGSTEN CORPORATION LTD
TETRA TECH

Geotechnical Assessment of Existing Tailings Facilities, Cantung Mine, NT

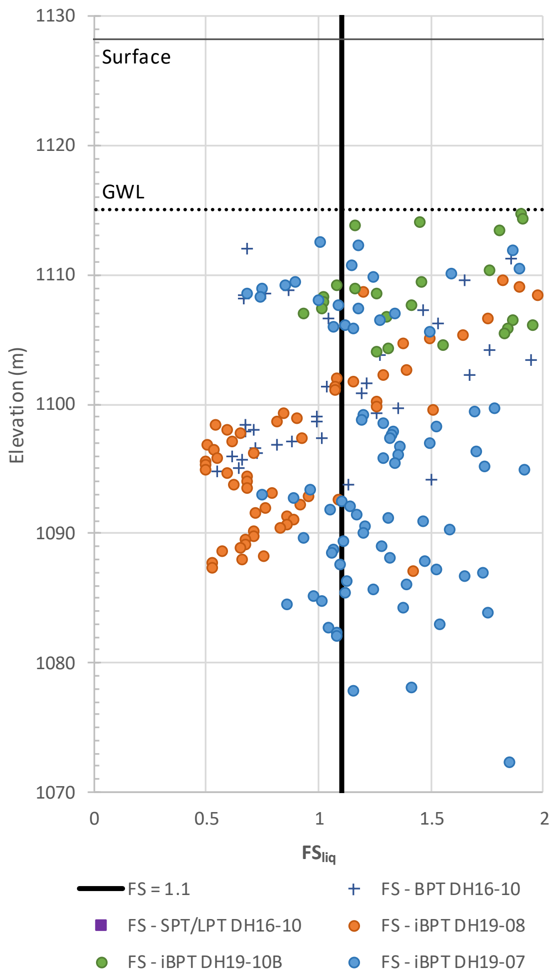
Liquefaction Assessment Methodology
TP4 – DH19-21

PROJECT NO.	DWN	CKD	APVD	REV
ENW.WENW03039-05	EW	AA	AA	0

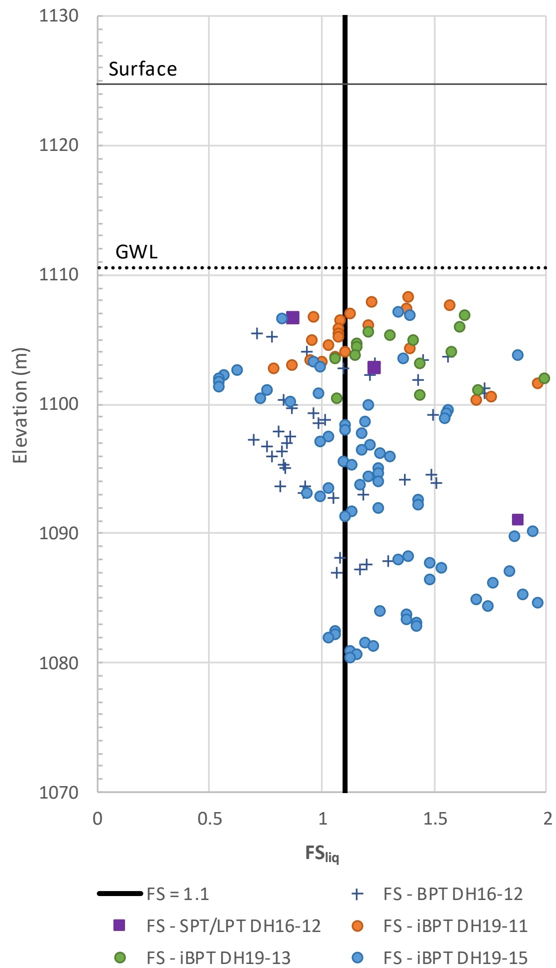
OFFICE	DATE
EBA-VANC	March 2021

Figure C.1

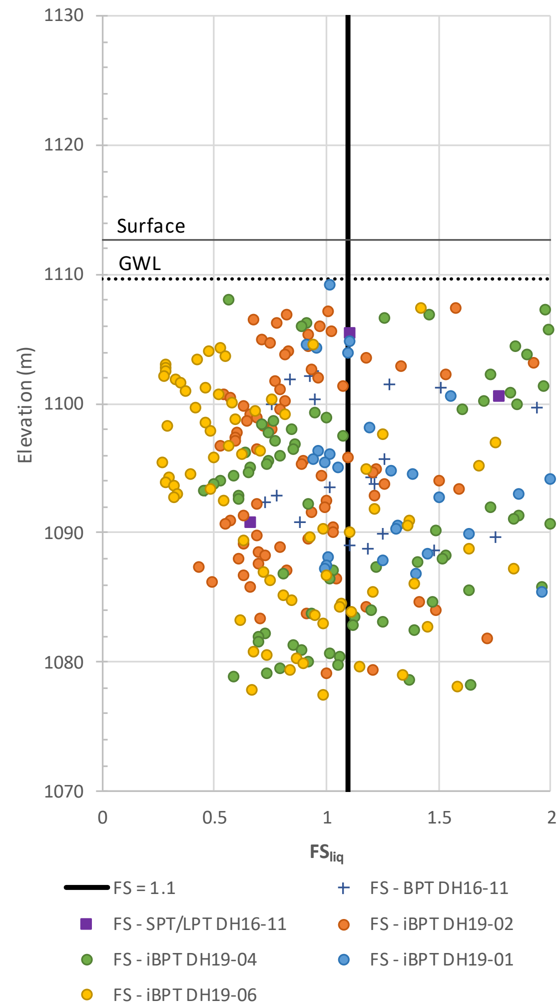
TP1 Crest (Section A-A')



TP2 Crest (Section B-B')



TP1/TP2 Toe (Sections A-A and B-B')



LEGEND

Data Types

- SCPT: Seismic Cone Penetration Test
- BPT: Becker Penetration Test
- SPT/LPT: Standard/Large Penetration Test
- iBPT: Instrumented Becker Penetration Test

NOTES

GWL: Groundwater Level
FS_{liq}: Factor of Safety against Liquefaction

Groundwater level and ground surface varies for each test location – values shown on plots are approximate.

STATUS
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TETRA TECH

Geotechnical Assessment of Existing Tailings Facilities, Cantung Mine, NT

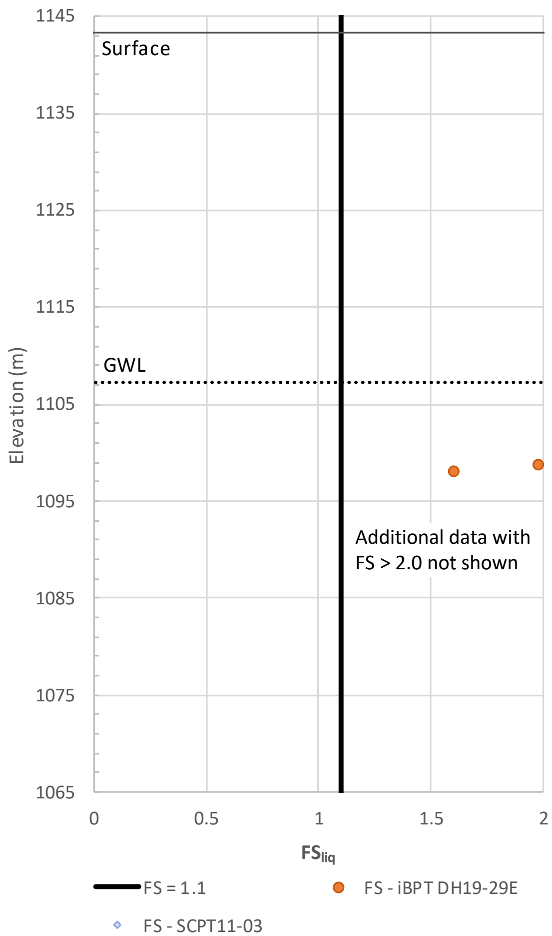
Liquefaction Assessment Results TP1/TP2 – Section A-A' and B-B'

PROJECT NO.	DWN	CKD	APVD	REV
ENW.WENW03039-05	EW	AA	AA	0

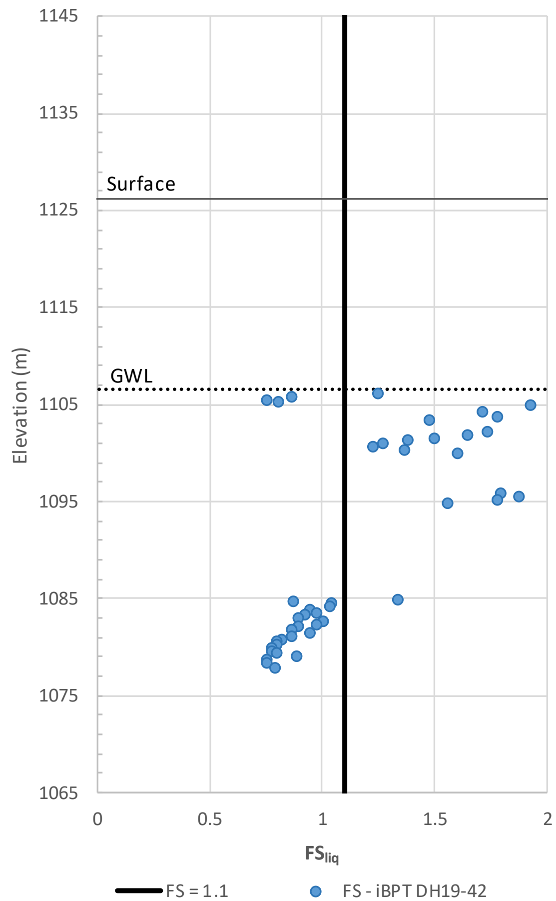
OFFICE	DATE
EBA-VANC	March 2021

Figure C.2

TP4 – Section C-C' Crest

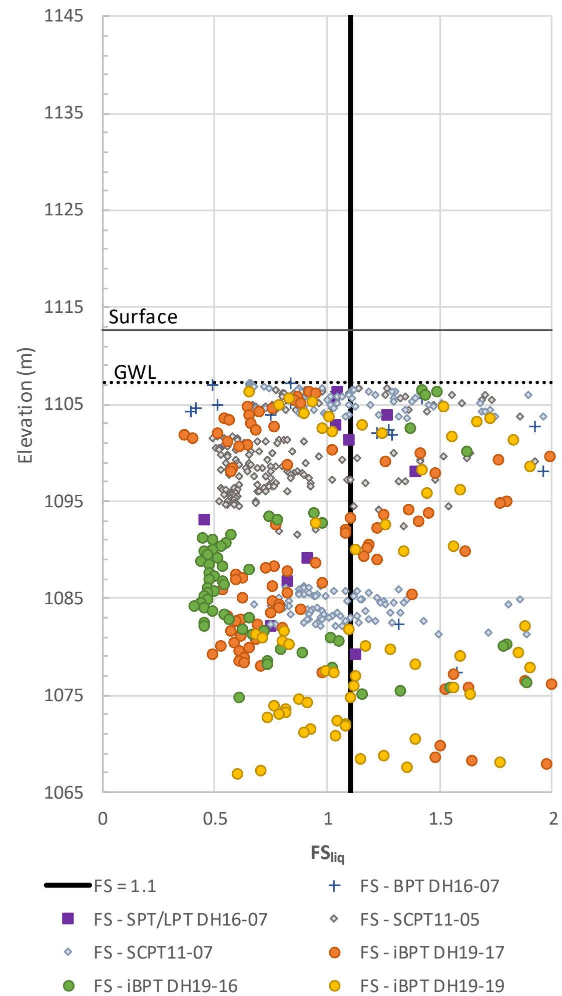


TP4 – Section C-C' Mid-Slope



Note: DH19-19 is located between Section C-C and D-D' and the results are included for both sections

TP4 – Section C-C' Toe



LEGEND

Data Types

- SCPT: Seismic Cone Penetration Test
- BPT: Becker Penetration Test
- SPT/LPT: Standard/Large Penetration Test
- iBPT: Instrumented Becker Penetration Test

NOTES

GWL: Groundwater Level
FS_{liq}: Factor of Safety against Liquefaction

Groundwater level and ground surface varies for each test location – values shown on plots are approximate.

STATUS
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TETRA TECH

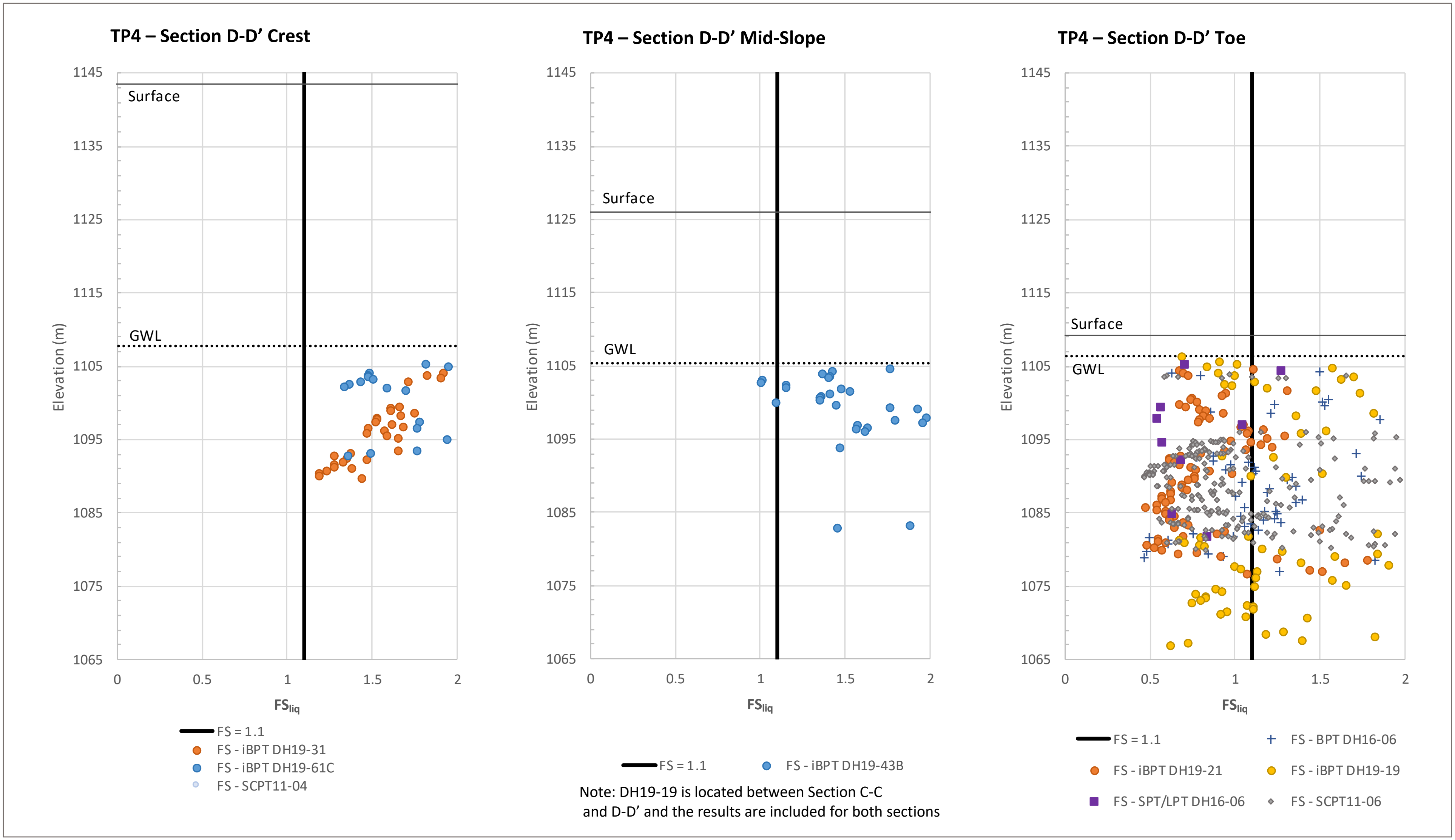
Geotechnical Assessment of Existing Tailings Facilities, Cantung Mine, NT

Liquefaction Assessment Results TP4 – Section C-C'

PROJECT NO.	DWN	CKD	APVD	REV
ENW.WENW03039-05	EW	AA	AA	0

OFFICE	DATE
EBA-VANC	March 2021

Figure C.3



LEGEND

Data Types

- SCPT: Seismic Cone Penetration Test
- BPT: Becker Penetration Test
- SPT/LPT: Standard/Large Penetration Test
- iBPT: Instrumented Becker Penetration Test

NOTES

GWL: Groundwater Level
FS_{liq}: Factor of Safety against Liquefaction

Groundwater level and ground surface varies for each test location – values shown on plots are approximate.

STATUS
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TETRA TECH

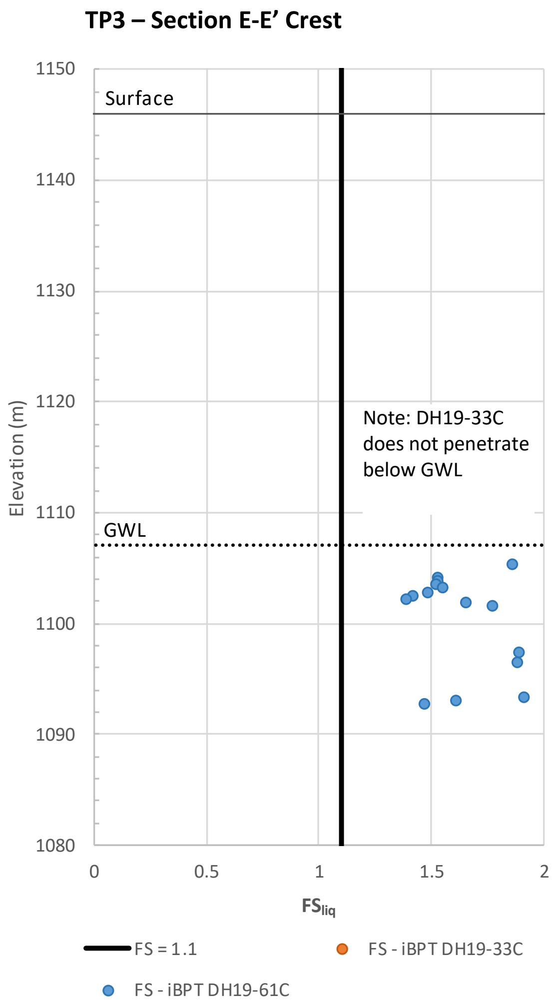
Geotechnical Assessment of Existing Tailings Facilities, Cantung Mine, NT

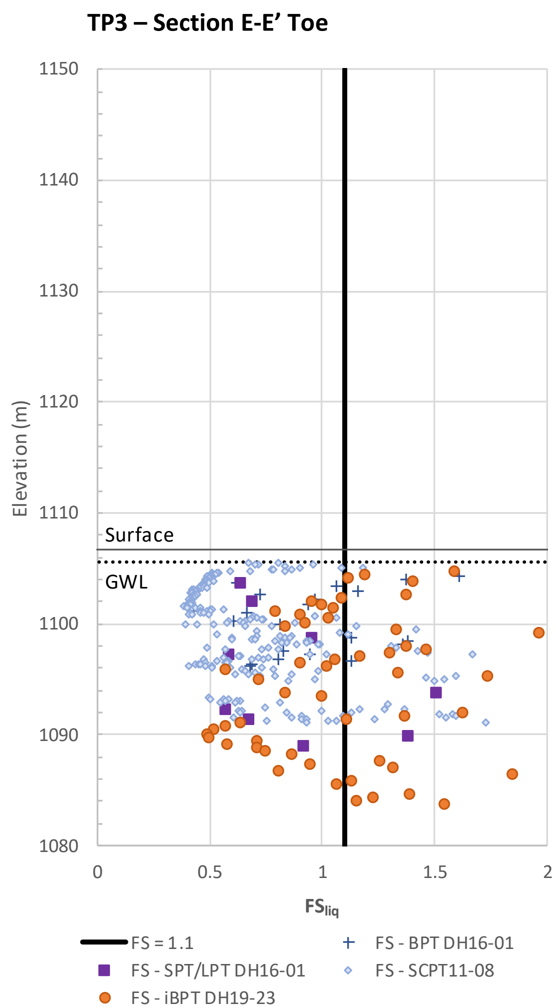
Liquefaction Assessment Results TP4 – Section D-D'

PROJECT NO.	DWN	CKD	APVD	REV
ENW.WENW03039-05	EW	AA	AA	0

OFFICE	DATE
EBA-VANC	March 2021

Figure C.4





LEGEND

Data Types

- SCPT: Seismic Cone Penetration Test
- BPT: Becker Penetration Test
- SPT/LPT: Standard/Large Penetration Test
- iBPT: Instrumented Becker Penetration Test

NOTES

GWL: Groundwater Level
FS_{liq}: Factor of Safety against Liquefaction

Groundwater level and ground surface varies for each test location – values shown on plots are approximate.

STATUS
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TETRA TECH

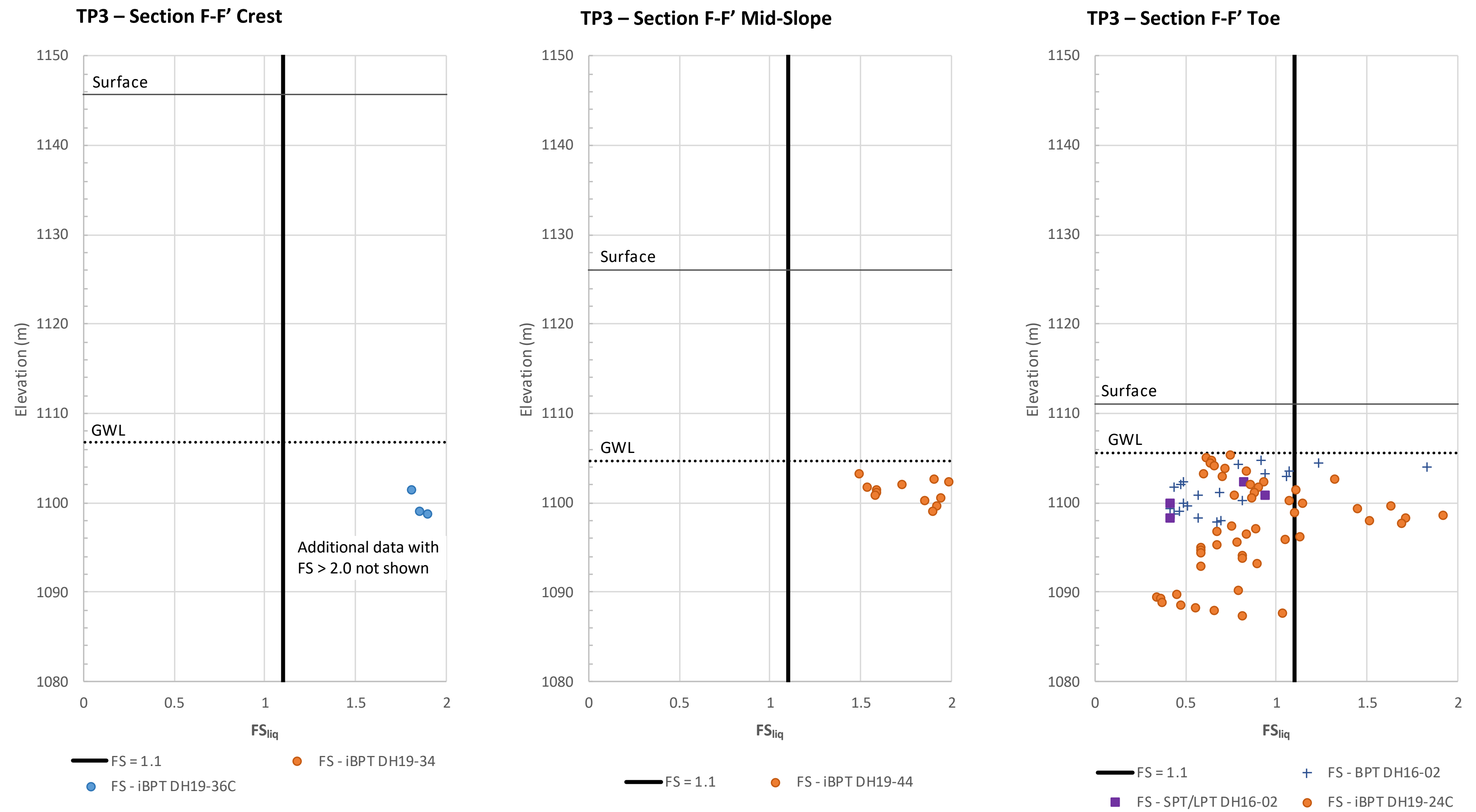
Geotechnical Assessment of Existing Tailings Facilities, Cantung Mine, NT

Liquefaction Assessment Results TP3 – Section E-E'

PROJECT NO.	DWN	CKD	APVD	REV
ENW.WENW03039-05	EW	AA	AA	0

OFFICE	DATE
EBA-VANC	March 2021

Figure C.5



Note: DH19-24C is located between Section F-F' and G-G' and the results are included for both sections

LEGEND

Data Types

- SCPT: Seismic Cone Penetration Test
- BPT: Becker Penetration Test
- SPT/LPT: Standard/Large Penetration Test
- iBPT: Instrumented Becker Penetration Test

NOTES

GWL: Groundwater Level
FS_{liq}: Factor of Safety against Liquefaction

Groundwater level and ground surface varies for each test location – values shown on plots are approximate.

STATUS
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TETRA TECH

Geotechnical Assessment of Existing Tailings Facilities, Cantung Mine, NT

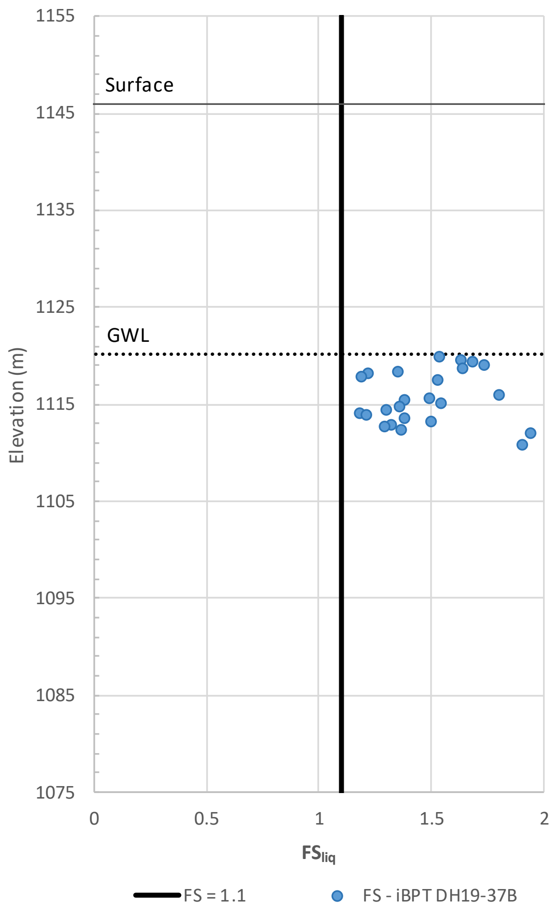
Liquefaction Assessment Results TP3 – Section F-F'

PROJECT NO.	DWN	CKD	APVD	REV
ENW.WENW03039-05	EW	AA	AA	0

OFFICE	DATE
EBA-VANC	March 2021

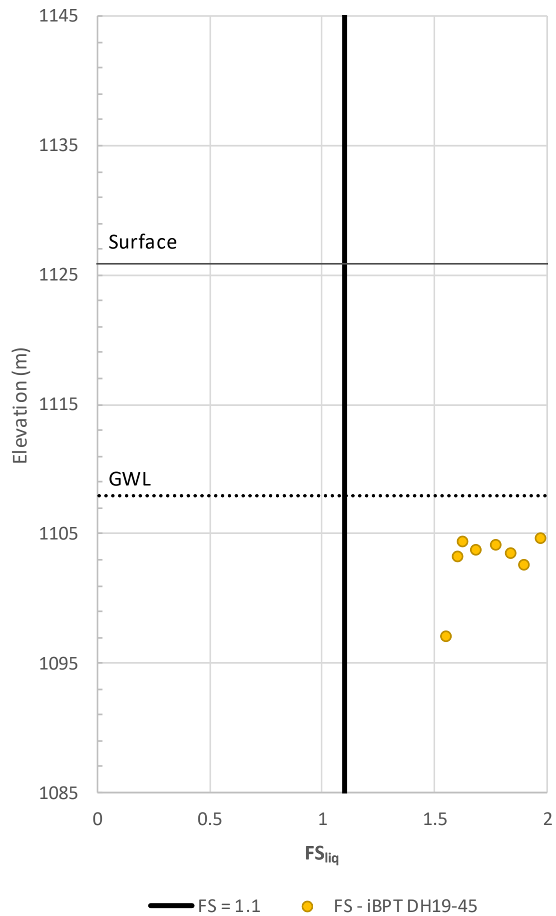
Figure C.6

TP3 – Section I-I’ Crest

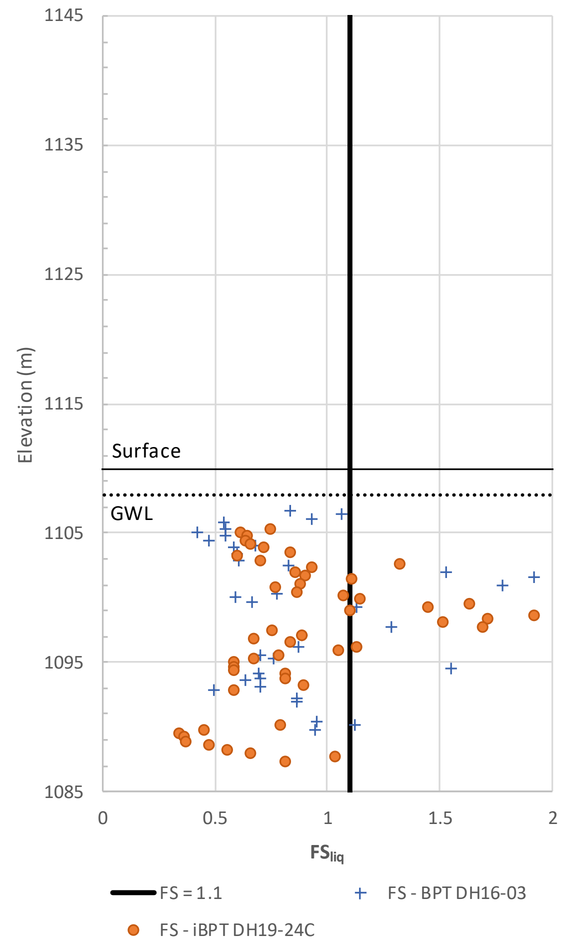


Note: No data below GWL at crest of Section G-G’

TP3 – Section G-G’ Mid-Slope



TP3 – Section G-G’ Toe



Note: DH19-24C is located between Section F-F’ and G-G’ and the results are included for both sections

LEGEND

Data Types

- SCPT: Seismic Cone Penetration Test
- BPT: Becker Penetration Test
- SPT/LPT: Standard/Large Penetration Test
- iBPT: Instrumented Becker Penetration Test

NOTES

GWL: Groundwater Level
FS_{liq}: Factor of Safety against Liquefaction

Groundwater level and ground surface varies for each test location – values shown on plots are approximate.

STATUS
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TETRA TECH

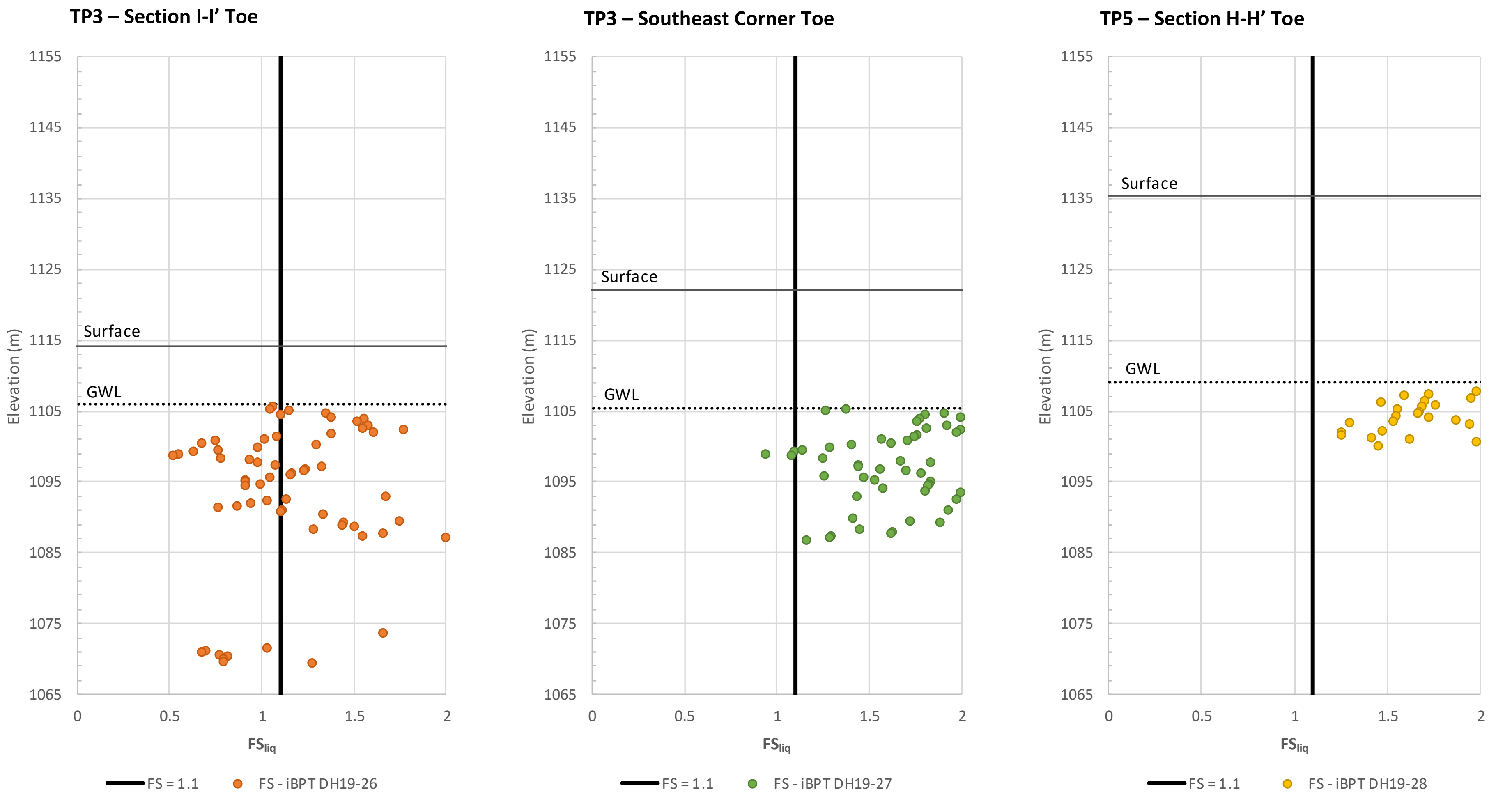
Geotechnical Assessment of Existing Tailings Facilities, Cantung Mine, NT

Liquefaction Assessment Results TP3 – Section G-G’ and Section I-I

PROJECT NO.	DWN	CKD	APVD	REV
ENW.WENW03039-05	EW	AA	AA	0

OFFICE	DATE
EBA-VANC	March 2021

Figure C.7



LEGEND

Data Types

- SCPT: Seismic Cone Penetration Test
- BPT: Becker Penetration Test
- SPT/LPT: Standard/Large Penetration Test
- iBPT: Instrumented Becker Penetration Test

NOTES

GWL: Groundwater Level
FS_{liq}: Factor of Safety against Liquefaction

Groundwater level and ground surface varies for each test location – values shown on plots are approximate.

STATUS
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TETRA TECH

Geotechnical Assessment of Existing Tailings Facilities, Cantung Mine, NT

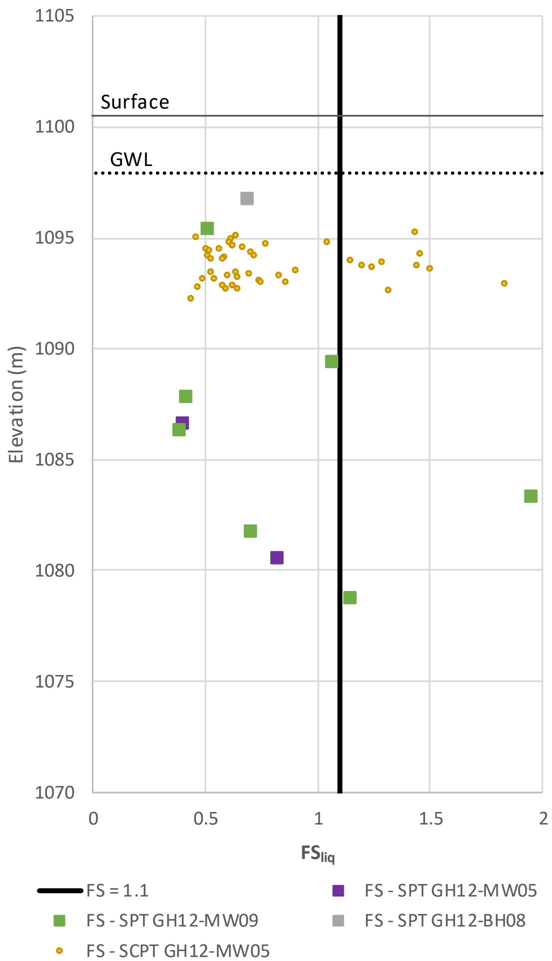
Liquefaction Assessment Results TP3 – Section I-I' and TP5 – Section H-H'

PROJECT NO.	DWN	CKD	APVD	REV
ENW.WENW03039-05	EW	AA	AA	0

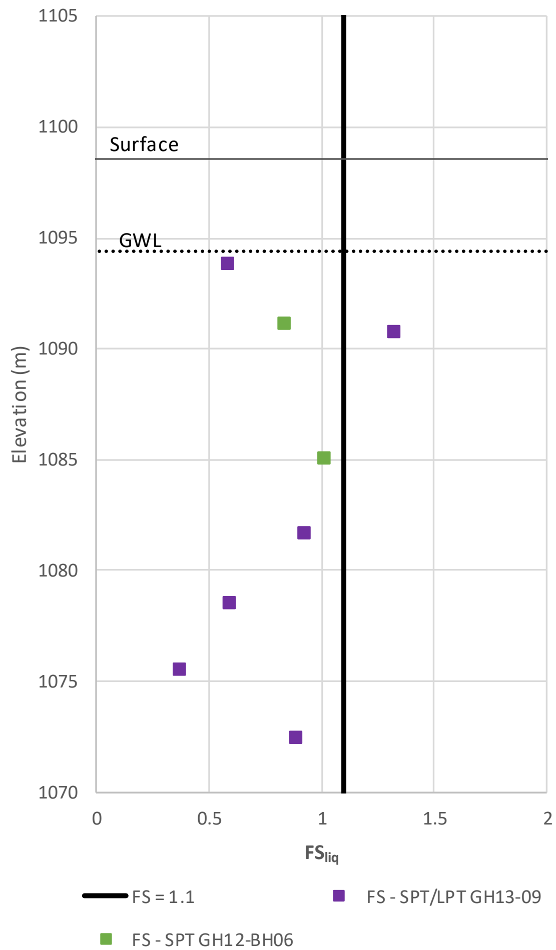
OFFICE	DATE
EBA-VANC	March 2021

Figure C.8

TSF6 – Northwest (GH12-MW05)



TSF6 – Northwest (GH13-09)



Note: GH12-B06 is located between GH13-09 and DH19-57B and the results are included for both locations

LEGEND

Data Types

- SCPT: Seismic Cone Penetration Test
- BPT: Becker Penetration Test
- SPT/LPT: Standard/Large Penetration Test
- iBPT: Instrumented Becker Penetration Test

NOTES

GWL: Groundwater Level
FS_{liq}: Factor of Safety against Liquefaction

Groundwater level and ground surface varies for each test location – values shown on plots are approximate.

STATUS
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NORTH AMERICAN TUNGSTEN CORPORATION LTD

TETRA TECH

Geotechnical Assessment of Existing Tailings Facilities, Cantung Mine, NT

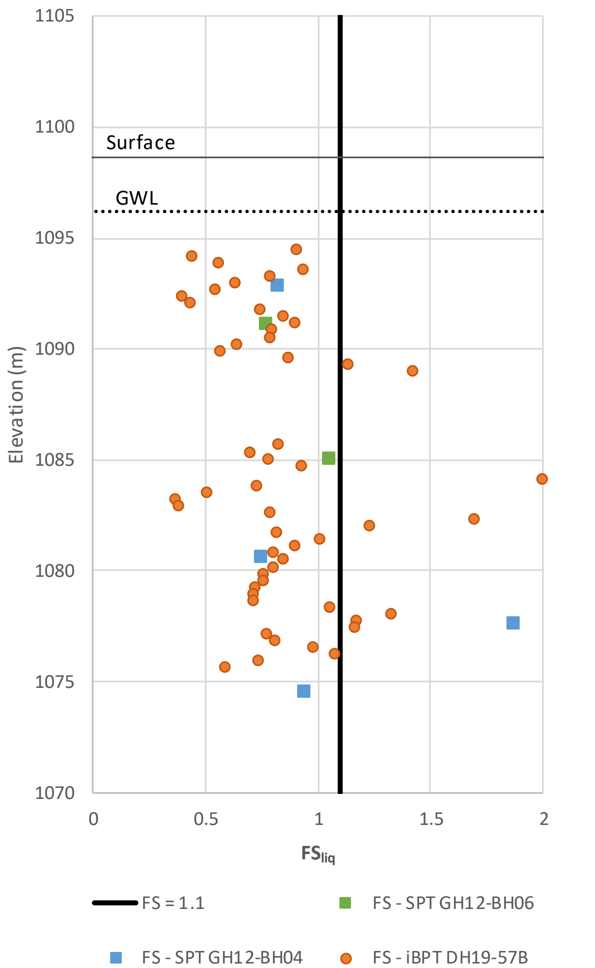
Liquefaction Assessment Results TSF6 – Northwest

PROJECT NO.	DWN	CKD	APVD	REV
ENW.WENW03039-05	EW	AA	AA	0

OFFICE	DATE
EBA-VANC	March 2021

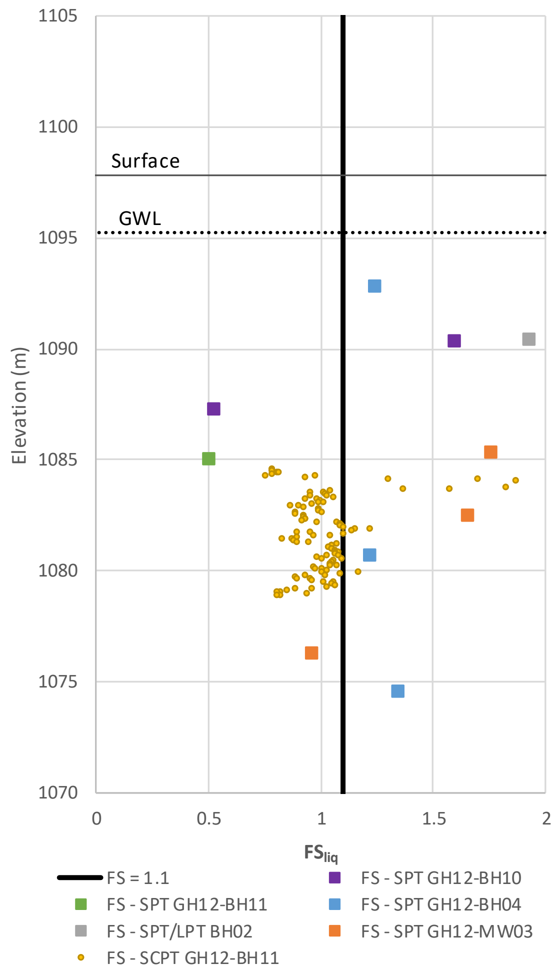
Figure C.9

TSF6 – Central (DH19-57B)



Note: GH12-BH06 is located between GH13-09 and DH19-57B and the results are included for both locations

TSF6 – Central (GH12-BH10)



Note: GH12-BH04 is located between DH19-57B and GH12-BH10 and the results are included for both locations

LEGEND

Data Types

- SCPT: Seismic Cone Penetration Test
- BPT: Becker Penetration Test
- SPT/LPT: Standard/Large Penetration Test
- iBPT: Instrumented Becker Penetration Test

NOTES

GWL: Groundwater Level
FS$_{liq}$: Factor of Safety against Liquefaction

Groundwater level and ground surface varies for each test location – values shown on plots are approximate.

STATUS
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TETRA TECH

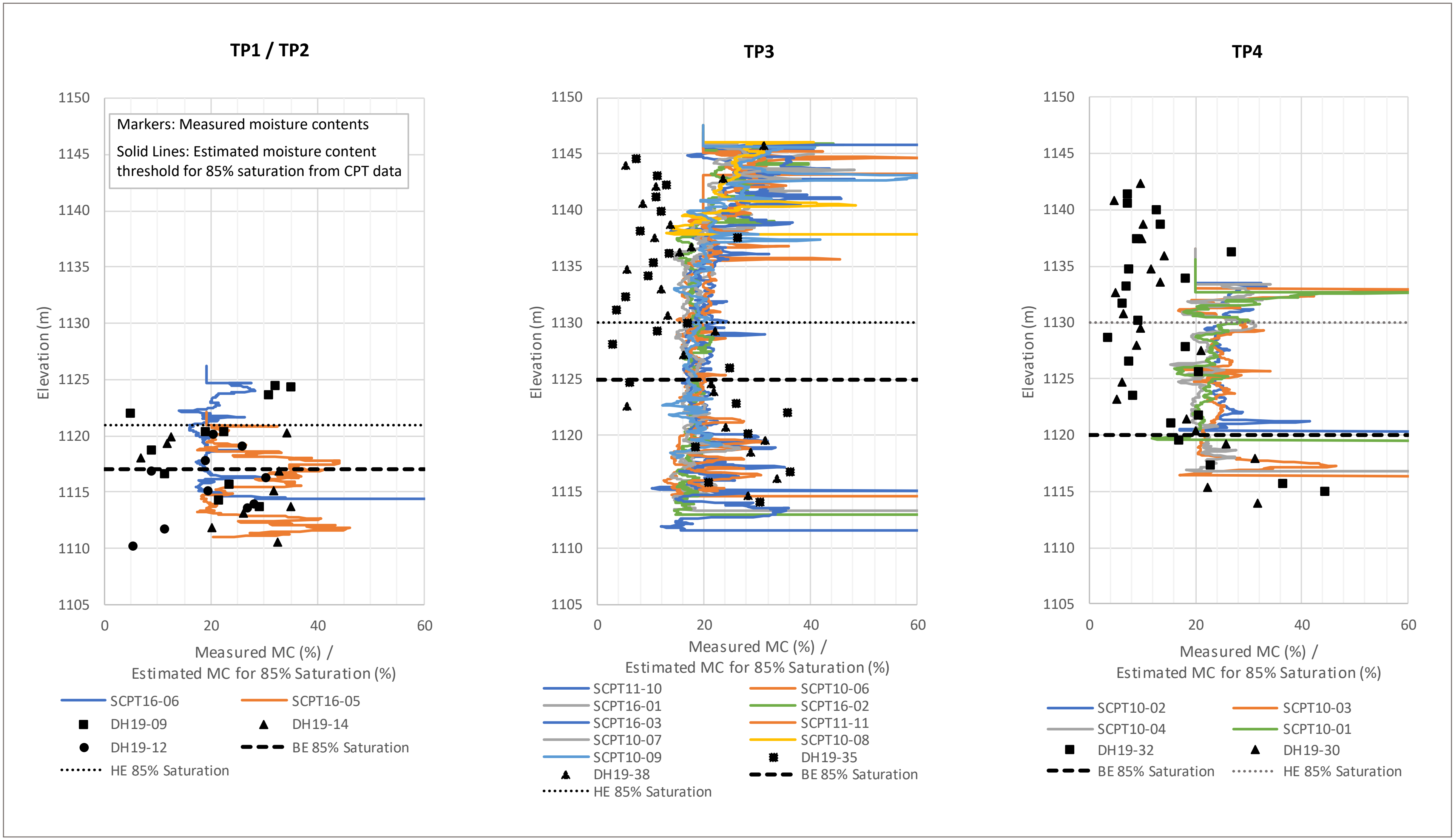
Geotechnical Assessment of Existing Tailings Facilities, Cantung Mine, NT

Liquefaction Assessment Results TSF6 – Central

PROJECT NO.	DWN	CKD	APVD	REV
ENW.WENW03039-05	EW	AA	AA	0

OFFICE	DATE
EBA-VANC	March 2021

Figure C.10



LEGEND

Markers: Measured moisture contents (MC) from 2019 investigation

Solid Lines: Estimated moisture content threshold for 85% saturation based on CPT data correlations

Dashed Lines: Best estimate (BE) elevation for 85% saturation of tailings, used in liquefaction assessment

Dotted Lines: High estimate (HE) elevation for 85% saturation of tailings, used in sensitivity analyses

NOTES

STATUS
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TETRA TECH

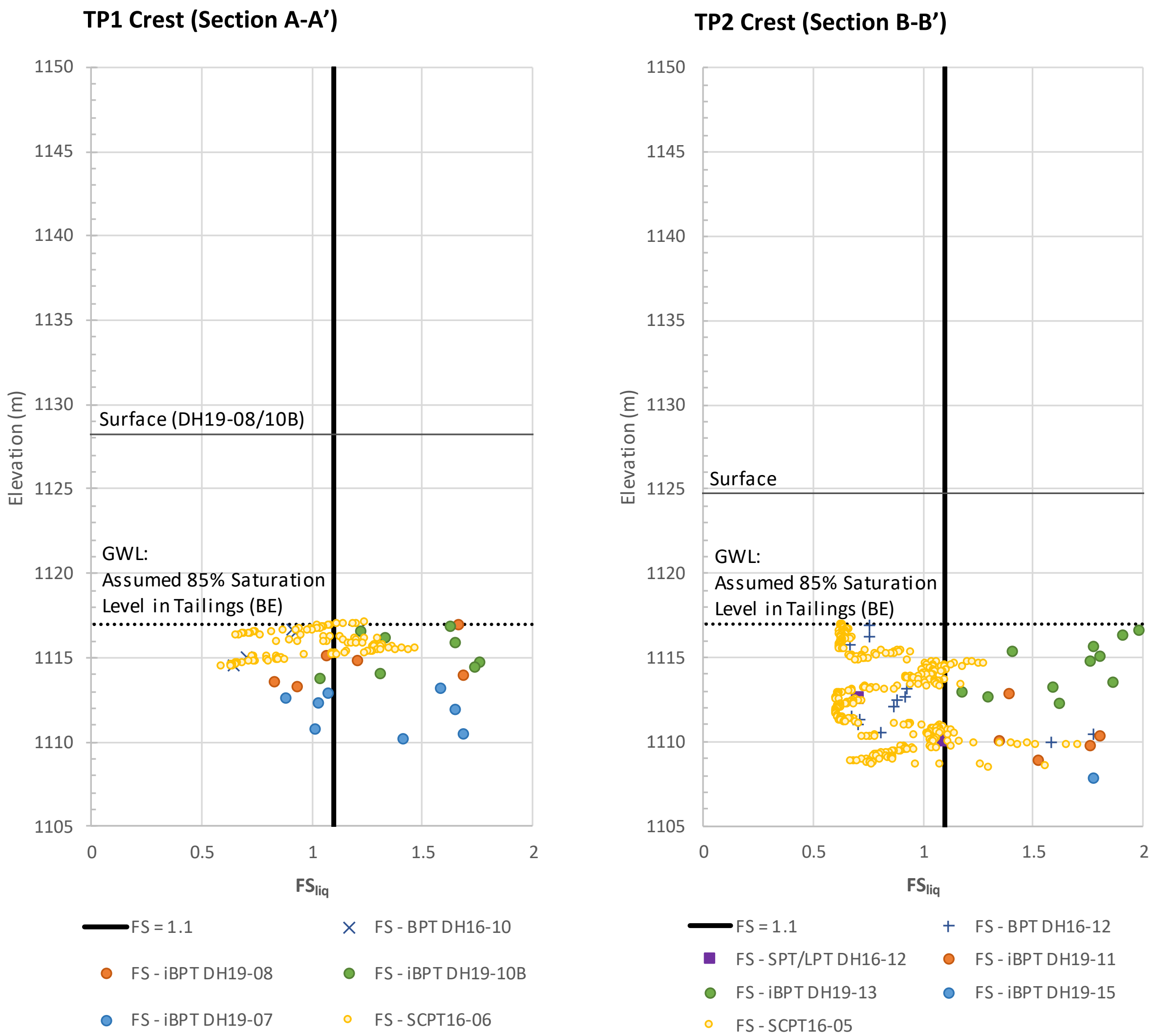
Geotechnical Assessment of Existing Tailings Facilities, Cantung Mine, NT

Estimated Tailings Saturation (S > 85%) Based on Measured Moisture Contents and CPT Correlations

PROJECT NO.	DWN	CKD	APVD	REV
ENW.WENW03039-05	EW	AA	AA	0

OFFICE	DATE
EBA-VANC	March 2021

Figure C.11



LEGEND

Data Types

- SCPT: Seismic Cone Penetration Test
- BPT: Becker Penetration Test
- SPT/LPT: Standard/Large Penetration Test
- iBPT: Instrumented Becker Penetration Test

NOTES

GWL: Groundwater Level
FS_{liq}: Factor of Safety against Liquefaction

An elevated GWL within the tailings was assumed based on the best estimate (BE) for 85% saturation, shown in Figure C.11.

Only data within the tailings is shown.

STATUS
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CLIENT

NORTH AMERICAN TUNGSTEN CORPORATION LTD

TETRA TECH

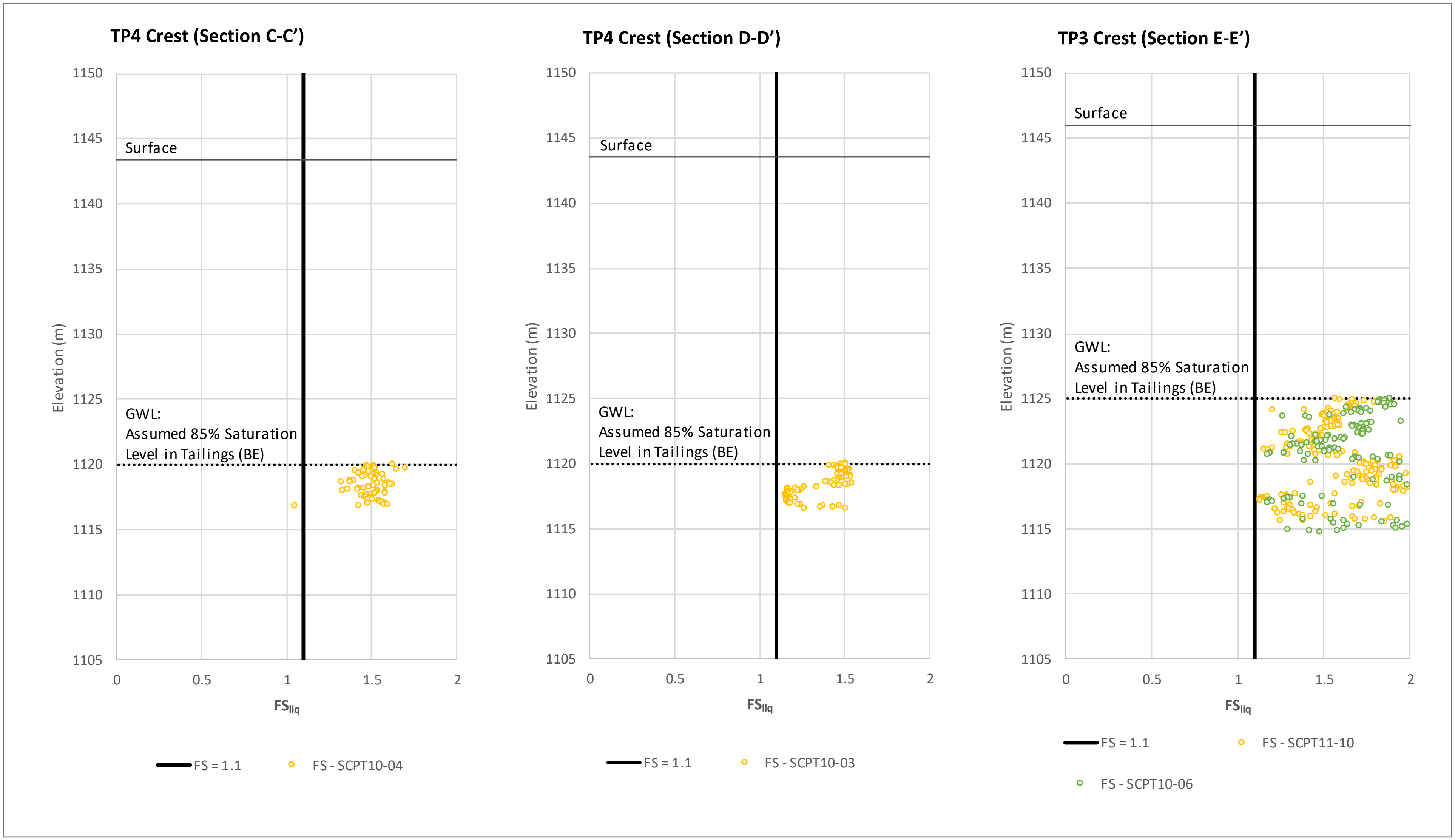
Geotechnical Assessment of Existing Tailings Facilities, Cantung Mine, NT

Tailings Liquefaction Assessment TP1/TP2 – Section A-A’ and B-B’

PROJECT NO.	DWN	CKD	APVD	REV
ENW.WENW03039-05	EW	AA	AA	0

OFFICE	DATE
EBA-VANC	March 2021

Figure C.12



LEGEND

Data Types

- SCPT: Seismic Cone Penetration Test
- BPT: Becker Penetration Test
- SPT/LPT: Standard/Large Penetration Test
- iBPT: Instrumented Becker Penetration Test

NOTES

GWL: Groundwater Level
FS_{liq}: Factor of Safety against Liquefaction

An elevated GWL within the tailings was assumed based on the best estimate (BE) for 85% saturation, shown in Figure C.11.

Only data within the tailings is shown.

STATUS
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TETRA TECH

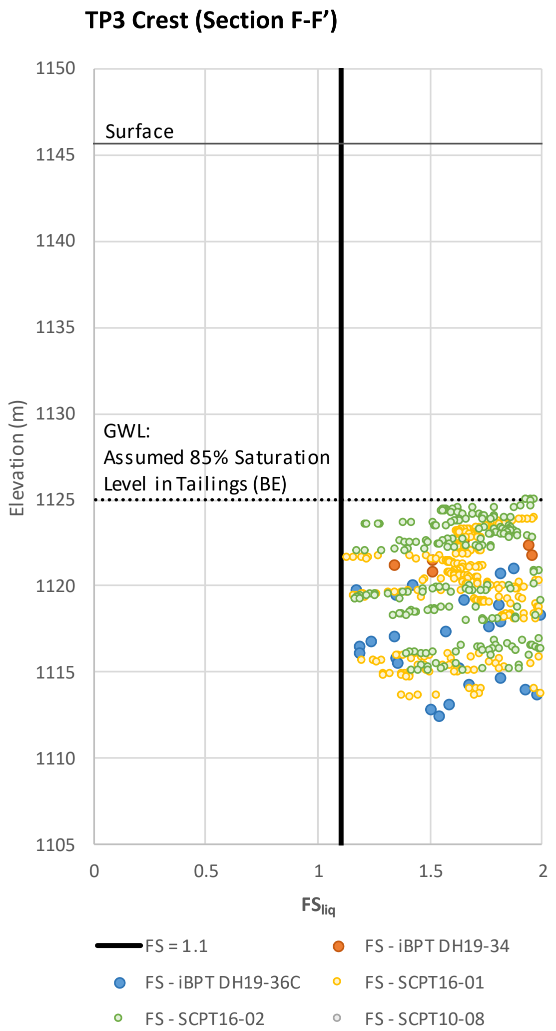
Geotechnical Assessment of Existing Tailings Facilities, Cantung Mine, NT

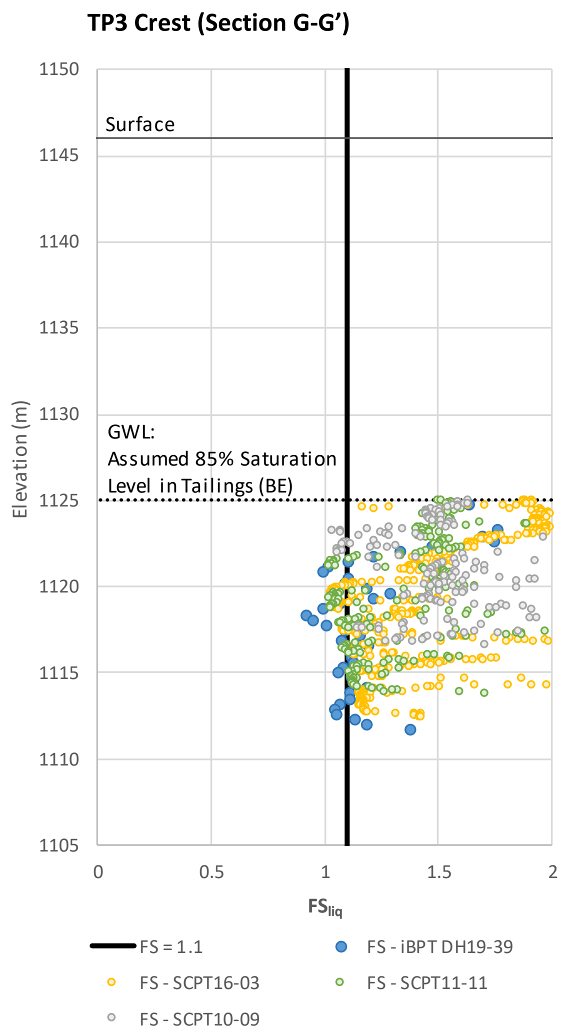
Tailings Liquefaction Assessment TP4/TP3 – Sections C-C', D-D' and E-E'

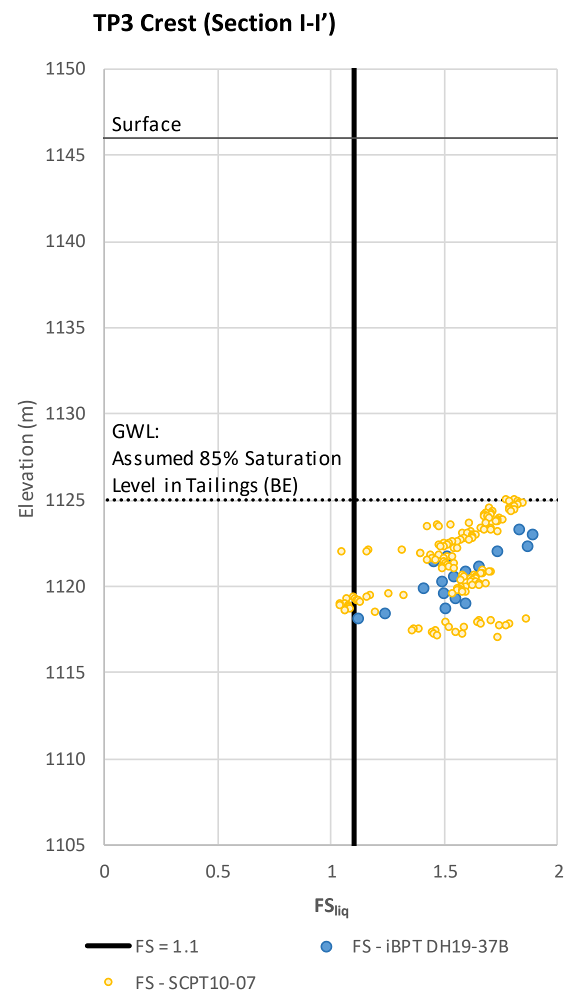
PROJECT NO.	DWN	CKD	APVD	REV
ENW.WENW03039-05	EW	AA	AA	0

OFFICE	DATE
EBA-VANC	March 2021

Figure C.13







LEGEND

Data Types

- SCPT: Seismic Cone Penetration Test
- BPT: Becker Penetration Test
- SPT/LPT: Standard/Large Penetration Test
- iBPT: Instrumented Becker Penetration Test

NOTES

GWL: Groundwater Level
FS_{liq}: Factor of Safety against Liquefaction

An elevated GWL within the tailings was assumed based on the best estimate (BE) for 85% saturation, shown in Figure C.11.

Only data within the tailings is shown.

STATUS
ISSUED FOR USE

CLIENT
NORTH AMERICAN TUNGSTEN CORPORATION LTD

TETRA TECH

Geotechnical Assessment of Existing Tailings Facilities, Cantung Mine, NT

Tailings Liquefaction Assessment TP3 – Sections F-F', G-G' and I-I'

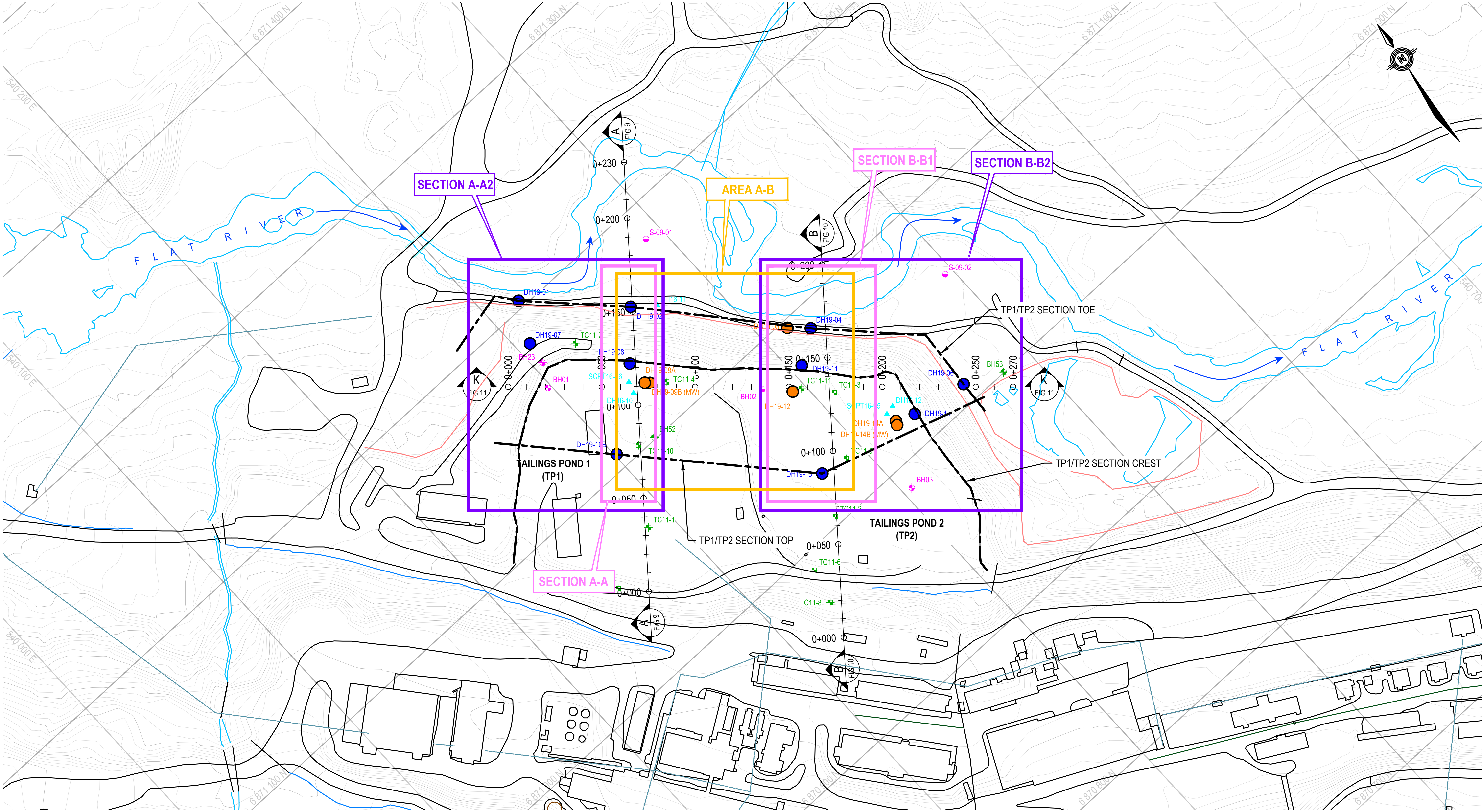
PROJECT NO.	DWN	CKD	APVD	REV
ENW.WENW03039-05	EW	AA	AA	0

OFFICE: EBA-VANC
DATE: March 2021

Figure C.14

APPENDIX D

STABILITY ANALYSIS FIGURES



LEGEND:

- 5 m MAJOR CONTOUR INTERVAL
- 1 m INTERMEDIATE CONTOUR INTERVAL
- GOLDER (1976)
- GOLDER (1977)
- EBA (2009)
- TETRA TECH EBA (2011)
- SRK (2016)
- TETRA TECH (2019 iBPT)
- TETRA TECH (2019 SONIC)

NOTES:

1. HORIZONTAL DATUM/PROJECTION: UTM ZONE 9N, NAD83 (CSRS) (2010) - METERS

STATUS
ISSUED FOR USE

0 100m
Scale: 1:2,000 @ 11"x17"

CLIENT
NORTH AMERICAN TUNGSTEN CORPORATION LTD

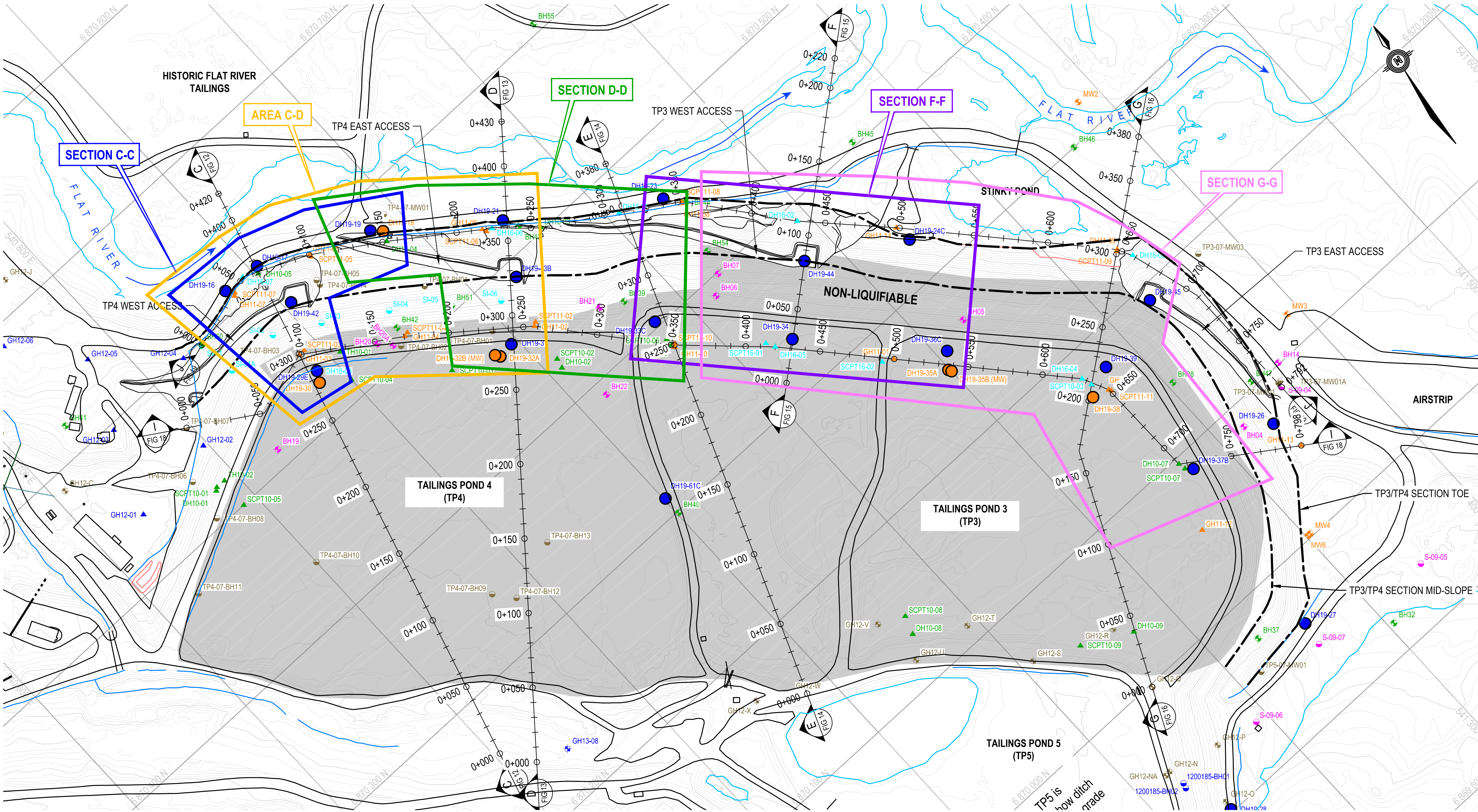
TETRA TECH

GEOTECHNICAL ASSESSMENT OF EXISTING TAILINGS FACILITIES
CANTUNG MINE, NT

TAILINGS PONDS 1 AND 2
BOREHOLE LOCATION PLAN

PROJECT NO.	DWN	CKD	REV
ENW.WENW03039-05	EL	RG	0
OFFICE	DATE		
EDMONTON	March 2021		

Figure D.1



LEGEND:

- 5 m MAJOR CONTOUR INTERVAL
- 1 m INTERMEDIATE CONTOUR INTERVAL
- GOLDER (1976)
- GOLDER (1977)
- GOLDER (1982)
- EBA (2005)
- EBA (2007 INSTRUMENTATION)
- EBA (2007)
- EBA (2009)
- KNIGHT PIESOLD (2010)
- KNIGHT PIESOLD (2011)
- KNIGHT PIESOLD (2012)
- TETRA TECH EBA (2012)
- SRK (2016)
- TETRA TECH (2019 iBPT)
- TETRA TECH (2019 SONIC)

NOTES:

1. HORIZONTAL DATUM/PROJECTION: UTM ZONE 9N, NAD83 (CSRS) (2010) - METERS

STATUS
ISSUED FOR USE

0 100m
Scale: 1:2,500 @ 11"x17"

CLIENT
NORTH AMERICAN TUNGSTEN CORPORATION LTD

TETRA TECH

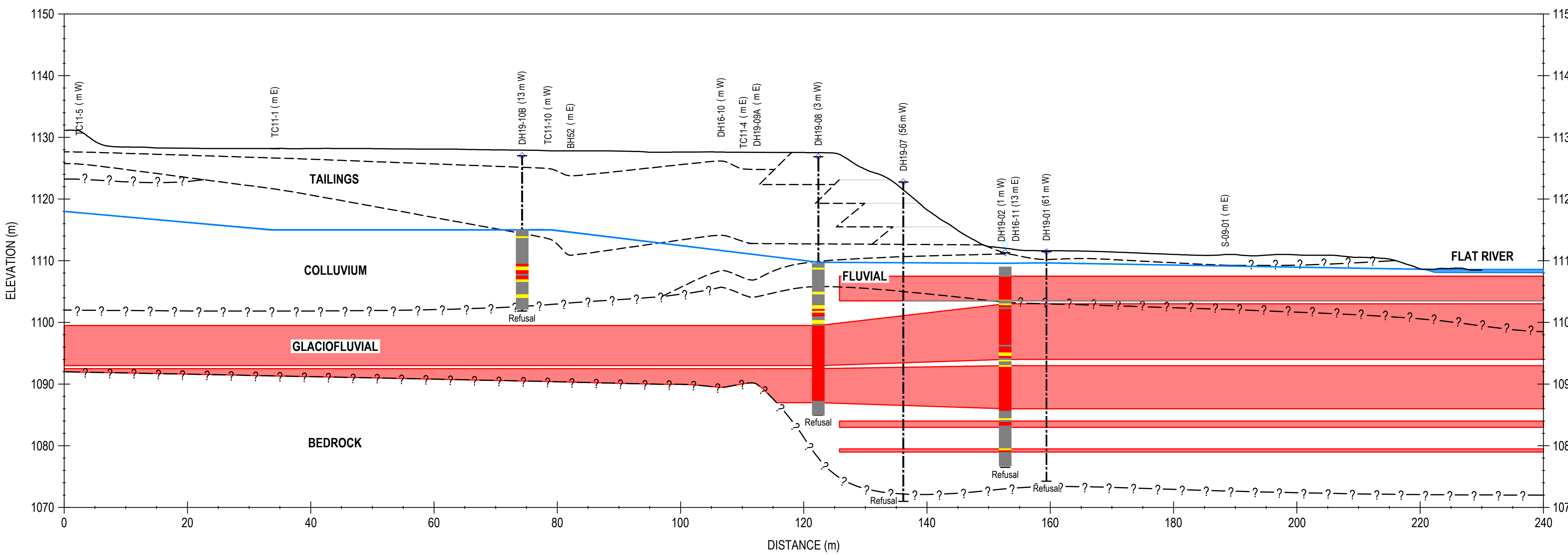
GEOTECHNICAL ASSESSMENT OF EXISTING TAILINGS FACILITIES
CANTUNG MINE, NT

TAILINGS PONDS 3 AND 4
BOREHOLE LOCATION PLAN

PROJECT NO.	DWN	CKD	REV
ENW.WENW03039-05	EL	RG	0

OFFICE	DATE
EDMONTON	March 2021

Figure D.2



SECTION A-A'

LEGEND:

INFERRED WATER TABLE	LIQUEFACTION TRIGGERING FOS > 2.0
INFERRED CONTACT	LIQUEFACTION TRIGGERING 1.1 < FOS < 2.0
INTERPRETED CONTACT	LIQUEFACTION TRIGGERING FOS ≤ 1.1
2019 iBPT	LIQUEFIABLE MATERIAL (INTERPRETED)

STATUS
ISSUED FOR USE

CLIENT
NORTH AMERICAN TUNGSTEN CORPORATION LTD

TETRA TECH

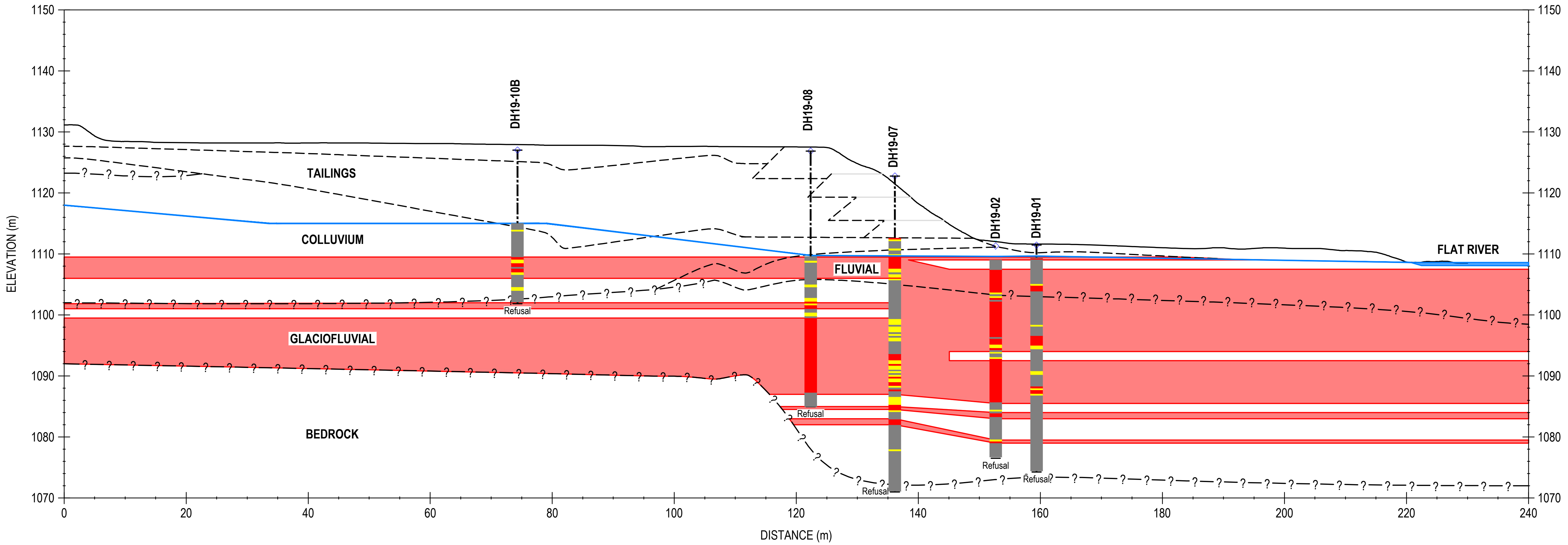
GEOTECHNICAL ASSESSMENT OF EXISTING TAILINGS FACILITIES
CANTUNG MINE, NT

TAILINGS POND LIQUEFIABLE MODEL
SECTION A-A'

PROJECT NO.	DWN	CKD	REV
ENW.WENW03039-05	EL/EP	GDK	0
OFFICE	DATE		
EDMONTON	March 2021		

Figure D.3

C:\Users\elvin.lee\Desktop\Cantung Site Model r2 Liquifaction.dwg [FIGURE D.3] August 07, 2020 - 1:46:30 pm (BY: LEE, ELVIN)



SECTION A-A2

LEGEND:

INFERRED WATER TABLE	LIQUEFACTION TRIGGERING FOS > 2.0
INFERRED CONTACT	LIQUEFACTION TRIGGERING 1.1 < FOS < 2.0
INTERPRETED CONTACT	LIQUEFACTION TRIGGERING FOS ≤ 1.1
2019 iBPT	LIQUEFIABLE MATERIAL (INTERPRETED)

STATUS
ISSUED FOR USE

CLIENT

NORTH AMERICAN TUNGSTEN CORPORATION LTD

TETRA TECH

GEOTECHNICAL ASSESSMENT OF EXISTING TAILINGS FACILITIES
CANTUNG MINE, NT

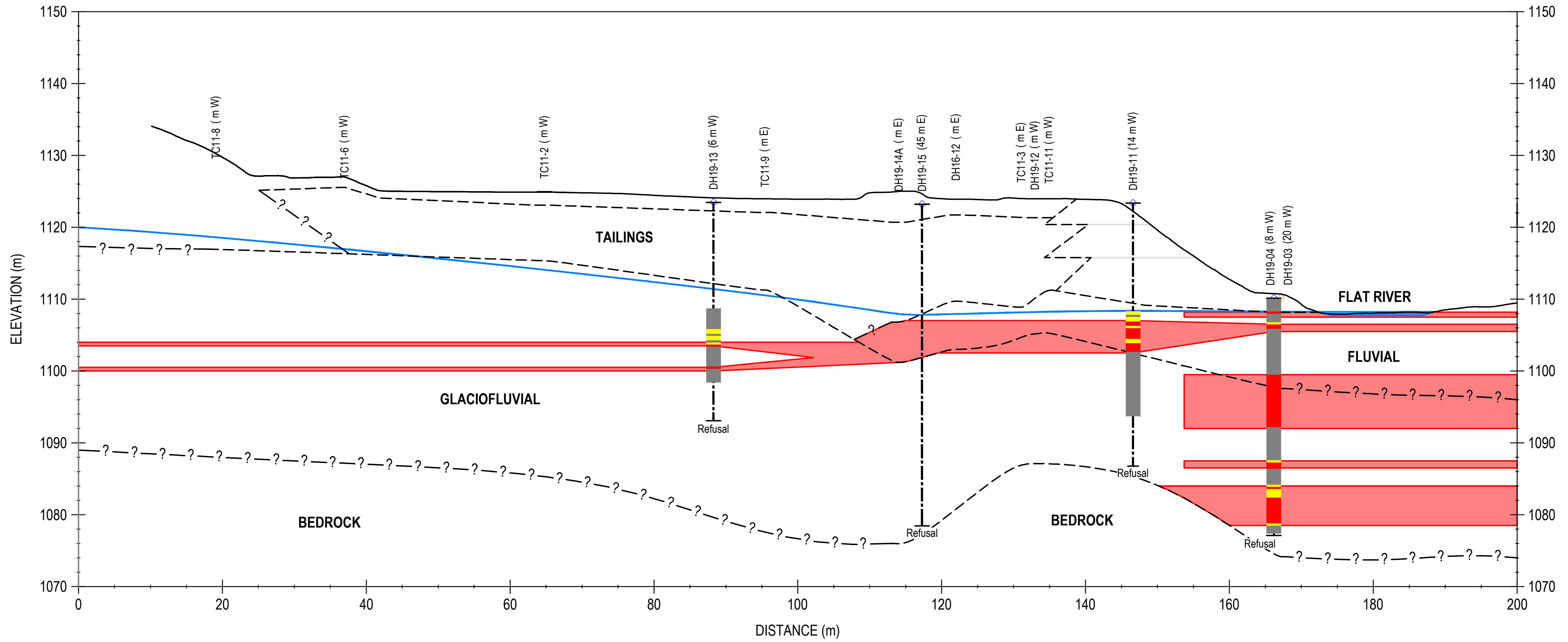
TAILINGS POND LIQUEFIABLE MODEL
SECTION A-A2

PROJECT NO.	DWN	CKD	REV
ENW.WENW03039-05	EL/EP	GDK	0

OFFICE	DATE
EDMONTON	March 2021

Figure D.4

C:\Users\elvin.lee\Desktop\Cantung Site Model r2 Liquifaction.dwg [FIGURE D.4] August 07, 2020 - 1:46:33 pm (BY: LEE, ELVIN)



SECTION B-B'

LEGEND:

(blue line)	INFERRED WATER TABLE
—?—?—?—	INFERRED CONTACT
— — — —	INTERPRETED CONTACT
(symbol)	2019 iBPT
(grey)	LIQUEFACTION TRIGGERING FOS > 2.0
(yellow)	LIQUEFACTION TRIGGERING 1.1 < FOS < 2.0
(red)	LIQUEFACTION TRIGGERING FOS ≤ 1.1
(light red)	LIQUEFIABLE MATERIAL (INTERPRETED)

STATUS
ISSUED FOR USE

CLIENT

NORTH AMERICAN TUNGSTEN CORPORATION LTD

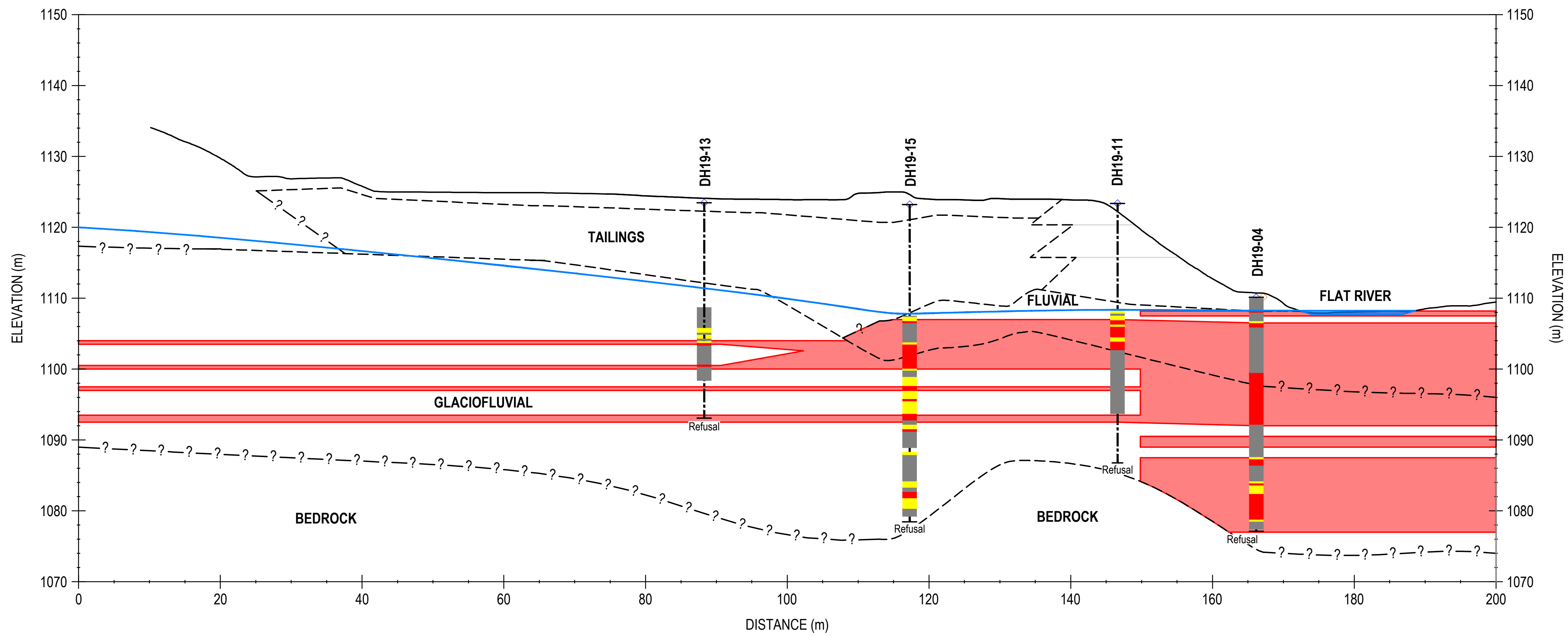
TETRA TECH

GEOTECHNICAL ASSESSMENT OF EXISTING TAILINGS FACILITIES
CANTUNG MINE, NT

TAILINGS POND LIQUEFIABLE MODEL
SECTION B-B1

PROJECT NO.	DWN	CKD	REV
ENW.WENW03039-05	EL/EP	GDK	0
OFFICE	DATE		
EDMONTON	March 2021		

Figure D.5



SECTION B-B2

LEGEND:

INFERRED WATER TABLE

—?—?—?— INFERRED CONTACT

— — — — INTERPRETED CONTACT

2019 iBPT

LIQUEFACTION TRIGGERING FOS > 2.0

LIQUEFACTION TRIGGERING 1.1 < FOS < 2.0

LIQUEFACTION TRIGGERING FOS ≤ 1.1

LIQUEFIABLE MATERIAL (INTERPRETED)

STATUS
ISSUED FOR USE

CLIENT

NORTH AMERICAN TUNGSTEN CORPORATION LTD

TETRA TECH

GEOTECHNICAL ASSESSMENT OF EXISTING TAILINGS FACILITIES
CANTUNG MINE, NT

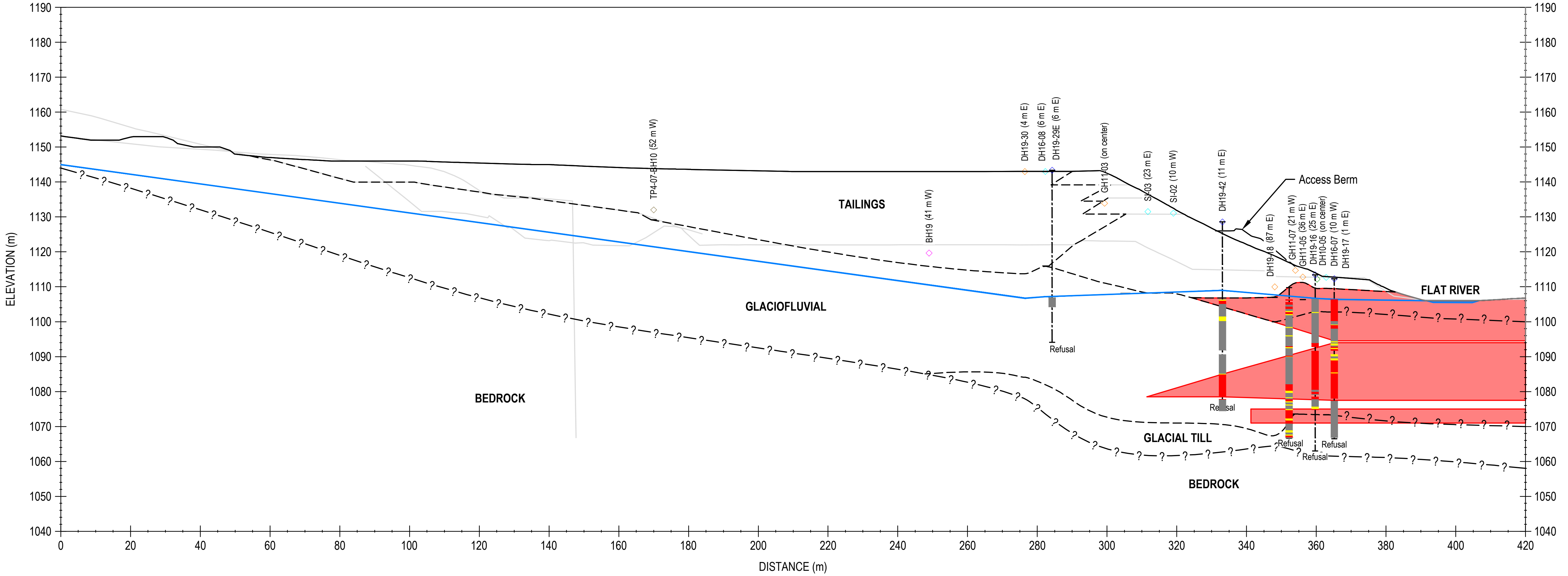
TAILINGS POND LIQUEFIABLE MODEL
SECTION B-B2

PROJECT NO.	DWN	CKD	REV
ENW.WENW03039-05	EL/EP	GDK	0

OFFICE	DATE
EDMONTON	March 2021

Figure D.6

C:\Users\elvin.lee\Desktop\Cantung Site Model r2 Liquifaction.dwg [FIGURE D.6] August 07, 2020 - 1:46:43 pm (BY: LEE, ELVIN)



SECTION C-C'

LEGEND:

INFERRED WATER TABLE	LIQUEFACTION TRIGGERING FOS > 2.0
INFERRED CONTACT	LIQUEFACTION TRIGGERING 1.1 < FOS < 2.0
INTERPRETED CONTACT	LIQUEFACTION TRIGGERING FOS ≤ 1.1
2019 iBPT	LIQUEFIABLE MATERIAL (INTERPRETED)

STATUS
ISSUED FOR USE

CLIENT
NORTH AMERICAN TUNGSTEN CORPORATION LTD

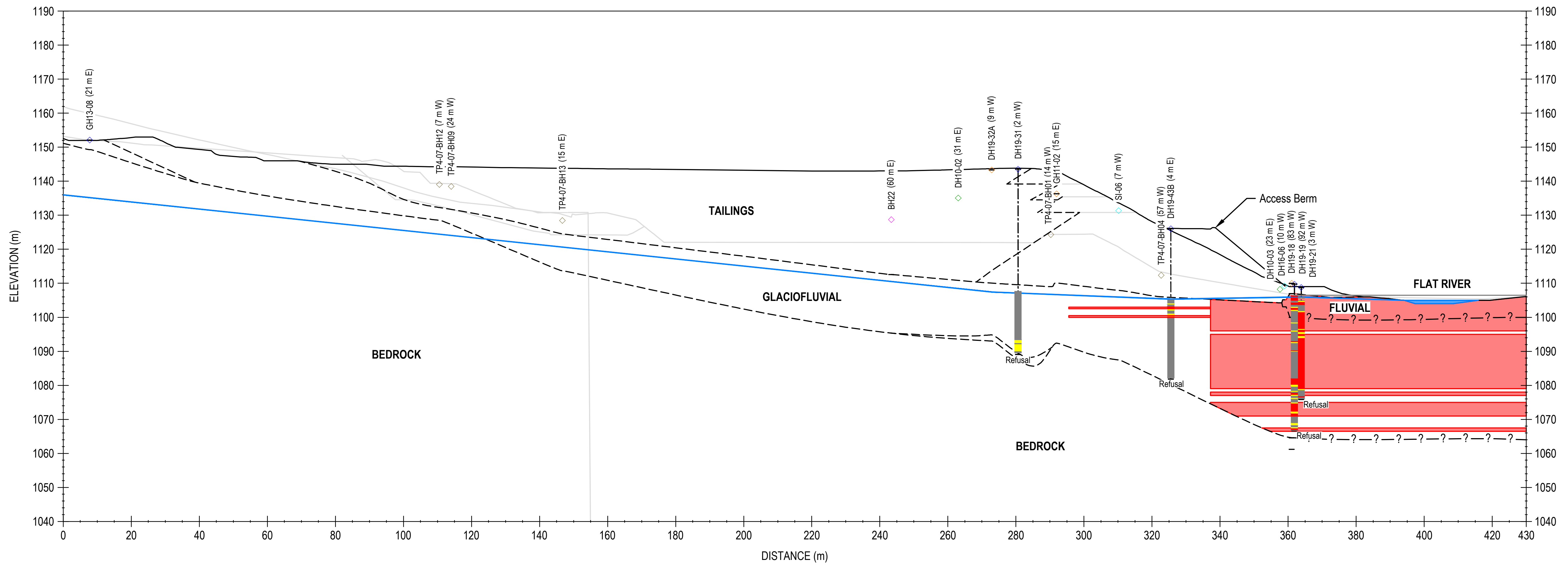
TETRA TECH

GEOTECHNICAL ASSESSMENT OF EXISTING TAILINGS FACILITIES
CANTUNG MINE, NT

TAILINGS POND LIQUEFIABLE MODEL
SECTION C-C'

PROJECT NO.	DWN	CKD	REV
ENW.WENW03039-05	EL/EP	GDK	0
OFFICE	DATE		
EDMONTON	March 2021		

Figure D.7



SECTION D-D'

LEGEND:

———	INFERRED WATER TABLE
—?—?—?—	INFERRED CONTACT
— — — —	INTERPRETED CONTACT
	2019 iBPT
	LIQUEFACTION TRIGGERING FOS > 2.0
	LIQUEFACTION TRIGGERING 1.1 < FOS < 2.0
	LIQUEFACTION TRIGGERING FOS ≤ 1.1
	LIQUEFIABLE MATERIAL (INTERPRETED)

STATUS
ISSUED FOR USE

CLIENT

NORTH AMERICAN TUNGSTEN CORPORATION LTD

TETRA TECH

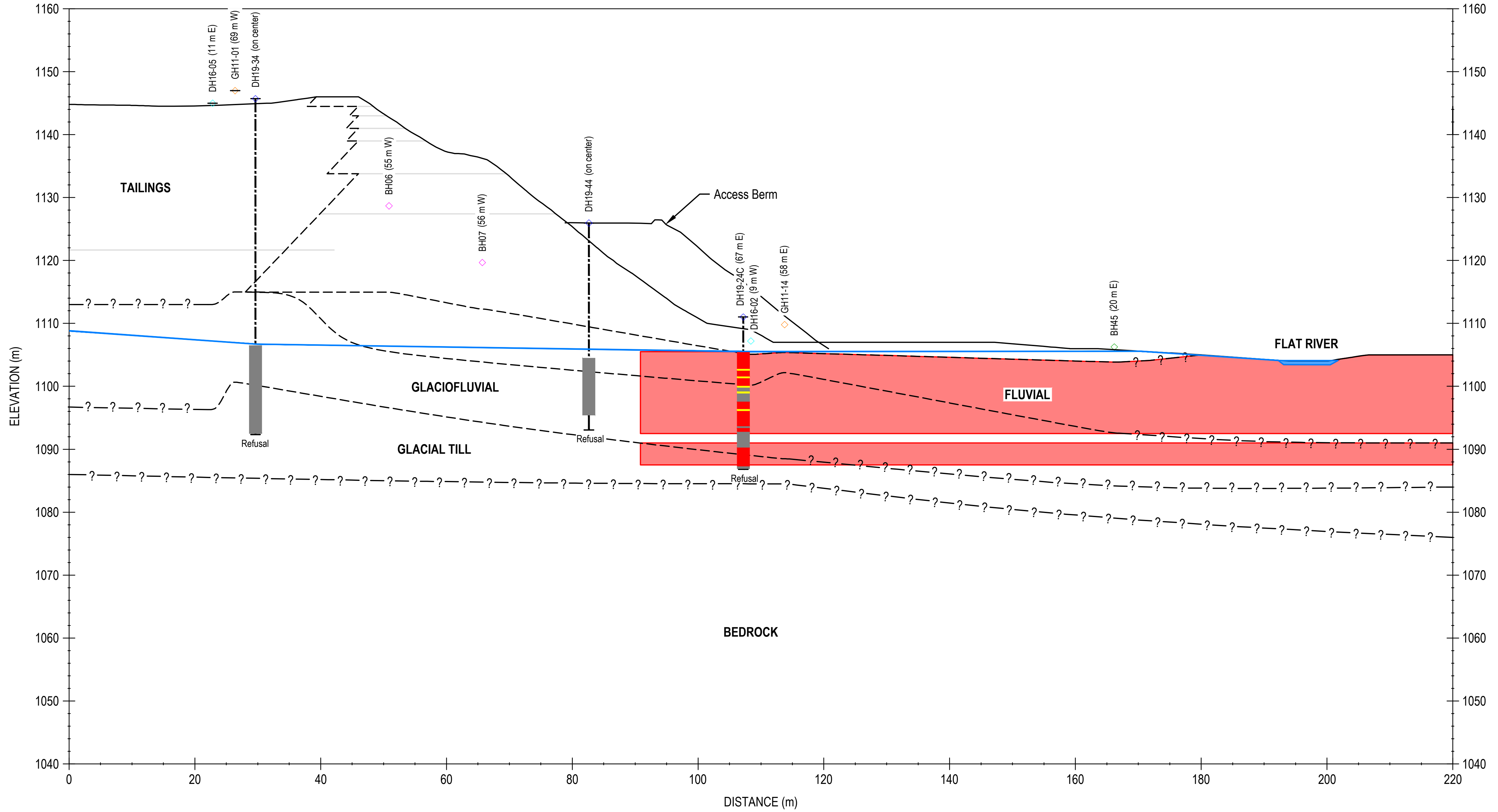
GEOTECHNICAL ASSESSMENT OF EXISTING TAILINGS FACILITIES
CANTUNG MINE, NT

TAILINGS POND LIQUEFIABLE MODEL
SECTION D-D'

PROJECT NO.	DWN	CKD	REV
ENW.WENW03039-05	EL/EP	GDK	0

OFFICE	DATE
EDMONTON	March 2021

Figure D.8



SECTION F-F'

LEGEND:

INFERRED WATER TABLE	LIQUEFACTION TRIGGERING FOS > 2.0
INFERRED CONTACT	LIQUEFACTION TRIGGERING 1.1 < FOS < 2.0
INTERPRETED CONTACT	LIQUEFACTION TRIGGERING FOS ≤ 1.1
2019 iBPT	LIQUEFIABLE MATERIAL (INTERPRETED)

STATUS
ISSUED FOR USE

CLIENT
NORTH AMERICAN TUNGSTEN CORPORATION LTD

TETRA TECH

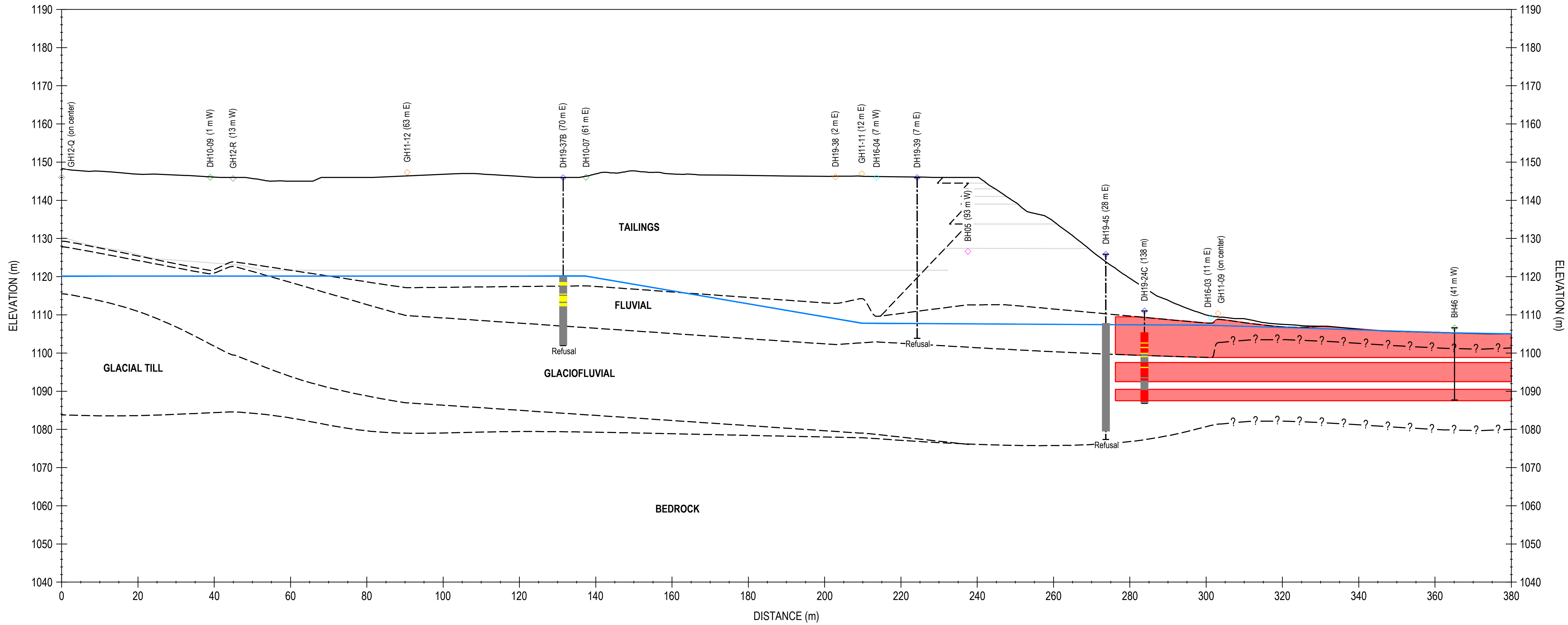
GEOTECHNICAL ASSESSMENT OF EXISTING TAILINGS FACILITIES
CANTUNG MINE, NT

TAILINGS POND LIQUEFIABLE MODEL
SECTION F-F'

PROJECT NO.	DWN	CKD	REV
ENW.WENW03039-05	EL/EP	GDK	0
OFFICE	DATE		
EDMONTON	March 2021		

Figure D.9

C:\Users\elvin.lee\Desktop\Cantung Site Model r2 Liquifaction.dwg [FIGURE D.9] August 07, 2020 - 1:46:58 pm (BY: LEE, ELVIN)



SECTION G-G'

LEGEND:

INFERRED WATER TABLE	LIQUEFACTION TRIGGERING FOS > 2.0
INFERRED CONTACT	LIQUEFACTION TRIGGERING 1.1 < FOS < 2.0
INTERPRETED CONTACT	LIQUEFACTION TRIGGERING FOS ≤ 1.1
2019 iBPT	LIQUEFIABLE MATERIAL (INTERPRETED)

STATUS
ISSUED FOR USE

CLIENT
NORTH AMERICAN TUNGSTEN CORPORATION LTD

TETRA TECH

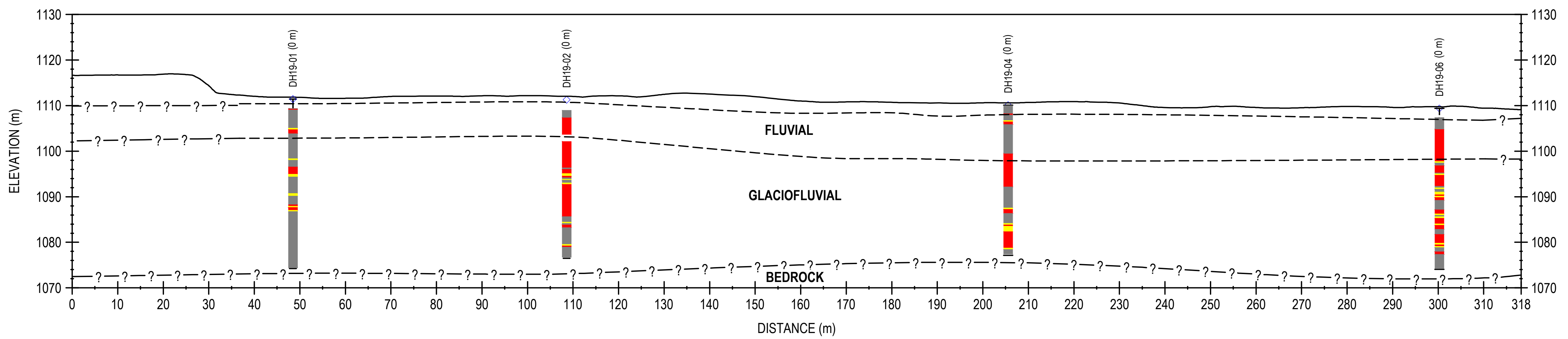
GEOTECHNICAL ASSESSMENT OF EXISTING TAILINGS FACILITIES
CANTUNG MINE, NT

TAILINGS POND LIQUEFIABLE MODEL
SECTION G-G'

PROJECT NO.	DWN	CKD	REV
ENW.WENW03039-05	EL/EP	GDK	0
OFFICE	DATE		
EDMONTON	March 2021		

Figure D.10

C:\Users\elvin.lee\Desktop\Cantung Site Model r2 Liquifaction.dwg [FIGURE D.10] August 07, 2020 - 1:47:03 pm (BY: LEE, ELVIN)



TP1/TP2 SECTION TOE

LEGEND:

	INFERRED WATER TABLE
—?—?—?—	INFERRED CONTACT
— — — —	INTERPRETED CONTACT
	2019 iBPT
	LIQUEFACTION TRIGGERING FOS > 2.0
	LIQUEFACTION TRIGGERING 1.1 < FOS < 2.0
	LIQUEFACTION TRIGGERING FOS ≤ 1.1
	LIQUEFIABLE MATERIAL (INTERPRETED)

STATUS
ISSUED FOR USE

CLIENT
NORTH AMERICAN TUNGSTEN CORPORATION LTD

TETRA TECH

GEOTECHNICAL ASSESSMENT OF EXISTING TAILINGS FACILITIES
CANTUNG MINE, NT

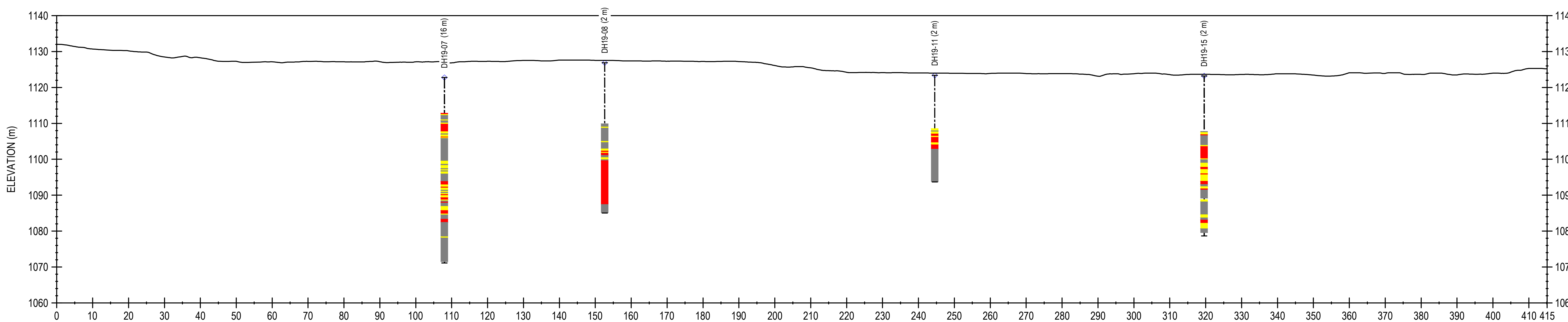
TAILINGS POND LIQUEFIABLE MODEL
TP1/TP2 SECTION TOE

PROJECT NO.	DWN	CKD	REV
ENW.WENW03039-05	EL/EP	GDK	0

OFFICE	DATE
EDMONTON	March 2021

Figure D.11

C:\Users\elvin.lee\Desktop\Cantung Site Model r2 Liquifaction.dwg [FIGURE D.11] August 07, 2020 - 1:47:09 pm (BY: LEE, ELVIN)



TP1/TP2 SECTION CREST

LEGEND:

- INFERRED WATER TABLE
- INFERRED CONTACT
- INTERPRETED CONTACT
- 2019 iBPT
- LIQUEFACTION TRIGGERING FOS > 2.0
- LIQUEFACTION TRIGGERING 1.1 < FOS < 2.0
- LIQUEFACTION TRIGGERING FOS ≤ 1.1
- LIQUEFIABLE MATERIAL (INTERPRETED)

STATUS
ISSUED FOR USE

CLIENT
NORTH AMERICAN TUNGSTEN CORPORATION LTD

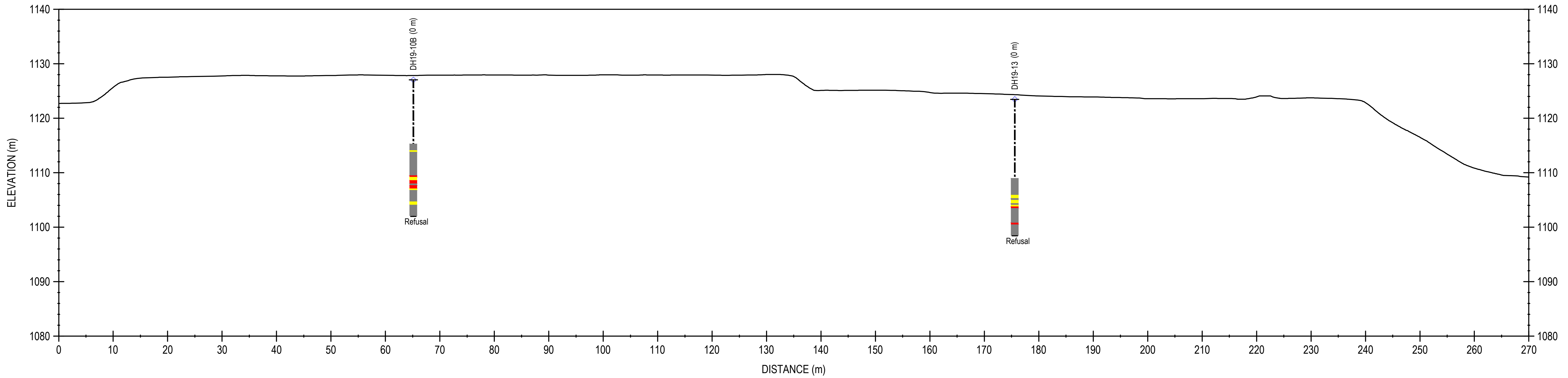
TETRA TECH

GEOTECHNICAL ASSESSMENT OF EXISTING TAILINGS FACILITIES
CANTUNG MINE, NT

TAILINGS POND LIQUEFIABLE MODEL
TP1/TP2 SECTION CREST

PROJECT NO.	DWN	CKD	REV
ENW.WENW03039-05	EL/EP	GDK	0
OFFICE	DATE		
EDMONTON	March 2021		

Figure D.12



SECTION TP1_TP2 Top-TP1_TP2 Top'

TP1/TP2 SECTION TOP

LEGEND:

INFERRED WATER TABLE	LIQUEFACTION TRIGGERING FOS > 2.0
—?—?—?— INFERRED CONTACT	LIQUEFACTION TRIGGERING 1.1 < FOS < 2.0
— — — — INTERPRETED CONTACT	LIQUEFACTION TRIGGERING FOS ≤ 1.1
2019 iBPT	LIQUEFIABLE MATERIAL (INTERPRETED)

STATUS
ISSUED FOR USE

CLIENT
NORTH AMERICAN TUNGSTEN CORPORATION LTD

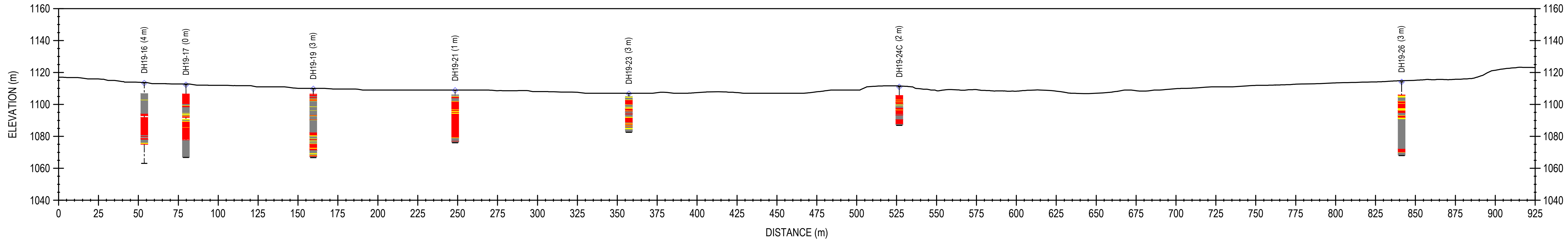
TETRA TECH

GEOTECHNICAL ASSESSMENT OF EXISTING TAILINGS FACILITIES
CANTUNG MINE, NT

TAILINGS POND LIQUEFIABLE MODEL
TP1/TP2 SECTION TOP

PROJECT NO.	DWN	CKD	REV	
ENW.WENW03039-05	EL/EP	GDK	0	**Figure D.13**
OFFICE	DATE			
EDMONTON	March 2021			

C:\Users\elvin.lee\Desktop\Cantung Site Model r2 Liquifaction.dwg [FIGURE D.13] August 07, 2020 - 1:47:22 pm (BY: LEE, ELVIN)



TP3/TP4 SECTION TOE

LEGEND:

(blue line)	INFERRED WATER TABLE
—?—?—?—	INFERRED CONTACT
— — — —	INTERPRETED CONTACT
	2019 iBPT
(grey)	LIQUEFACTION TRIGGERING FOS > 2.0
(yellow)	LIQUEFACTION TRIGGERING 1.1 < FOS < 2.0
(red)	LIQUEFACTION TRIGGERING FOS ≤ 1.1
(pink)	LIQUEFIABLE MATERIAL (INTERPRETED)

STATUS
ISSUED FOR USE

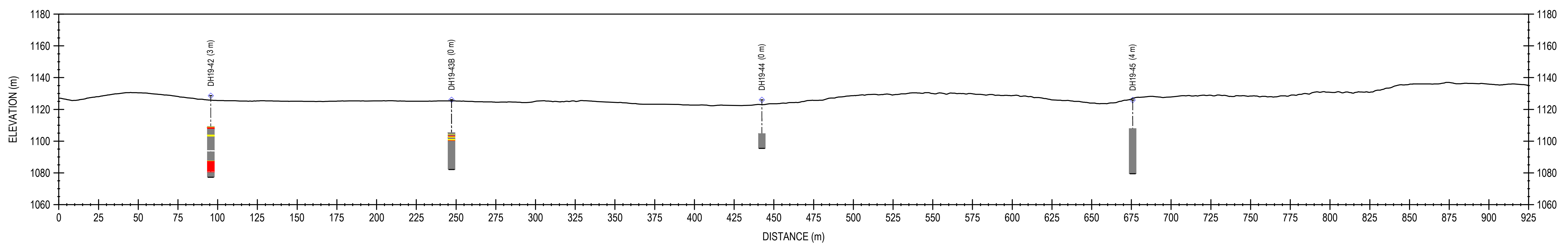
CLIENT
NORTH AMERICAN TUNGSTEN CORPORATION LTD

TETRA TECH

GEOTECHNICAL ASSESSMENT OF EXISTING TAILINGS FACILITIES
CANTUNG MINE, NT

TAILINGS POND LIQUEFIABLE MODEL
TP3/TP4 SECTION TOE

PROJECT NO.	DWN	CKD	REV	
ENW.WENW03039-05	EL/EP	GDK	0	Figure D.14
OFFICE	DATE			
EDMONTON	March 2021			



TP3/TP4 SECTION MID-SLOPE

LEGEND:

- INFERRED WATER TABLE
- INFERRED CONTACT
- INTERPRETED CONTACT
- 2019 iBPT
- LIQUEFACTION TRIGGERING FOS > 2.0
- LIQUEFACTION TRIGGERING 1.1 < FOS < 2.0
- LIQUEFACTION TRIGGERING FOS ≤ 1.1
- LIQUEFIABLE MATERIAL (INTERPRETED)

STATUS
ISSUED FOR USE

CLIENT
NORTH AMERICAN TUNGSTEN CORPORATION LTD

TETRA TECH

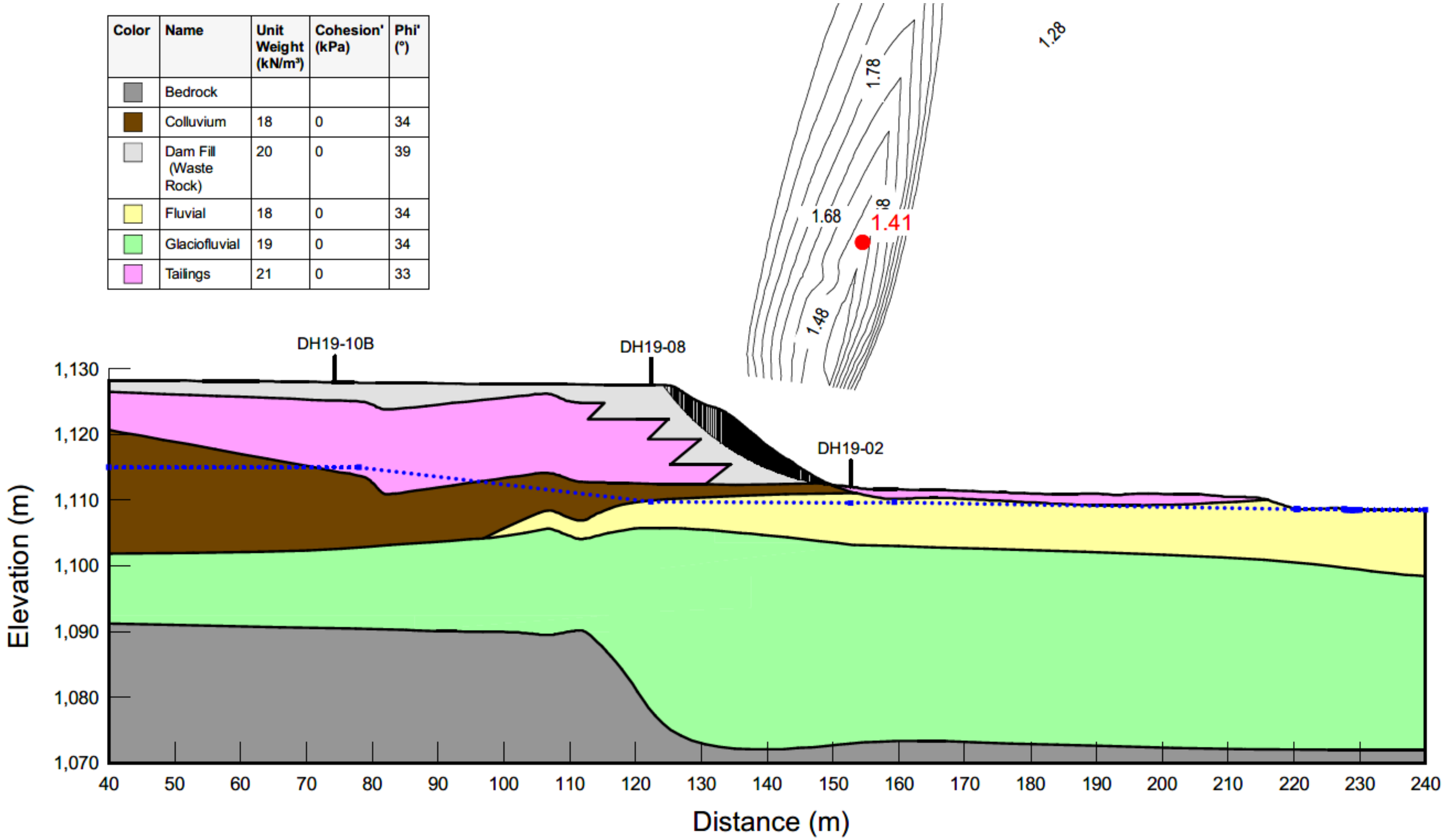
GEOTECHNICAL ASSESSMENT OF EXISTING TAILINGS FACILITIES
CANTUNG MINE, NT

TAILINGS POND LIQUEFIABLE MODEL
TP3/TP4 SECTION MID-SLOPE

PROJECT NO.	DWN	CKD	REV
ENW.WENW03039-05	EL/EP	GDK	0
OFFICE	DATE		
EDMONTON	March 2021		

Figure D.15

Color	Name	Unit Weight (kN/m³)	Cohesion' (kPa)	Phi' (°)
	Bedrock			
	Colluvium	18	0	34
	Dam Fill (Waste Rock)	20	0	39
	Fluvial	18	0	34
	Glaciofluvial	19	0	34
	Tailings	21	0	33



LEGEND

NOTES

STATUS

ISSUED FOR USE

CLIENT

NORTH AMERICAN TUNGSTEN CORPORATION LTD

TETRA TECH

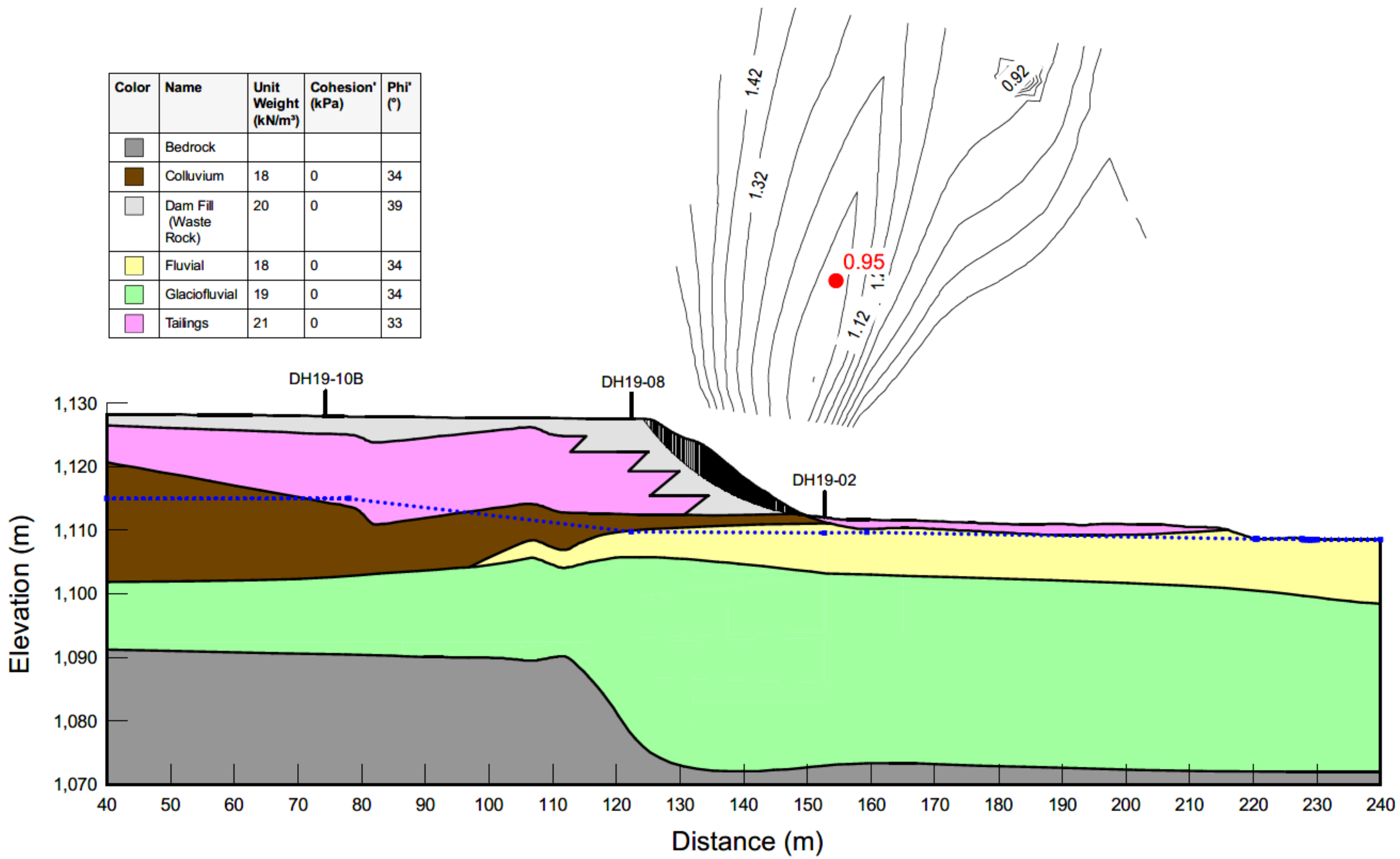
Geotechnical Assessment of Existing Tailings Facilities, Cantung Mine, NT

TP1 – Section A-A' Static Loading via Deep Rotational Failure

PROJECT NO.	DWN	CKD	APVD	REV
ENW.WENW03039-05	CP	EW	GDK	0

OFFICE	DATE
EBA-EDMONTON	March 2021

Figure D.16



Color	Name	Unit Weight (kN/m³)	Cohesion' (kPa)	Phi' (°)
	Bedrock			
	Colluvium	18	0	34
	Dam Fill (Waste Rock)	20	0	39
	Fluvial	18	0	34
	Glaciofluvial	19	0	34
	Tailings	21	0	33

LEGEND

NOTES

STATUS
ISSUED FOR USE

CLIENT
NORTH AMERICAN TUNGSTEN CORPORATION LTD

TETRA TECH

Geotechnical Assessment of Existing Tailings Facilities, Cantung Mine, NT

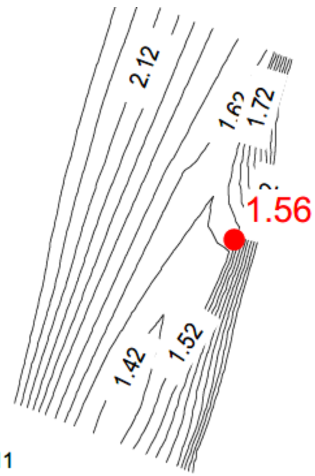
TP1 – Section A-A' Seismic Loading via Deep Rotational Failure

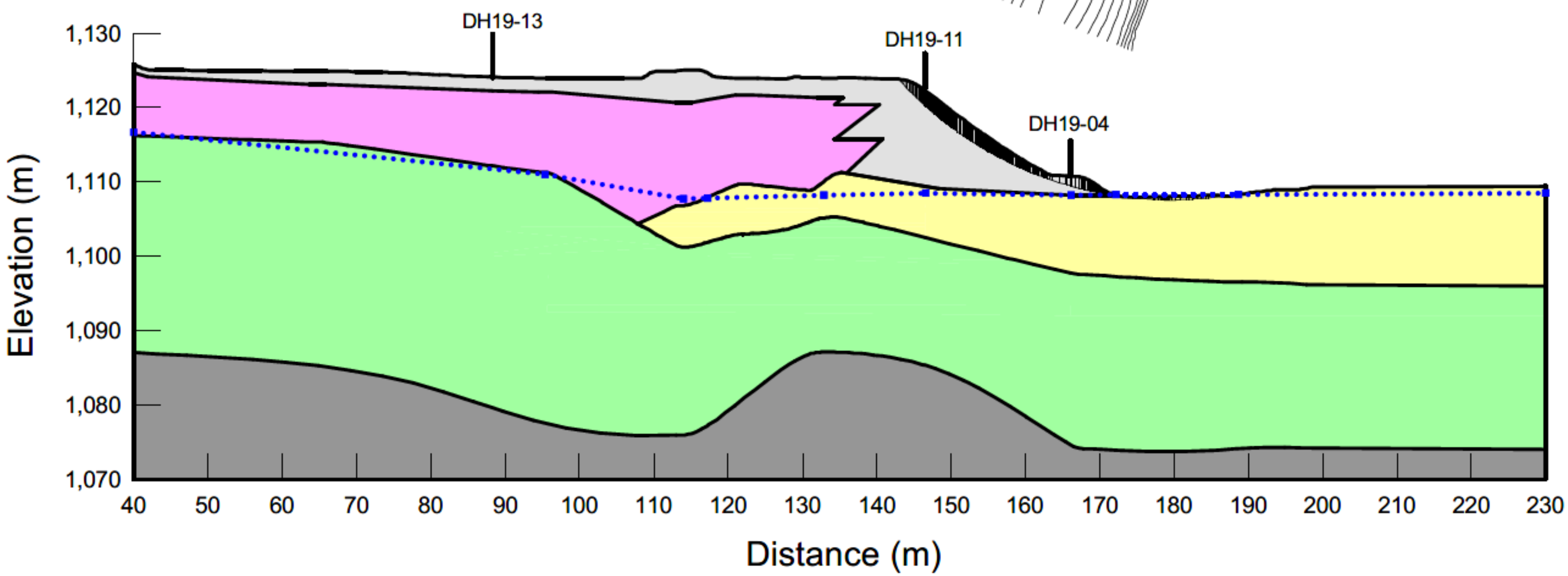
PROJECT NO.	DWN	CKD	APVD	REV
ENW.WENW03039-05	CP	EW	GDK	0

OFFICE	DATE
EBA-EDMONTON	March 2021

Figure D.17

Color	Name	Unit Weight (kN/m³)	Cohesion' (kPa)	Phi' (°)
	Bedrock			
	Dam Fill (Waste Rock)	20	0	39
	Fluvial	18	0	34
	Glaciofluvial	19	0	34
	Tailings	21	0	33





LEGEND

NOTES

STATUS
ISSUED FOR USE

CLIENT

NORTH AMERICAN TUNGSTEN CORPORATION LTD

TETRA TECH

Geotechnical Assessment of Existing Tailings Facilities, Cantung Mine, NT

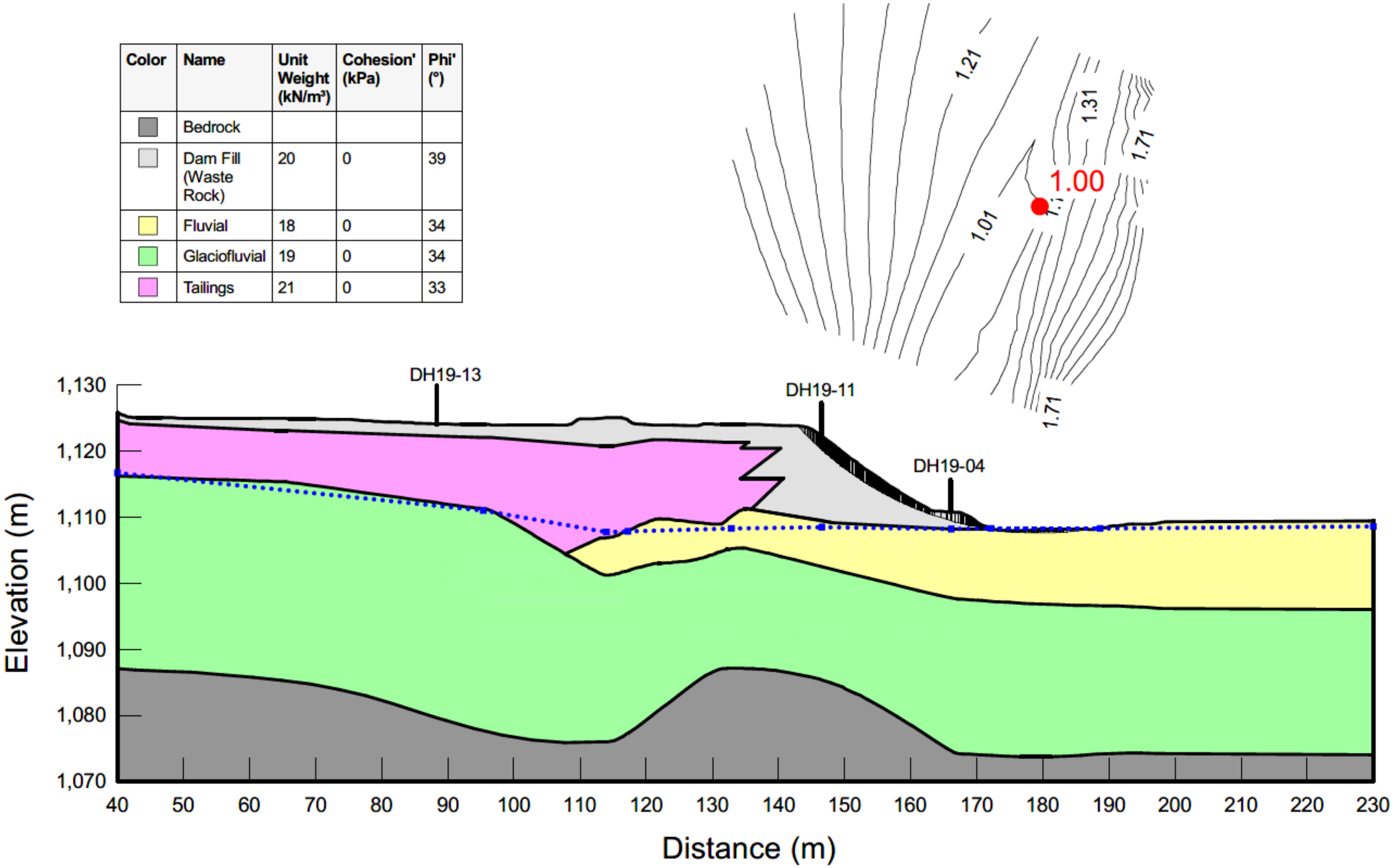
TP2 – Section B-B' Static Loading via Deep Rotational Failure

PROJECT NO.	DWN	CKD	APVD	REV
ENW.WENW03039-05	CP	EW	GDK	0

OFFICE	DATE
EBA-EDMONTON	March 2021

Figure D.18

Color	Name	Unit Weight (kN/m³)	Cohesion' (kPa)	Phi' (°)
	Bedrock			
	Dam Fill (Waste Rock)	20	0	39
	Fluvial	18	0	34
	Glaciofluvial	19	0	34
	Tailings	21	0	33



LEGEND

NOTES

STATUS
ISSUED FOR USE

CLIENT

NORTH AMERICAN TUNGSTEN CORPORATION LTD

TETRA TECH

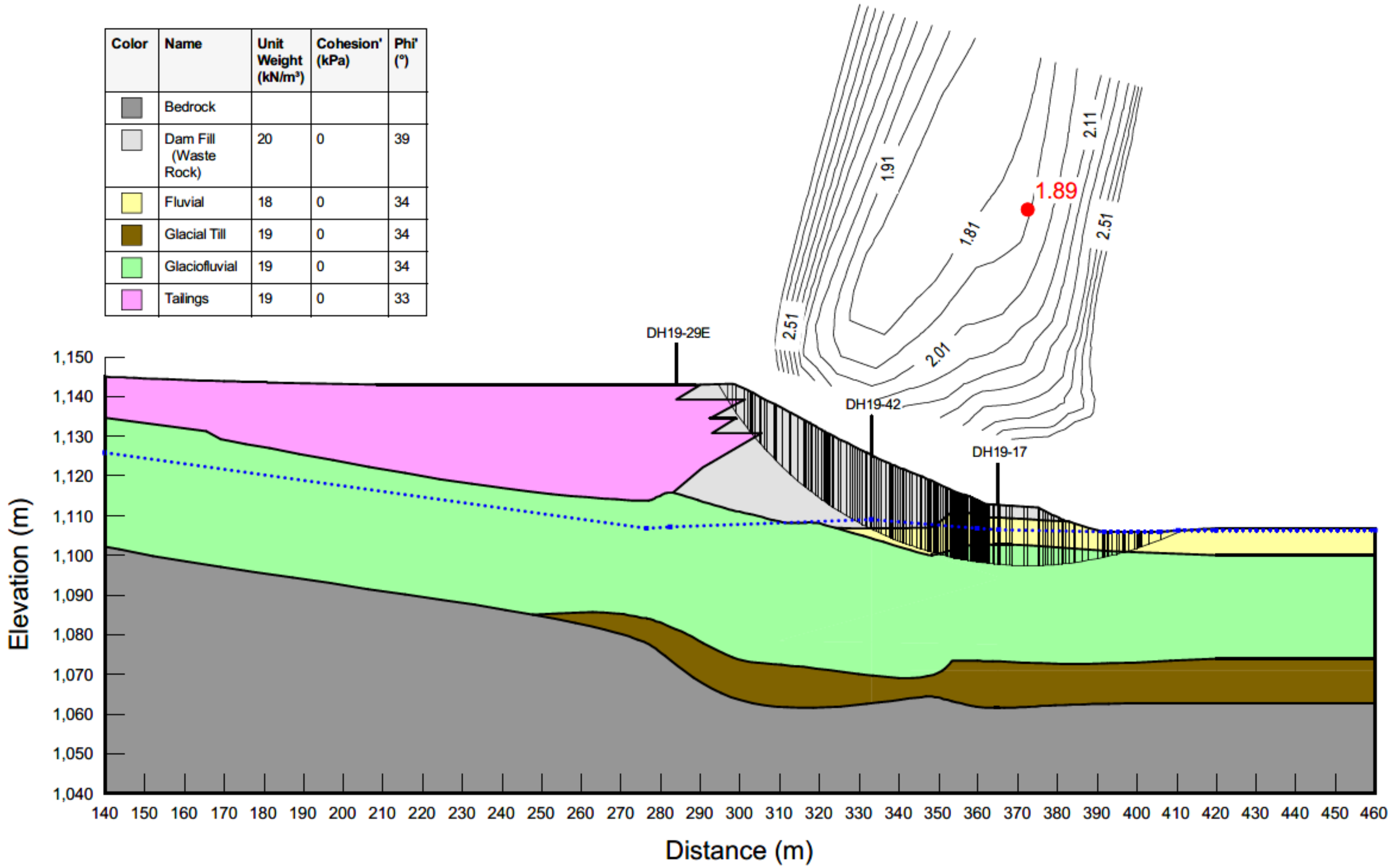
Geotechnical Assessment of Existing Tailings Facilities, Cantung Mine, NT

TP2 – Section B-B'
Seismic Loading via
Deep Rotational Failure

PROJECT NO.	DWN	CKD	APVD	REV
ENW.WENW03039-05	CP	EW	GDK	0

OFFICE	DATE
EBA-EDMONTON	March 2021

Figure D.19



Color	Name	Unit Weight (kN/m³)	Cohesion' (kPa)	Phi' (°)
	Bedrock			
	Dam Fill (Waste Rock)	20	0	39
	Fluvial	18	0	34
	Glacial Till	19	0	34
	Glaciofluvial	19	0	34
	Tailings	19	0	33

LEGEND

NOTES

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NORTH AMERICAN TUNGSTEN CORPORATION LTD

TETRA TECH

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Geotechnical Assessment of Existing Tailings Facilities, Cantung Mine, NT

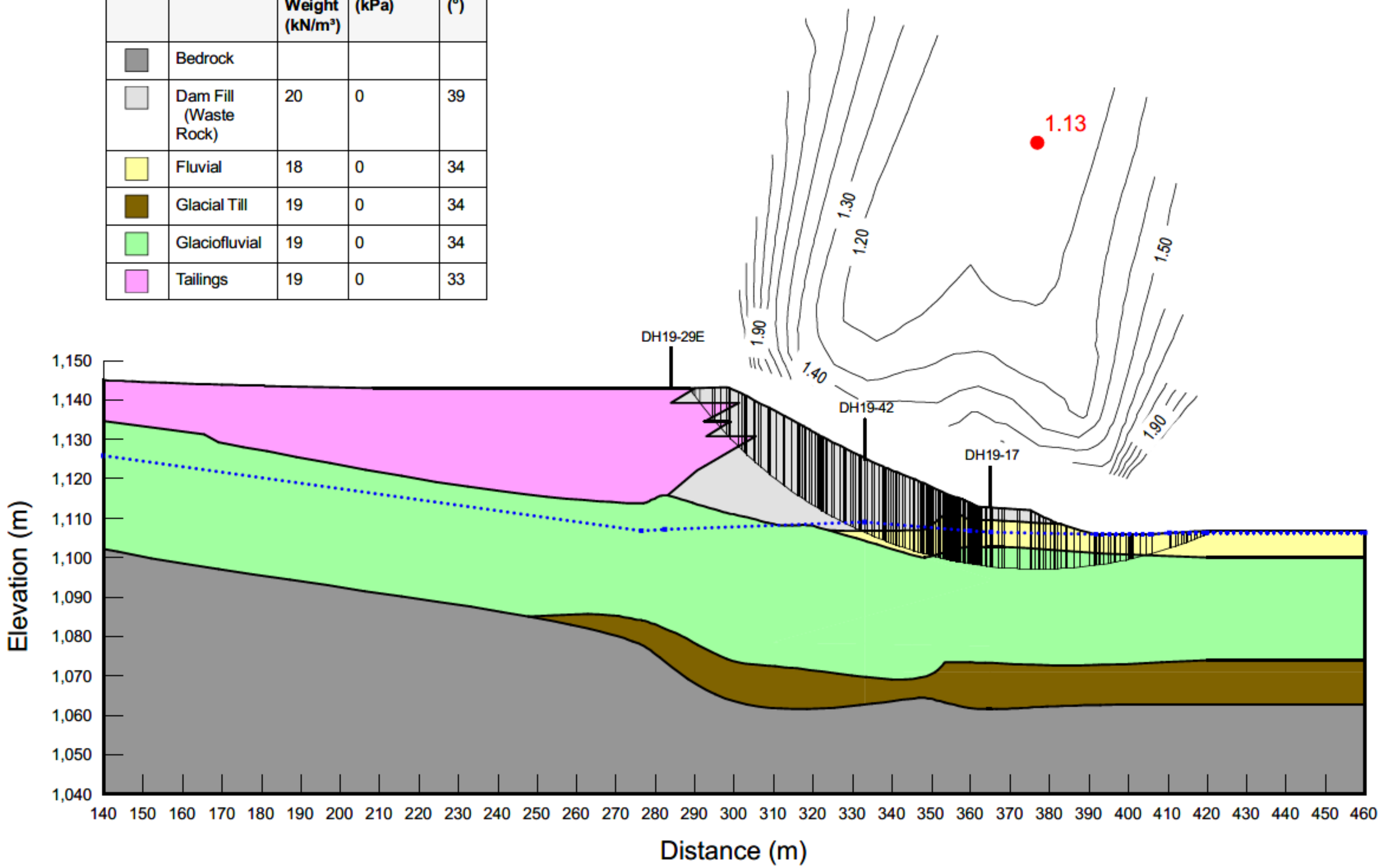
TP4 – Section C-C' Static Loading via Deep Rotational Failure

PROJECT NO.	DWN	CKD	APVD	REV
ENW.WENW03039-05	CP	EW	GDK	0

OFFICE	DATE
EBA-EDMONTON	March 2021

Figure D.20

Color	Name	Unit Weight (kN/m³)	Cohesion' (kPa)	Phi' (°)
	Bedrock			
	Dam Fill (Waste Rock)	20	0	39
	Fluvial	18	0	34
	Glacial Till	19	0	34
	Glaciofluvial	19	0	34
	Tailings	19	0	33



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NOTES

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NORTH AMERICAN TUNGSTEN CORPORATION LTD

TETRA TECH

Geotechnical Assessment of Existing Tailings Facilities, Cantung Mine, NT

TP4 – Section C-C' Seismic Loading via Deep Rotational Failure

PROJECT NO.	DWN	CKD	APVD	REV
ENW.WENW03039-05	CP	EW	GDK	0

OFFICE	DATE
EBA-EDMONTON	March 2021

Figure D.21

STATUS

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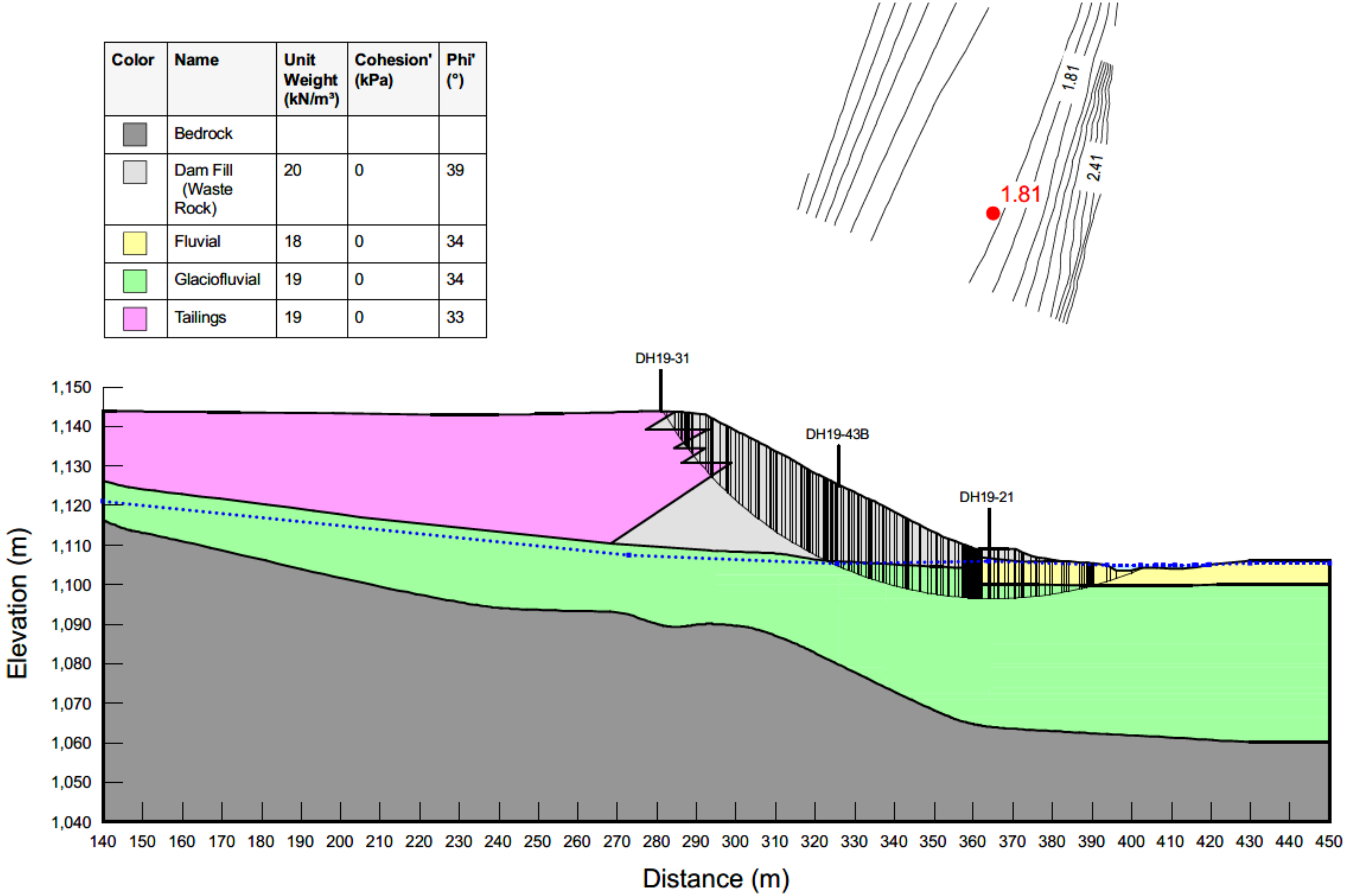
Color	Name	Unit Weight (kN/m³)	Cohesion' (kPa)	Phi' (°)
	Bedrock			
	Dam Fill (Waste Rock)	20	0	39
	Fluvial	18	0	34
	Glaciofluvial	19	0	34
	Tailings	19	0	33



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Geotechnical Assessment of Existing Tailings Facilities, Cantung Mine, NT

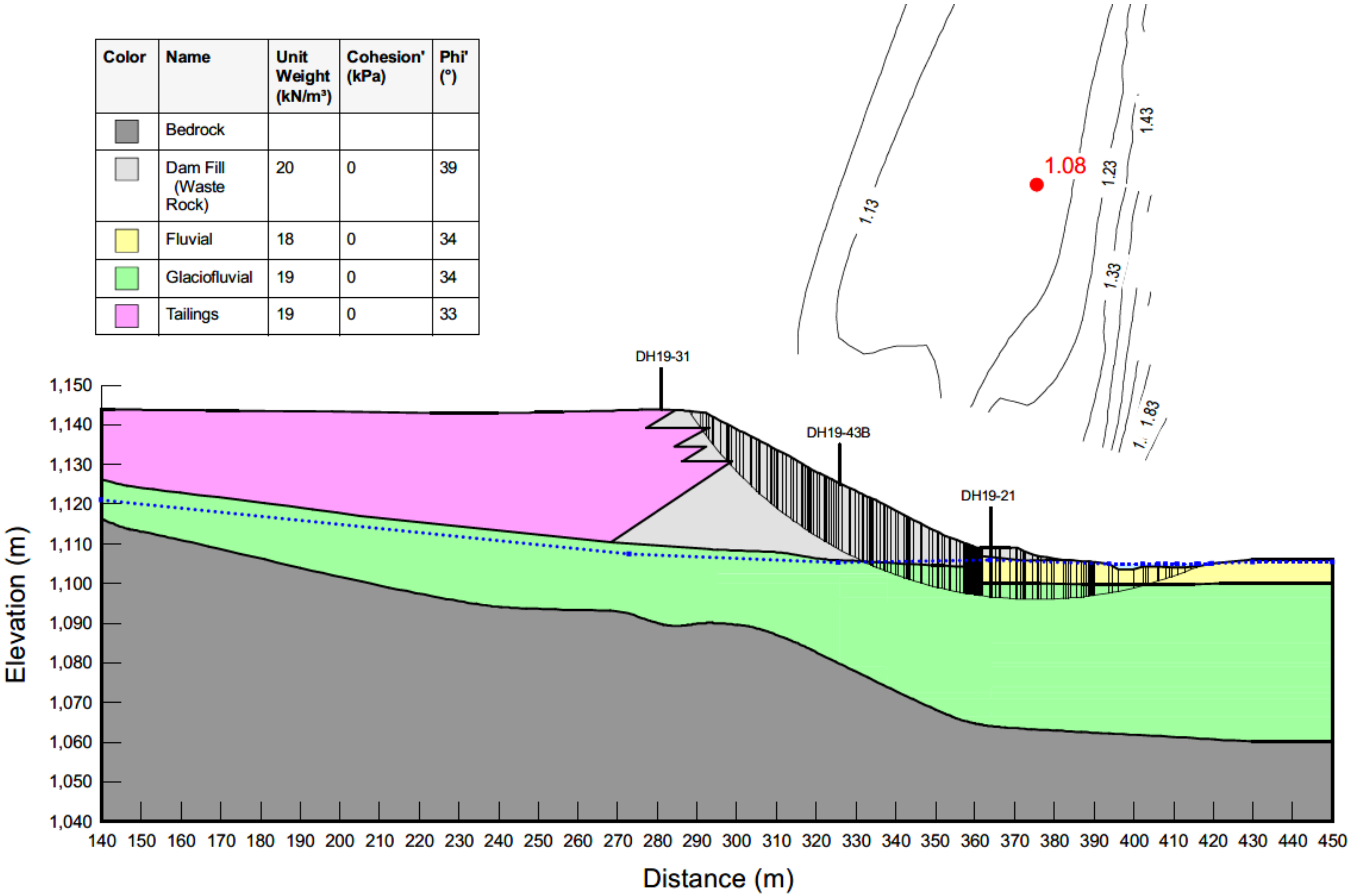
TP4 – Section D-D' Static Loading via Deep Rotational Failure

PROJECT NO.	DWN	CKD	APVD	REV
ENW.WENW03039-05	CP	EW	GDK	0

OFFICE	DATE
EBA-EDMONTON	March 2021

Figure D.22

Color	Name	Unit Weight (kN/m³)	Cohesion' (kPa)	Phi' (°)
	Bedrock			
	Dam Fill (Waste Rock)	20	0	39
	Fluvial	18	0	34
	Glaciofluvial	19	0	34
	Tailings	19	0	33



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Geotechnical Assessment of Existing Tailings Facilities, Cantung Mine, NT

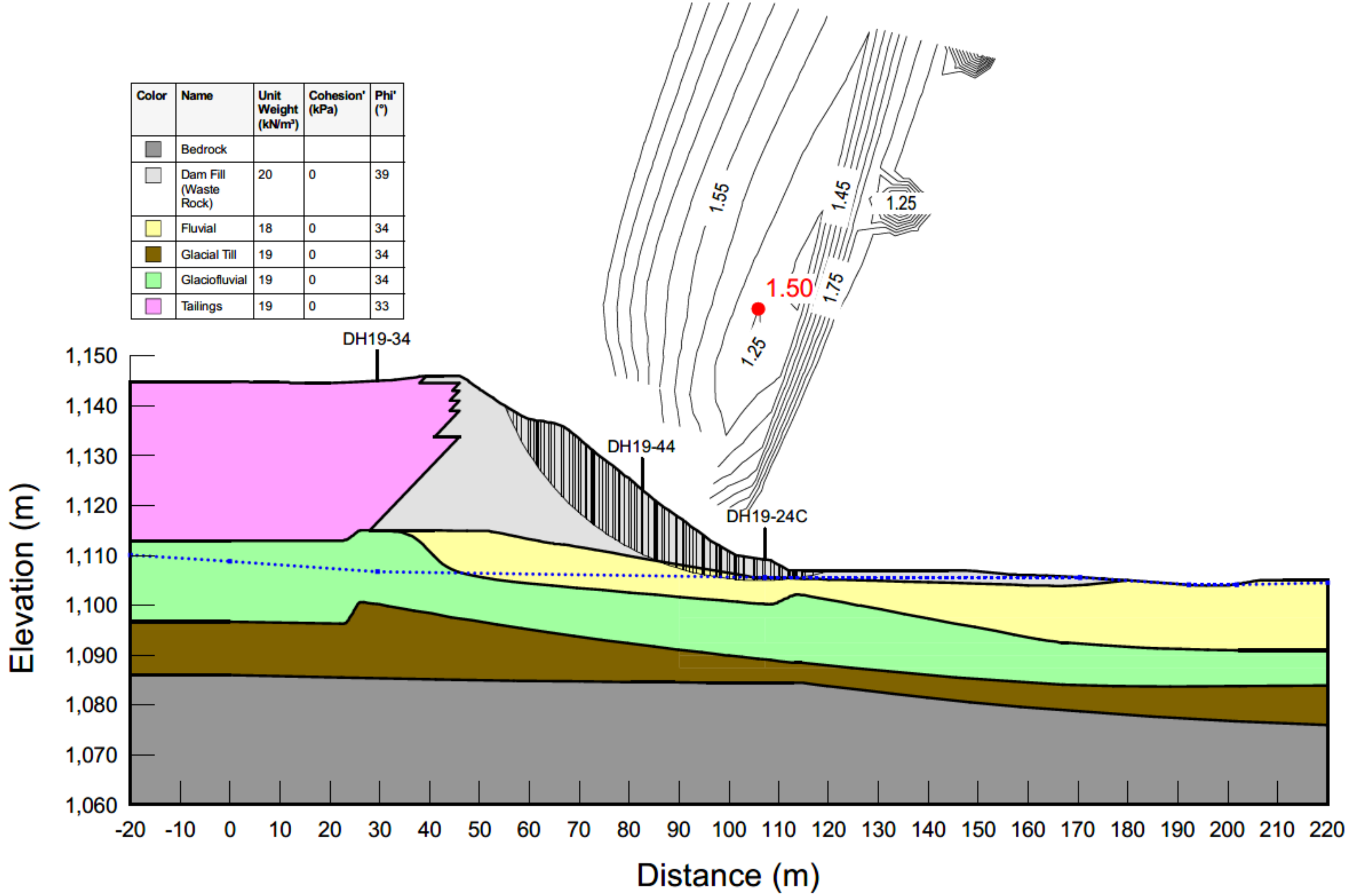
TP4 – Section D-D' Seismic Loading via Deep Rotational Failure

PROJECT NO.	DWN	CKD	APVD	REV
ENW.WENW03039-05	CP	EW	GDK	0

OFFICE	DATE
EBA-EDMONTON	March 2021

Figure D.23

Color	Name	Unit Weight (kN/m³)	Cohesion' (kPa)	Phi' (°)
	Bedrock			
	Dam Fill (Waste Rock)	20	0	39
	Fluvial	18	0	34
	Glacial Till	19	0	34
	Glaciofluvial	19	0	34
	Tailings	19	0	33



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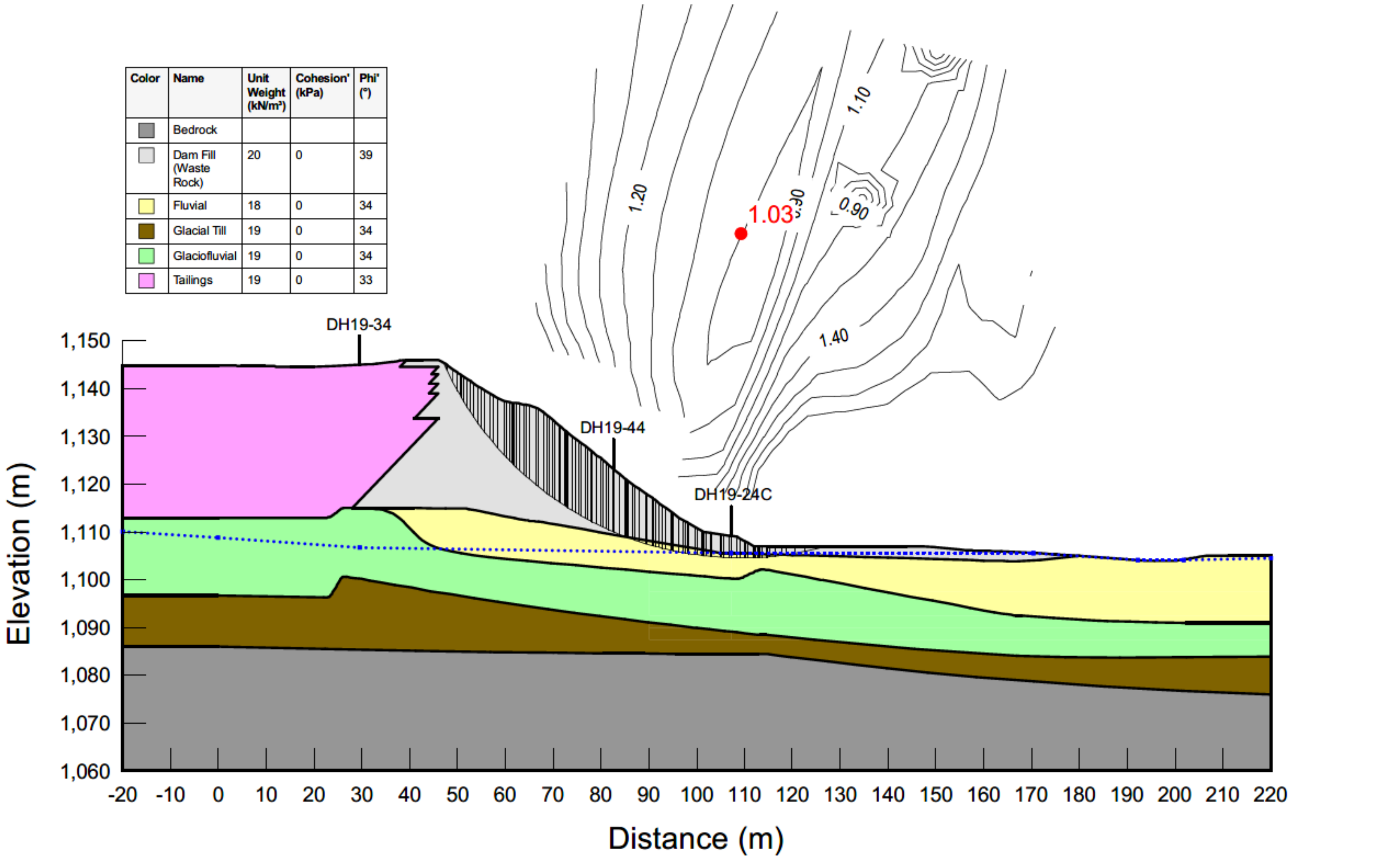
Geotechnical Assessment of Existing Tailings Facilities, Cantung Mine, NT

TP3 – Section F-F'
Static Loading via
Deep Rotational Failure

PROJECT NO.	DWN	CKD	APVD	REV
ENW.WENW03039-05	CP	EW	GDK	0

OFFICE	DATE
EBA-EDMONTON	March 2021

Figure D.24



Color	Name	Unit Weight (kN/m³)	Cohesion' (kPa)	Phi' (°)
	Bedrock			
	Dam Fill (Waste Rock)	20	0	39
	Fluvial	18	0	34
	Glacial Till	19	0	34
	Glaciofluvial	19	0	34
	Tailings	19	0	33

LEGEND

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TETRA TECH

Geotechnical Assessment of Existing Tailings Facilities, Cantung Mine, NT

TP3 – Section F-F' Seismic Loading via Deep Rotational Failure

PROJECT NO.	DWN	CKD	APVD	REV
ENW.WENW03039-05	CP	EW	GDK	0

OFFICE	DATE
EBA-EDMONTON	March 2021

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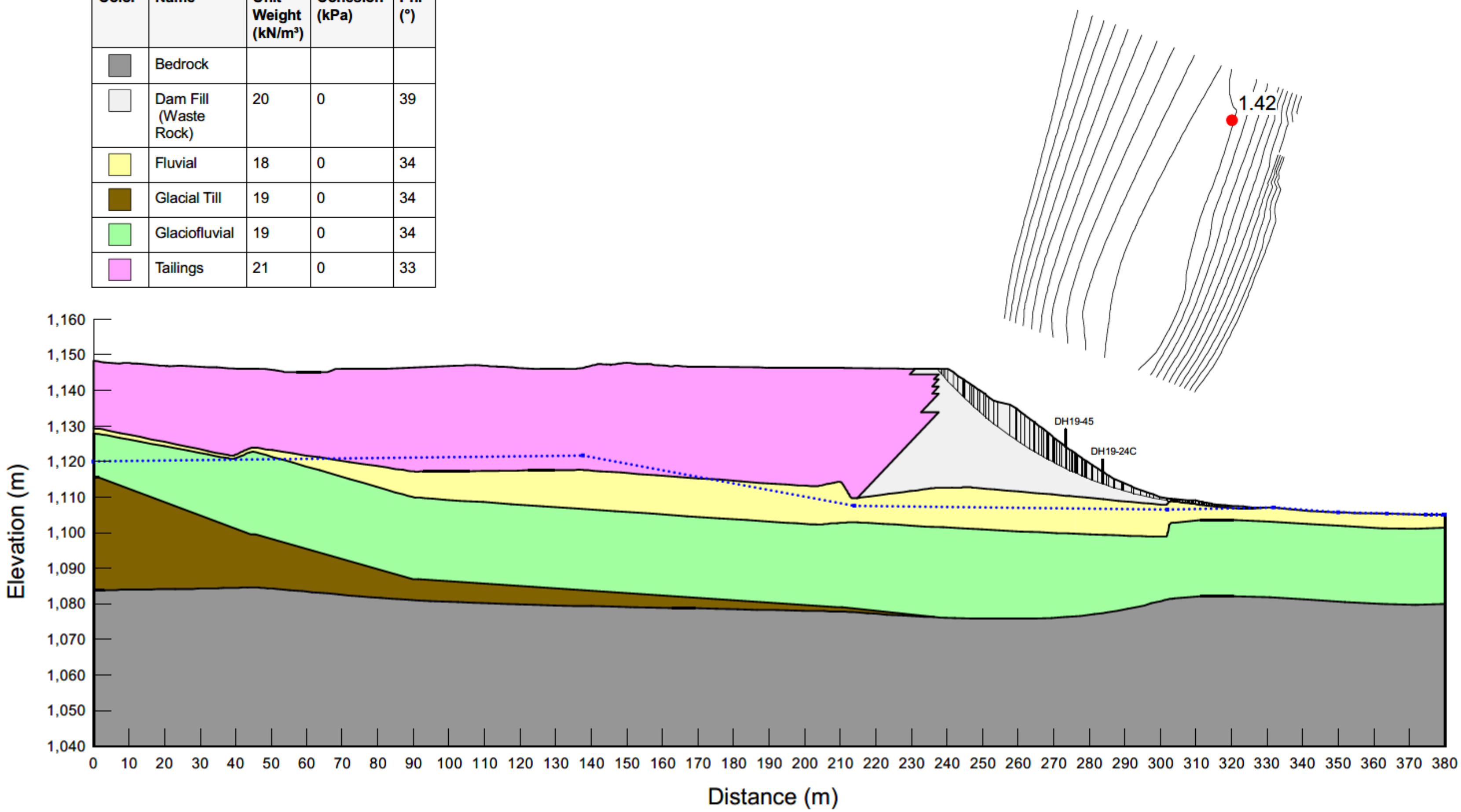
Figure D.25

Color	Name	Unit Weight (kN/m³)	Cohesion' (kPa)	Phi' (°)
	Bedrock			
	Dam Fill (Waste Rock)	20	0	39
	Fluvial	18	0	34
	Glacial Till	19	0	34
	Glaciofluvial	19	0	34
	Tailings	21	0	33



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TETRA TECH

Geotechnical Assessment of Existing Tailings Facilities, Cantung Mine, NT

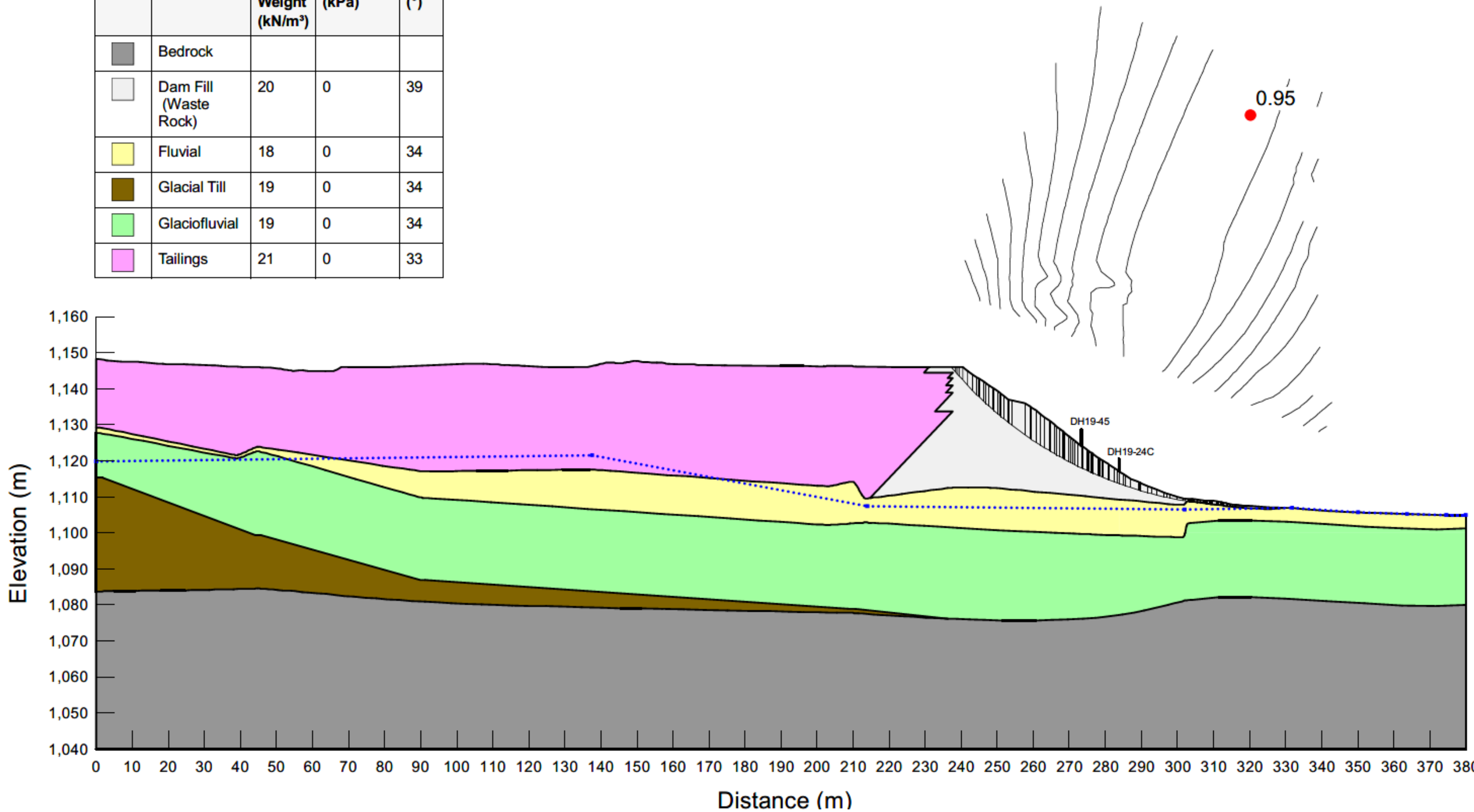
**TP3 – Section G-G'
Static Loading via
Deep Rotational Failure**

PROJECT NO.	DWN	CKD	APVD	REV
ENW.WENW03039-05	CP	EW	GDK	0

OFFICE	DATE
EBA-EDMONTON	March 2021

Figure D.26

Color	Name	Unit Weight (kN/m³)	Cohesion' (kPa)	Phi' (°)
	Bedrock			
	Dam Fill (Waste Rock)	20	0	39
	Fluvial	18	0	34
	Glacial Till	19	0	34
	Glaciofluvial	19	0	34
	Tailings	21	0	33



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Geotechnical Assessment of Existing Tailings Facilities, Cantung Mine, NT

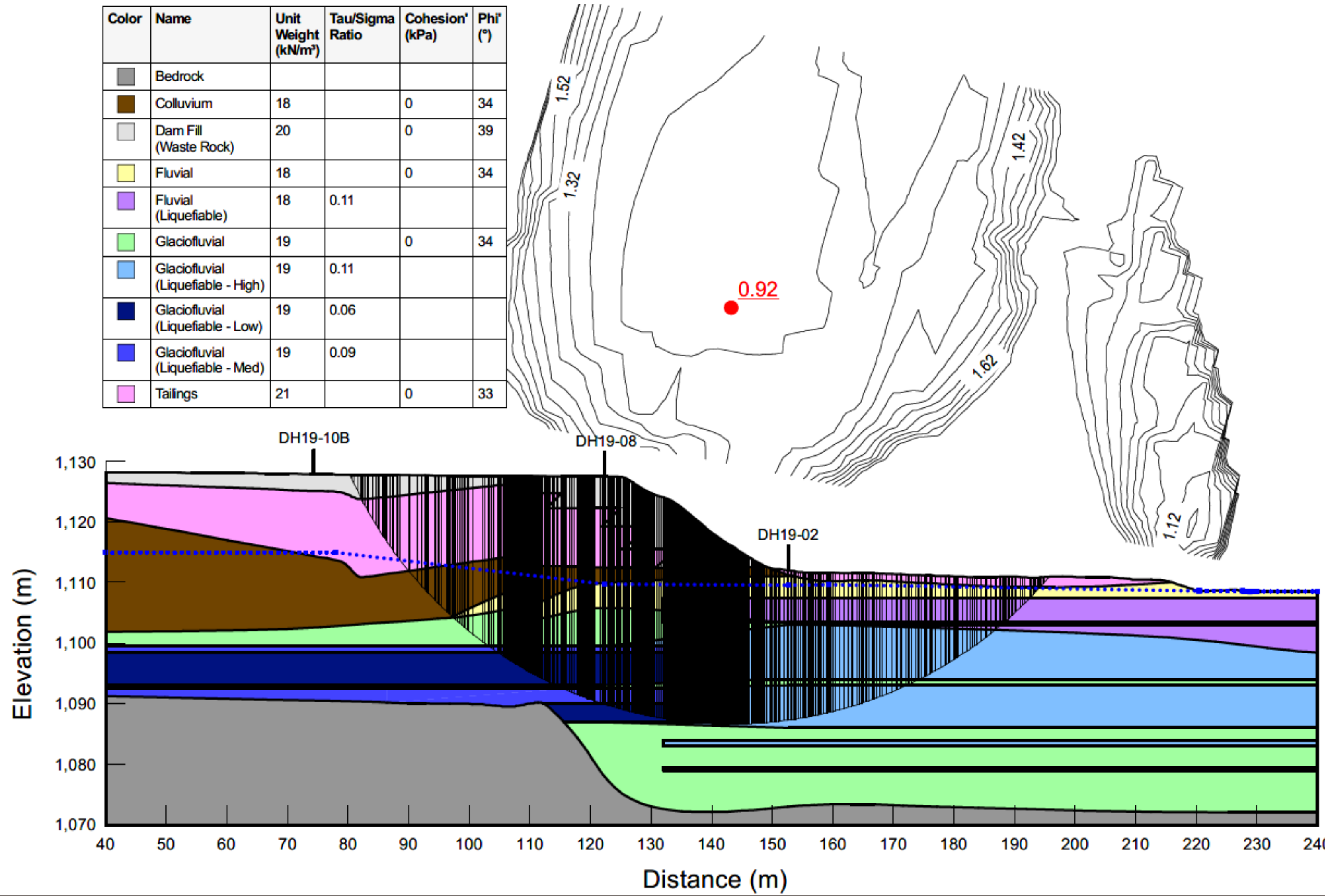
TP3 – Section G-G' Seismic Loading via Deep Rotational Failure

PROJECT NO.	DWN	CKD	APVD	REV
ENW.WENW03039-05	CP	EW	GDK	0

OFFICE	DATE
EBA-EDMONTON	March 2021

Figure D.27

Color	Name	Unit Weight (kN/m³)	Tau/Sigma Ratio	Cohesion' (kPa)	Phi' (°)
	Bedrock				
	Colluvium	18		0	34
	Dam Fill (Waste Rock)	20		0	39
	Fluvial	18		0	34
	Fluvial (Liquefiable)	18	0.11		
	Glaciofluvial	19		0	34
	Glaciofluvial (Liquefiable - High)	19	0.11		
	Glaciofluvial (Liquefiable - Low)	19	0.06		
	Glaciofluvial (Liquefiable - Med)	19	0.09		
	Tailings	21		0	33



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Geotechnical Assessment of Existing Tailings Facilities, Cantung Mine, NT

TP1 – Section A-A' Post-Seismic Loading with No Remediation via Deep Rotational Failure

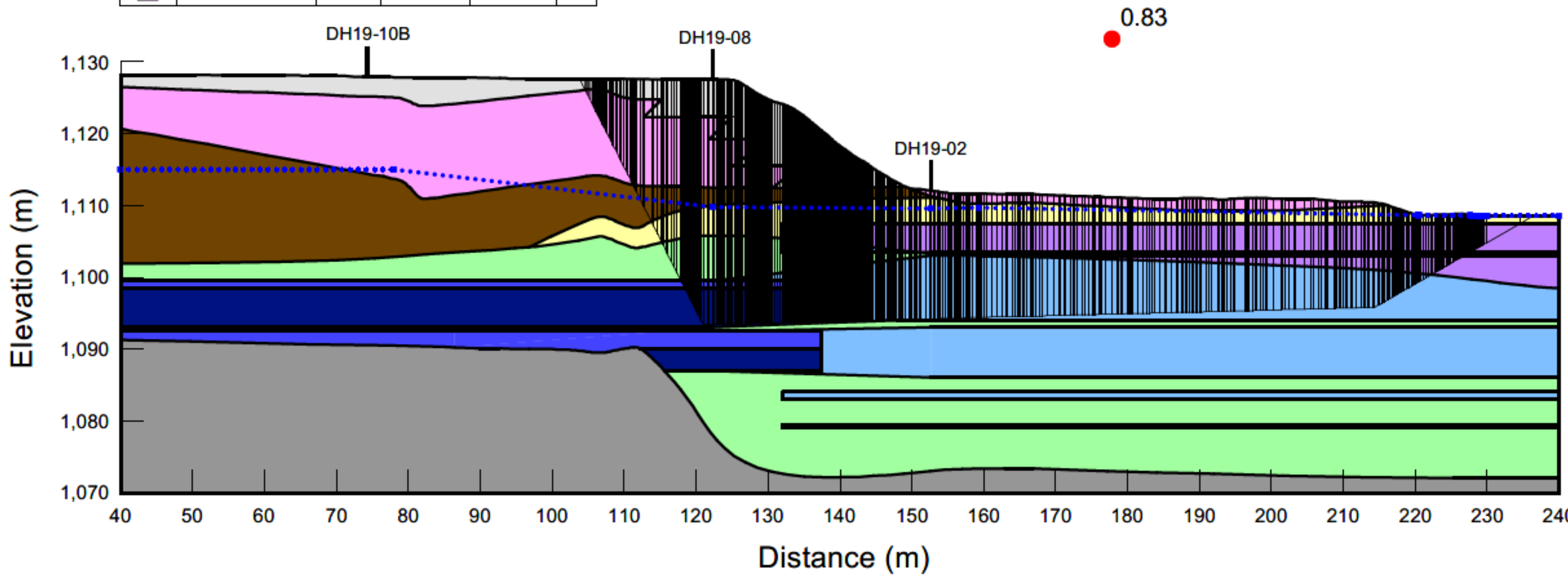
PROJECT NO.	DWN	CKD	APVD	REV
ENW.WENW03039-05	CP	EW	GDK	0

OFFICE
EBA-EDMONTON

DATE
March 2021

Figure D.28

Color	Name	Unit Weight (kN/m³)	Tau/Sigma Ratio	Cohesion' (kPa)	Phi' (°)
	Bedrock				
	Colluvium	18		0	34
	Dam Fill (Waste Rock)	20		0	39
	Fluvial	18		0	34
	Fluvial (Liquefiable)	18	0.11		
	Glaciofluvial	19		0	34
	Glaciofluvial (Liquefiable - Low)	19	0.06		
	Glaciofluvial (Liquefiable - Med)	19	0.09		
	Glaciofluvial (Liquefiable)	19	0.11		
	Tailings	21		0	33



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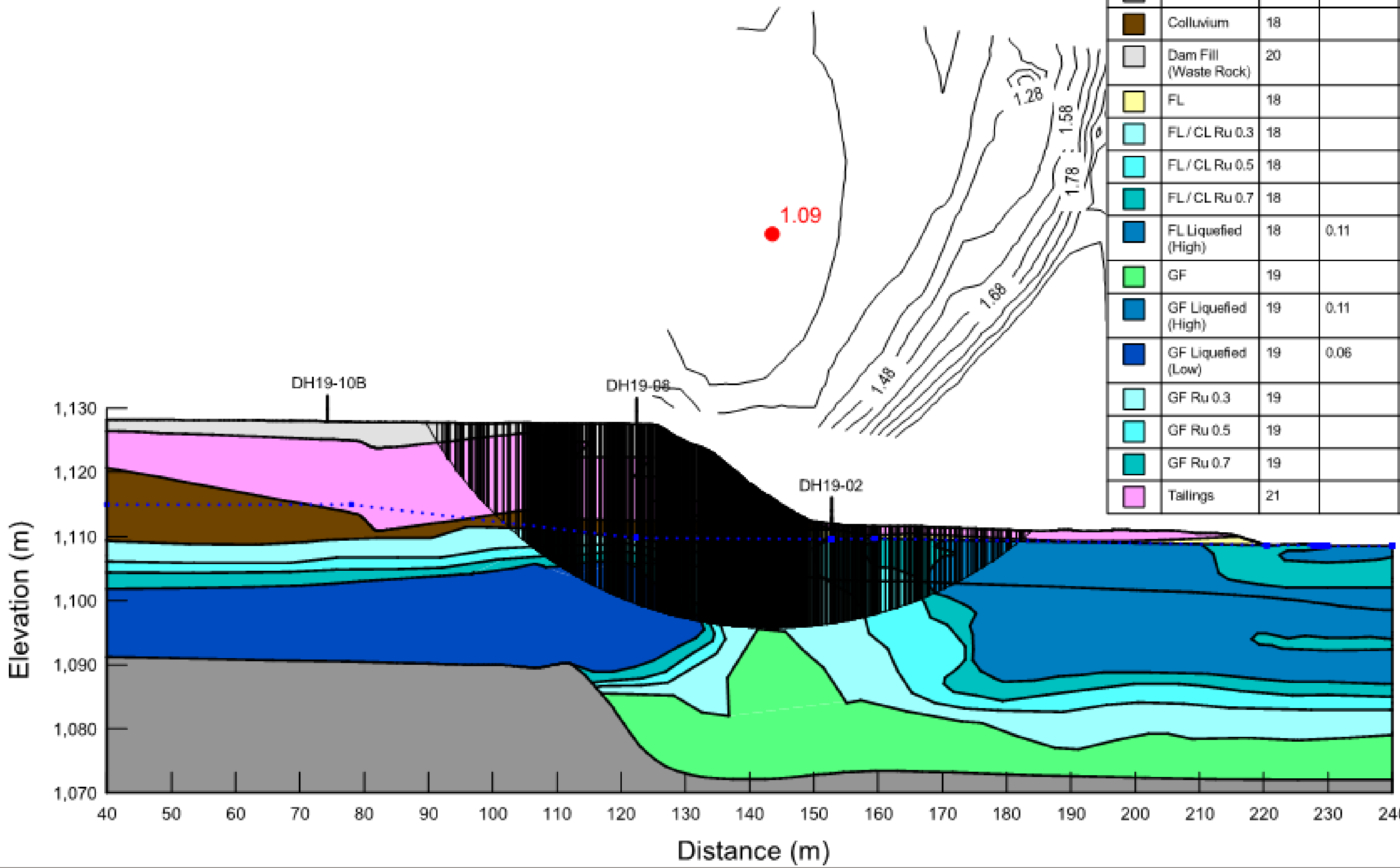
Geotechnical Assessment of Existing Tailings Facilities, Cantung Mine, NT

TP1 – Section A-A'
Post-Seismic Loading with No Remediation via Translational Failure

PROJECT NO.	DWN	CKD	APVD	REV
ENW.WENW03039-05	CP	CP	EW	0

OFFICE	DATE
EBA-EDMONTON	March 2021

Figure D.29



Color	Name	Unit Weight (kN/m³)	Tau/Sigma Ratio	Cohesion' (kPa)	Phi' (°)
	Bedrock				
	Colluvium	18		0	34
	Dam Fill (Waste Rock)	20		0	39
	FL	18		0	34
	FL / CL Ru 0.3	18		0	25
	FL / CL Ru 0.5	18		0	19
	FL / CL Ru 0.7	18		0	11
	FL Liquefied (High)	18	0.11		
	GF	19		0	34
	GF Liquefied (High)	19	0.11		
	GF Liquefied (Low)	19	0.06		
	GF Ru 0.3	19		0	25
	GF Ru 0.5	19		0	19
	GF Ru 0.7	19		0	11
	Tailings	21		0	33

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NORTH AMERICAN TUNGSTEN CORPORATION LTD

TETRA TECH

Geotechnical Assessment of Existing Tailings Facilities, Cantung Mine, NT

TP1 – Section A-A' [FLAC Layers] Post-Seismic Loading with No Remediation via Deep Rotational Failure

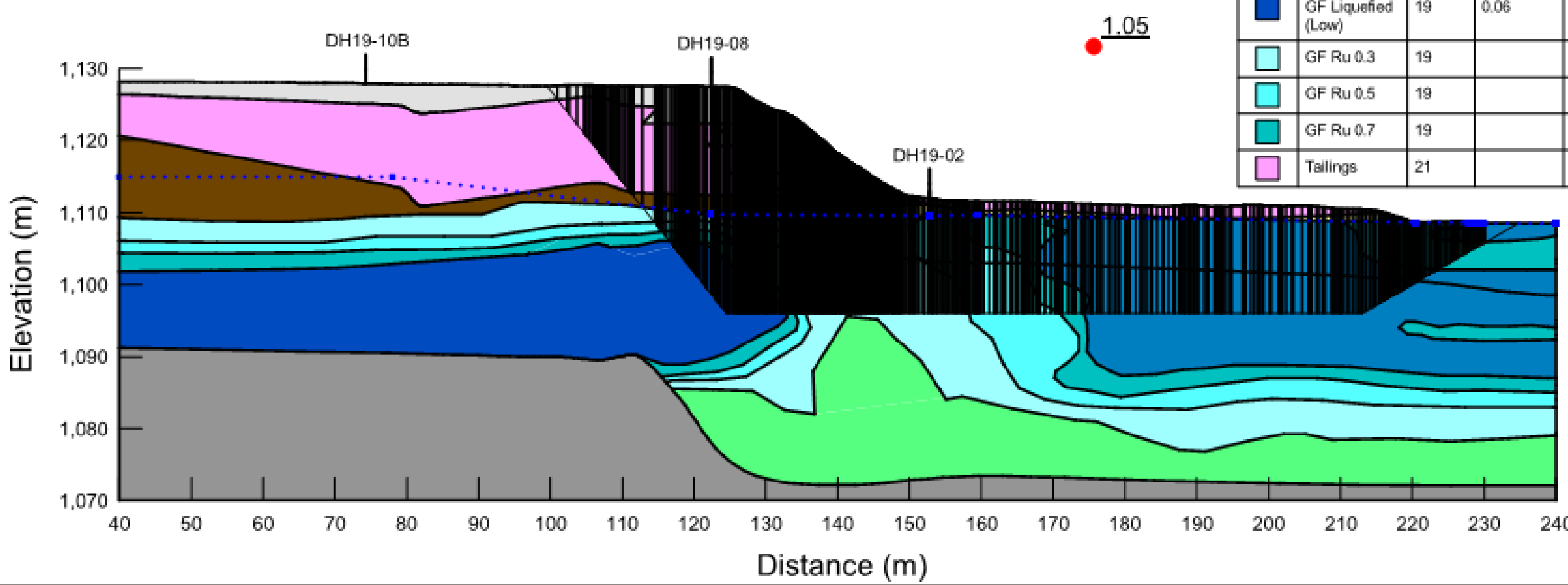
PROJECT NO.	DWN	CKD	APVD	REV
ENW.WENW03039-05	EW	CP	GDK	0

OFFICE
EBA-EDMONTON

DATE
March 2021

Figure D.30

Color	Name	Unit Weight (kN/m³)	Tau/Sigma Ratio	Cohesion' (kPa)	Phi' (°)
	Bedrock				
	Colluvium	18		0	34
	Dam Fill (Waste Rock)	20		0	39
	FL	18		0	34
	FL / CL Ru 0.3	18		0	25
	FL / CL Ru 0.5	18		0	19
	FL / CL Ru 0.7	18		0	11
	FL Liquefied (High)	18	0.11		
	GF	19		0	34
	GF Liquefied (High)	19	0.11		
	GF Liquefied (Low)	19	0.06		
	GF Ru 0.3	19		0	25
	GF Ru 0.5	19		0	19
	GF Ru 0.7	19		0	11
	Tailings	21		0	33



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NOTES

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Geotechnical Assessment of Existing Tailings Facilities, Cantung Mine, NT

TP1 – Section A-A' [FLAC Layers] Post-Seismic Loading with No Remediation via Translational Failure

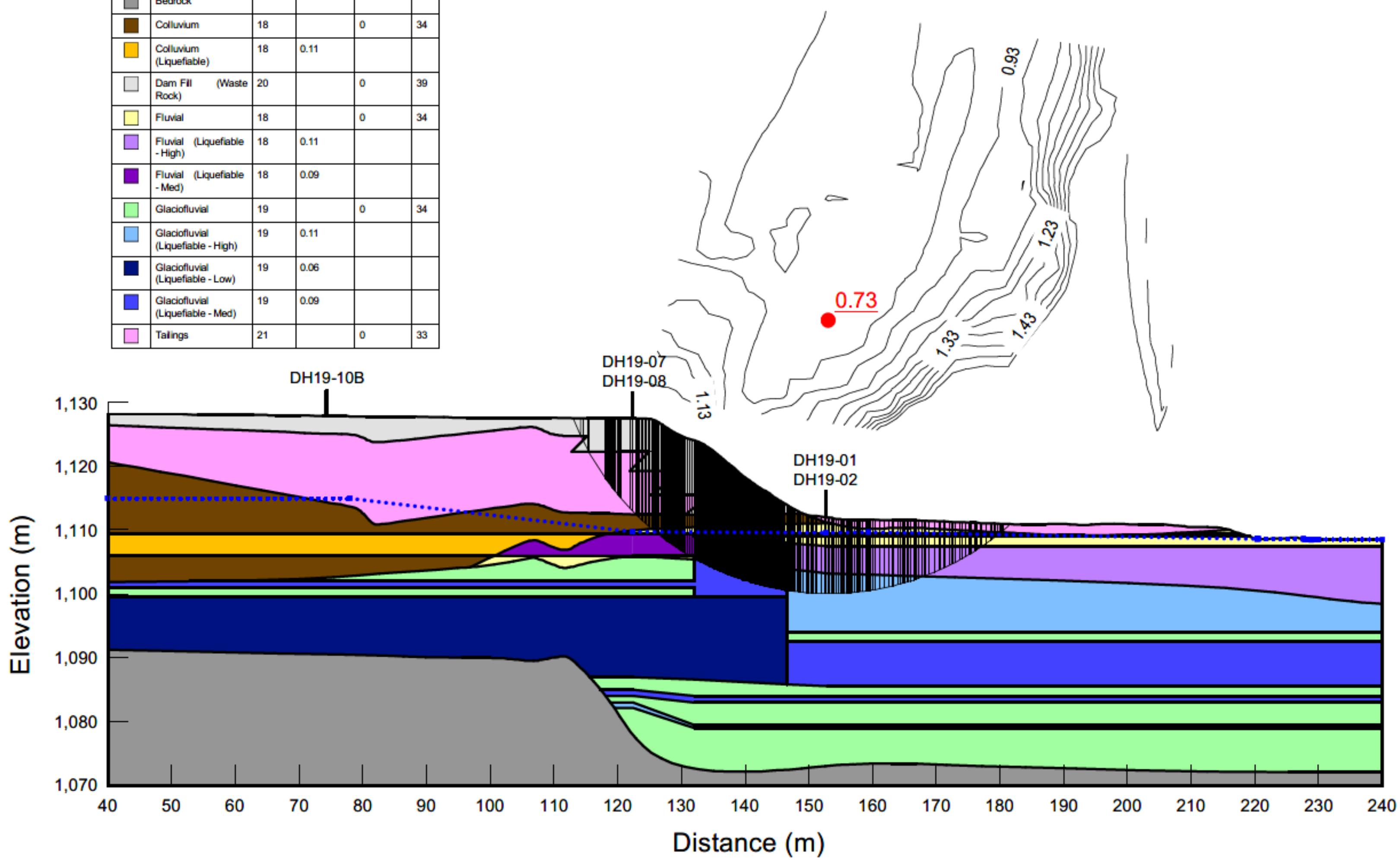
PROJECT NO.	DWN	CKD	APVD	REV
ENW.WENW03039-05	EW	CP	GDK	0

OFFICE: EBA-EDMONTON

DATE: March 2021

Figure D.31

Color	Name	Unit Weight (kN/m³)	Tau/Sigma Ratio	Cohesion' (kPa)	Phi' (°)
	Bedrock				
	Colluvium	18		0	34
	Colluvium (Liquefiable)	18	0.11		
	Dam Fill (Waste Rock)	20		0	39
	Fluvial	18		0	34
	Fluvial (Liquefiable - High)	18	0.11		
	Fluvial (Liquefiable - Med)	18	0.09		
	Glaciofluvial	19		0	34
	Glaciofluvial (Liquefiable - High)	19	0.11		
	Glaciofluvial (Liquefiable - Low)	19	0.06		
	Glaciofluvial (Liquefiable - Med)	19	0.09		
	Tailings	21		0	33



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NOTES

STATUS
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NORTH AMERICAN TUNGSTEN CORPORATION LTD

TETRA TECH

Geotechnical Assessment of Existing Tailings Facilities, Cantung Mine, NT

TP1 – Section A-A'$_2$ Post-Seismic Loading with No Remediation via Deep Rotational Failure

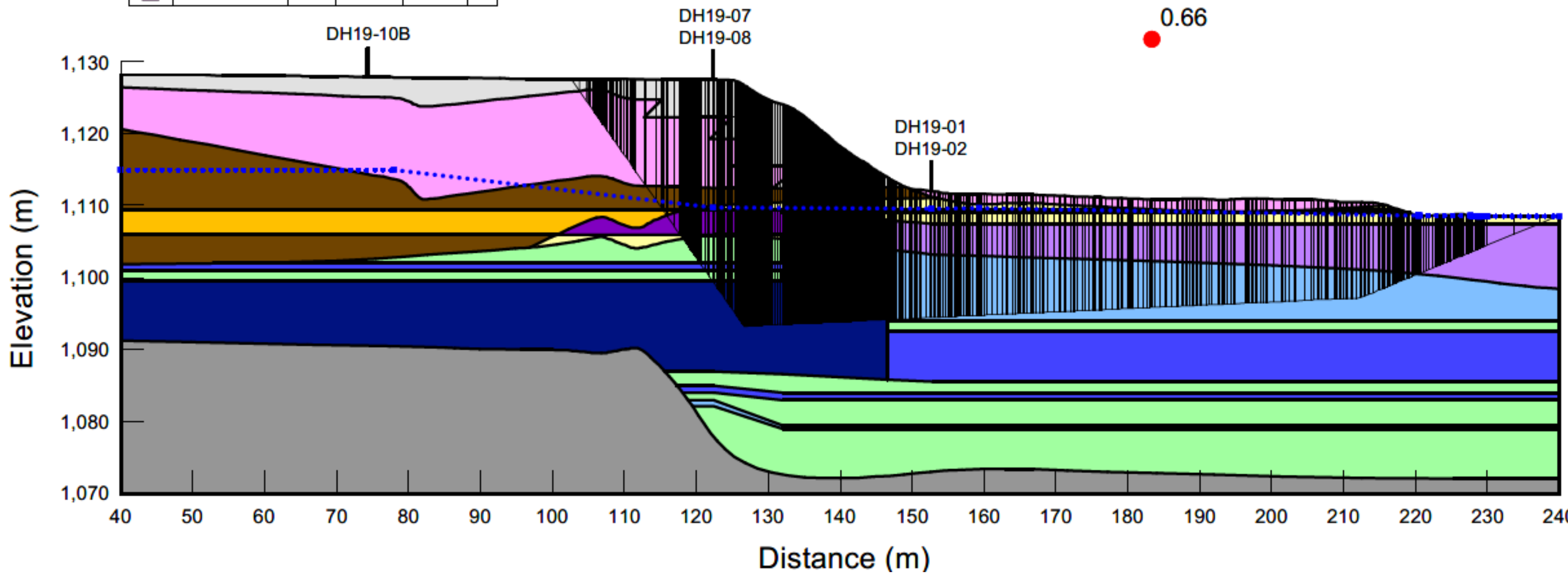
PROJECT NO.	DWN	CKD	APVD	REV
ENW.WENW03039-05	CP	EW	GDK	0

OFFICE: EBA-EDMONTON

DATE: March 2021

Figure D.32

Color	Name	Unit Weight (kN/m³)	Tau/Sigma Ratio	Cohesion' (kPa)	Phi' (°)
	Bedrock				
	Colluvium	18		0	34
	Colluvium (Liquefiable)	18	0.11		
	Dam Fill (Waste Rock)	20		0	39
	Fluvial	18		0	34
	Fluvial (Liquefiable - High)	18	0.11		
	Fluvial (Liquefiable - Med)	18	0.09		
	Glaciofluvial	19		0	34
	Glaciofluvial (Liquefiable - High)	19	0.11		
	Glaciofluvial (Liquefiable - Low)	19	0.06		
	Glaciofluvial (Liquefiable - Med)	19	0.09		
	Tailings	21		0	33



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NOTES

STATUS
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NORTH AMERICAN TUNGSTEN CORPORATION LTD

TETRA TECH

Geotechnical Assessment of Existing Tailings Facilities, Cantung Mine, NT

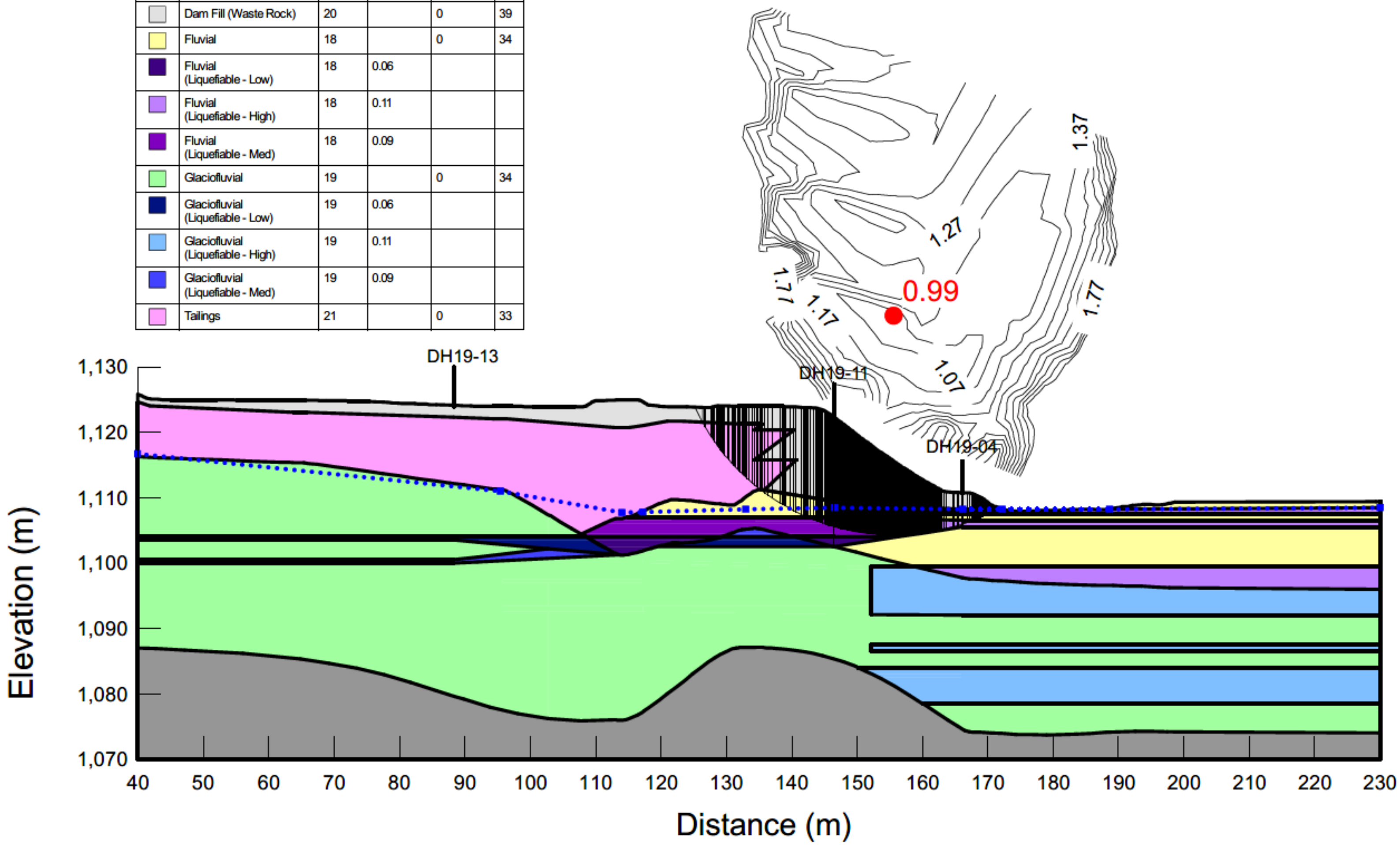
TP1 – Section A-A'$_2$
Post-Seismic Loading with No Remediation via Translational Failure

PROJECT NO.	DWN	CKD	APVD	REV
ENW.WENW03039-05	CP	EW	GDK	0

OFFICE	DATE
EBA-EDMONTON	March 2021

Figure D.33

Color	Name	Unit Weight (kN/m³)	Tau/Sigma Ratio	Cohesion' (kPa)	Phi' (°)
	Bedrock				
	Dam Fill (Waste Rock)	20		0	39
	Fluvial	18		0	34
	Fluvial (Liquefiable - Low)	18	0.06		
	Fluvial (Liquefiable - High)	18	0.11		
	Fluvial (Liquefiable - Med)	18	0.09		
	Glaciofluvial	19		0	34
	Glaciofluvial (Liquefiable - Low)	19	0.06		
	Glaciofluvial (Liquefiable - High)	19	0.11		
	Glaciofluvial (Liquefiable - Med)	19	0.09		
	Tailings	21		0	33



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NOTES

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TETRA TECH

Geotechnical Assessment of Existing Tailings Facilities, Cantung Mine, NT

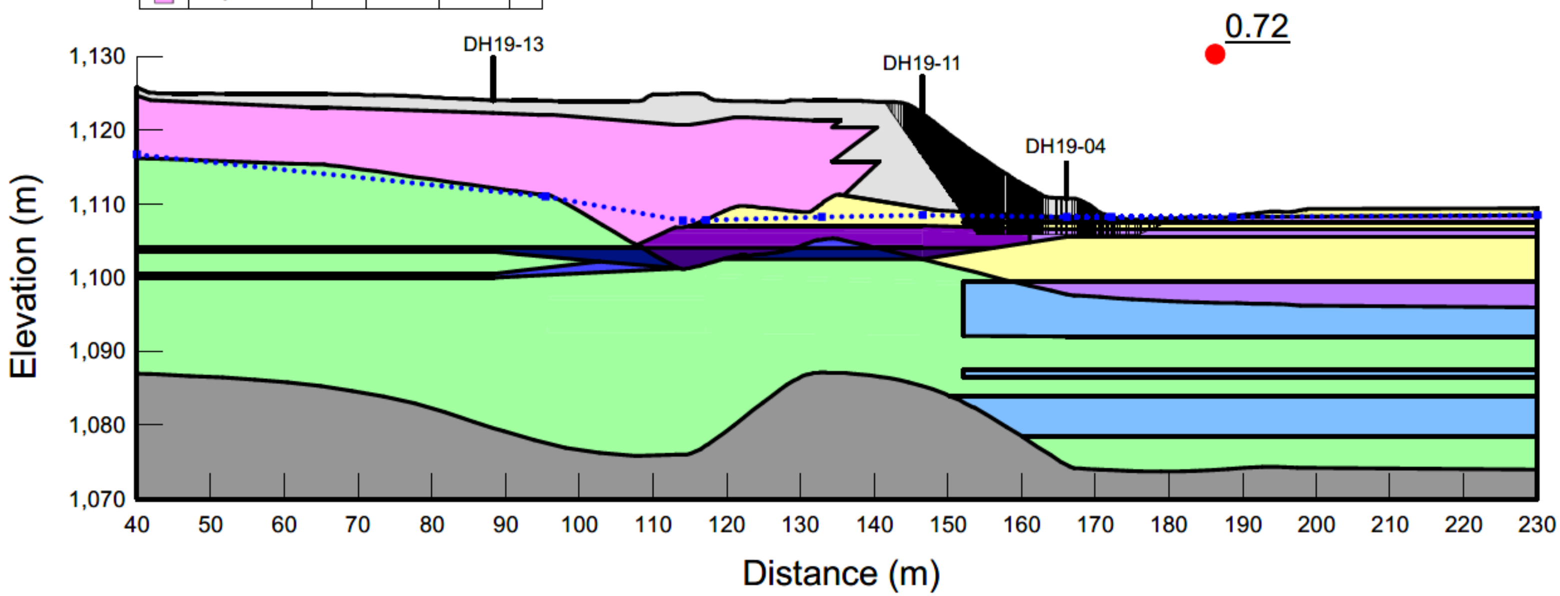
TP2 – Section B-B'
Post-Seismic Loading with No Remediation via Deep Rotational Failure

PROJECT NO.	DWN	CKD	APVD	REV
ENW.WENW03039-05	CP	EW	GDK	0

OFFICE	DATE
EBA-EDMONTON	March 2021

Figure D.34

Color	Name	Unit Weight (kN/m³)	Tau/Sigma Ratio	Cohesion' (kPa)	Phi' (°)
	Bedrock				
	Dam Fill (Waste Rock)	20		0	39
	Fluvial	18		0	34
	Fluvial (Liquefiable - High)	18	0.11		
	Fluvial (Liquefiable - Low)	18	0.06		
	Fluvial (Liquefiable - Med)	18	0.09		
	Glaciofluvial	19		0	34
	Glaciofluvial (Liquefiable - High)	19	0.11		
	Glaciofluvial (Liquefiable - Low)	19	0		
	Glaciofluvial (Liquefiable - Med)	19	0.09		
	Tailings	21		0	33



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NOTES

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TETRA TECH

Geotechnical Assessment of Existing Tailings Facilities, Cantung Mine, NT

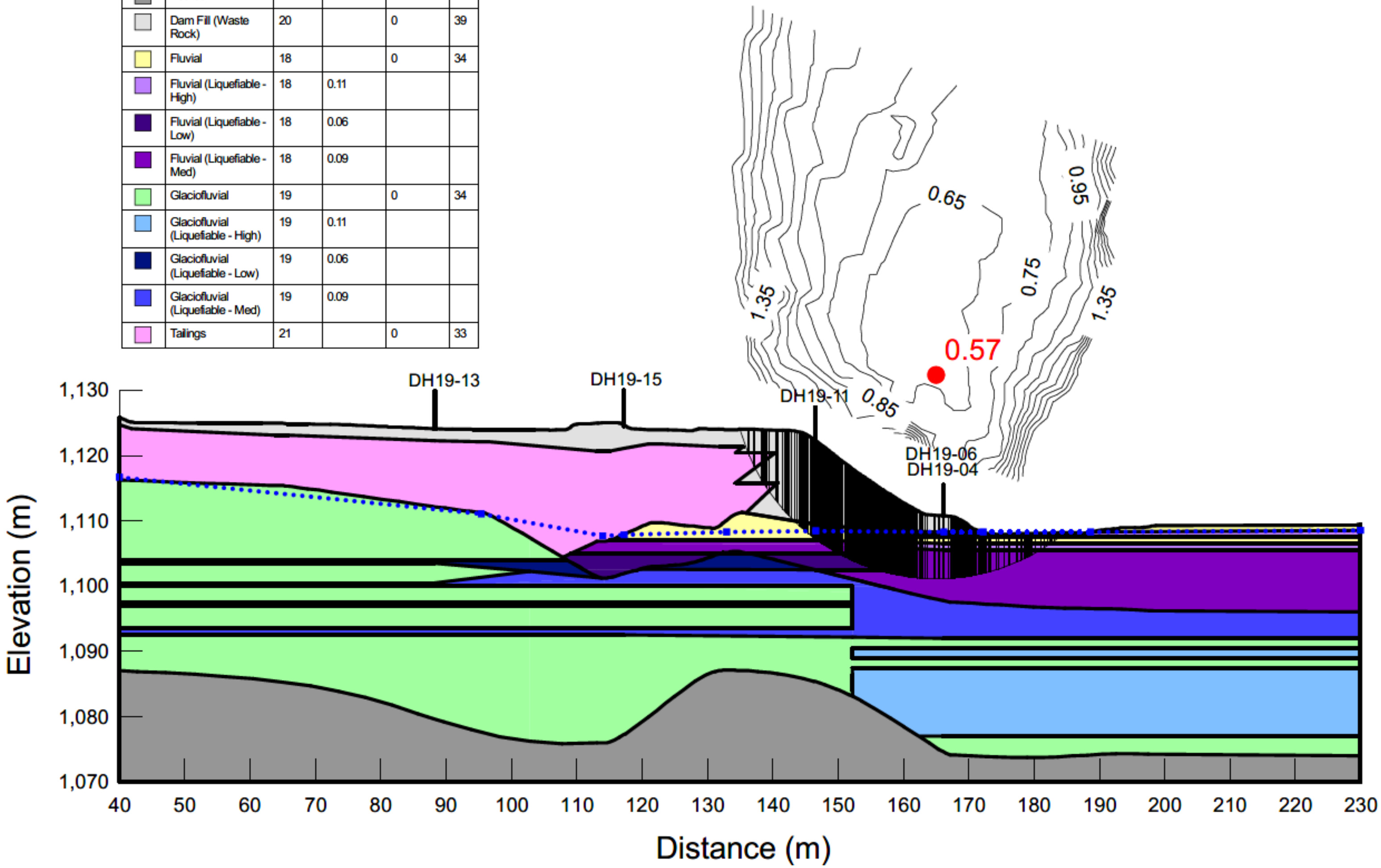
TP2 – Section B-B'
Post-Seismic Loading with No Remediation via Translational Failure

PROJECT NO.	DWN	CKD	APVD	REV
ENW.WENW03039-05	CP	EW	GDK	0

OFFICE	DATE
EBA-EDMONTON	March 2021

Figure D.35

Color	Name	Unit Weight (kN/m³)	Tau/Sigma Ratio	Cohesion' (kPa)	Phi' (°)
	Bedrock				
	Dam Fill (Waste Rock)	20		0	39
	Fluvial	18		0	34
	Fluvial (Liquefiable - High)	18	0.11		
	Fluvial (Liquefiable - Low)	18	0.06		
	Fluvial (Liquefiable - Med)	18	0.09		
	Glaciofluvial	19		0	34
	Glaciofluvial (Liquefiable - High)	19	0.11		
	Glaciofluvial (Liquefiable - Low)	19	0.06		
	Glaciofluvial (Liquefiable - Med)	19	0.09		
	Tailings	21		0	33



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TETRA TECH

Geotechnical Assessment of Existing Tailings Facilities, Cantung Mine, NT

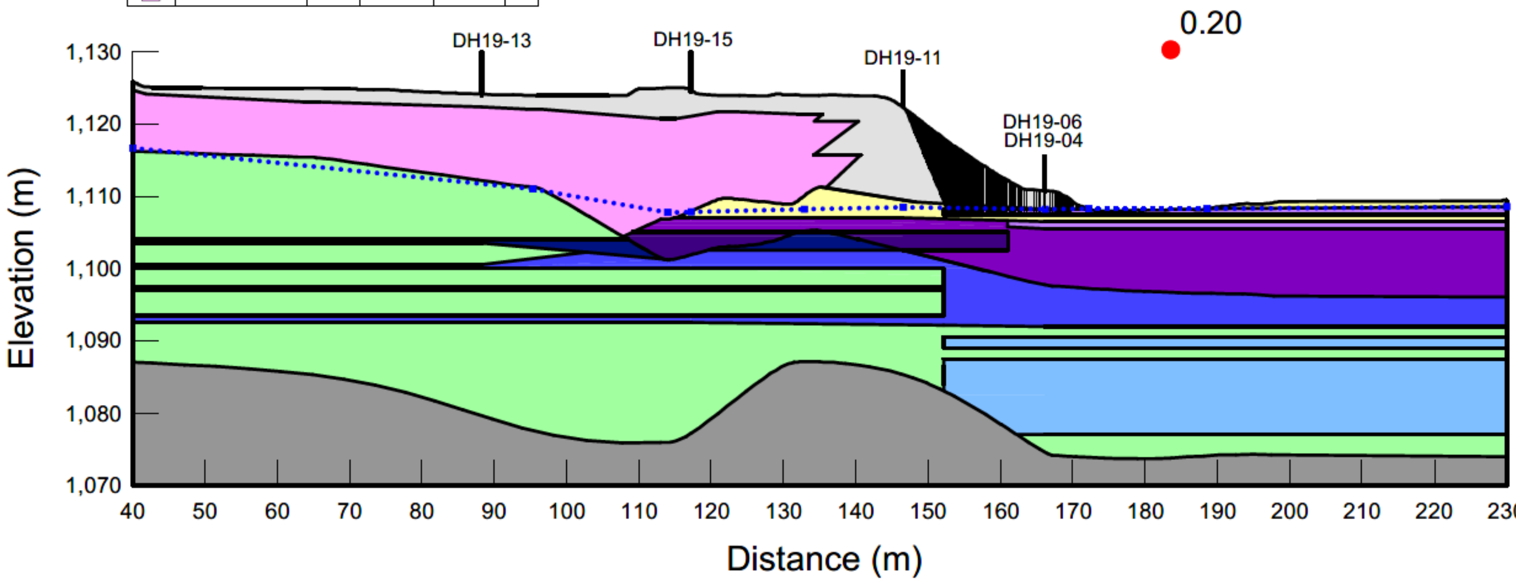
TP2 – Section B-B'$_2$
Post-Seismic Loading with No Remediation via Deep Rotational Failure

PROJECT NO.	DWN	CKD	APVD	REV
ENW.WENW03039-05	CP	EW	GDK	0

OFFICE	DATE
EBA-EDMONTON	March 2021

Figure D.36

Color	Name	Unit Weight (kN/m³)	Tau/Sigma Ratio	Cohesion' (kPa)	Phi' (°)
	Bedrock				
	Dam Fill (Waste Rock)	20		0	39
	Fluvial	18		0	34
	Fluvial (Liquefiable - High)	18	0.11		
	Fluvial (Liquefiable - Low)	18	0.06		
	Fluvial (Liquefiable - Med)	18	0.09		
	Glaciofluvial	19		0	34
	Glaciofluvial (Liquefiable - High)	19	0.11		
	Glaciofluvial (Liquefiable - Low)	19	0.06		
	Glaciofluvial (Liquefiable - Med)	19	0.09		
	Tailings	21		0	33



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TETRA TECH

Geotechnical Assessment of Existing Tailings Facilities, Cantung Mine, NT

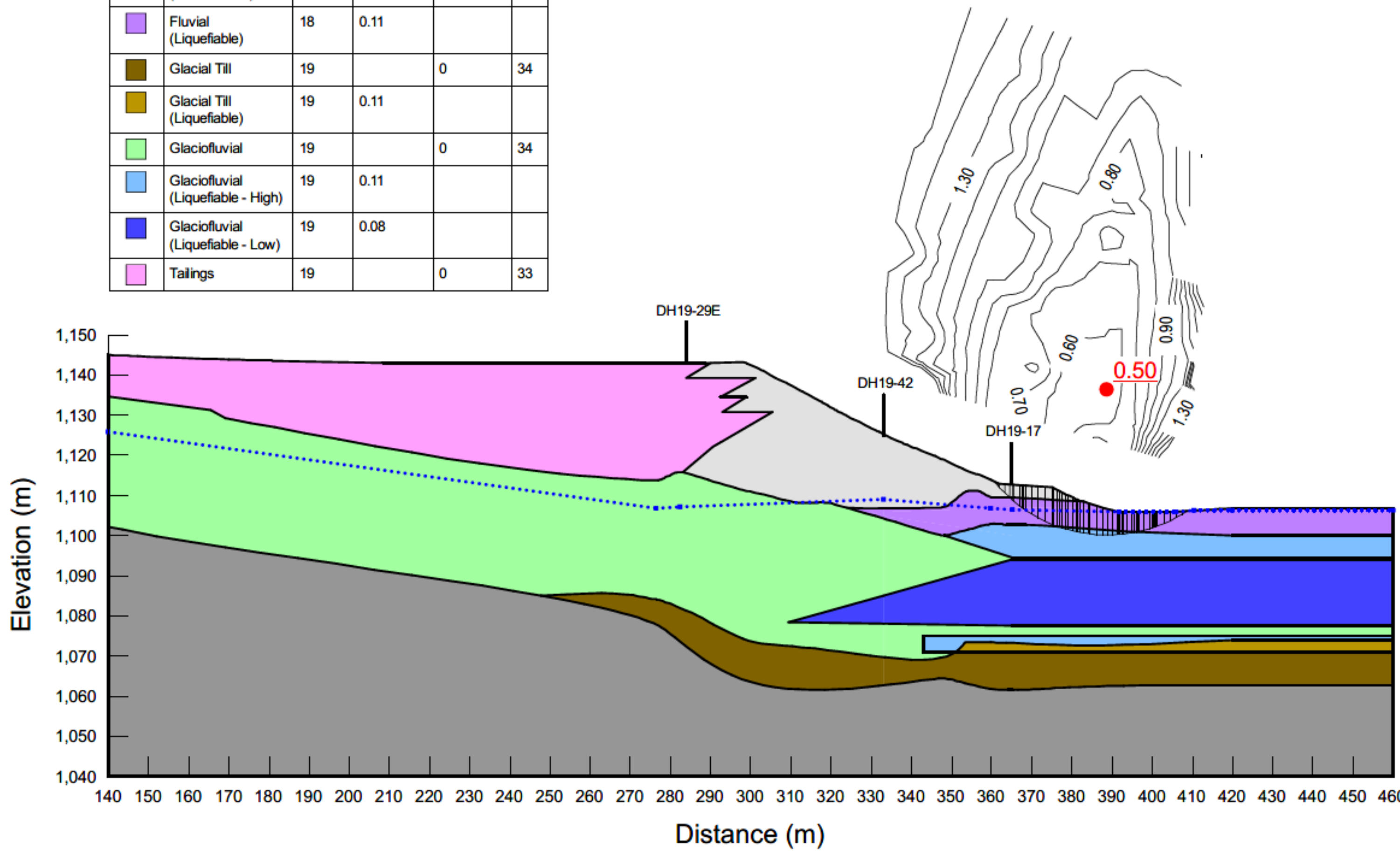
TP2 – Section B-B'$_2$
Post-Seismic Loading with No Remediation via Translational Failure

PROJECT NO.	DWN	CKD	APVD	REV
ENW.WENW03039-05	CP	EW	GDK	0

OFFICE	DATE
EBA-EDMONTON	March 2021

Figure D.37

Color	Name	Unit Weight (kN/m³)	Tau/Sigma Ratio	Cohesion' (kPa)	Phi' (°)
	Bedrock				
	Dam Fill (Waste Rock)	20		0	39
	Fluvial (Liquefiable)	18	0.11		
	Glacial Till	19		0	34
	Glacial Till (Liquefiable)	19	0.11		
	Glaciofluvial	19		0	34
	Glaciofluvial (Liquefiable - High)	19	0.11		
	Glaciofluvial (Liquefiable - Low)	19	0.08		
	Tailings	19		0	33



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NORTH AMERICAN TUNGSTEN CORPORATION LTD

TETRA TECH

Geotechnical Assessment of Existing Tailings Facilities, Cantung Mine, NT

TP4 – Section C-C' Post-Seismic Loading with No Remediation via Deep Rotational Failure

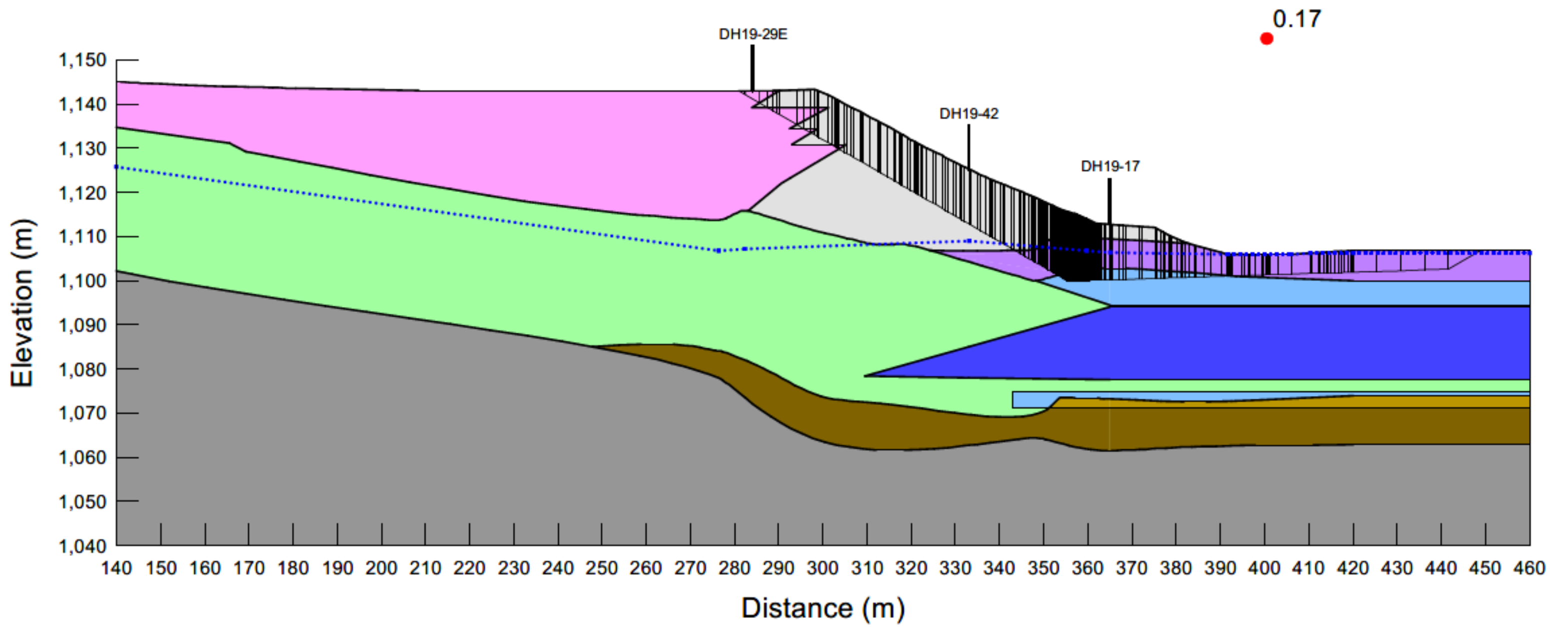
PROJECT NO.	DWN	CKD	APVD	REV
ENW.WENW03039-05	CP	EW	GDK	0

OFFICE: EBA-EDMONTON

DATE: March 2021

Figure D.38

Color	Name	Unit Weight (kN/m³)	Tau/Sigma Ratio	Cohesion' (kPa)	Phi' (°)
	Bedrock				
	Dam Fill (Waste Rock)	20		0	39
	Fluvial (Liquefiable)	18	0.11		
	Glacial Till	19		0	34
	Glacial Till (Liquefiable)	19	0.11		
	Glaciofluvial	19		0	34
	Glaciofluvial (Liquefiable - High)	19	0.11		
	Glaciofluvial (Liquefiable - Low)	19	0.08		
	Tailings	19		0	33



LEGEND

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Geotechnical Assessment of Existing Tailings Facilities, Cantung Mine, NT

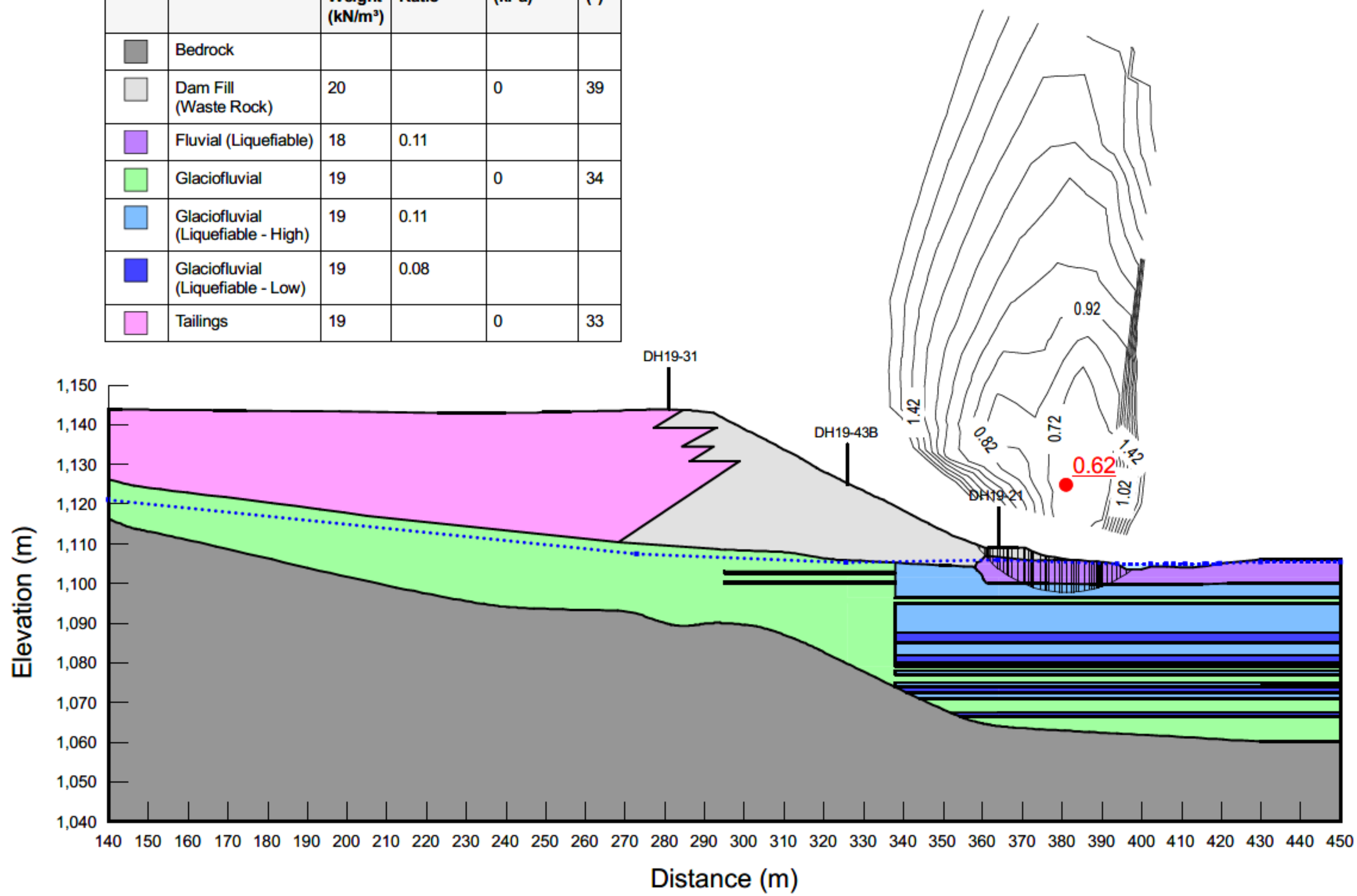
TP4 – Section C-C' Post-Seismic Loading with No Remediation via Translational Failure

PROJECT NO.	DWN	CKD	APVD	REV
ENW.WENW03039-05	CP	EW	GDK	0

OFFICE	DATE
EBA-EDMONTON	March 2021

Figure D.39

Color	Name	Unit Weight (kN/m³)	Tau/Sigma Ratio	Cohesion' (kPa)	Phi' (°)
	Bedrock				
	Dam Fill (Waste Rock)	20		0	39
	Fluvial (Liquefiable)	18	0.11		
	Glaciofluvial	19		0	34
	Glaciofluvial (Liquefiable - High)	19	0.11		
	Glaciofluvial (Liquefiable - Low)	19	0.08		
	Tailings	19		0	33



LEGEND

NOTES

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Geotechnical Assessment of Existing Tailings Facilities, Cantung Mine, NT

TP4 – Section D-D'
Post-Seismic Loading with No Remediation via Deep Rotational Failure

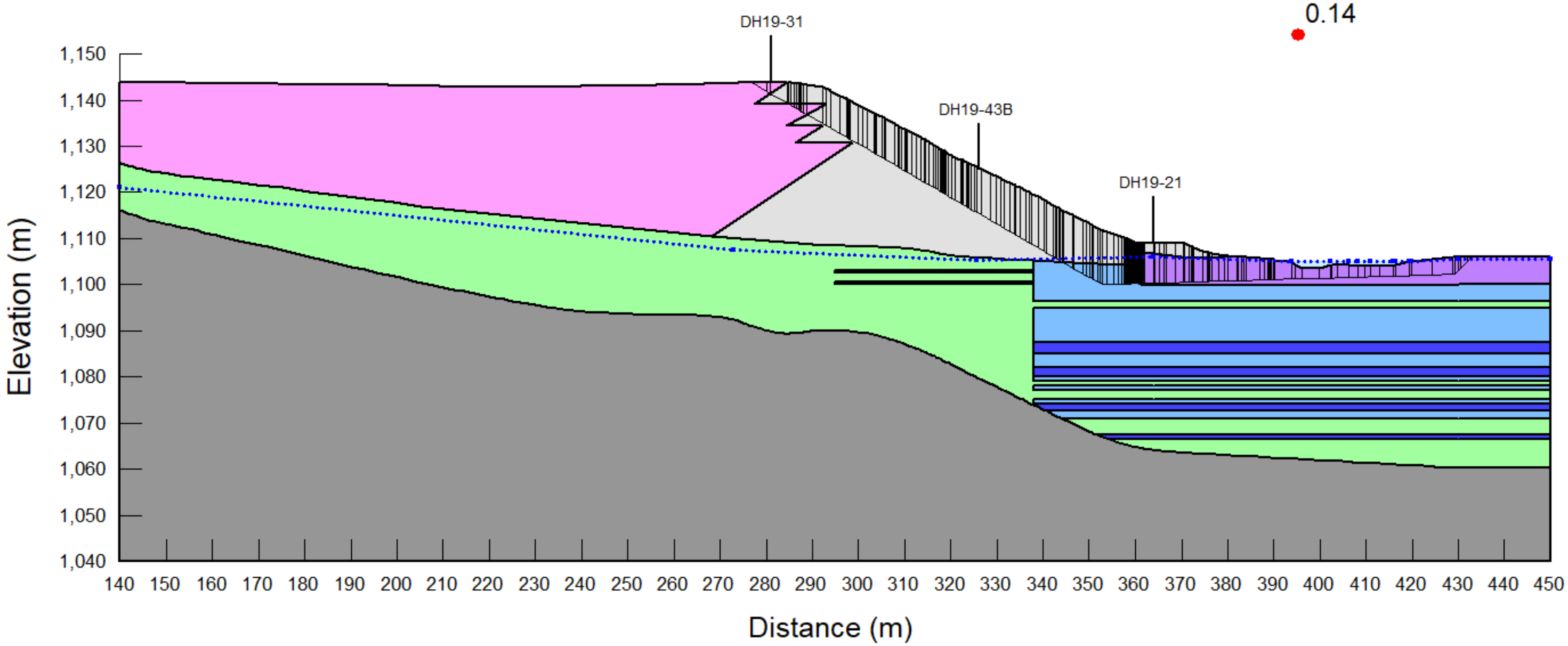
PROJECT NO.	DWN	CKD	APVD	REV
ENW.WENW03039-05	CP	EW	GDK	0

OFFICE	DATE
EBA-EDMONTON	March 2021

Figure D.40

121.08150, 1,219.0260 m

Color	Name	Unit Weight (kN/m³)	Tau/Sigma Ratio	Cohesion' (kPa)	Phi' (°)
	[illegible]				
	Dam Fill (Waste Rock)	20		0	39
	Fluvial (Liquefiable)	18	0.11		
	Glaciofluvial	19		0	34
	Glaciofluvial (Liquefiable - High)	19	0.11		
	Glaciofluvial (Liquefiable - Low)	19	0.08		
	Tailings	19		0	33



LEGEND

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Geotechnical Assessment of Existing Tailings Facilities, Cantung Mine, NT

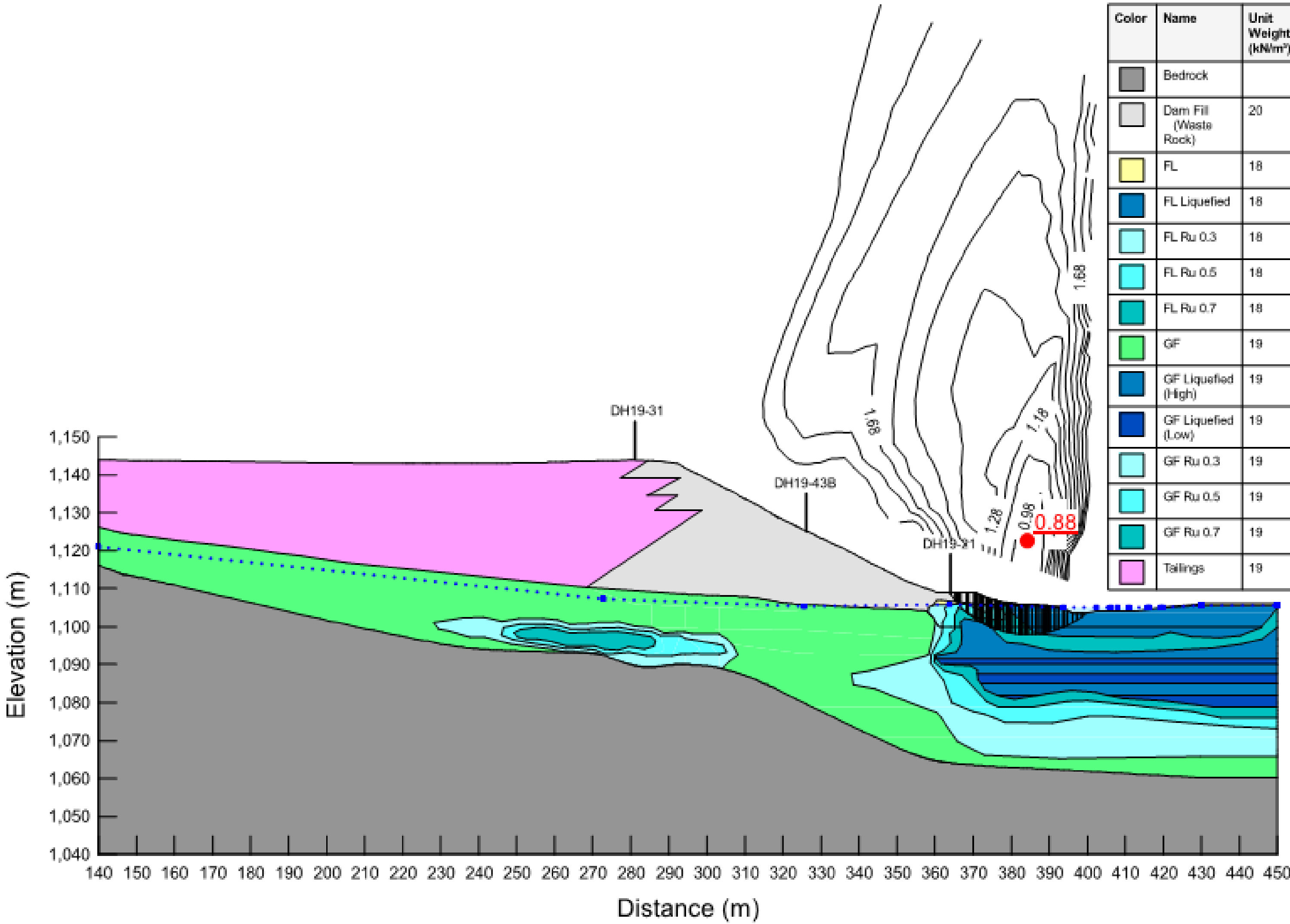
TP4 – Section D-D' Post-Seismic Loading with No Remediation via Translational Failure

PROJECT NO.	DWN	CKD	APVD	REV
ENW.WENW03039-05	CP	EW	GDK	0

OFFICE
EBA-EDMONTON

DATE
March 2021

Figure D.41



Color	Name	Unit Weight (kN/m³)	Tau/Sigma Ratio	Cohesion' (kPa)	Phi' (°)
	Bedrock				
	Dam Fill (Waste Rock)	20		0	39
	FL	18		0	34
	FL Liquefied	18	0.11		
	FL Ru 0.3	18		0	25
	FL Ru 0.5	18		0	19
	FL Ru 0.7	18		0	11
	GF	19		0	34
	GF Liquefied (High)	19	0.11		
	GF Liquefied (Low)	19	0.08		
	GF Ru 0.3	19		0	25
	GF Ru 0.5	19		0	19
	GF Ru 0.7	19		0	11
	Tailings	19		0	33

LEGEND

NOTES

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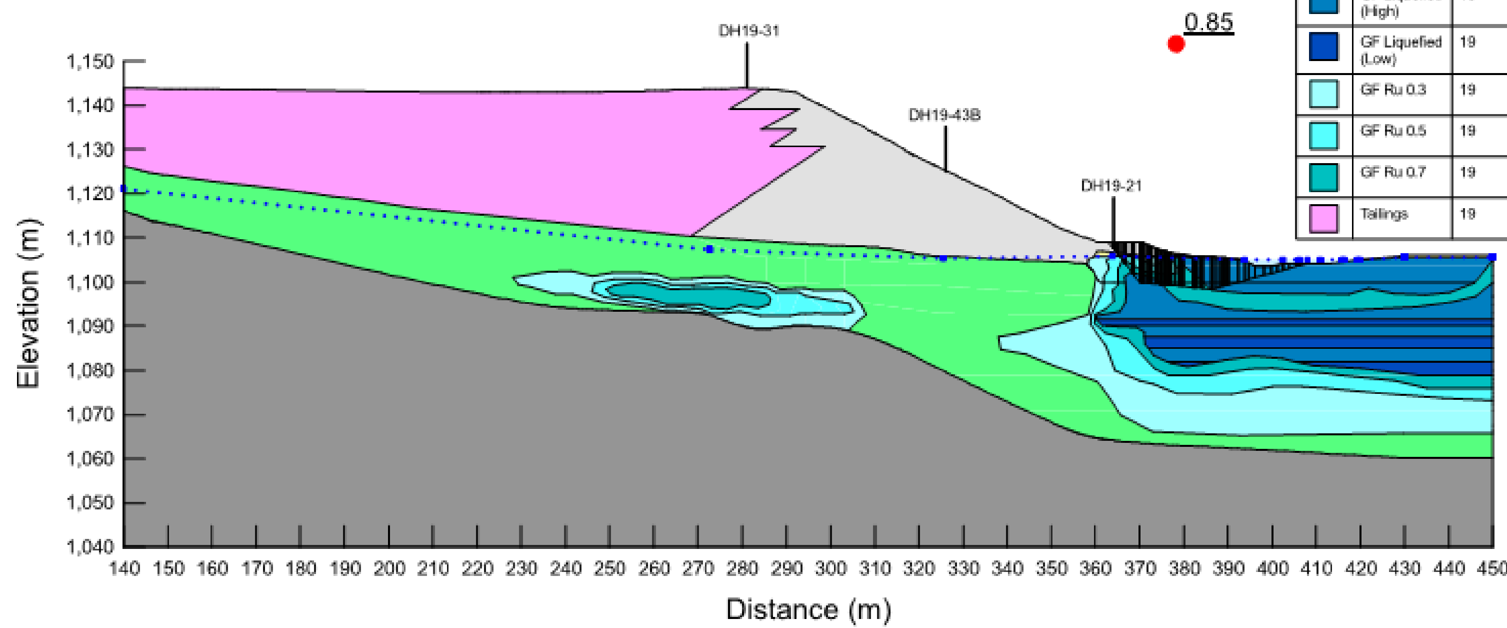
Geotechnical Assessment of Existing Tailings Facilities, Cantung Mine, NT

TP4 – Section D-D' [FLAC Layers] Post-Seismic Loading with No Remediation via Deep Rotational Failure

PROJECT NO.	DWN	CKD	APVD	REV
ENW.WENW03039-05	EW	CP	GDK	0

OFFICE	DATE
EBA-EDMONTON	March 2021

Figure D.42



Color	Name	Unit Weight (kN/m³)	Tau/Sigma Ratio	Cohesion' (kPa)	Phi' (°)
	Bedrock				
	Dam Fill (Waste Rock)	20		0	39
	FL	18		0	34
	FL Liquefied	18	0.11		
	FL Ru 0.3	18		0	25
	FL Ru 0.5	18		0	19
	FL Ru 0.7	18		0	11
	GF	19		0	34
	GF Liquefied (High)	19	0.11		
	GF Liquefied (Low)	19	0.08		
	GF Ru 0.3	19		0	25
	GF Ru 0.5	19		0	19
	GF Ru 0.7	19		0	11
	Tailings	19		0	33

LEGEND

NOTES

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Geotechnical Assessment of Existing Tailings Facilities, Cantung Mine, NT

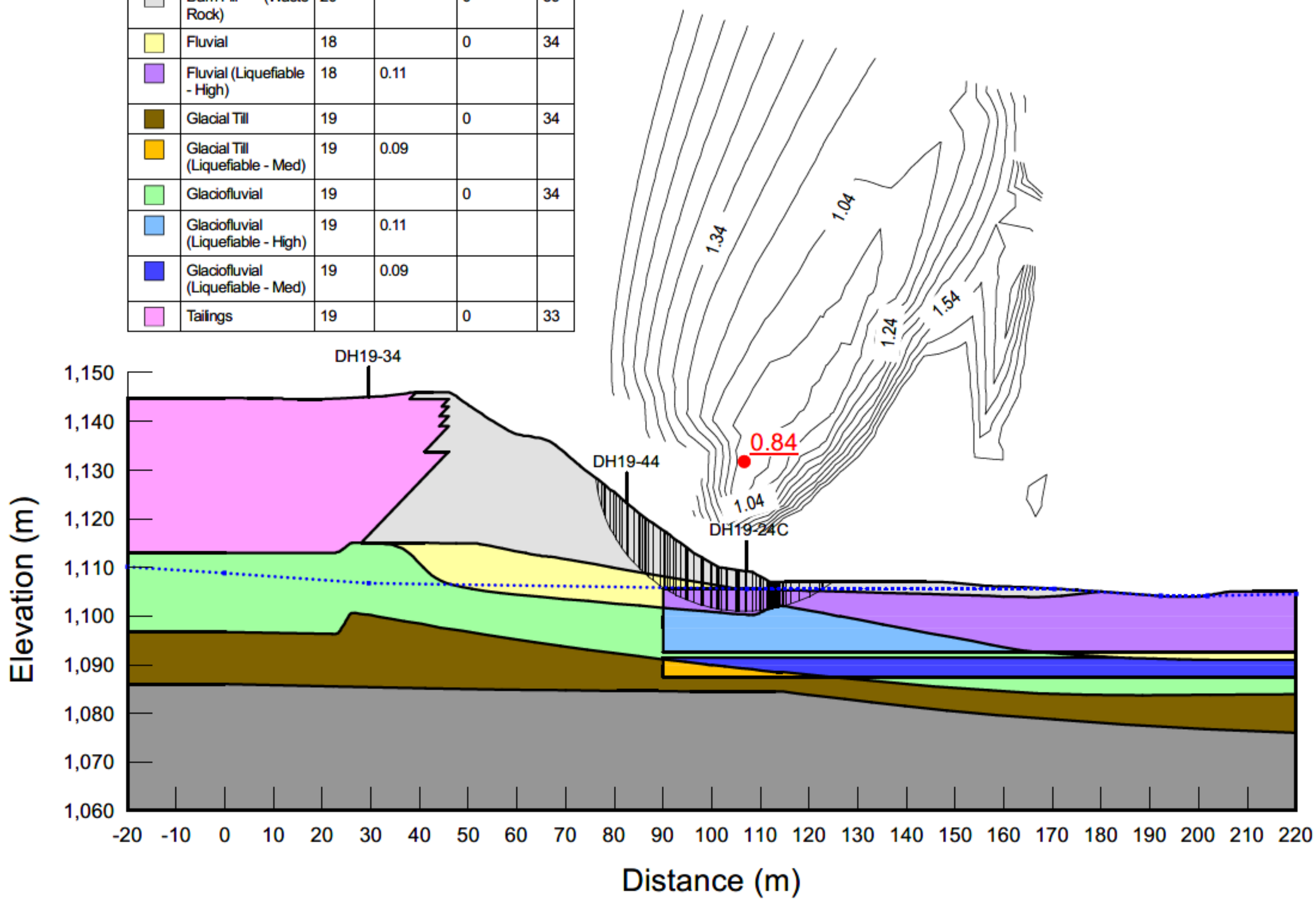
TP4 – Section D-D' [FLAC Layers] Post-Seismic Loading with No Remediation via Translational Failure

PROJECT NO.	DWN	CKD	APVD	REV
ENW.WENW03039-05	EW	CP	GDK	0

OFFICE	DATE
EBA-EDMONTON	March 2021

Figure D.43

Color	Name	Unit Weight (kN/m³)	Tau/Sigma Ratio	Cohesion' (kPa)	Phi' (°)
	Bedrock				
	Dam Fill (Waste Rock)	20		0	39
	Fluvial	18		0	34
	Fluvial (Liquefiable - High)	18	0.11		
	Glacial Till	19		0	34
	Glacial Till (Liquefiable - Med)	19	0.09		
	Glaciofluvial	19		0	34
	Glaciofluvial (Liquefiable - High)	19	0.11		
	Glaciofluvial (Liquefiable - Med)	19	0.09		
	Tailings	19		0	33



LEGEND

NOTES

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Geotechnical Assessment of Existing Tailings Facilities, Cantung Mine, NT

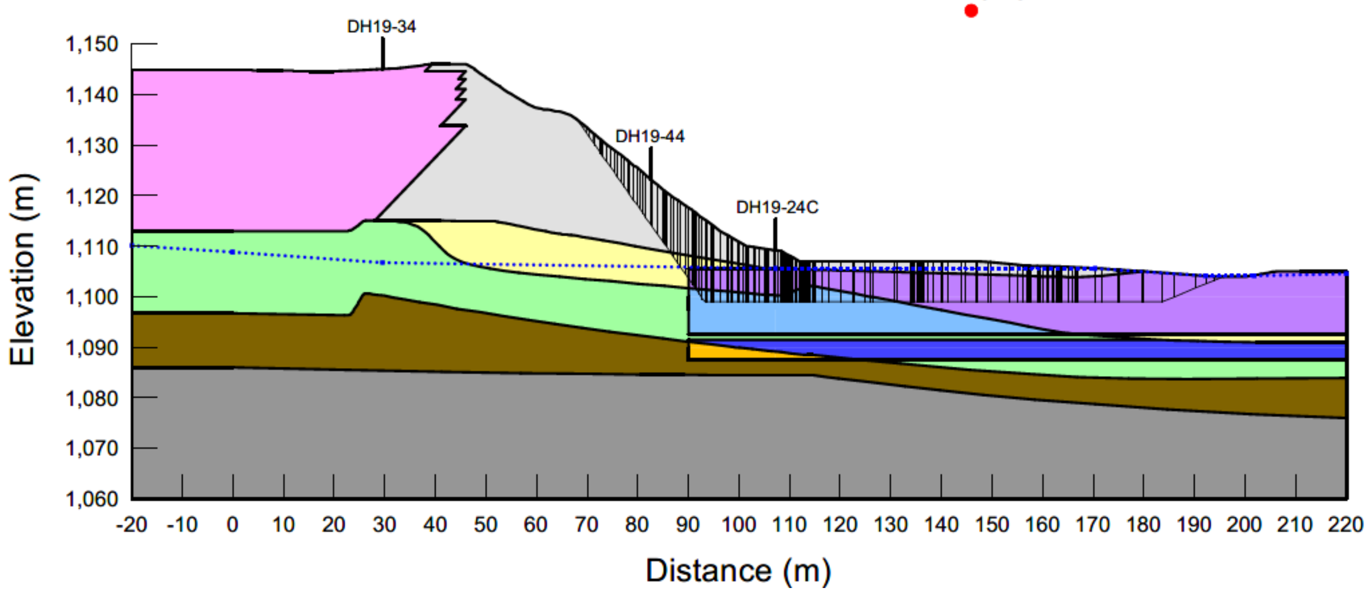
TP3 – Section F-F'
Post-Seismic Loading with No Remediation via Deep Rotational Failure

PROJECT NO.	DWN	CKD	APVD	REV
ENW.WENW03039-05	CP	EW	GDK	0

OFFICE	DATE
EBA-EDMONTON	March 2021

Figure D.44

Color	Name	Unit Weight (kN/m³)	Tau/Sigma Ratio	Cohesion' (kPa)	Phi' (°)
	Bedrock				
	Dam Fill (Waste Rock)	20		0	39
	Fluvial	18		0	34
	Fluvial (Liquefiable - High)	18	0.11		
	Glacial Till	19		0	34
	Glacial Till (Liquefiable - Med)	19	0.09		
	Glaciofluvial	19		0	34
	Glaciofluvial (Liquefiable - High)	19	0.11		
	Glaciofluvial (Liquefiable - Med)	19	0.09		
	Tailings	19		0	33



LEGEND

NOTES

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Geotechnical Assessment of Existing Tailings Facilities, Cantung Mine, NT

TP3 – Section F-F'
Post-Seismic Loading with No Remediation via Translational Failure

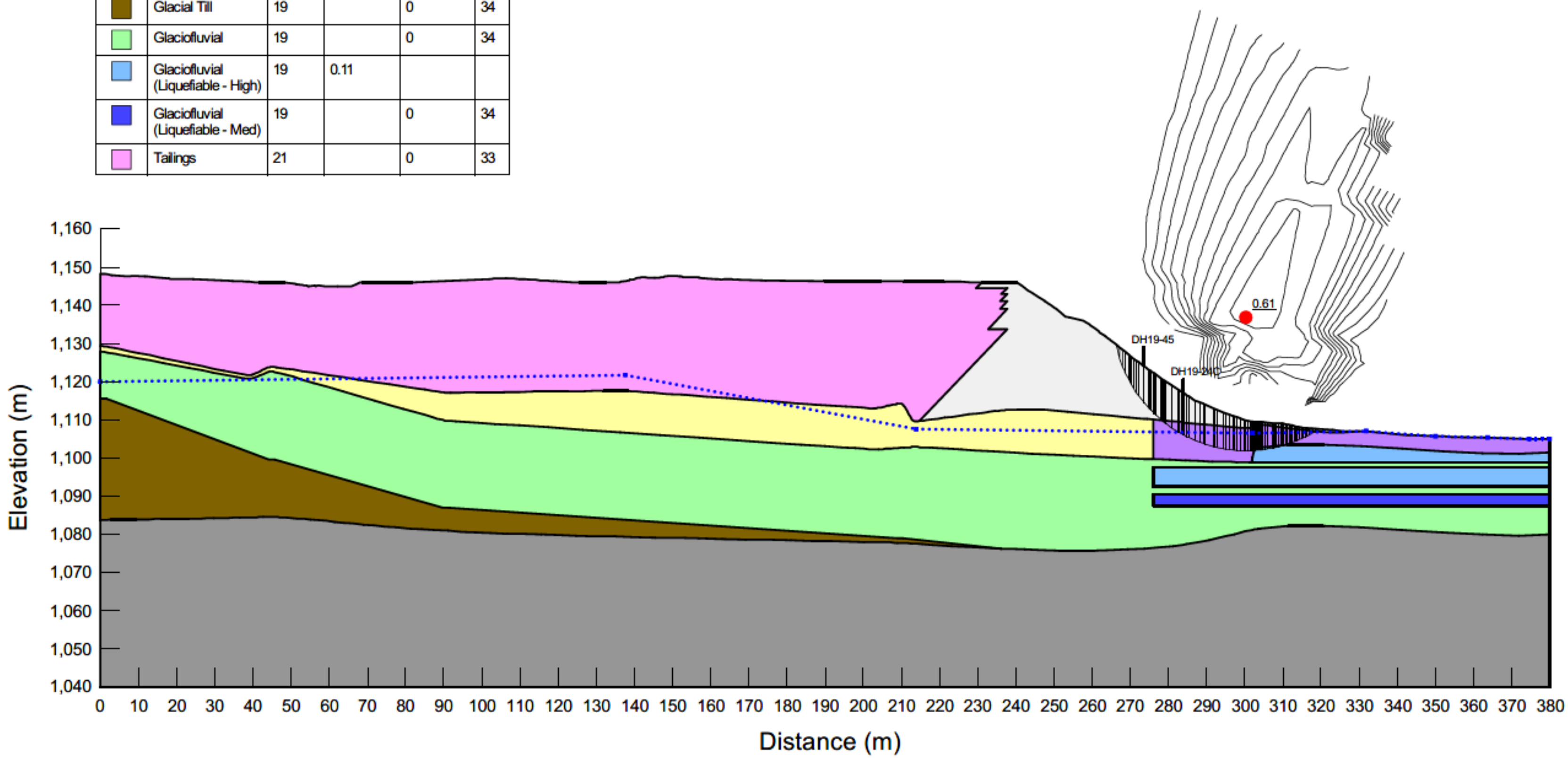
PROJECT NO.	DWN	CKD	APVD	REV
ENW.WENW03039-05	CP	EW	GDK	0

OFFICE
EBA-EDMONTON

DATE
March 2021

Figure D.45

Color	Name	Unit Weight (kN/m³)	Tau/Sigma Ratio	Cohesion' (kPa)	Phi' (°)
	Bedrock				
	Dam Fill (Waste Rock)	20		0	39
	Fluvial	18		0	34
	Fluvial (Liquefiable - High)	18	0.11		
	Glacial Till	19		0	34
	Glaciofluvial	19		0	34
	Glaciofluvial (Liquefiable - High)	19	0.11		
	Glaciofluvial (Liquefiable - Med)	19		0	34
	Tailings	21		0	33



LEGEND

NOTES

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TETRA TECH

Geotechnical Assessment of Existing Tailings Facilities, Cantung Mine, NT

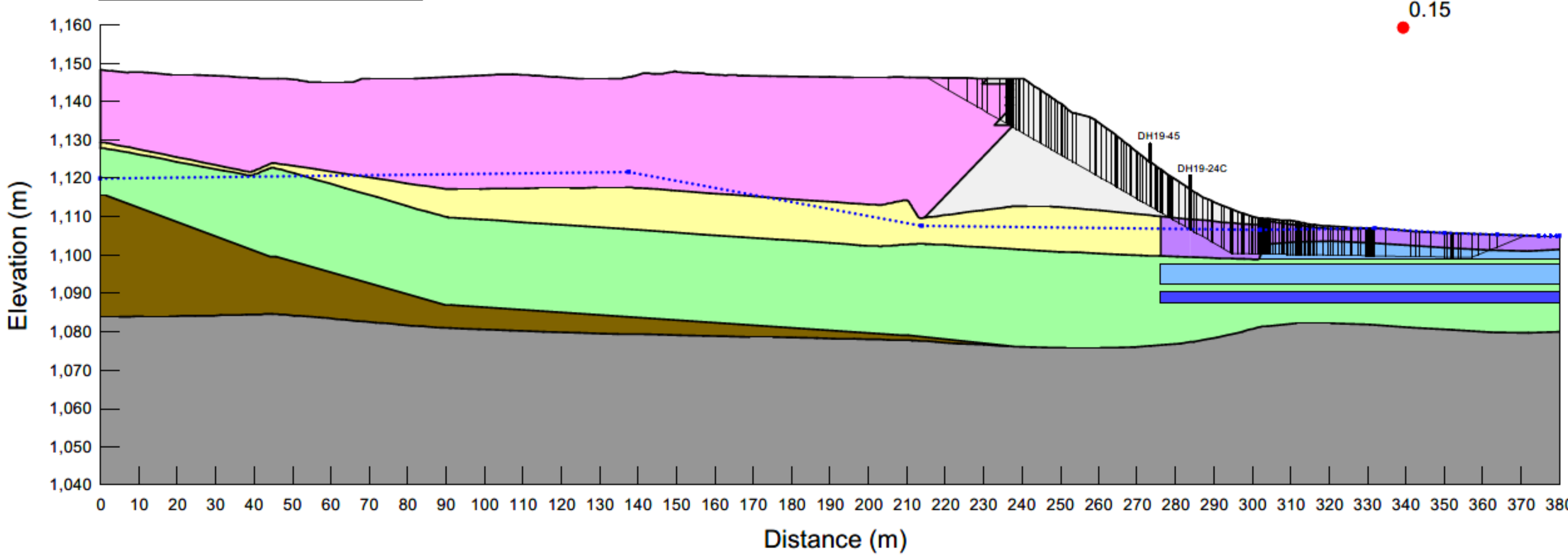
TP3 – Section G-G'
Post-Seismic Loading with No Remediation via Deep Rotational Failure

PROJECT NO.	DWN	CKD	APVD	REV
ENW.WENW03039-05	CP	EW	GDK	0

OFFICE	DATE
EBA-EDMONTON	March 2021

Figure D.46

Color	Name	Unit Weight (kN/m³)	Tau/Sigma Ratio	Cohesion' (kPa)	Phi' (°)
	Bedrock				
	Dam Fill (Waste Rock)	20		0	39
	Fluvial	18		0	34
	Fluvial (Liquefiable)	18	0.11		
	Glacial Till	19		0	34
	Glaciofluvial	19		0	34
	Glaciofluvial (Liquefiable - Med)	19		0	32
	Glaciofluvial (Liquefiable)	19	0.11		
	Tailings	21		0	33



LEGEND

NOTES

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Geotechnical Assessment of Existing Tailings Facilities, Cantung Mine, NT

TP3 – Section G-G' Post-Seismic Loading with No Remediation via Translational Failure

PROJECT NO.	DWN	CKD	APVD	REV
ENW.WENW03039-05	CP	EW	GDK	0

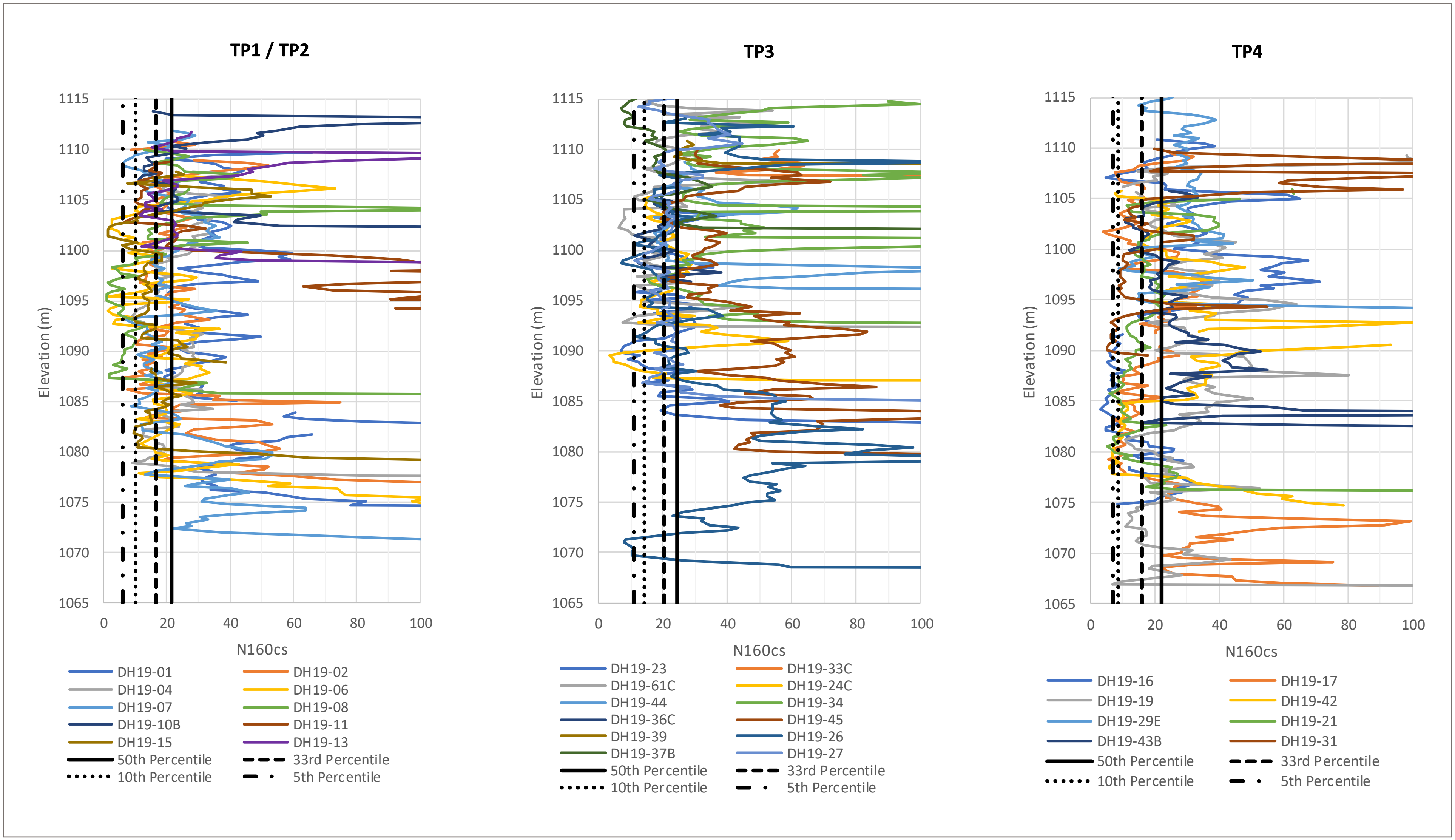
OFFICE
EBA-EDMONTON

DATE
March 2021

Figure D.47

APPENDIX E

DEFORMATION ANALYSIS FIGURES



LEGEND

Calculated N160cs Percentile Values:

Percentile	TP1 / TP2	TP3	TP4
5th	6	11	7
10th	10	14	9
33rd	16	21	16
50th	21	25	22
Average	30	35	27

NOTES

The plots show iBPT data from El. 1115 m to El. 1065 m. The specific elevation ranges of foundation soils were estimated for each testhole based on the geological model.

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Geotechnical Assessment of Existing Tailings Facilities, Cantung Mine, NT

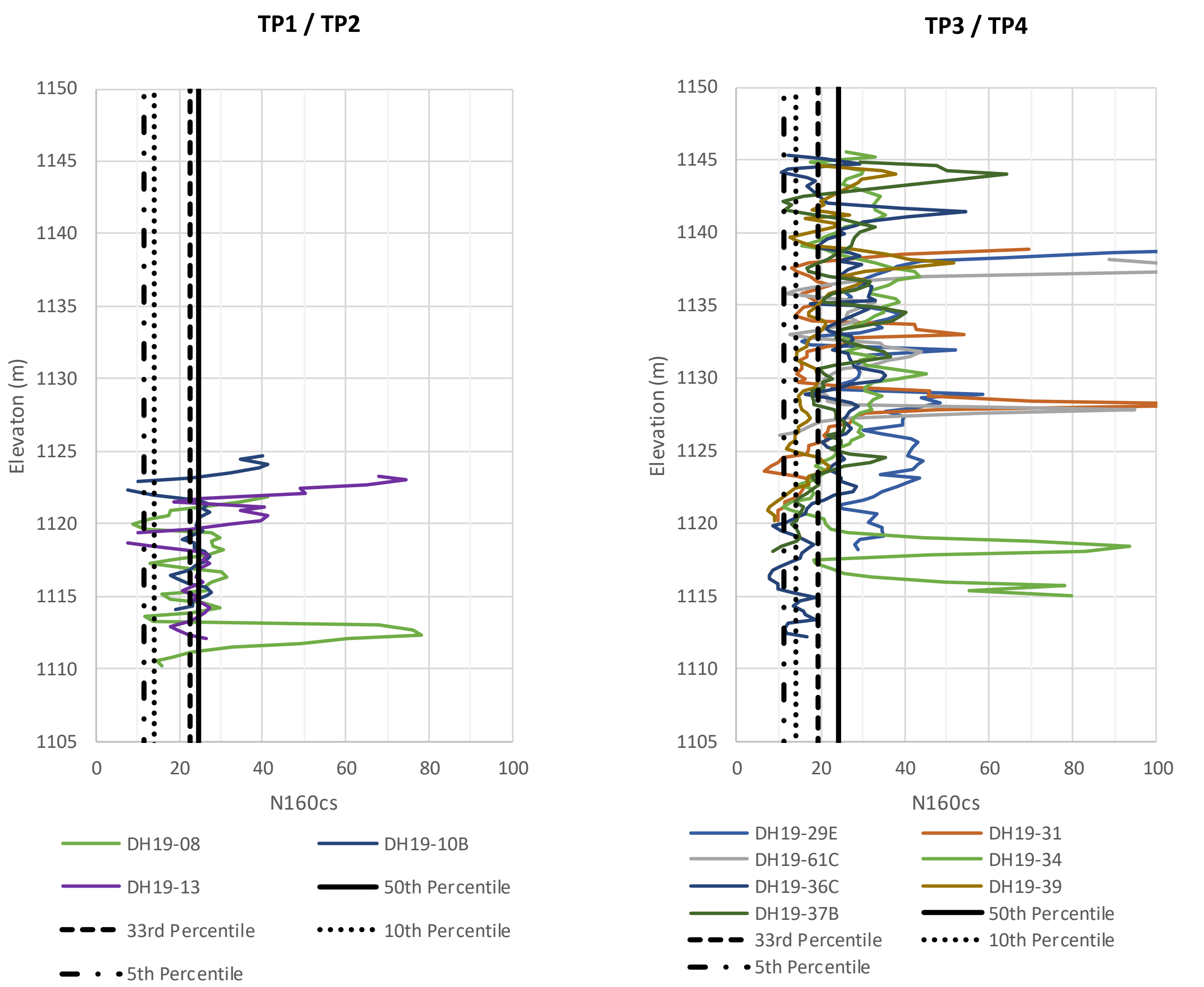
Calculated N160cs from iBPT Data Foundation Soils

PROJECT NO.	DWN	CKD	APVD	REV
ENW.WENW03039-05	EW	AA	AA	0

OFFICE: EBA-VANC

DATE: March 2021

Figure E.1



LEGEND

Calculated N160cs Percentile Values:

Percentile	TP1 / TP2	TP3 / TP4
5th	12	11
10th	14	14
33rd	23	19
50th	25	24
Average	26	27

NOTES

The plots show iBPT data from El. 1150 m to El. 1105 m. The specific elevation ranges of the tailings were estimated for each testhole based on the geological model.

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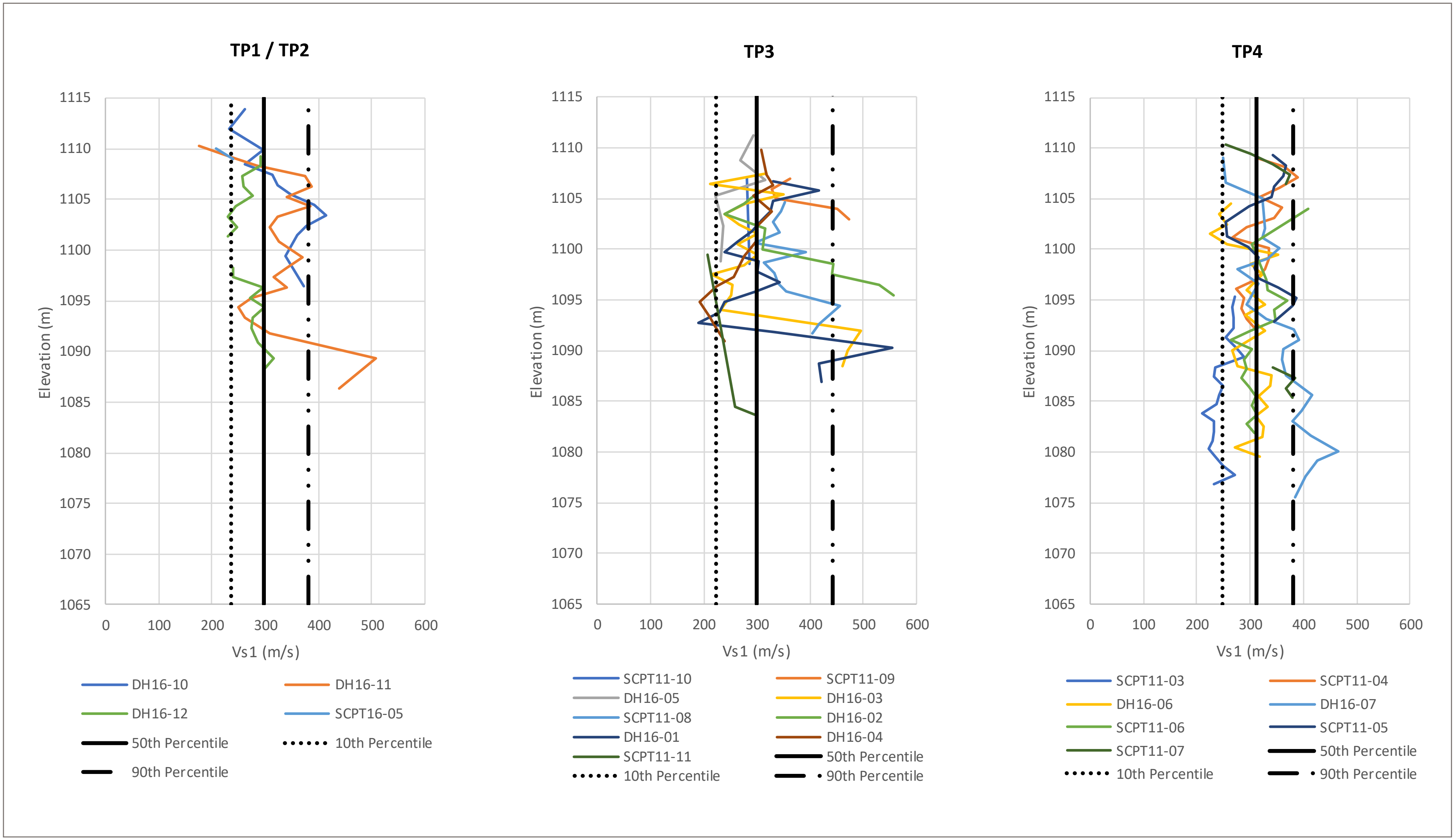
Geotechnical Assessment of Existing Tailings Facilities, Cantung Mine, NT

Calculated N160cs from iBPT Data Tailings

PROJECT NO.	DWN	CKD	APVD	REV
ENW.WENW03039-05	EW	AA	AA	0

OFFICE	DATE
EBA-VANC	March 2021

Figure E.2



LEGEND

Calculated Vs1 Percentile Values (m/s):

Percentile	TP1 / TP2	TP3	TP4
10th	235	225	250
50th	300	300	310
90th	380	445	380
Average	305	310	315

NOTES

The plots show Vs1 data from El. 1115 m to El. 1065 m. The specific elevation ranges of the foundation soils were estimated for each testhole based on the geological model.

Vs1 = shear wave velocity normalized for a reference stress level of 1 atm

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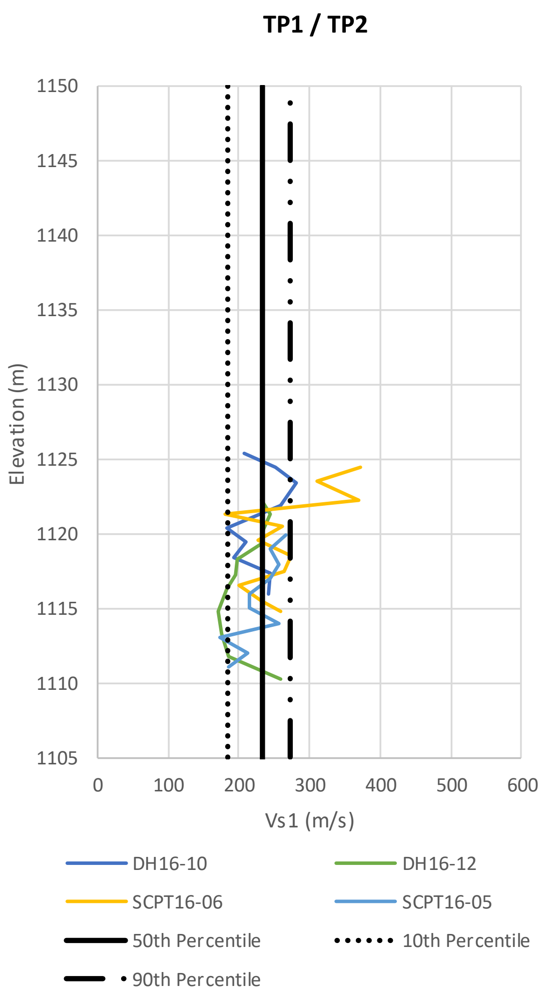
Geotechnical Assessment of Existing Tailings Facilities, Cantung Mine, NT

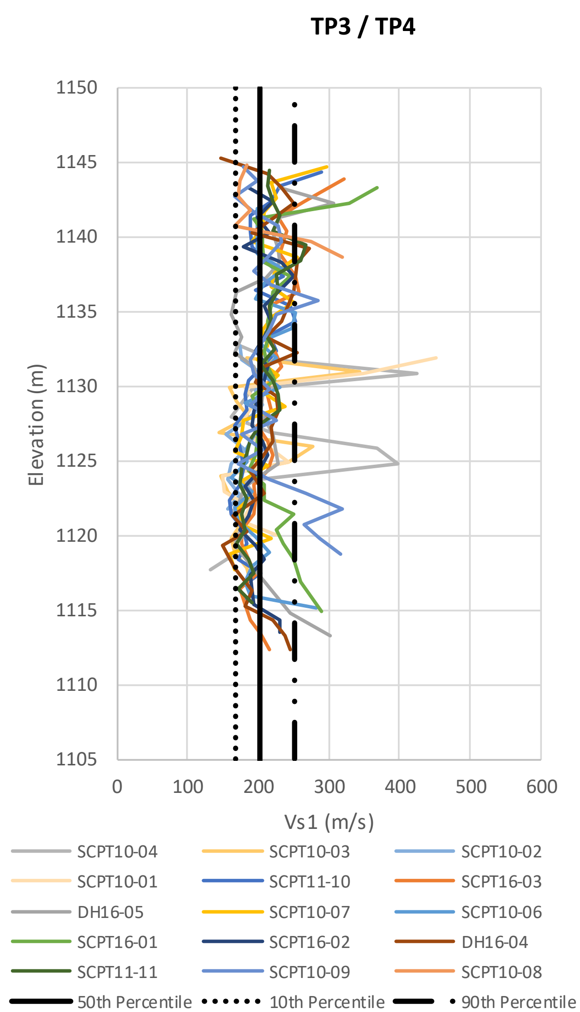
Reference Shear Wave Velocity, Vs1 Foundation Soils

PROJECT NO.	DWN	CKD	APVD	REV
ENW.WENW03039-05	EW	AA	AA	0

OFFICE	DATE
EBA-VANC	March 2021

Figure E.3





LEGEND

Calculated Vs1 Percentile Values (m/s):

Percentile	TP1 / TP2	TP3 / TP4
10th	185	170
50th	235	205
90th	275	250
Average	235	210

NOTES

The plots show Vs1 data from El. 1150 m to El. 1105 m. The specific elevation ranges of the tailings were estimated for each testhole based on the geological model.

Vs1 = shear wave velocity normalized for a reference stress level of 1 atm

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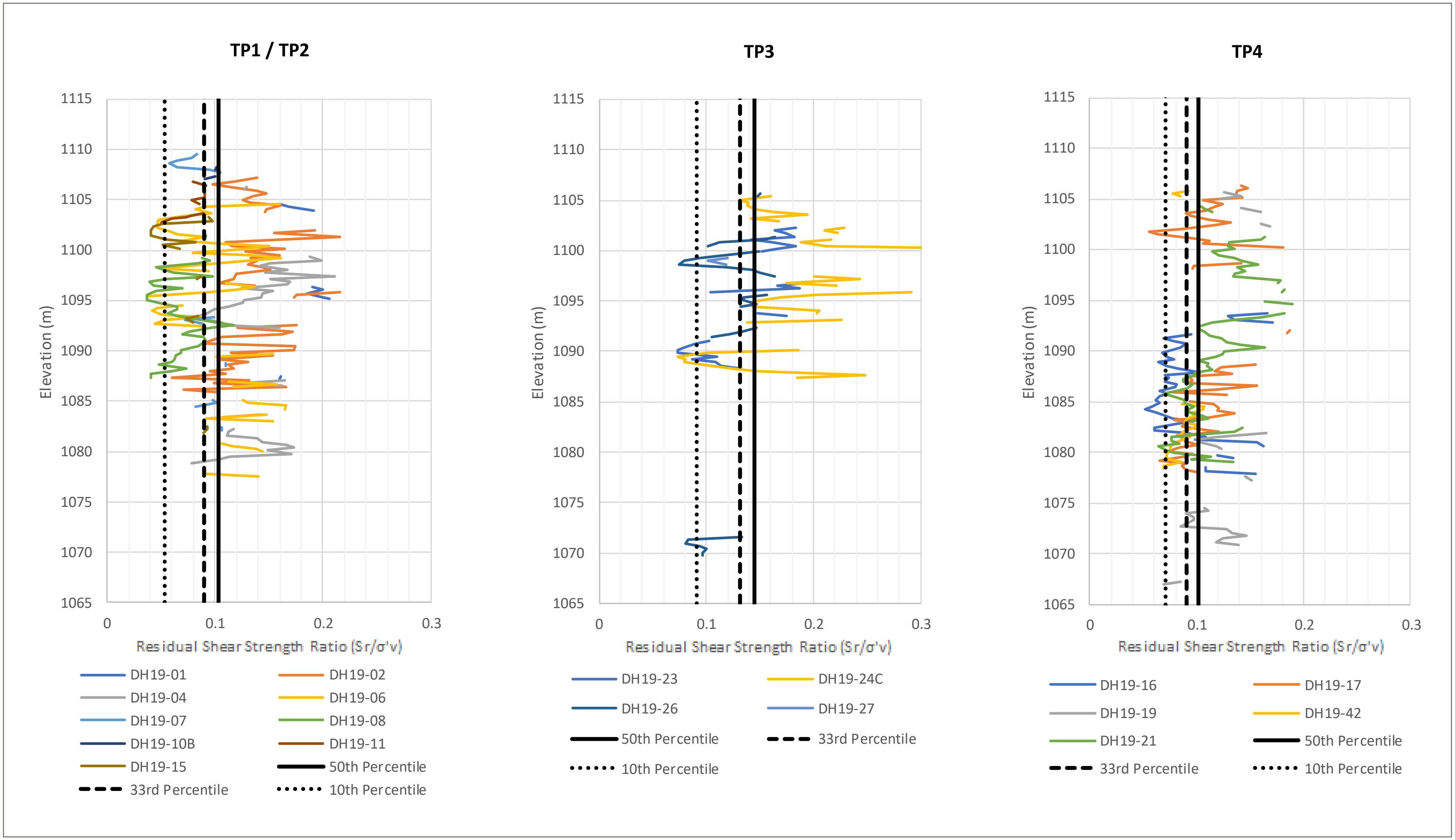
Geotechnical Assessment of Existing Tailings Facilities, Cantung Mine, NT

Reference Shear Wave Velocity, Vs1 Tailings

PROJECT NO.	DWN	CKD	APVD	REV
ENW.WENW03039-05	EW	AA	AA	0

OFFICE	DATE
EBA-VANC	March 2021

Figure E.4



LEGEND

Calculated Residual Shear Strength Ratio Percentile Values:

Percentile	TP1 / TP2	TP3	TP4
5th	0.05	0.08	0.07
10th	0.05	0.09	0.07
33rd	0.09	0.13	0.09
50th	0.10	0.14	0.10
Average	0.11	0.15	0.11

NOTES

The plots show post-liquefaction residual shear strength ratios calculated based on Idriss & Boulanger (2008) for soils with a factor of safety against liquefaction (FS_{liq}) of less than 1.1.

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Geotechnical Assessment of Existing Tailings Facilities, Cantung Mine, NT

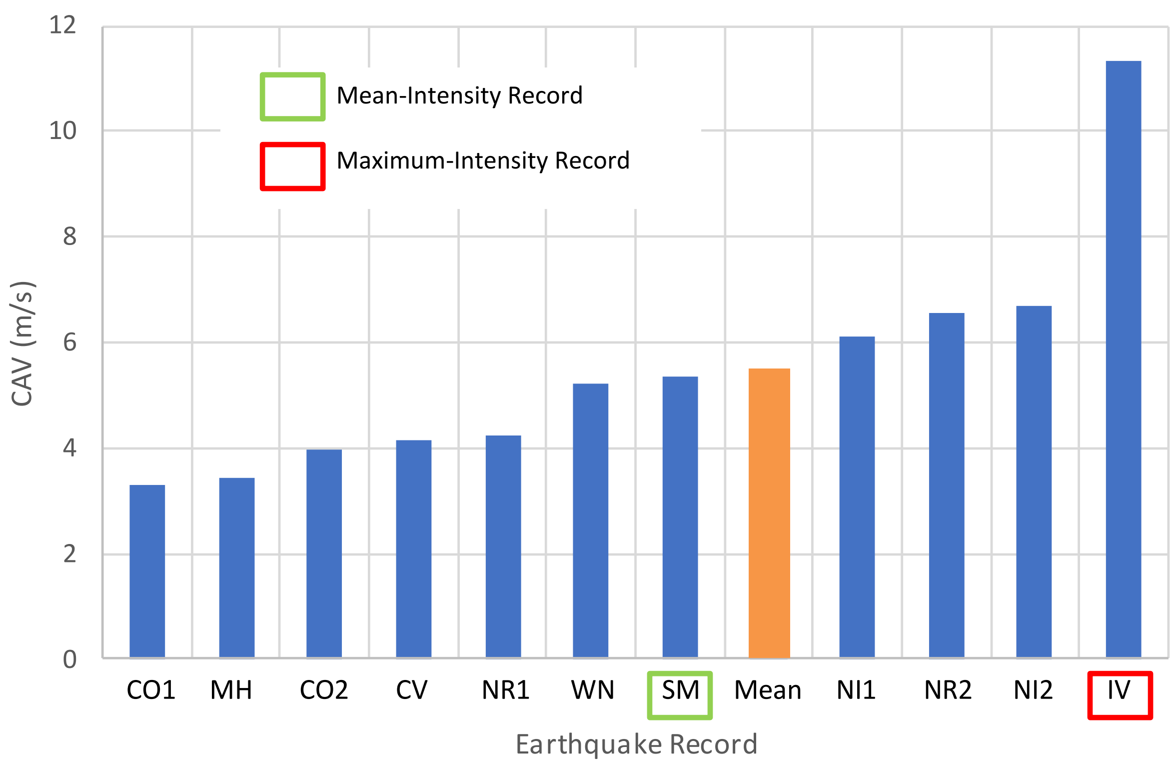
Calculated Residual Strength Ratios from iBPT Data

PROJECT NO.	DWN	CKD	APVD	REV
ENW.WENW03039-05	EW	AA	AA	0

OFFICE	DATE
EBA-VANC	March 2021

Figure E.5

Cumulative Absolute Velocity (CAV) for each Earthquake Record



LEGEND

Earthquake Records:
IV: Imperial Valley, 1979
CO1, 2: Coalinga, 1983
MH: Morgan Hill, 1984
CV: Chalfant Valley, 1986
WN: Whittier Narrows, 1987
NR1, 2: Northridge, 1994
SM: Sierra Madre, 1991
NI1, 2: Niigata, Japan, 2004

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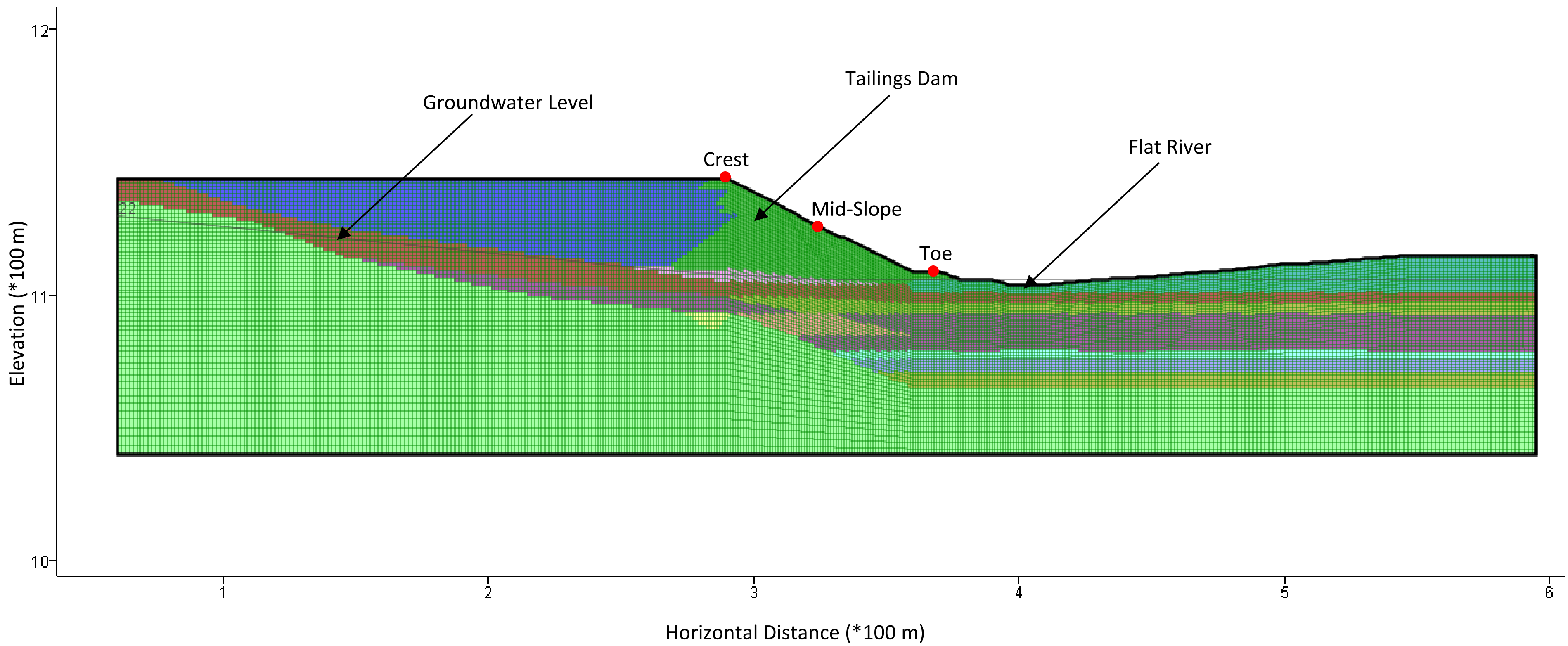
Geotechnical Assessment of Existing Tailings Facilities, Cantung Mine, NT

Horizontal Ground Motions
Cumulative Absolute Velocity (CAV)

PROJECT NO.	DWN	CKD	APVD	REV
ENW.WENW03039-05	EW	AA	AA	0

OFFICE	DATE
EBA-VANC	March 2021

Figure E.6



LEGEND

- Tailings_17
- Tailings_11
- Fill
- FL
- GF_15
- GF_10
- GF_20
- GF_14
- Bedrock
- GF_23
- GF_27
- GF_30
- GF_8

NOTES

● Displacement Output Locations

FL: Fluvial
GF: Glaciofluvial

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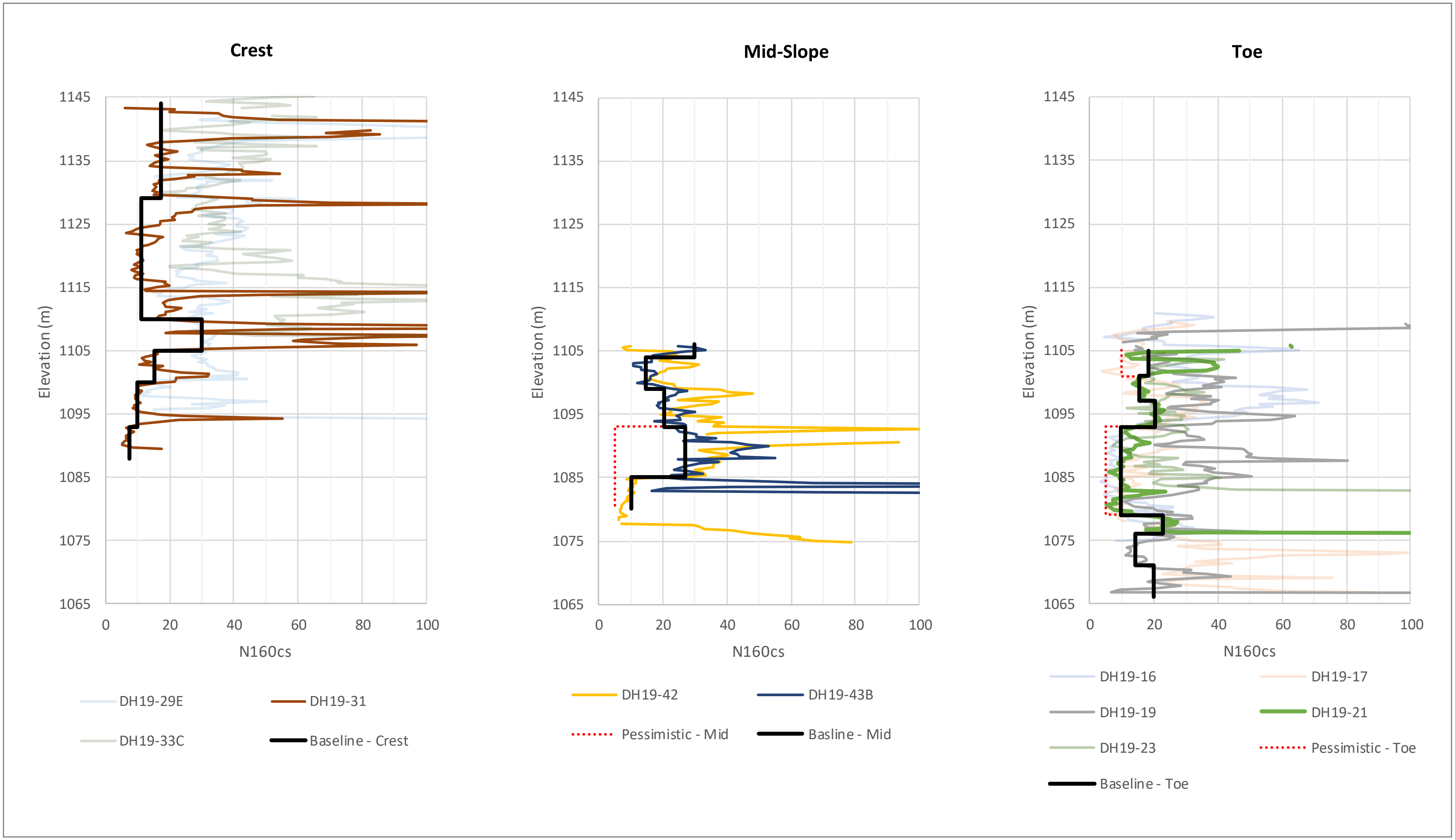
Geotechnical Assessment of Existing Tailings Facilities, Cantung Mine, NT

2D FLAC Model Configuration Section D-D' - Baseline

PROJECT NO.	DWN	CKD	APVD	REV
ENW.WENW03039-05	EW	AA	AA	0

OFFICE	DATE
EBA-VANC	March 2021

Figure E.7



LEGEND

NOTES

The design line at the crest location shows values selected for the tailings (El. 1145 m to 1110 m) and for the foundation soils beneath the tailings (below El. 1110 m).

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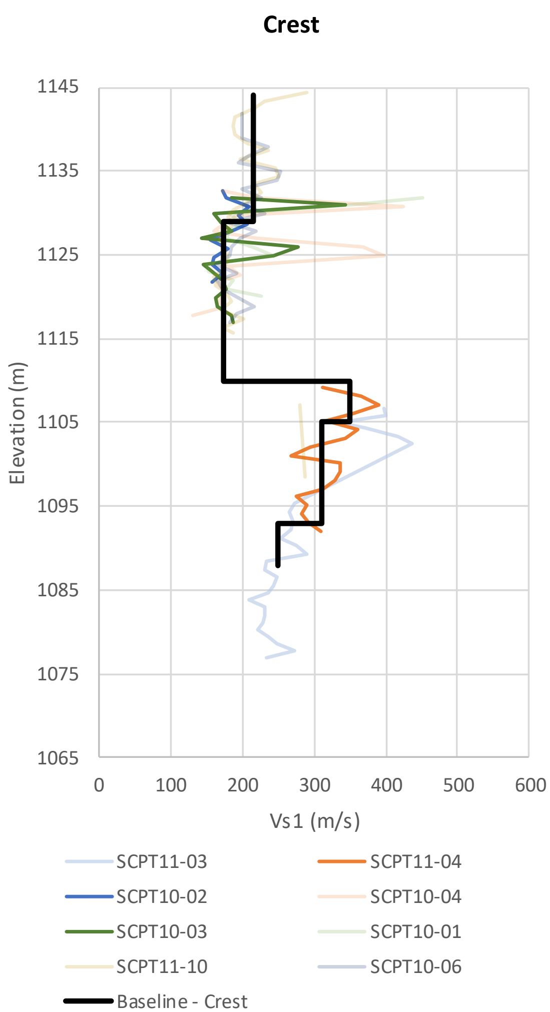
Geotechnical Assessment of Existing Tailings Facilities, Cantung Mine, NT

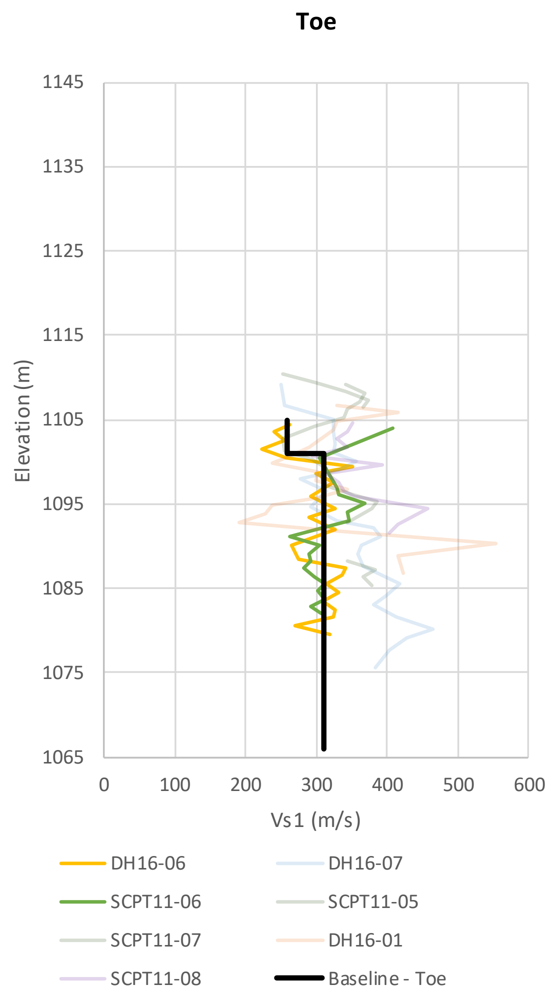
FLAC Model – Section D-D’ Selected N160cs Values

PROJECT NO.	DWN	CKD	APVD	REV
ENW.WENW03039-05	EW	AA	AA	0

OFFICE	DATE
EBA-VANC	March 2021

Figure E.8





LEGEND

NOTES

The design line at the crest location shows values selected for the tailings (El. 1145 m to 1110 m) and for the foundation soils beneath the tailings (below El. 1110 m).

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NORTH AMERICAN TUNGSTEN CORPORATION LTD

TETRA TECH

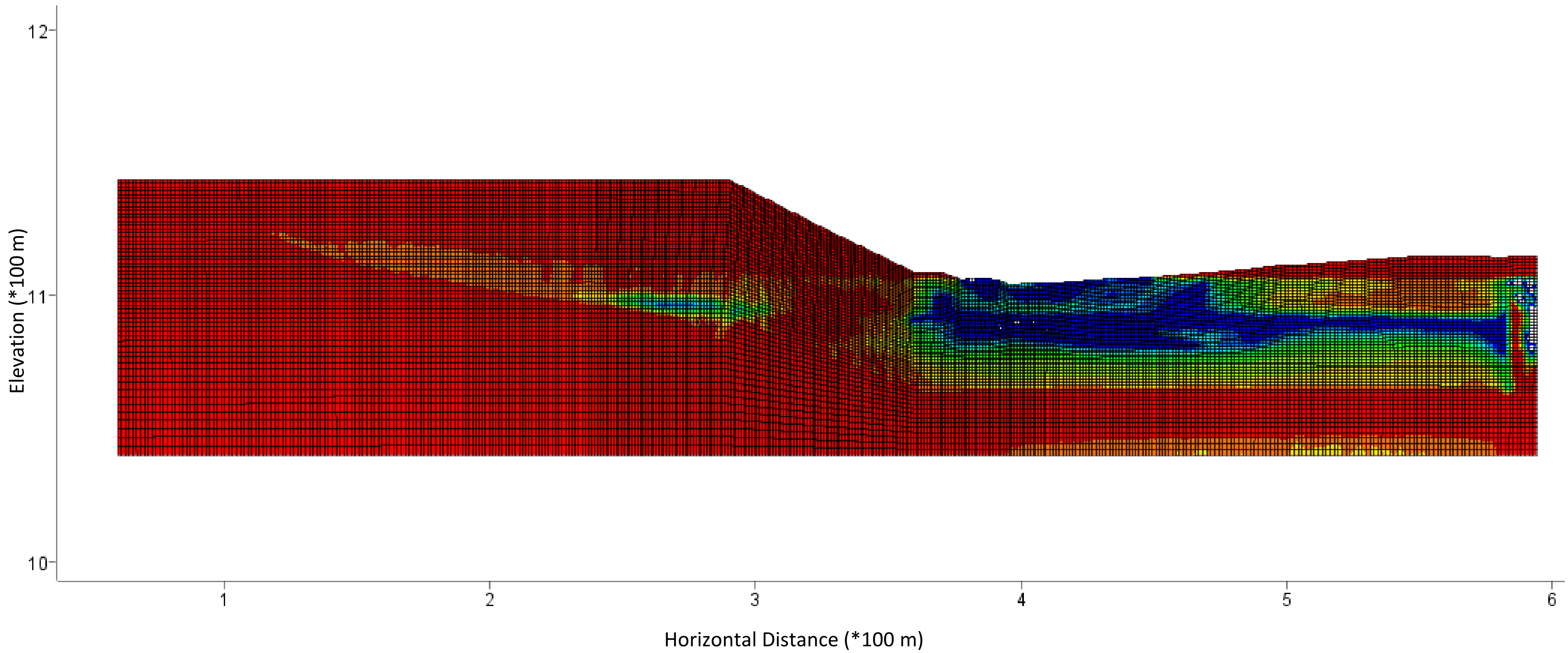
Geotechnical Assessment of Existing Tailings Facilities, Cantung Mine, NT

FLAC Model – Section D-D' Selected Vs1 Values

PROJECT NO.	DWN	CKD	APVD	REV
ENW.WENW03039-05	EW	AA	AA	0

OFFICE	DATE
EBA-VANC	March 2021

Figure E.9



LEGEND

Ru_max Contours

- 0.00E+00
- 1.00E-01
- 2.00E-01
- 3.00E-01
- 4.00E-01
- 5.00E-01
- 6.00E-01
- 7.00E-01
- 8.00E-01
- 9.00E-01
- 1.00E+00

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Geotechnical Assessment of Existing Tailings Facilities, Cantung Mine, NT

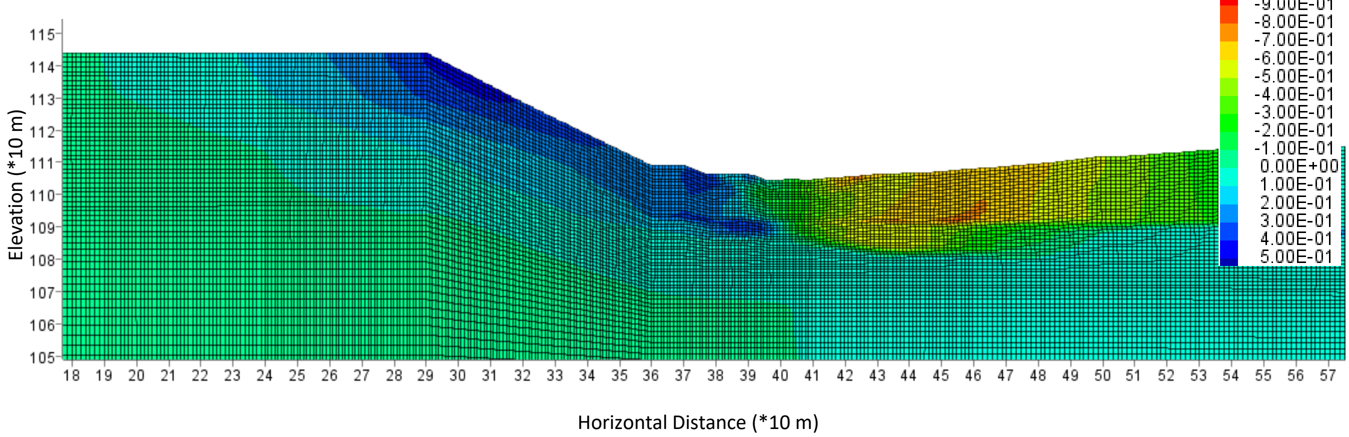
FLAC Model – Section D-D'
Ru_max – IV Record (Max)

PROJECT NO.	DWN	CKD	APVD	REV
ENW.WENW03039-05	EW	AA	AA	0

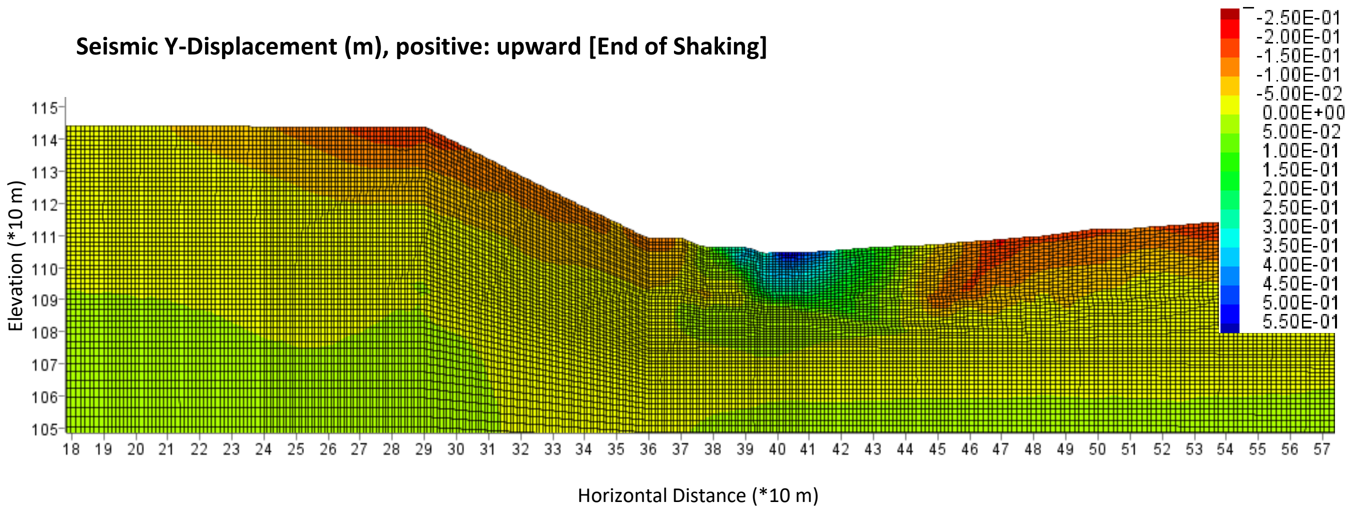
OFFICE	DATE
EBA-VANC	March 2021

Figure E.10

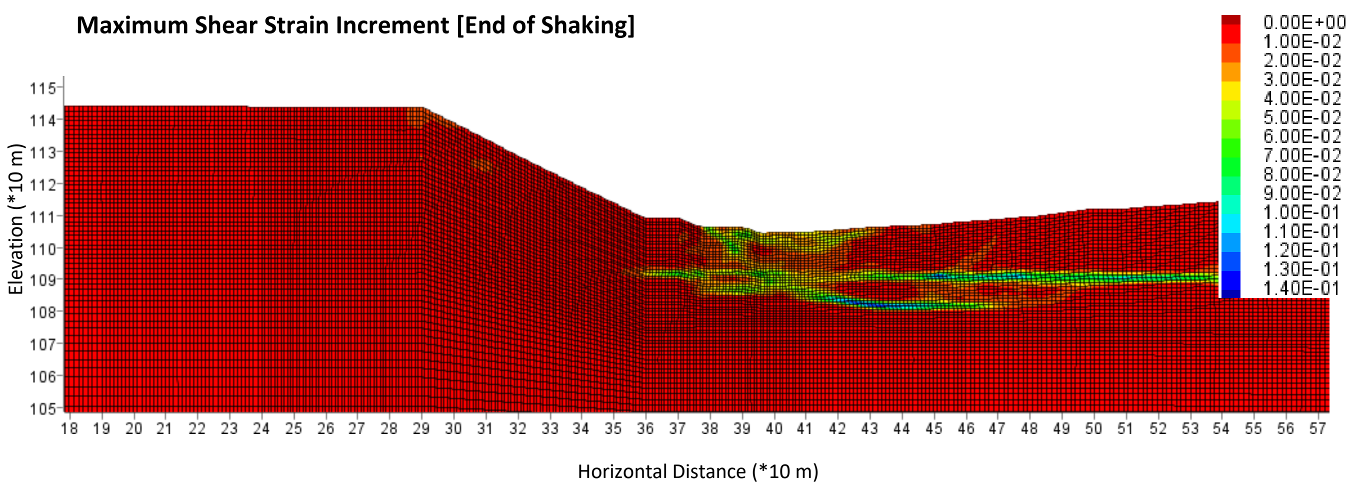
Seismic X-Displacement (m), positive: left to right [End of Shaking]



Seismic Y-Displacement (m), positive: upward [End of Shaking]



Maximum Shear Strain Increment [End of Shaking]



LEGEND

NOTES

Engineering shear strains are 2x the FLAC shear strains shown above.

STATUS

ISSUED FOR USE

CLIENT

NORTH AMERICAN TUNGSTEN CORPORATION LTD

TETRA TECH

Geotechnical Assessment of Existing Tailings Facilities, Cantung Mine, NT

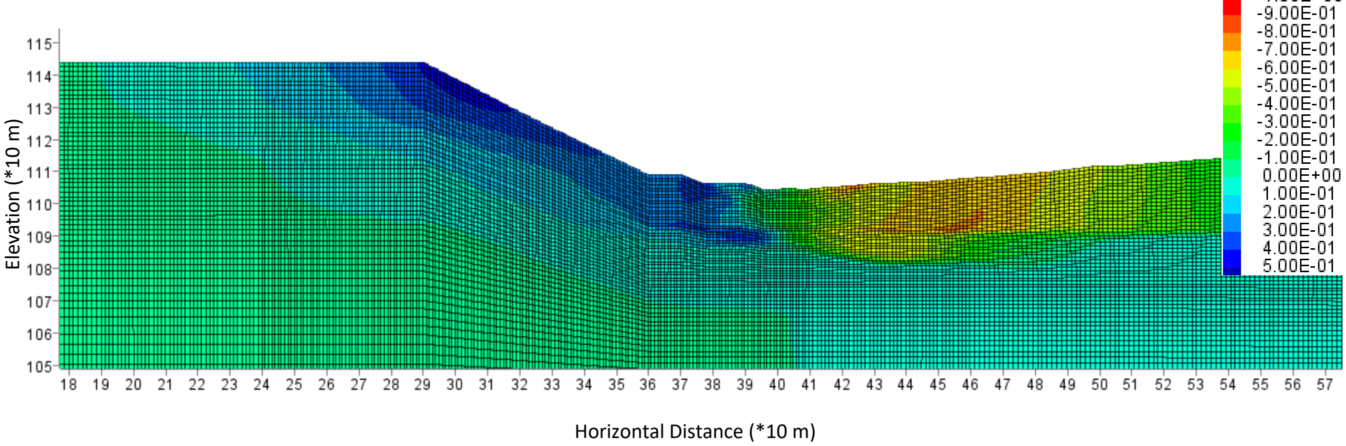
FLAC Model – Section D-D'
Displacement and Shear Strain Contours
End of Shaking, IV Record (Max)

PROJECT NO.	DWN	CKD	APVD	REV
ENW.WENW03039-05	EW	AA	AA	0

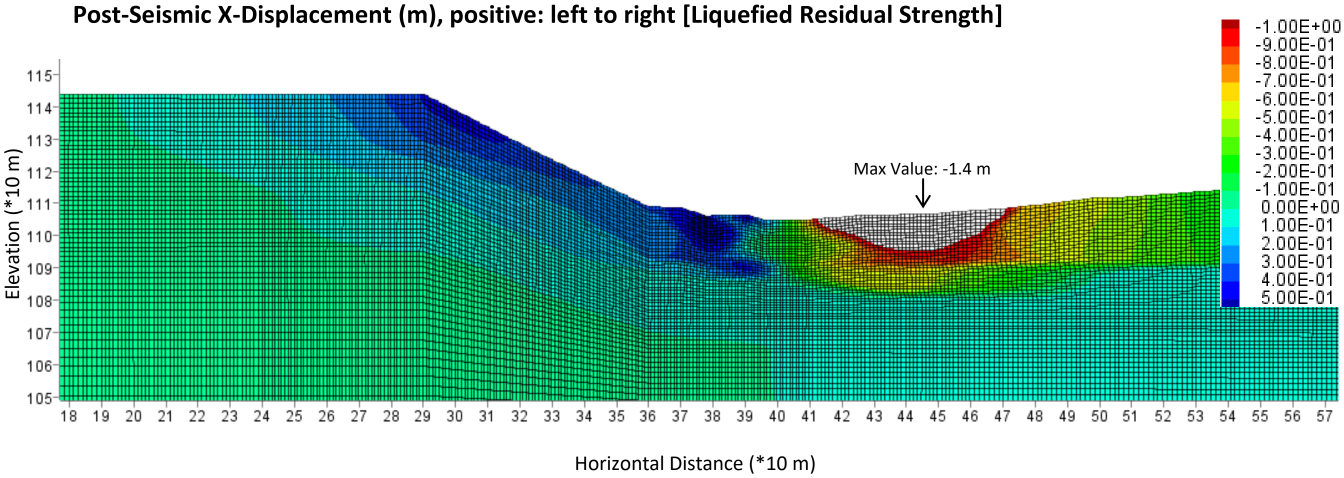
OFFICE	DATE
EBA-VANC	March 2021

Figure E.11

Seismic X-Displacement (m), positive: left to right [End of Shaking]



Post-Seismic X-Displacement (m), positive: left to right [Liquefied Residual Strength]



LEGEND

NOTES

Engineering shear strains are 2x the FLAC shear strains shown above.

STATUS

ISSUED FOR USE

CLIENT

NORTH AMERICAN TUNGSTEN CORPORATION LTD

TETRA TECH

Geotechnical Assessment of Existing Tailings Facilities, Cantung Mine, NT

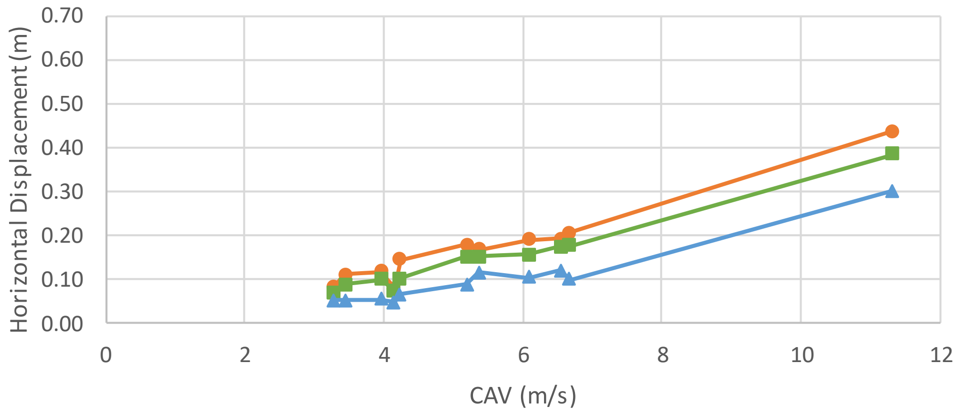
FLAC Model – Section D-D' Horizontal Displacements – End of Shaking vs. Post-Seismic, IV Record (Max)

PROJECT NO.	DWN	CKD	APVD	REV
ENW.WENW03039-05	EW	AA	AA	0

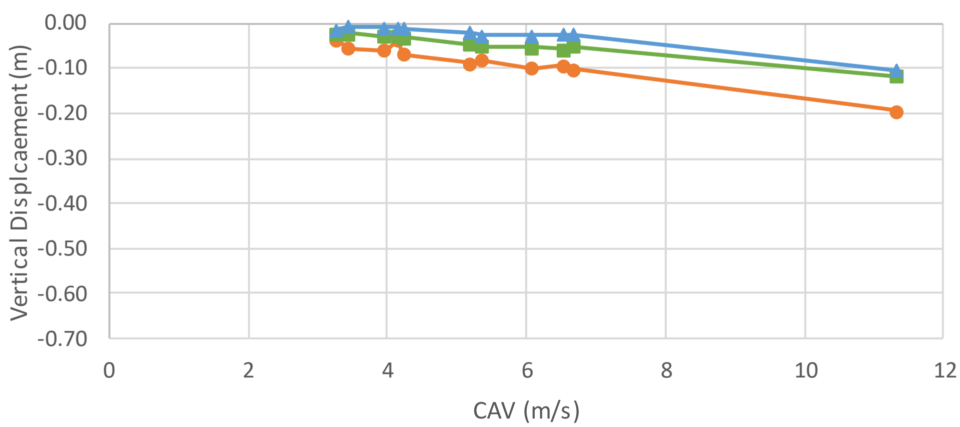
OFFICE	DATE
EBA-VANC	March 2021

Figure E.12

Seismic Horizontal Displacement (m) [End of Shaking]



Seismic Vertical Displacement (m) [End of Shaking]



LEGEND

- Crest
- Mid-Slope
- Toe

NOTES

Output locations shown on Figure E.7

STATUS

ISSUED FOR USE

CLIENT

NORTH AMERICAN TUNGSTEN CORPORATION LTD

TETRA TECH

Geotechnical Assessment of Existing Tailings Facilities, Cantung Mine, NT

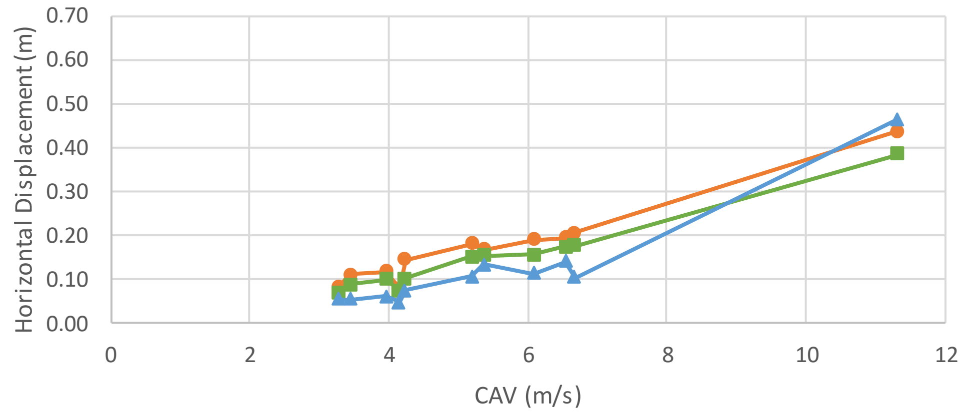
FLAC Model – Section D-D'
Seismic Displacement Summary – End of Shaking

PROJECT NO.	DWN	CKD	APVD	REV
ENW.WENW03039-05	EW	AA	AA	0

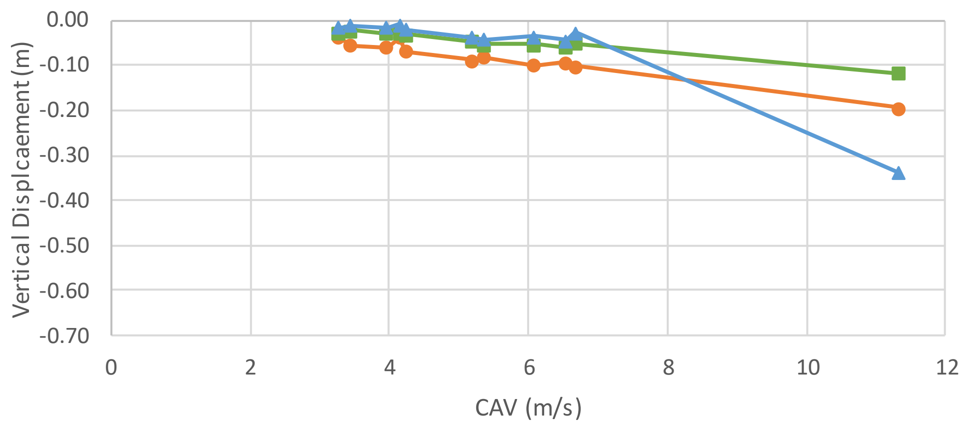
OFFICE	DATE
EBA-VANC	March 2021

Figure E.13a

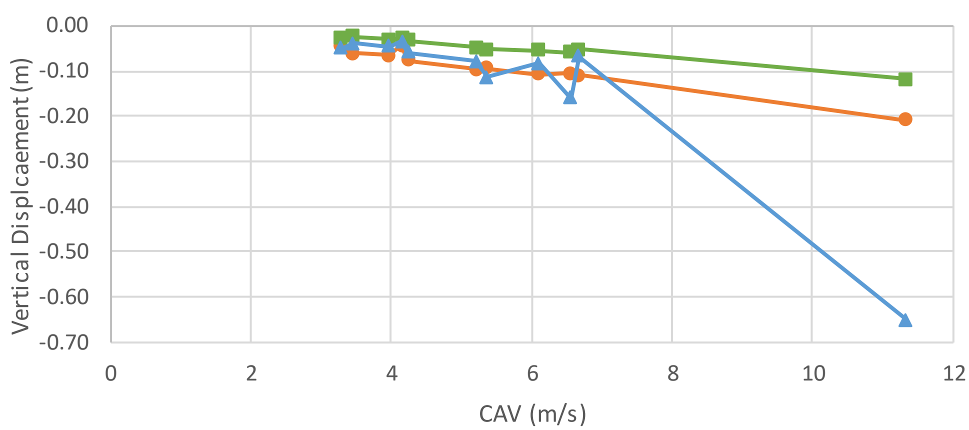
Post-Seismic Horizontal Displacement (m) [Liquefied Residual Strengths]



Post-Seismic Vertical Displacement (m) [Liquefied Residual Strengths]



Total Post-Seismic Vertical Displacement (m) [Including Volumetric Settlement]



LEGEND

Crest
Mid-Slope
Toe

NOTES

Output locations shown on Figure E.7

STATUS
ISSUED FOR USE

CLIENT

NORTH AMERICAN TUNGSTEN CORPORATION LTD

TETRA TECH

Geotechnical Assessment of Existing Tailings Facilities, Cantung Mine, NT

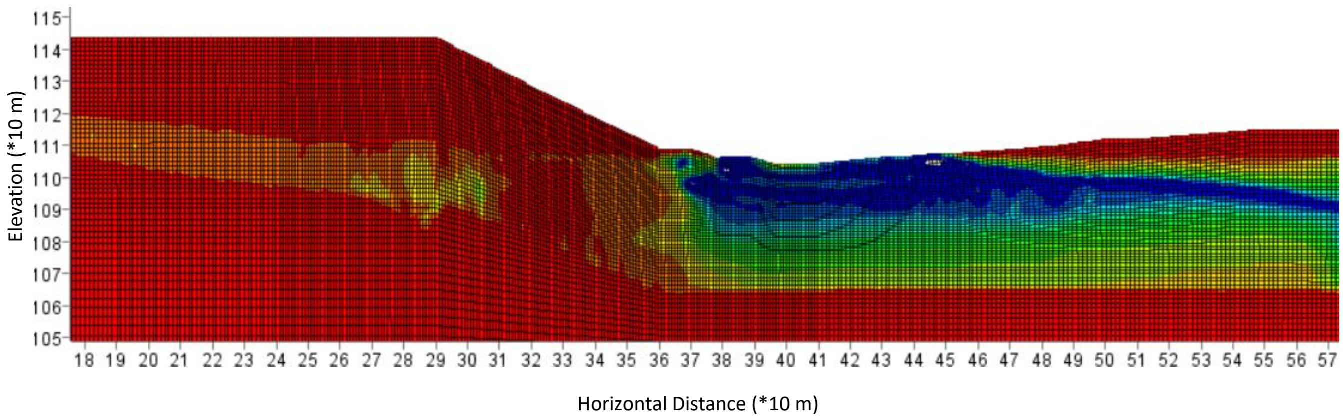
FLAC Model – Section D-D'
Post-Seismic Displacement Summary

PROJECT NO.	DWN	CKD	APVD	REV
ENW.WENW03039-05	EW	AA	AA	0

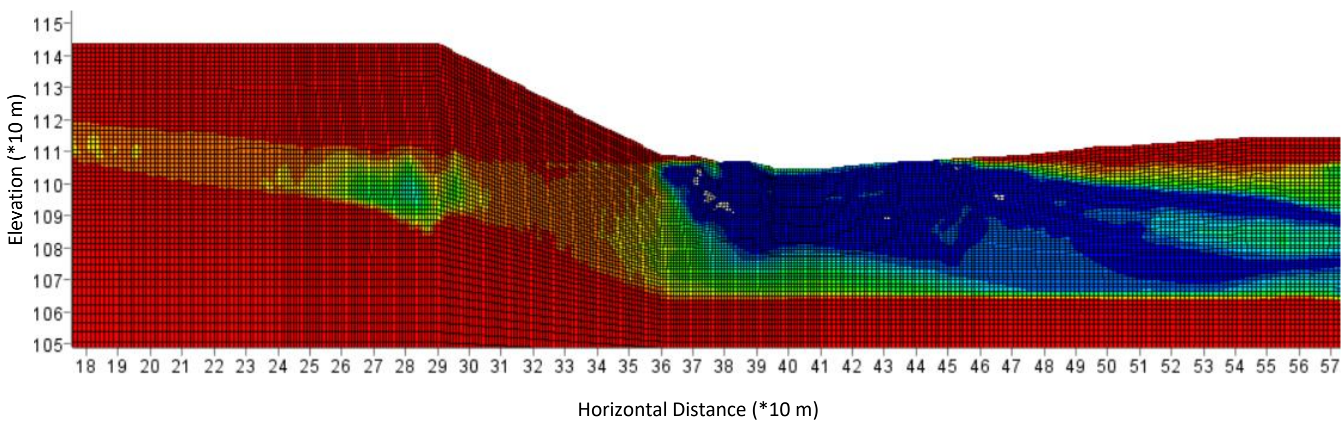
OFFICE	DATE
EBA-VANC	March 2021

Figure E.13b

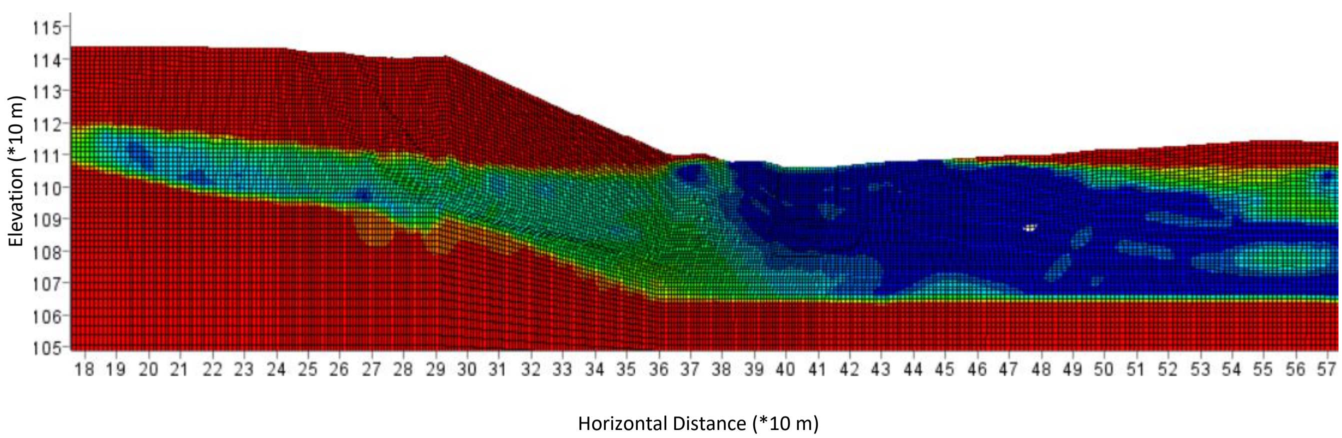
Ru_max, N160cs = 15



Ru_max, N160cs = 10



Ru_max, N160cs = 5



LEGEND

0.00E+00
1.00E-01
2.00E-01
3.00E-01
4.00E-01
5.00E-01
6.00E-01
7.00E-01
8.00E-01
9.00E-01
1.00E+00

NOTES

STATUS
ISSUED FOR USE

CLIENT

NORTH AMERICAN TUNGSTEN CORPORATION LTD

TETRA TECH

Geotechnical Assessment of Existing Tailings Facilities, Cantung Mine, NT

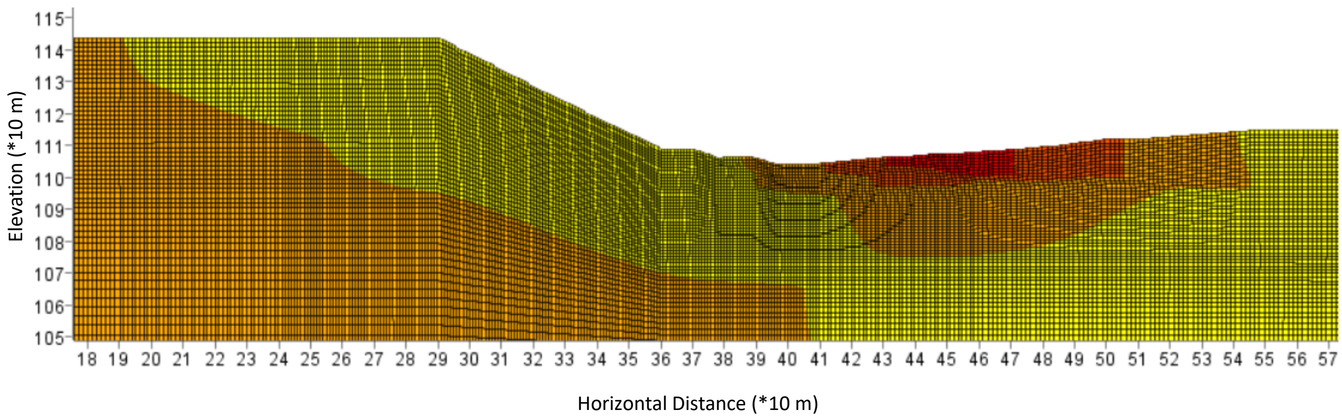
FLAC Model – Section D-D'
N160cs Sensitivity
Ru_max – IV Record (Max)

PROJECT NO.	DWN	CKD	APVD	REV
ENW.WENW03039-05	EW	AA	AA	0

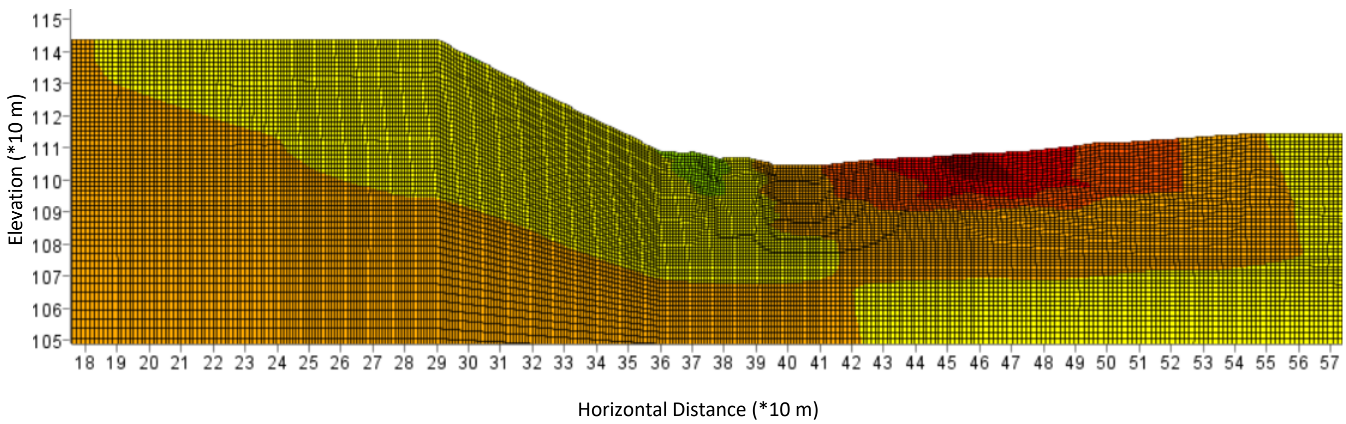
OFFICE	DATE
EBA-VANC	March 2021

Figure E.14

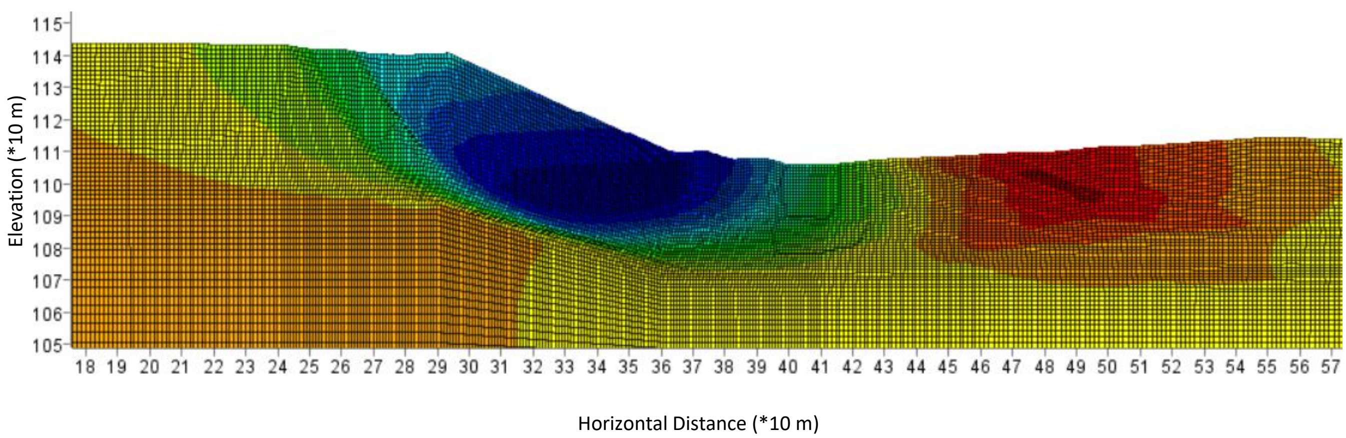
Seismic Horizontal Displacement (m) [End of Shaking], N160cs = 15



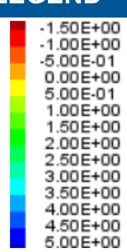
Seismic Horizontal Displacement (m) [End of Shaking], N160cs = 10



Seismic Horizontal Displacement (m) [End of Shaking], N160cs = 5



LEGEND



NOTES

Positive displacement values: left to right

STATUS

ISSUED FOR USE

CLIENT

NORTH AMERICAN TUNGSTEN CORPORATION LTD

TETRA TECH

Geotechnical Assessment of Existing Tailings Facilities, Cantung Mine, NT

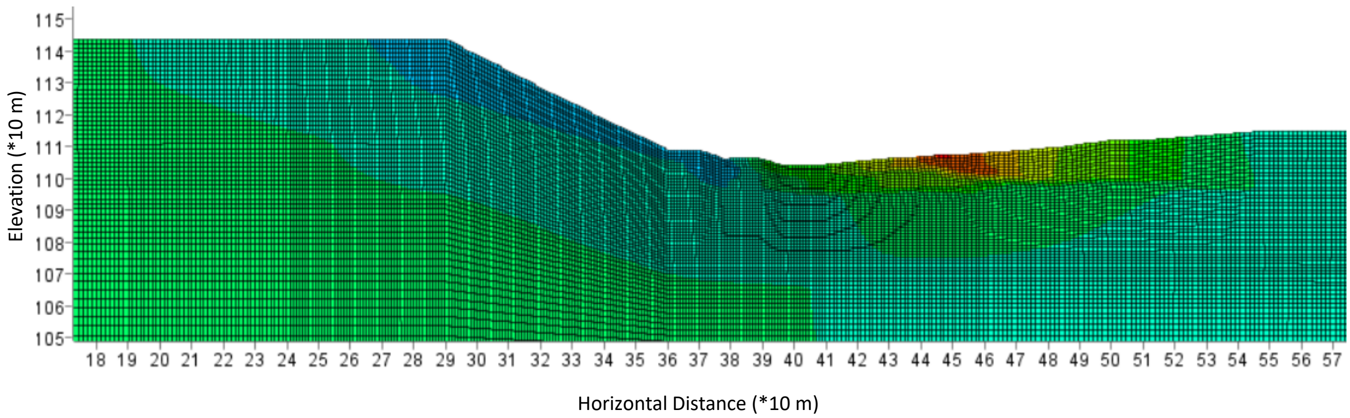
FLAC Model – Section D-D'
N160cs Sensitivity
Horizontal Displacement – IV Record (Max)

PROJECT NO.	DWN	CKD	APVD	REV
ENW.WENW03039-05	EW	AA	AA	0

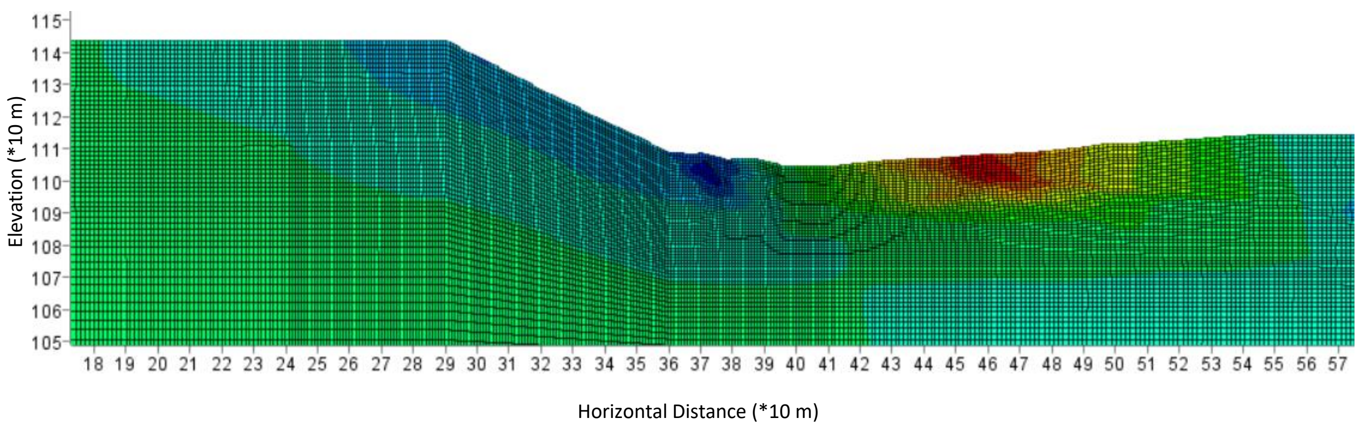
OFFICE	DATE
EBA-VANC	March 2021

Figure E.15a

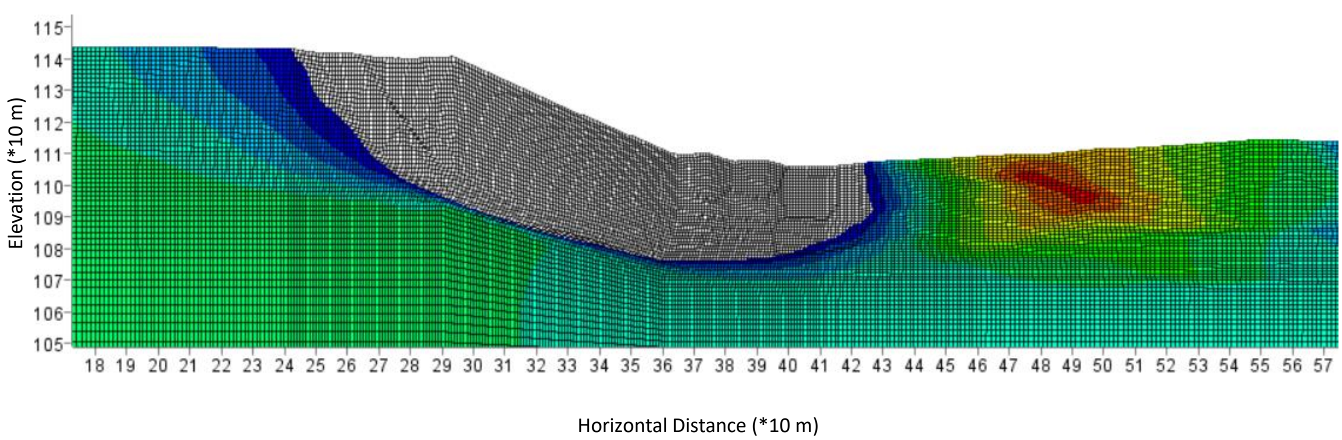
Seismic Horizontal Displacement (m) [End of Shaking], N160cs = 15



Seismic Horizontal Displacement (m) [End of Shaking], N160cs = 10



Seismic Horizontal Displacement (m) [End of Shaking], N160cs = 5



LEGEND

-1.75E+00
-1.50E+00
-1.25E+00
-1.00E+00
-7.50E-01
-5.00E-01
-2.50E-01
0.00E+00
2.50E-01
5.00E-01
7.50E-01
1.00E+00

NOTES

Positive displacement values: left to right

STATUS

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CLIENT

NORTH AMERICAN TUNGSTEN CORPORATION LTD

TETRA TECH

Geotechnical Assessment of Existing Tailings Facilities, Cantung Mine, NT

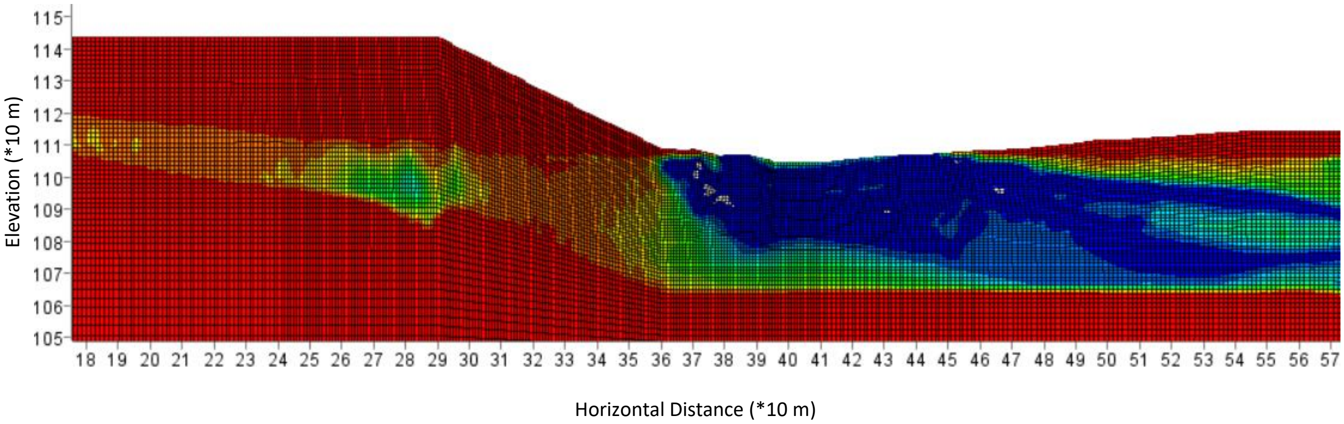
FLAC Model – Section D-D' Sensitivity Analyses Horizontal Displacement – IV Record (Max)

PROJECT NO.	DWN	CKD	APVD	REV
ENW.WENW03039-05	EW	AA	AA	0

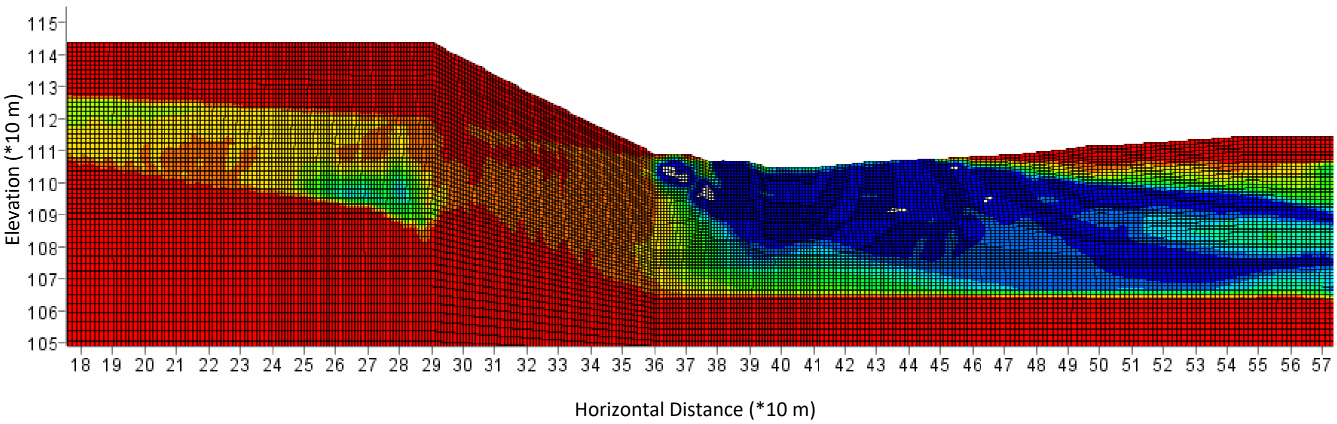
OFFICE	DATE
EBA-VANC	March 2021

Figure E.15b

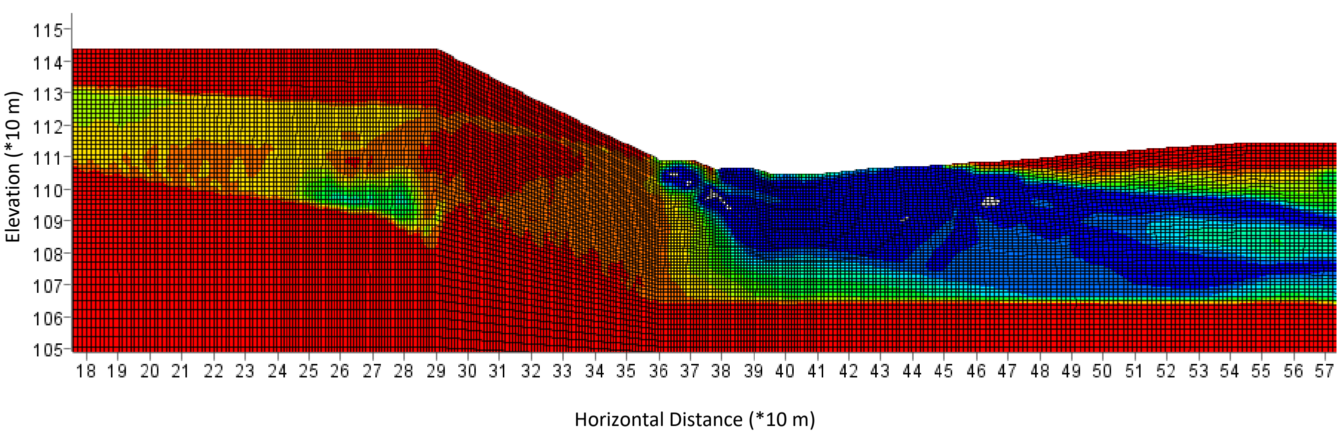
Ru_max, N160cs = 10, Groundwater below Tailings



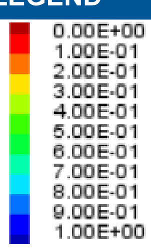
Ru_max, N160cs = 10, Tailings Groundwater El. 1125 m



Ru_max, N160cs = 10, Tailings Groundwater El. 1130 m



LEGEND



NOTES

STATUS
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NORTH AMERICAN TUNGSTEN CORPORATION LTD

TETRA TECH

Geotechnical Assessment of Existing Tailings Facilities, Cantung Mine, NT

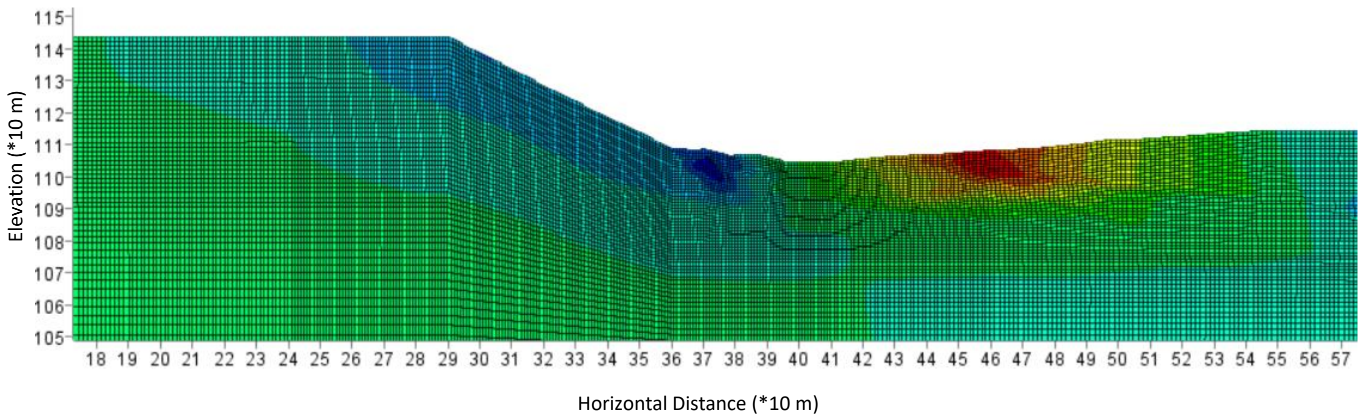
FLAC Model – Section D-D'
Tailings Saturation Sensitivity
Ru_max – IV Record (Max)

PROJECT NO.	DWN	CKD	APVD	REV
ENW.WENW03039-05	EW	AA	AA	0

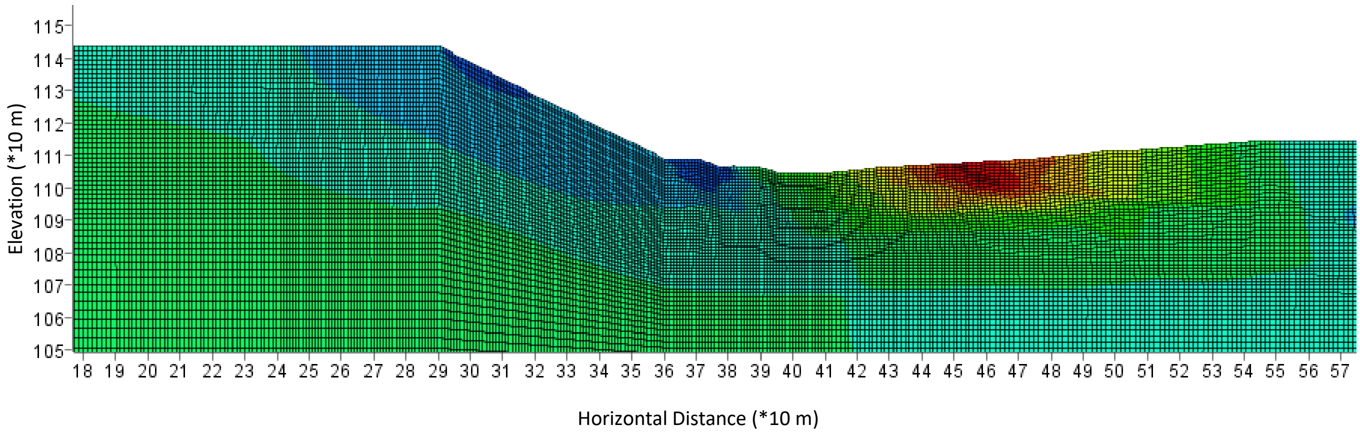
OFFICE	DATE
EBA-VANC	March 2021

Figure E.16

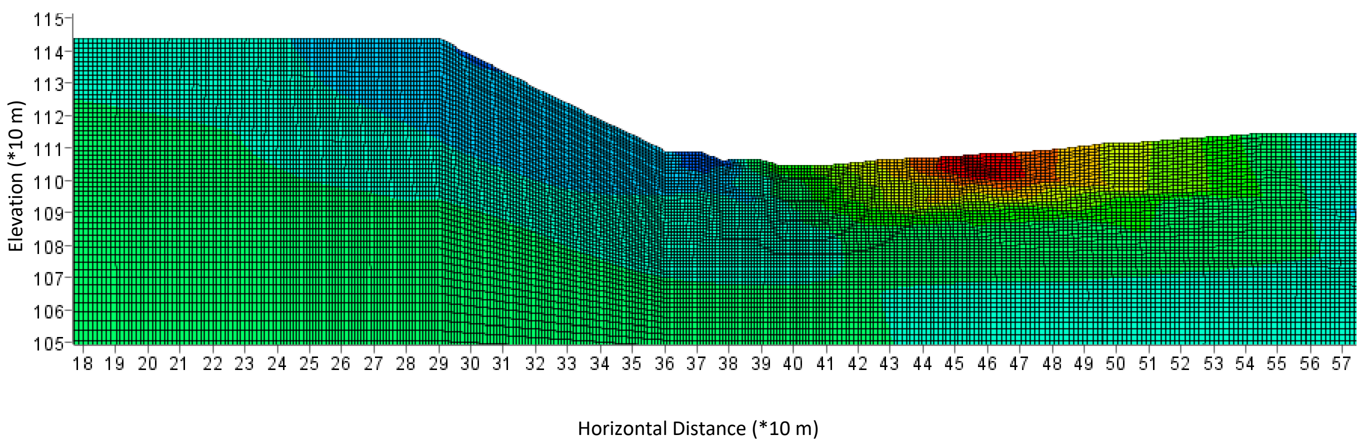
Seismic Horizontal Displacement (m) [End of Shaking], N160cs = 10, Groundwater below Tailings



Seismic Horizontal Displacement (m) [End of Shaking], N160cs = 10, Tailings Groundwater El. 1125 m



Seismic Horizontal Displacement (m) [End of Shaking], N160cs = 10, Tailings Groundwater El. 1130 m



LEGEND

- -1.75E+00
- -1.50E+00
- -1.25E+00
- -1.00E+00
- -7.50E-01
- -5.00E-01
- -2.50E-01
- 0.00E+00
- 2.50E-01
- 5.00E-01
- 7.50E-01
- 1.00E+00

NOTES

Positive displacement values: left to right

STATUS

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NORTH AMERICAN TUNGSTEN CORPORATION LTD

TETRA TECH

Geotechnical Assessment of Existing Tailings Facilities, Cantung Mine, NT

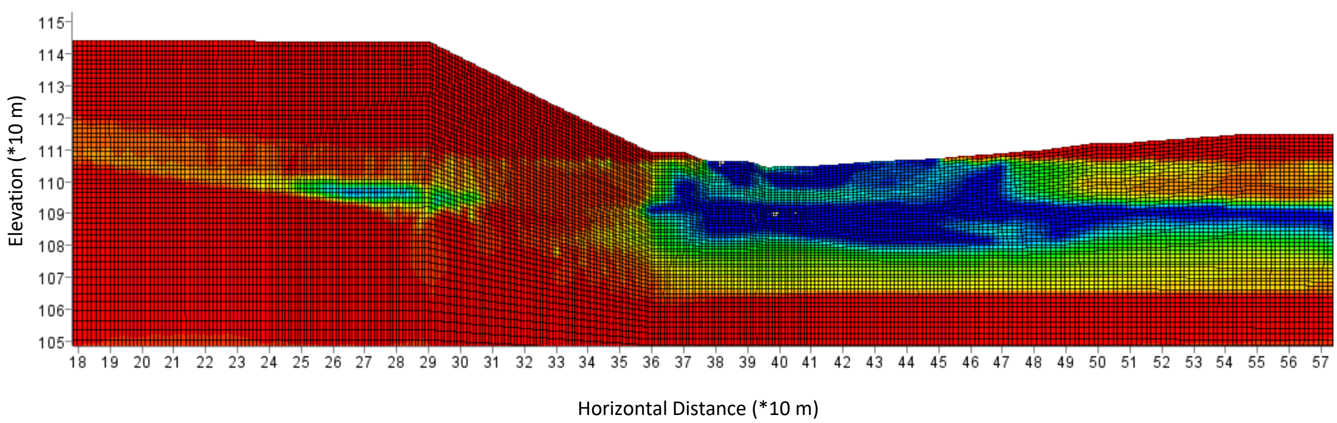
FLAC Model – Section D-D'
Tailings Saturation Sensitivity
Horizontal Displacement – IV Record (Max)

PROJECT NO.	DWN	CKD	APVD	REV
ENW.WENW03039-05	EW	AA	AA	0

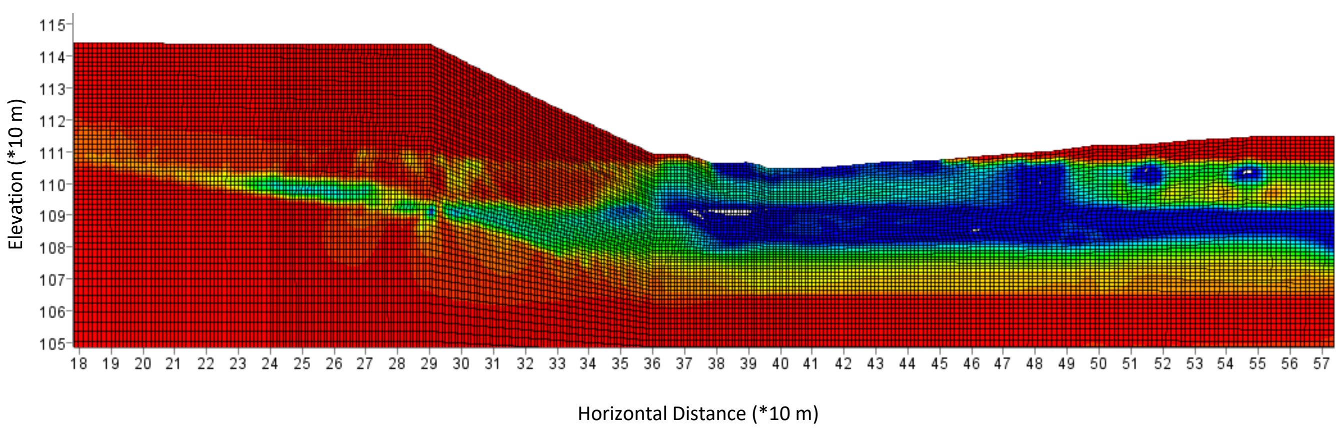
OFFICE	DATE
EBA-VANC	March 2021

Figure E.17

Ru_max, Baseline Section D



Ru_max, Pessimistic Soil Profile TP4



LEGEND

0.00E+00
1.00E-01
2.00E-01
3.00E-01
4.00E-01
5.00E-01
6.00E-01
7.00E-01
8.00E-01
9.00E-01
1.00E+00

NOTES

STATUS
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CLIENT

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Geotechnical Assessment of Existing Tailings Facilities, Cantung Mine, NT

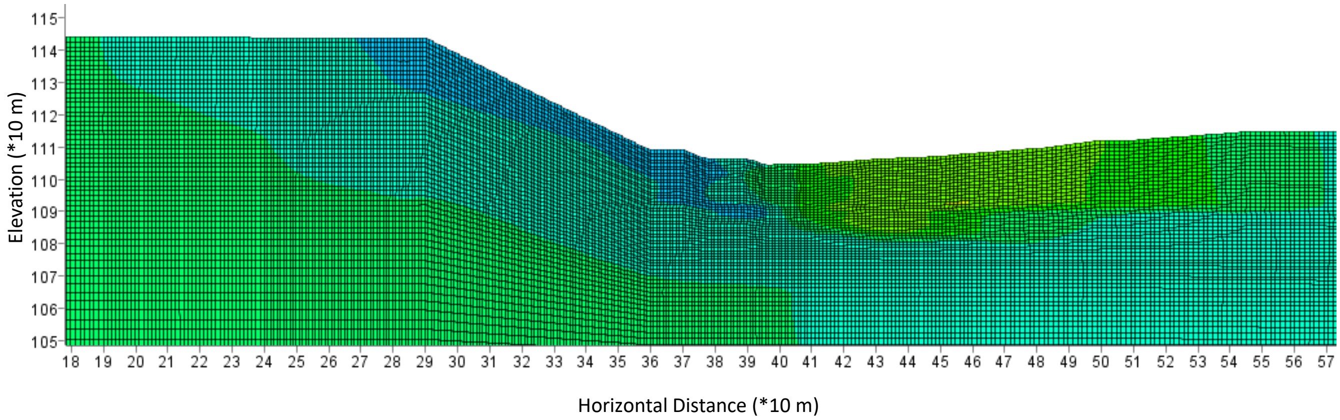
FLAC Model – Section D-D'
Baseline vs. Pessimistic Soil Profile
Ru_max – IV Record (Max)

PROJECT NO.	DWN	CKD	APVD	REV
ENW.WENW03039-05	EW	AA	AA	0

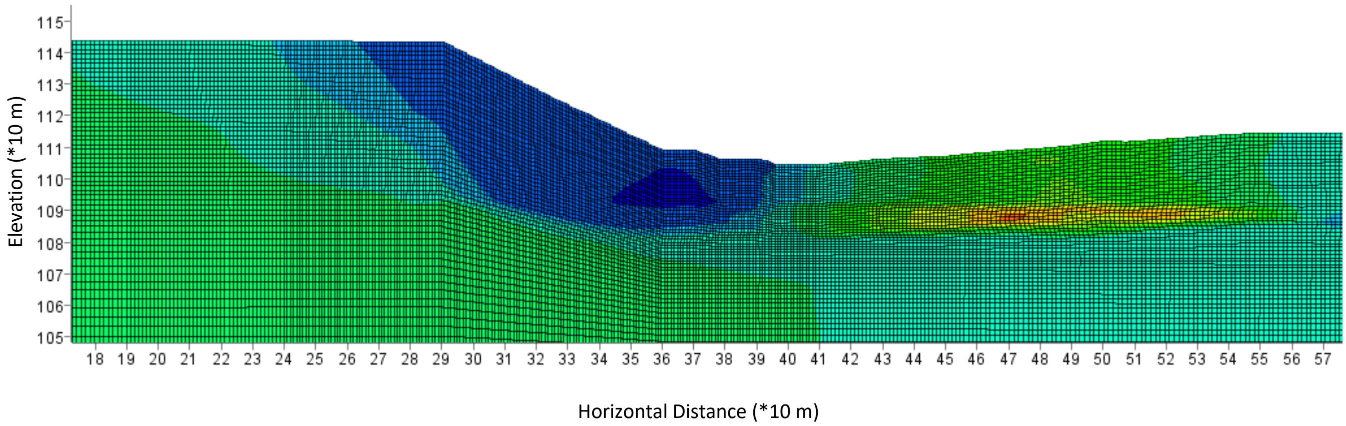
OFFICE	DATE
EBA-VANC	March 2021

Figure E.18

Seismic Horizontal Displacement (m) [End of Shaking], Baseline Section D



Seismic Horizontal Displacement (m) [End of Shaking], Pessimistic Soil Profile TP4



LEGEND

-1.75E+00
-1.50E+00
-1.25E+00
-1.00E+00
-7.50E-01
-5.00E-01
-2.50E-01
0.00E+00
2.50E-01
5.00E-01
7.50E-01
1.00E+00

NOTES

Positive displacement values: left to right

STATUS

ISSUED FOR USE

CLIENT

NORTH AMERICAN TUNGSTEN CORPORATION LTD

TETRA TECH

Geotechnical Assessment of Existing Tailings Facilities, Cantung Mine, NT

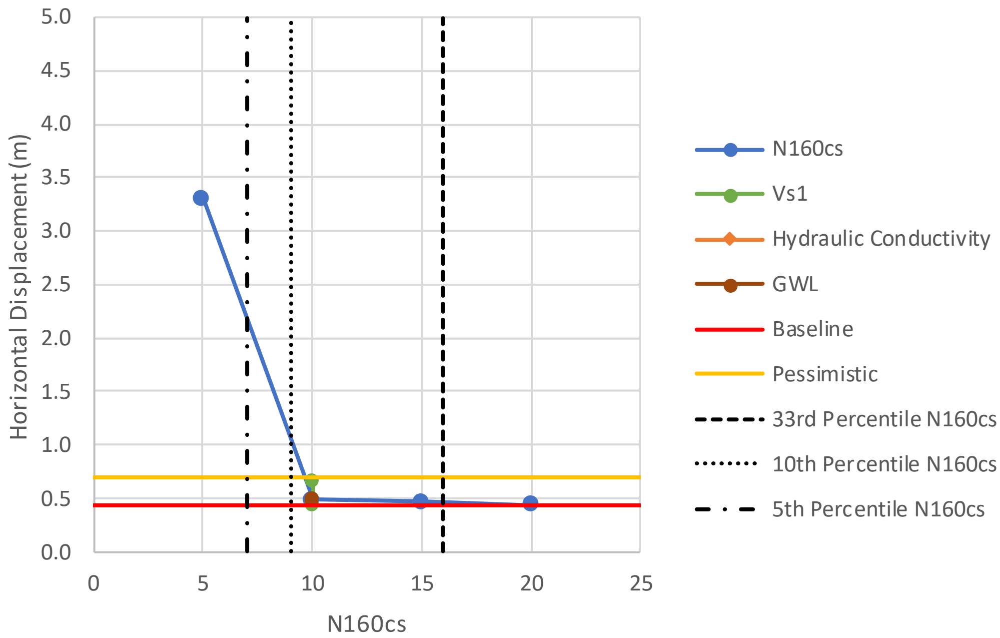
FLAC Model – Section D-D'
Baseline vs. Pessimistic Soil Profile
Horizontal Displacement – IV Record (Max)

PROJECT NO.	DWN	CKD	APVD	REV
ENW.WENW03039-05	EW	AA	AA	0

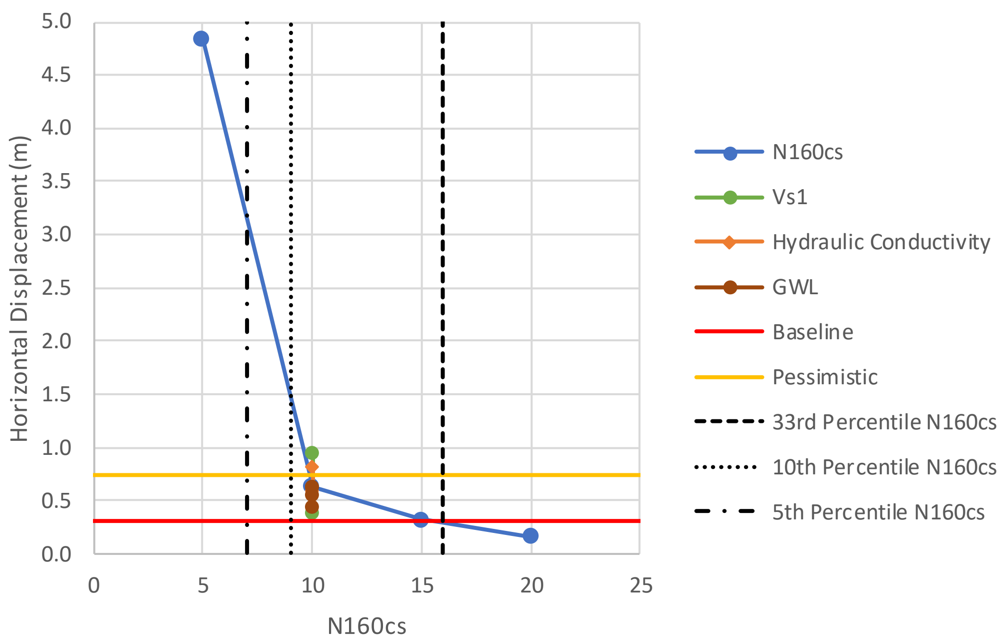
OFFICE	DATE
EBA-VANC	March 2021

Figure E.19

Seismic Horizontal Displacement (m) at Crest [End of Shaking]



Seismic Horizontal Displacement (m) at Toe [End of Shaking]



LEGEND

NOTES

Sensitivity Parameters
N160cs: 5 – 20
Vs1: 200 – 400 m/s
Hydraulic Conductivity: 1e-6 – 1e-4
GWL: El. 1120 m – 1130 m within Tailings

STATUS
ISSUED FOR USE

CLIENT

NORTH AMERICAN TUNGSTEN CORPORATION LTD

TETRA TECH

Geotechnical Assessment of Existing Tailings Facilities, Cantung Mine, NT

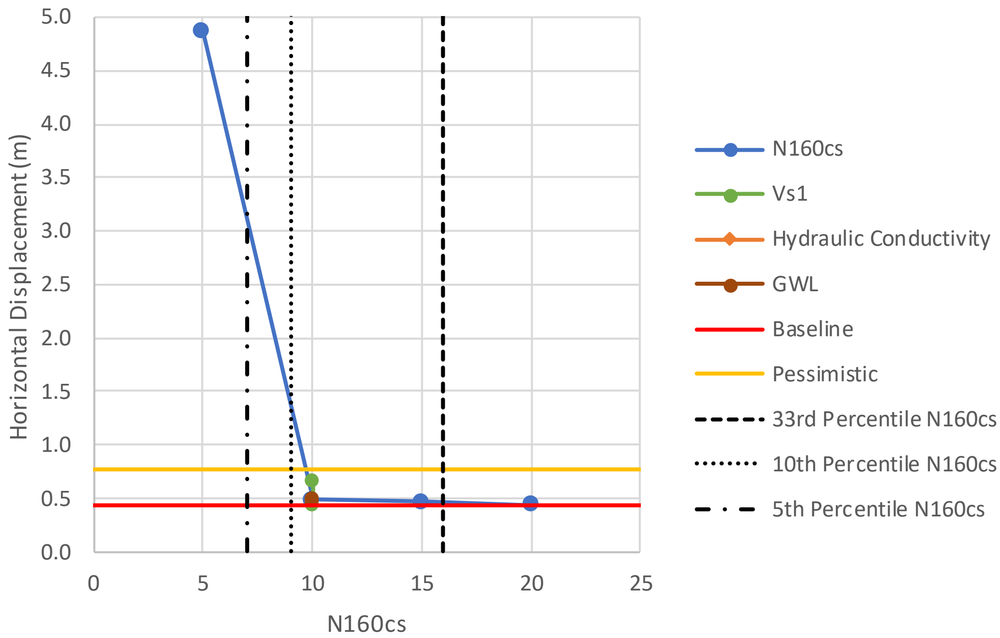
FLAC Model – Section D-D' Sensitivity Displacement Summary End of Shaking – IV Record (Max)

PROJECT NO.	DWN	CKD	APVD	REV
ENW.WENW03039-05	EW	AA	AA	0

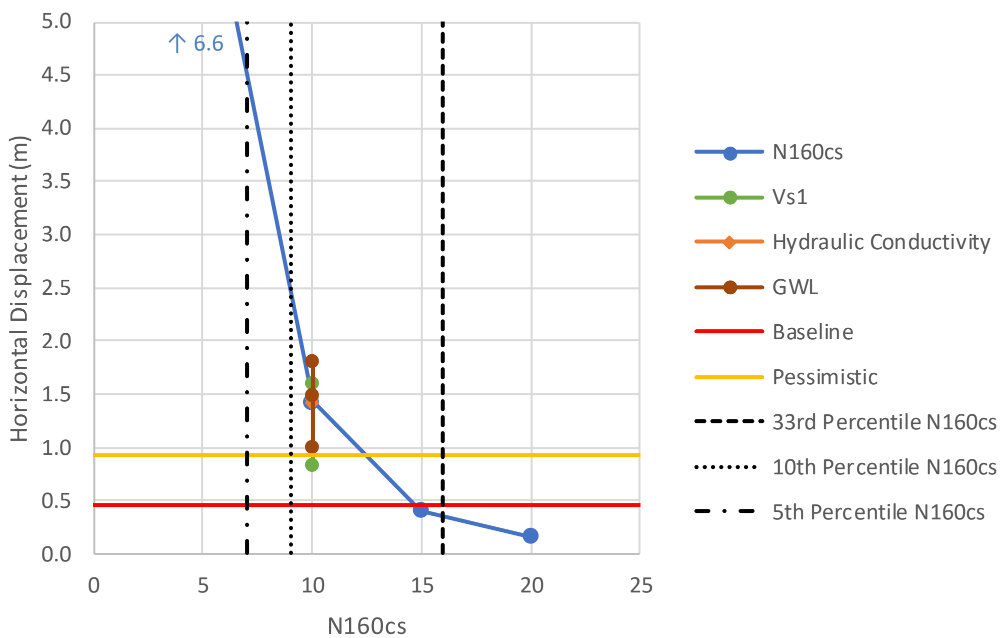
OFFICE	DATE
EBA-VANC	March 2021

Figure E.20a

Post-Seismic Horizontal Displacement (m) at Crest [Liquefied Residual Strength]



Post-Seismic Horizontal Displacement (m) at Toe [Liquefied Residual Strength]



LEGEND

NOTES

Sensitivity Parameters
N160cs: 5 – 20
Vs1: 200 – 400 m/s
Hydraulic Conductivity: 1e-6 – 1e-4
GWL: El. 1120 m – 1130 m within Tailings

STATUS
ISSUED FOR USE

CLIENT

NORTH AMERICAN TUNGSTEN CORPORATION LTD

TETRA TECH

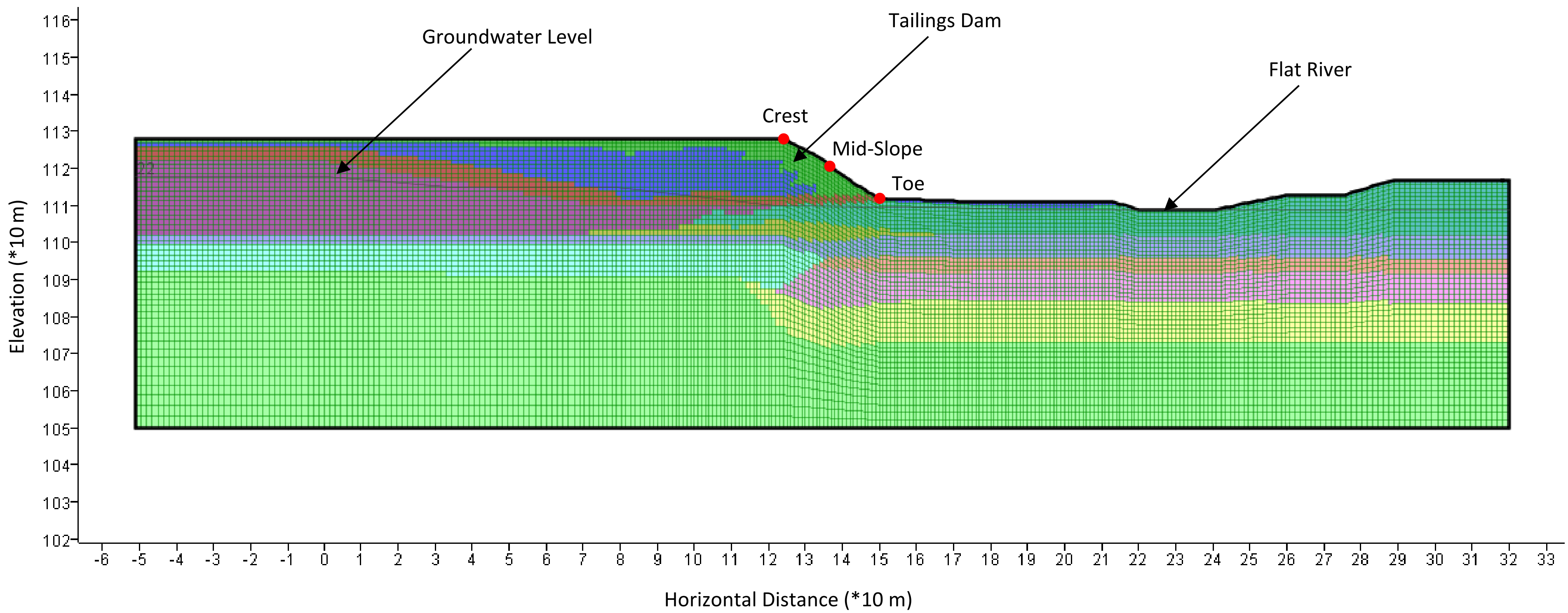
Geotechnical Assessment of Existing Tailings Facilities, Cantung Mine, NT

FLAC Model – Section D-D'
Sensitivity Displacement Summary
Post-Seismic – IV Record (Max)

PROJECT NO.	DWN	CKD	APVD	REV
ENW.WENW03039-05	EW	AA	AA	0

OFFICE	DATE
EBA-VANC	March 2021

Figure E.20b



LEGEND

- Tailings
- Fill
- FL
- CL_30
- CL_16
- GF_20
- GF_14
- Bedrock
- GF_5
- GF_22
- GF_13
- GF_29

NOTES

Displacement Output Locations

FL: Fluvial
GF: Glaciofluvial

STATUS
ISSUED FOR USE

CLIENT
NORTH AMERICAN TUNGSTEN CORPORATION LTD

TETRA TECH

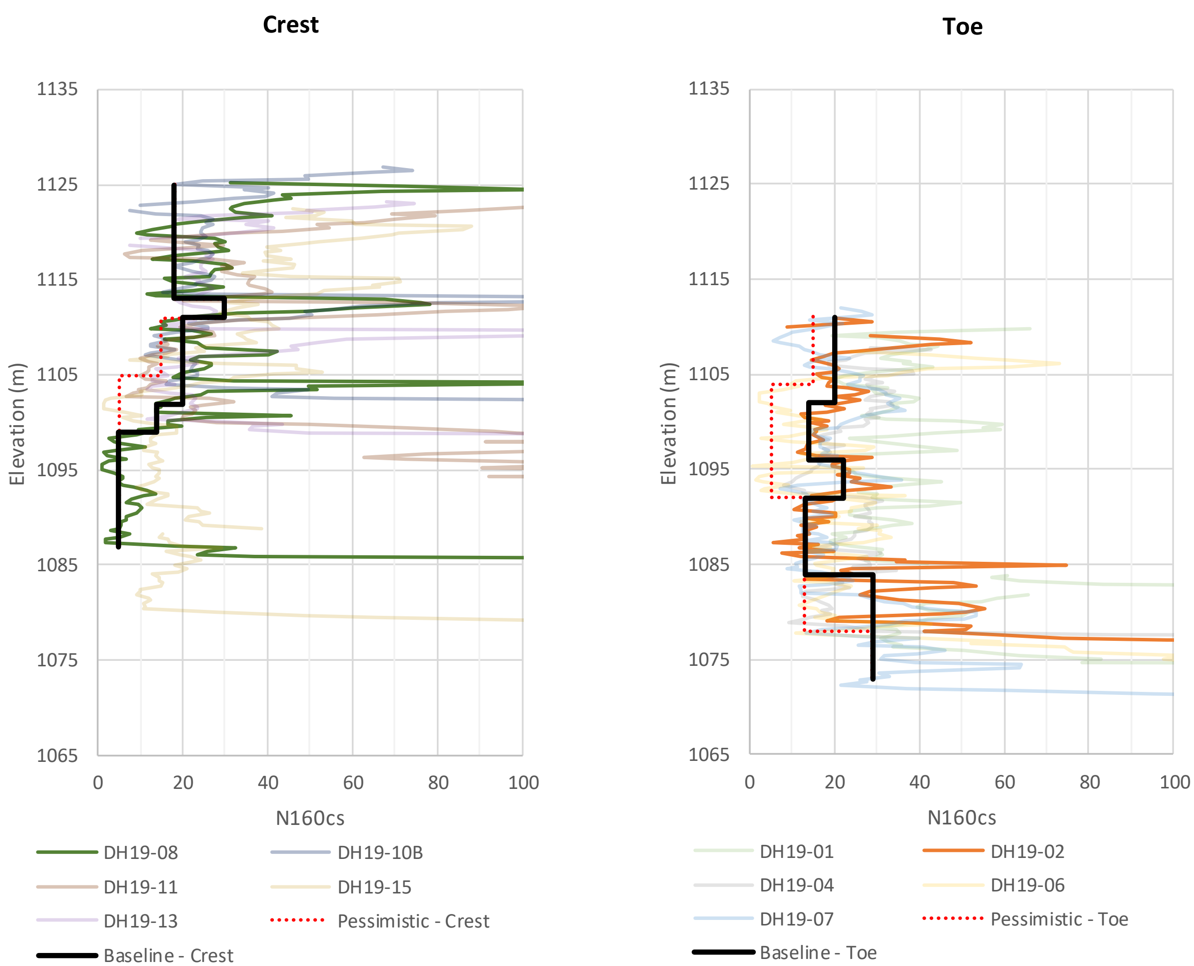
Geotechnical Assessment of Existing Tailings Facilities, Cantung Mine, NT

2D FLAC Model Configuration Section A-A' - Baseline

PROJECT NO.	DWN	CKD	APVD	REV
ENW.WENW03039-05	EW	AA	AA	0

OFFICE	DATE
EBA-VANC	March 2021

Figure E.21



LEGEND

NOTES

The design line at the crest location shows values selected for the tailings (El. 1125 m to 1113 m) and for the foundation soils beneath the tailings (below El. 1113 m).

STATUS
ISSUED FOR USE

CLIENT

NORTH AMERICAN TUNGSTEN CORPORATION LTD

TETRA TECH

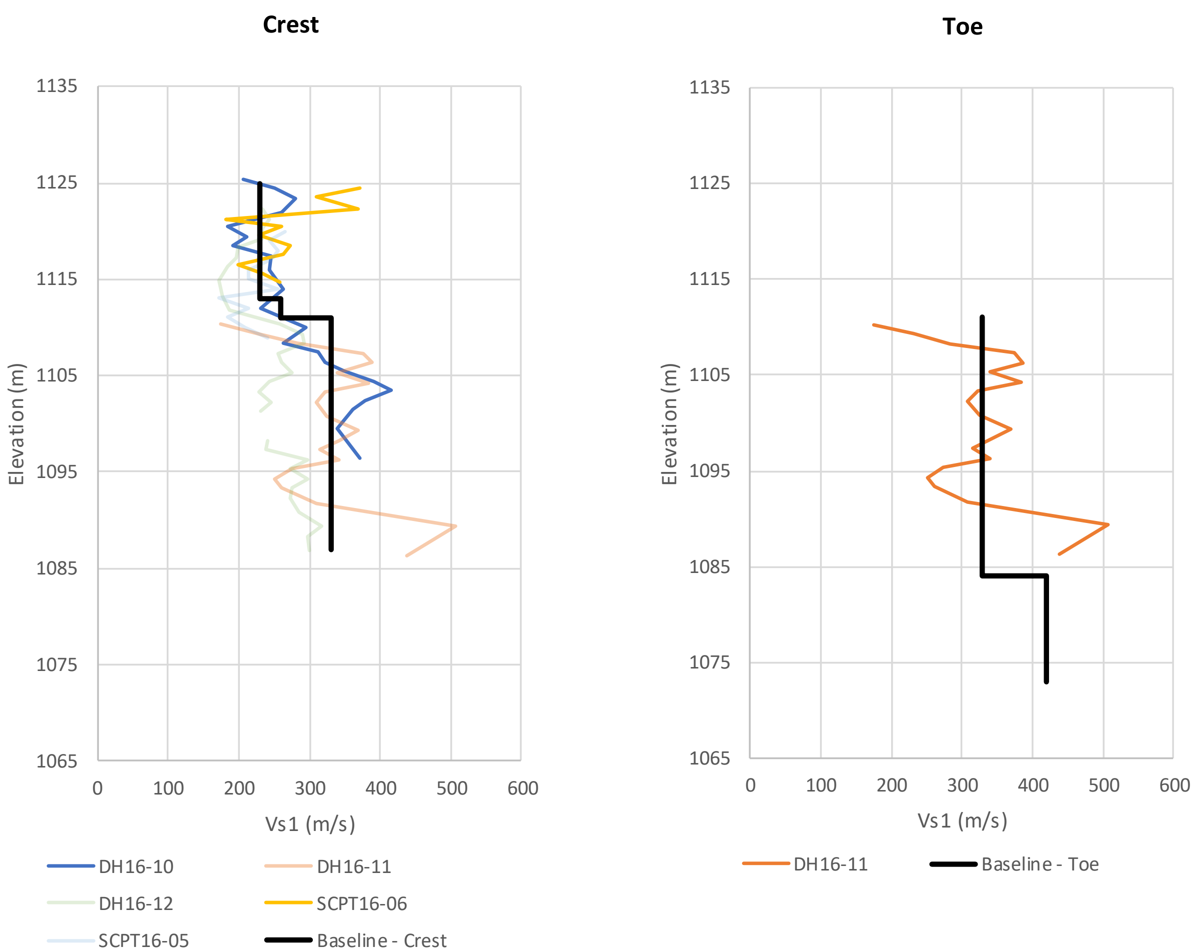
Geotechnical Assessment of Existing Tailings Facilities, Cantung Mine, NT

FLAC Model – Section A-A' Selected N160cs Values

PROJECT NO.	DWN	CKD	APVD	REV
ENW.WENW03039-05	EW	AA	AA	0

OFFICE	DATE
EBA-VANC	March 2021

Figure E.22



LEGEND

NOTES

The design line at the crest location shows values selected for the tailings (El. 1125 m to 1113 m) and for the foundation soils beneath the tailings (below El. 1113 m).

STATUS
ISSUED FOR USE

CLIENT
NORTH AMERICAN TUNGSTEN CORPORATION LTD

TETRA TECH

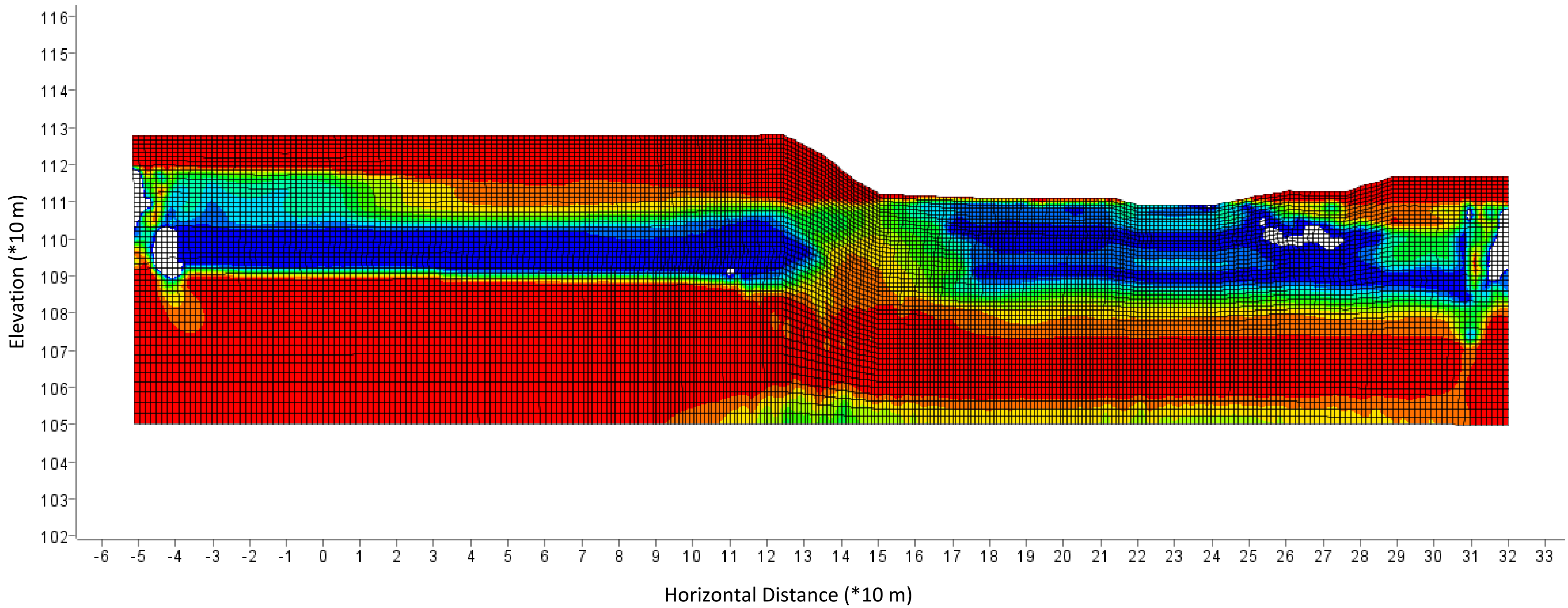
Geotechnical Assessment of Existing Tailings Facilities, Cantung Mine, NT

FLAC Model – Section A-A' Selected Vs1 Values

PROJECT NO.	DWN	CKD	APVD	REV
ENW.WENW03039-05	EW	AA	AA	0

OFFICE	DATE
EBA-VANC	March 2021

Figure E.23



LEGEND

Ru_max Contours

- 0.00E+00
- 1.00E-01
- 2.00E-01
- 3.00E-01
- 4.00E-01
- 5.00E-01
- 6.00E-01
- 7.00E-01
- 8.00E-01
- 9.00E-01
- 1.00E+00

NOTES

STATUS
ISSUED FOR USE

CLIENT

NORTH AMERICAN TUNGSTEN CORPORATION LTD

TETRA TECH

Geotechnical Assessment of Existing Tailings Facilities, Cantung Mine, NT

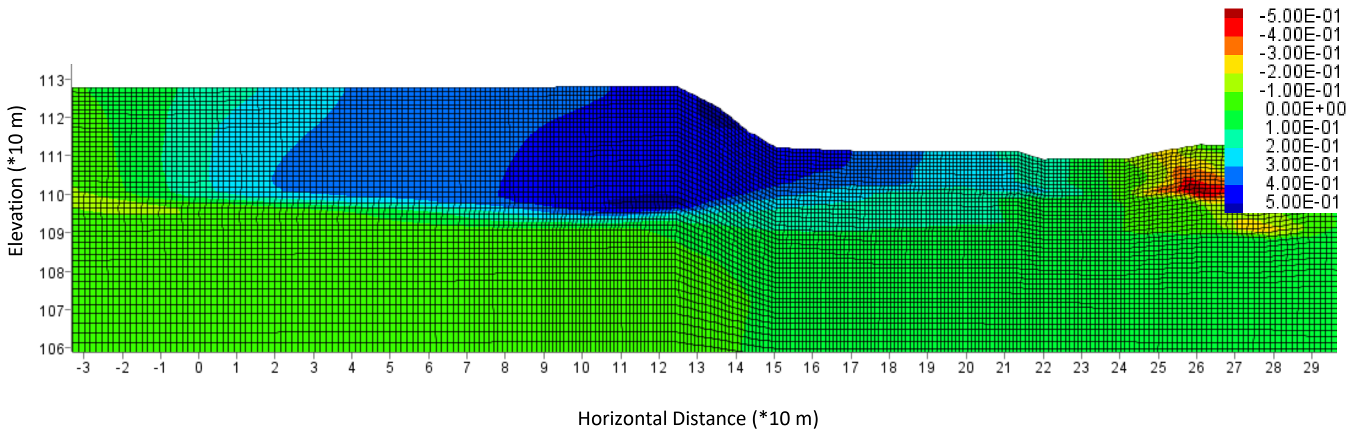
FLAC Model – Section A-A'
Ru_max – IV Record (Max)

PROJECT NO.	DWN	CKD	APVD	REV
ENW.WENW03039-05	EW	AA	AA	0

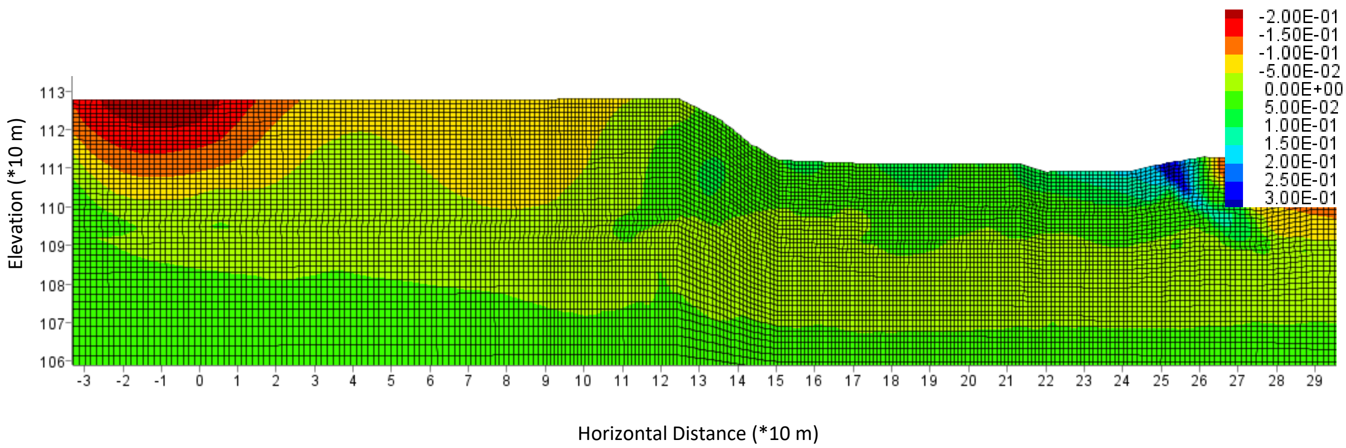
OFFICE	DATE
EBA-VANC	March 2021

Figure E.24

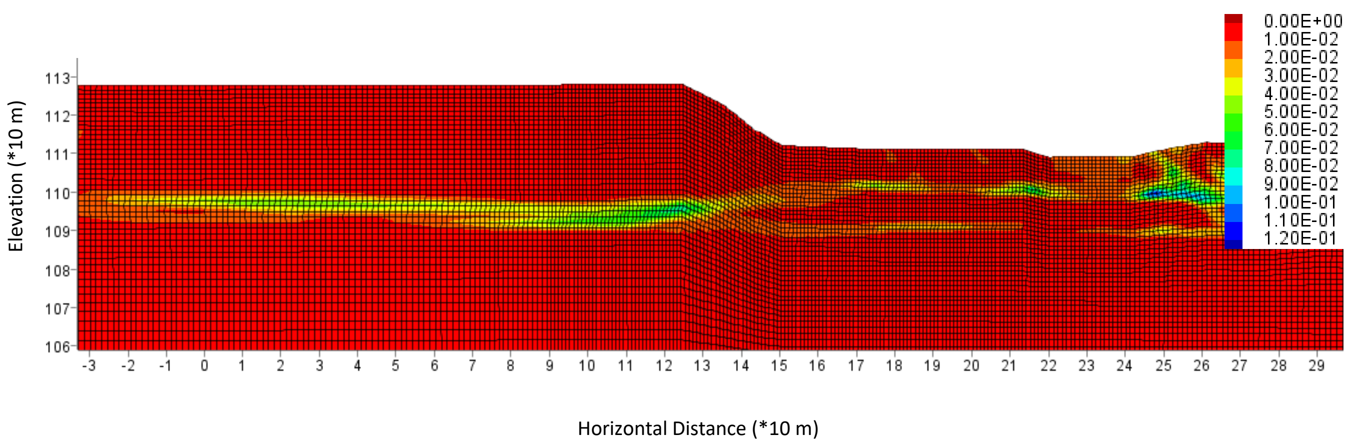
Seismic X-Displacement (m), positive: left to right [End of Shaking]



Seismic Y-Displacement (m), positive: upward [End of Shaking]



Maximum Shear Strain Increment [End of Shaking]



LEGEND

NOTES

Engineering shear strains are 2x the FLAC shear strains shown above.

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TETRA TECH

Geotechnical Assessment of Existing Tailings Facilities, Cantung Mine, NT

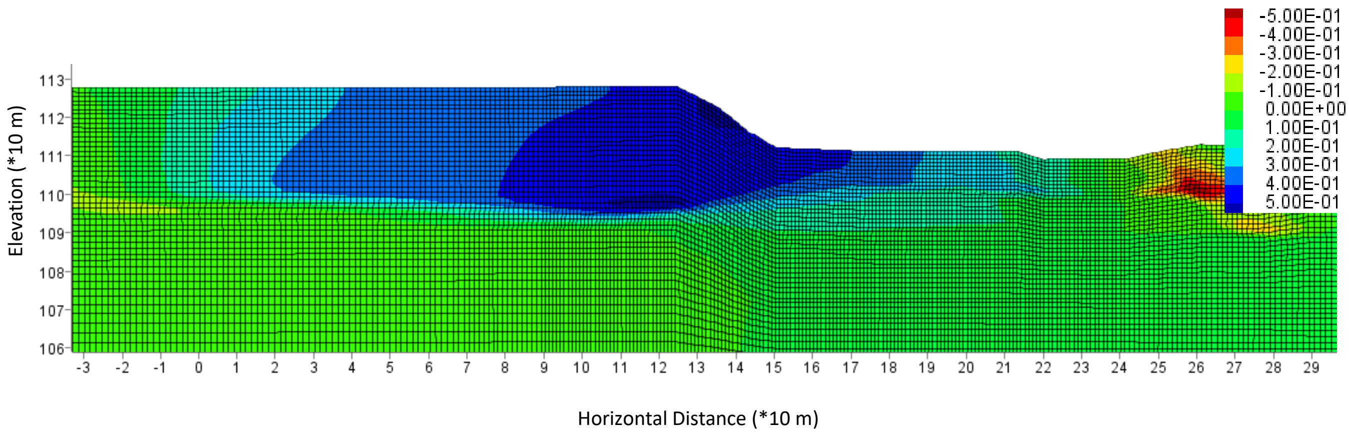
FLAC Model – Section A-A’
Displacement and Shear Strain Contours
End of Shaking, IV Record (Max)

PROJECT NO.	DWN	CKD	APVD	REV
ENW.WENW03039-05	EW	AA	AA	0

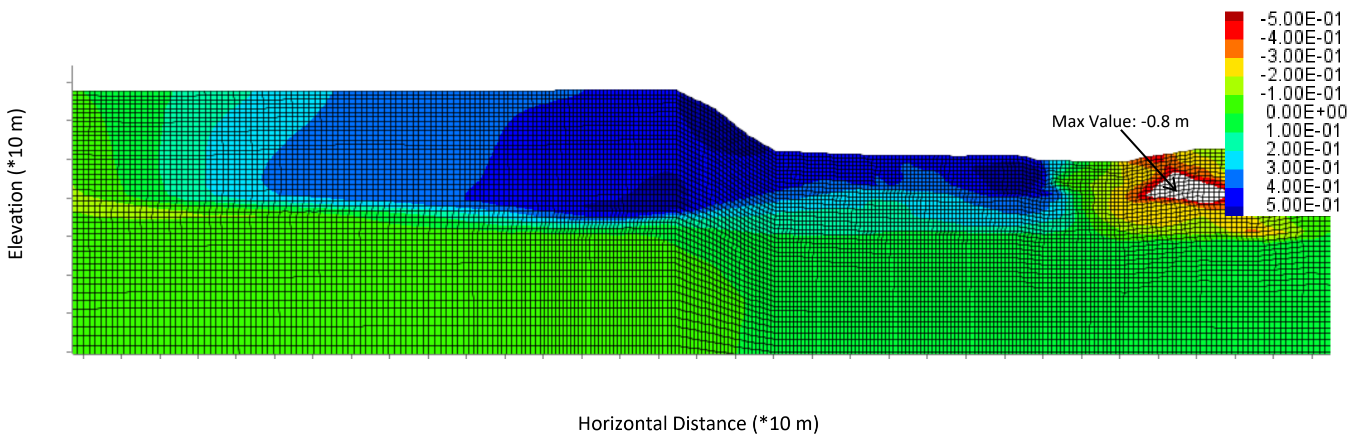
OFFICE	DATE
EBA-VANC	March 2021

Figure E.25

Seismic X-Displacement (m), positive: left to right [End of Shaking]



Post Seismic X-Displacement (m), positive: upward [Liquefied Residual Strength]



LEGEND

NOTES

Engineering shear strains are 2x the FLAC shear strains shown above.

STATUS

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NORTH AMERICAN TUNGSTEN CORPORATION LTD

TETRA TECH

Geotechnical Assessment of Existing Tailings Facilities, Cantung Mine, NT

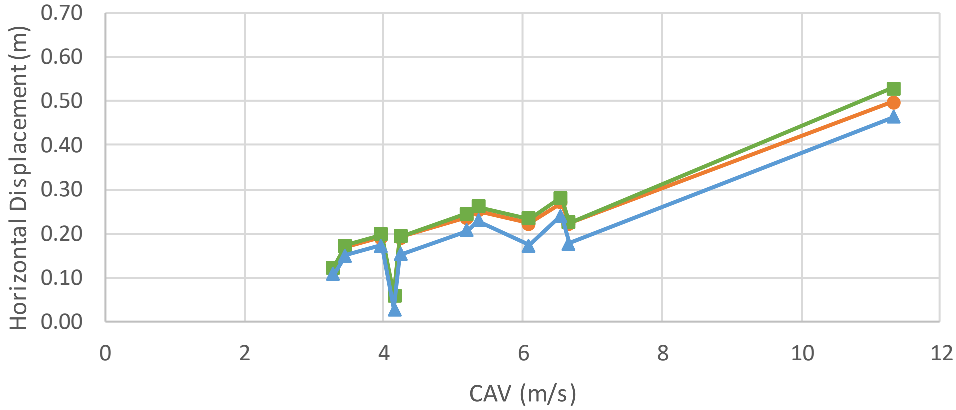
FLAC Model – Section A-A'
Horizontal Displacements – End of Shaking vs. Post-Seismic, IV Record (Max)

PROJECT NO.	DWN	CKD	APVD	REV
ENW.WENW03039-05	EW	AA	AA	0

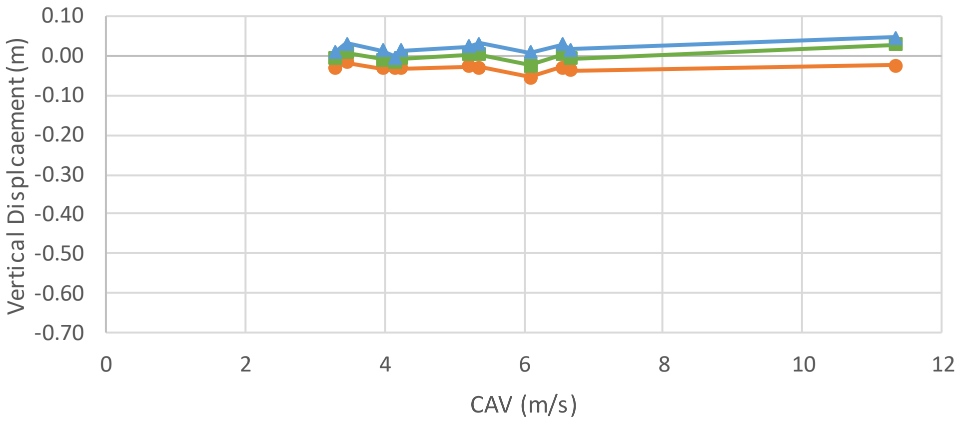
OFFICE	DATE
EBA-VANC	March 2021

Figure E.26

Seismic Horizontal Displacement (m) [End of Shaking]



Seismic Vertical Displacement (m) [End of Shaking]



LEGEND

Crest
Mid-Slope
Toe

NOTES

Output locations shown on Figure E.21

STATUS
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TETRA TECH

Geotechnical Assessment of Existing Tailings Facilities, Cantung Mine, NT

FLAC Model – Section A-A'
Seismic Displacement Summary – End of Shaking

PROJECT NO.	DWN	CKD	APVD	REV
ENW.WENW03039-05	EW	AA	AA	0

OFFICE	DATE
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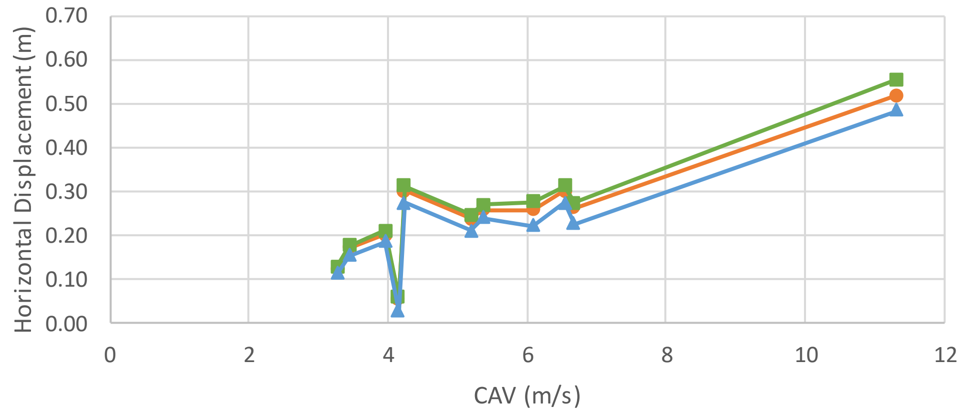
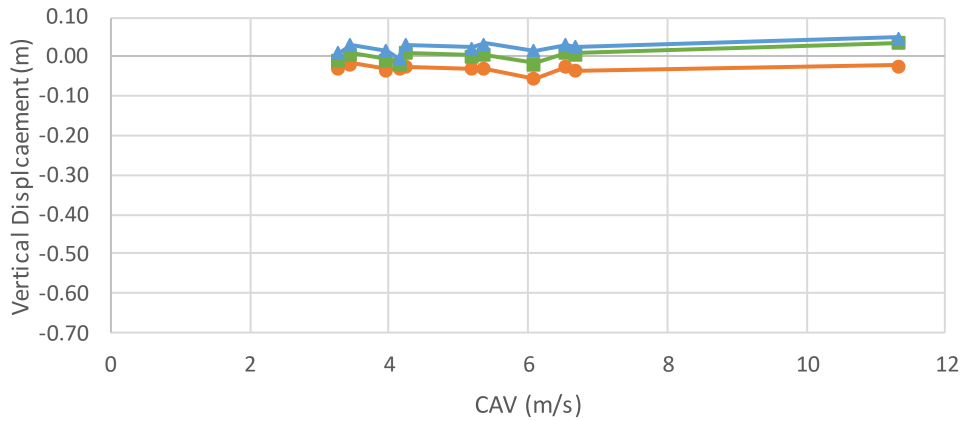
Figure E.27a

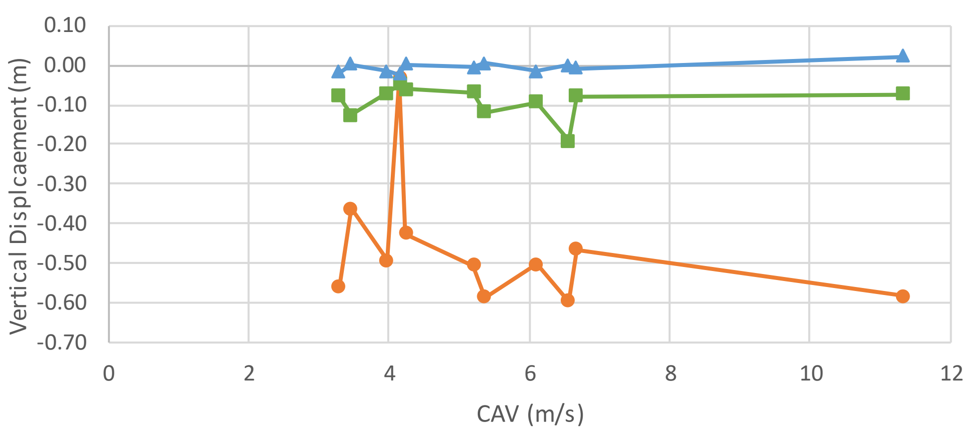
Post-Seismic Horizontal Displacement (m) [Liquefied Residual Strengths]



Post-Seismic Vertical Displacement (m) [Liquefied Residual Strengths]



Total Post-Seismic Vertical Displacement (m) [Including Volumetric Settlement]



LEGEND

Crest
Mid-Slope
Toe

NOTES

Output locations shown on Figure E.21

STATUS
ISSUED FOR USE

CLIENT

NORTH AMERICAN TUNGSTEN CORPORATION LTD

TETRA TECH

Geotechnical Assessment of Existing Tailings Facilities, Cantung Mine, NT

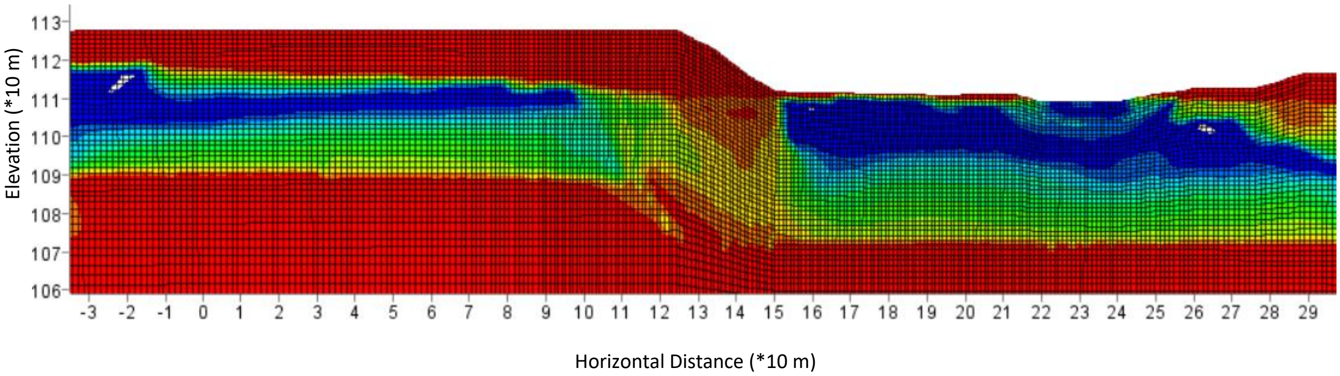
FLAC Model – Section A-A'
Post-Seismic Displacement Summary

PROJECT NO.	DWN	CKD	APVD	REV
ENW.WENW03039-05	EW	AA	AA	0

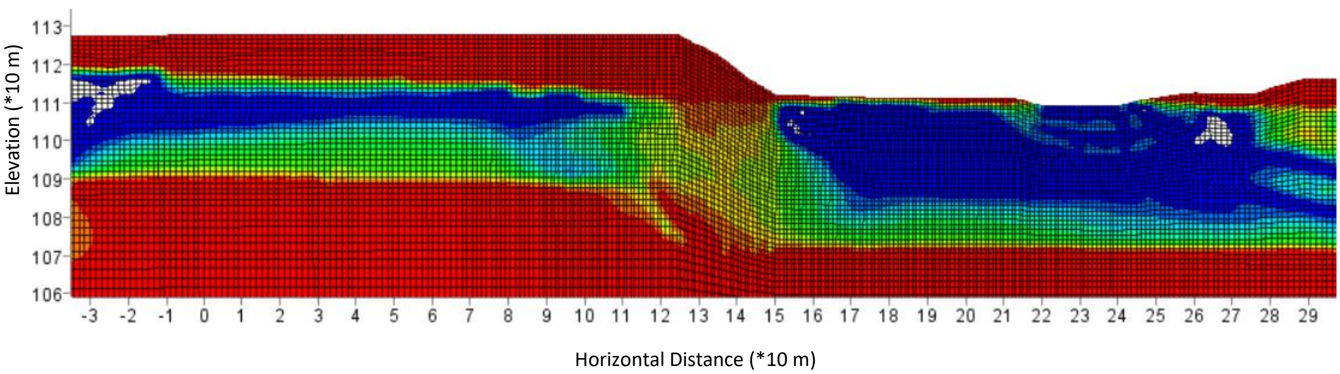
OFFICE	DATE
EBA-VANC	March 2021

Figure E.27b

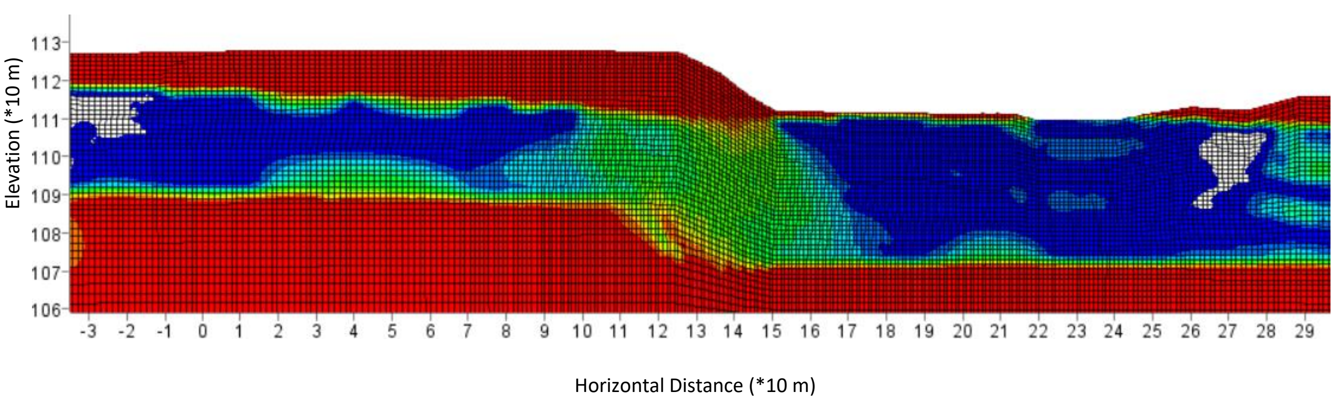
Ru_max, N160cs = 15



Ru_max, N160cs = 10



Ru_max, N160cs = 5



LEGEND

0.00E+00
1.00E-01
2.00E-01
3.00E-01
4.00E-01
5.00E-01
6.00E-01
7.00E-01
8.00E-01
9.00E-01
1.00E+00

NOTES

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TETRA TECH

Geotechnical Assessment of Existing Tailings Facilities, Cantung Mine, NT

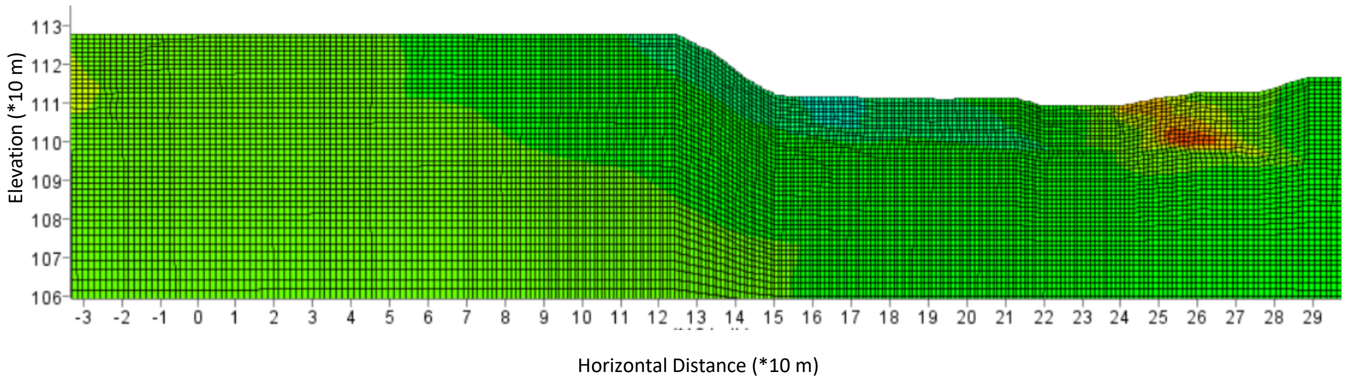
FLAC Model – Section A-A'
N160cs Sensitivity
Ru_max – IV Record (Max)

PROJECT NO.	DWN	CKD	APVD	REV
ENW.WENW03039-05	EW	AA	AA	0

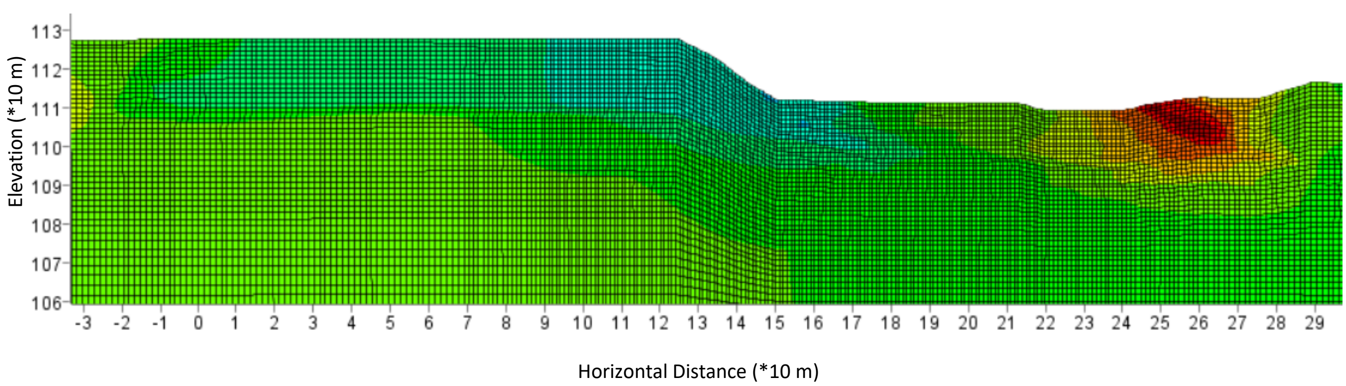
OFFICE	DATE
EBA-VANC	March 2021

Figure E.28

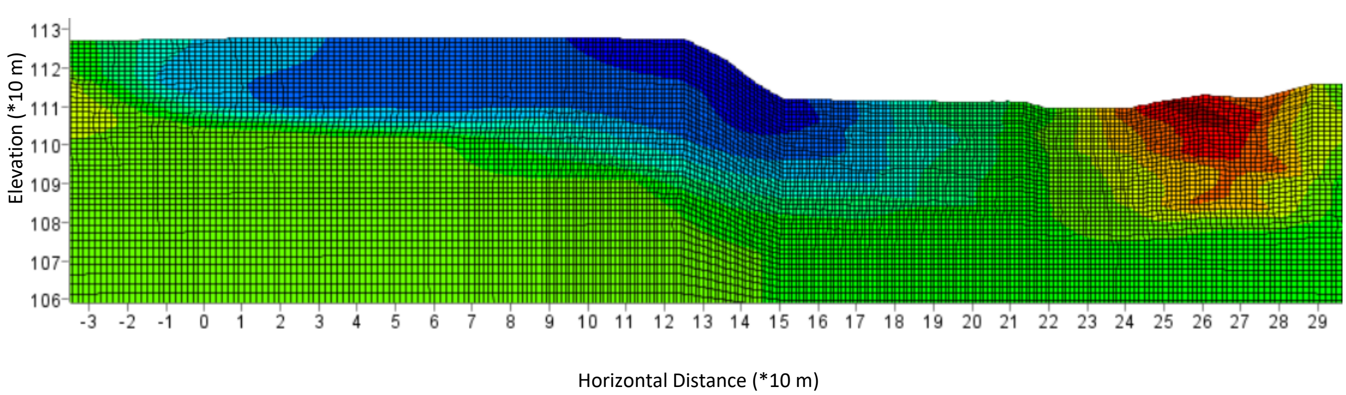
Seismic Horizontal Displacement (m) [End of Shaking], N160cs = 15



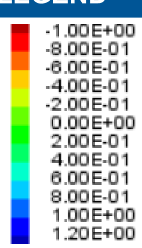
Seismic Horizontal Displacement (m) [End of Shaking], N160cs = 10



Seismic Horizontal Displacement (m) [End of Shaking], N160cs = 5



LEGEND



NOTES

Positive displacement values: left to right

STATUS

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Geotechnical Assessment of Existing Tailings Facilities, Cantung Mine, NT

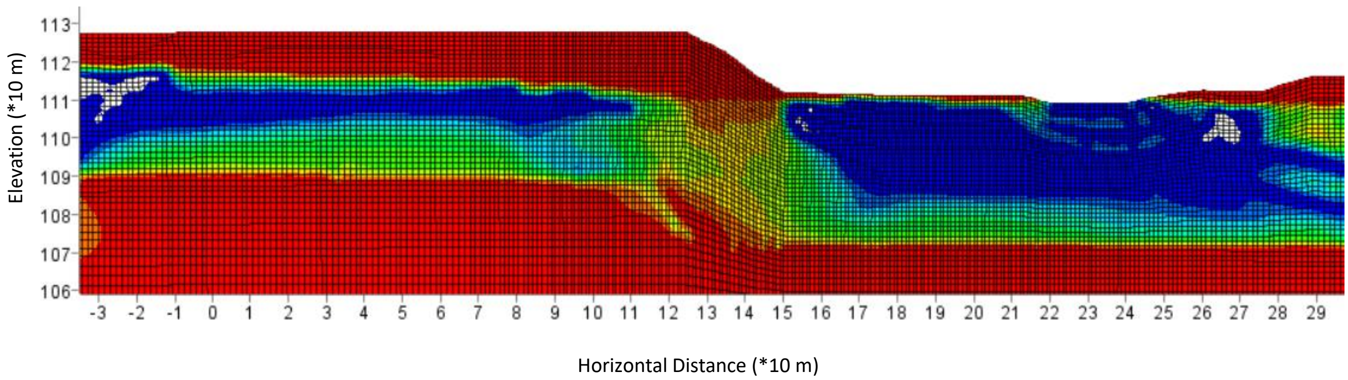
FLAC Model – Section A-A'
N160cs Sensitivity
Horizontal Displacement – IV Record (Max)

PROJECT NO.	DWN	CKD	APVD	REV
ENW.WENW03039-05	EW	AA	AA	0

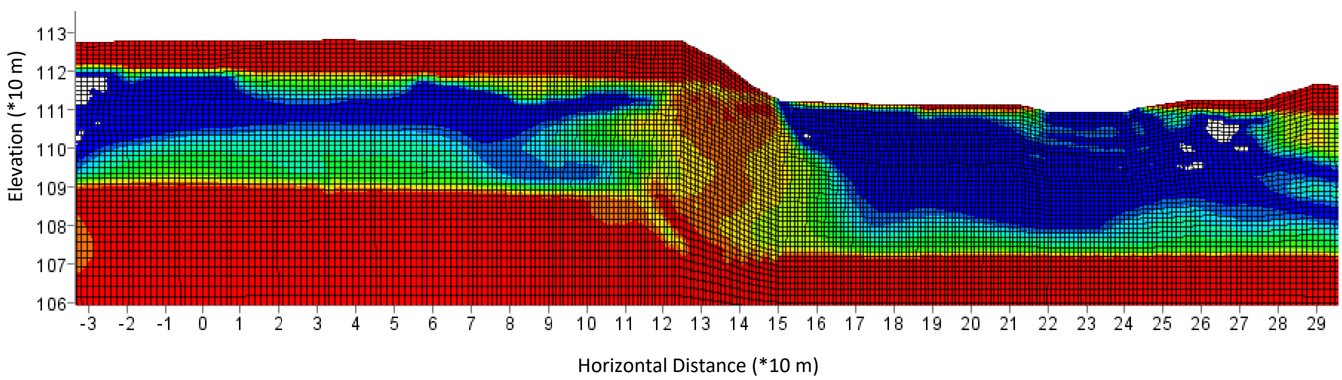
OFFICE	DATE
EBA-VANC	March 2021

Figure E.29

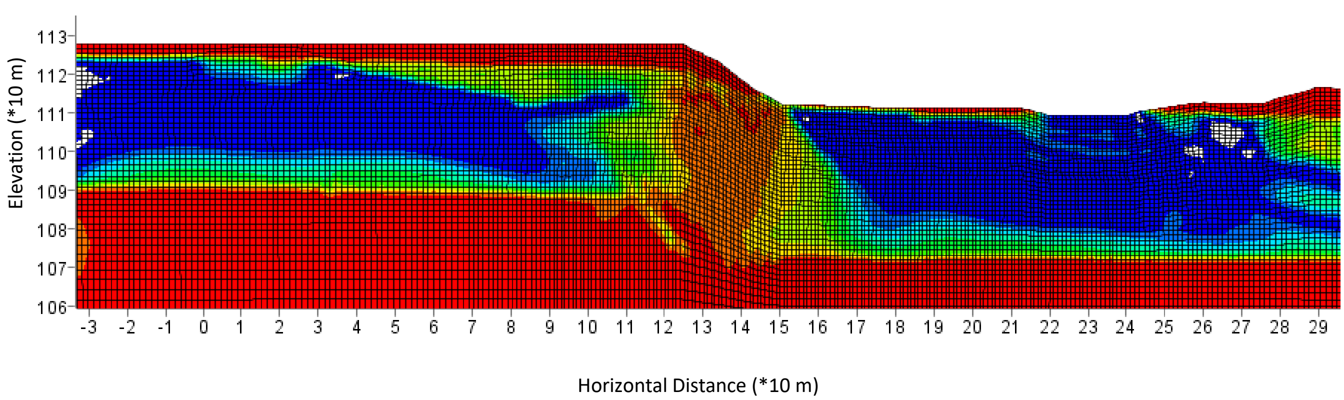
Ru_max, N160cs = 10, Groundwater below Tailings



Ru_max, N160cs = 10, Tailings Groundwater El. 1117 m



Ru_max, N160cs = 10, Tailings Groundwater El. 1121 m



LEGEND

0.00E+00
1.00E-01
2.00E-01
3.00E-01
4.00E-01
5.00E-01
6.00E-01
7.00E-01
8.00E-01
9.00E-01
1.00E+00

NOTES

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Geotechnical Assessment of Existing Tailings Facilities, Cantung Mine, NT

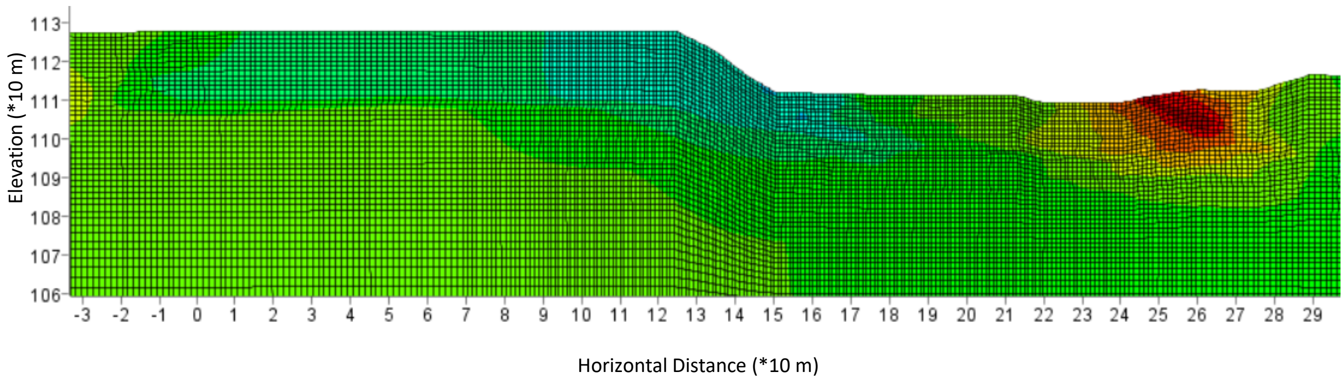
FLAC Model – Section A-A'
Tailings Saturation Sensitivity
Ru_max – IV Record (Max)

PROJECT NO.	DWN	CKD	APVD	REV
ENW.WENW03039-05	EW	AA	AA	0

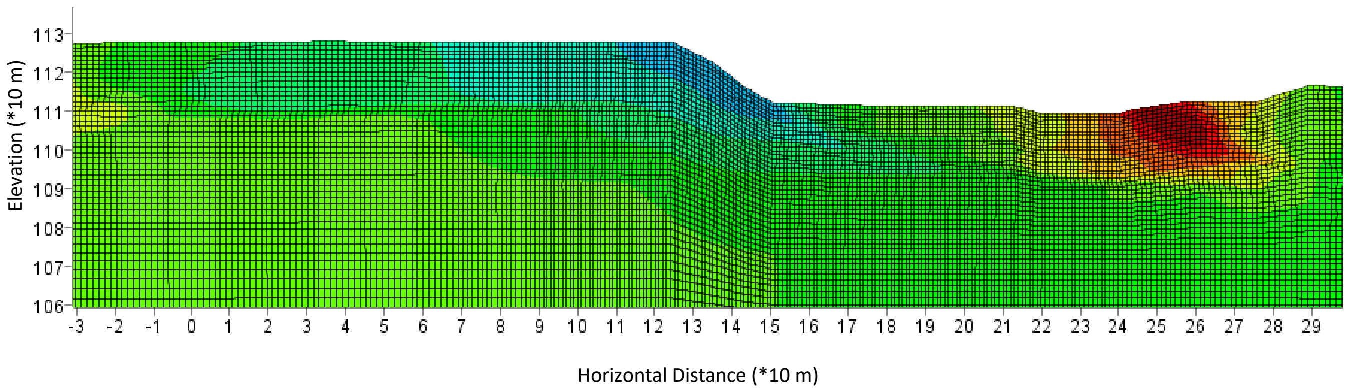
OFFICE	DATE
EBA-VANC	March 2021

Figure E.30

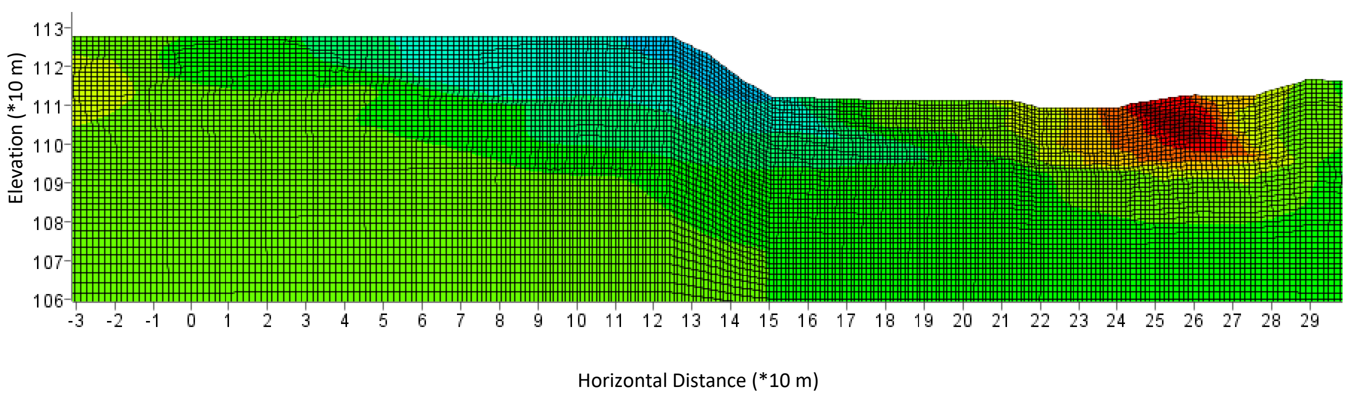
Seismic Horizontal Displacement (m) [End of Shaking], N160cs = 10, Groundwater below Tailings



Seismic Horizontal Displacement (m) [End of Shaking], N160cs = 10, Tailings Groundwater El. 1117 m



Seismic Horizontal Displacement (m) [End of Shaking], N160cs = 10, Tailings Groundwater El. 1121 m



LEGEND

-1.00E+00
-8.00E-01
-6.00E-01
-4.00E-01
-2.00E-01
0.00E+00
2.00E-01
4.00E-01
6.00E-01
8.00E-01
1.00E+00
1.20E+00

NOTES

Positive displacement values: left to right

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TETRA TECH

Geotechnical Assessment of Existing Tailings Facilities, Cantung Mine, NT

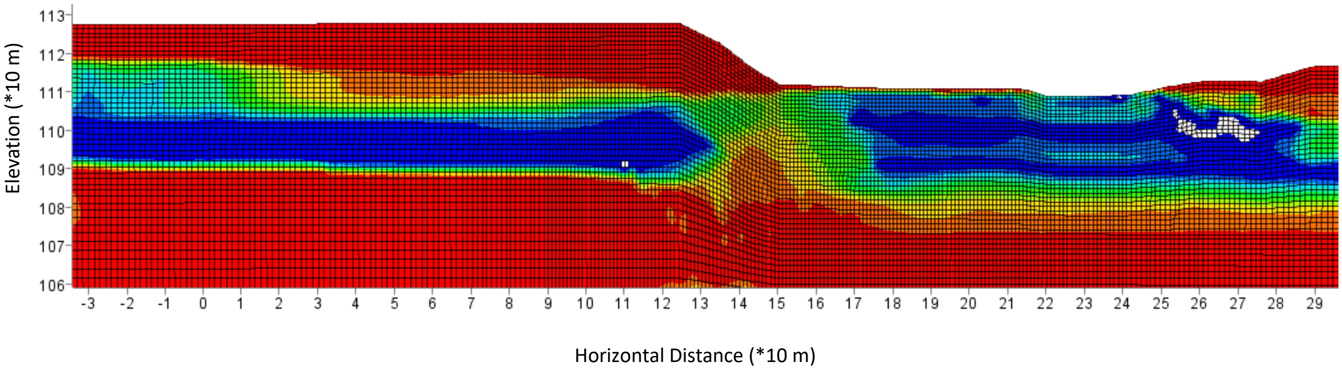
FLAC Model – Section A-A'
Tailings Saturation Sensitivity
Horizontal Displacement – IV Record (Max)

PROJECT NO.	DWN	CKD	APVD	REV
ENW.WENW03039-05	EW	AA	AA	0

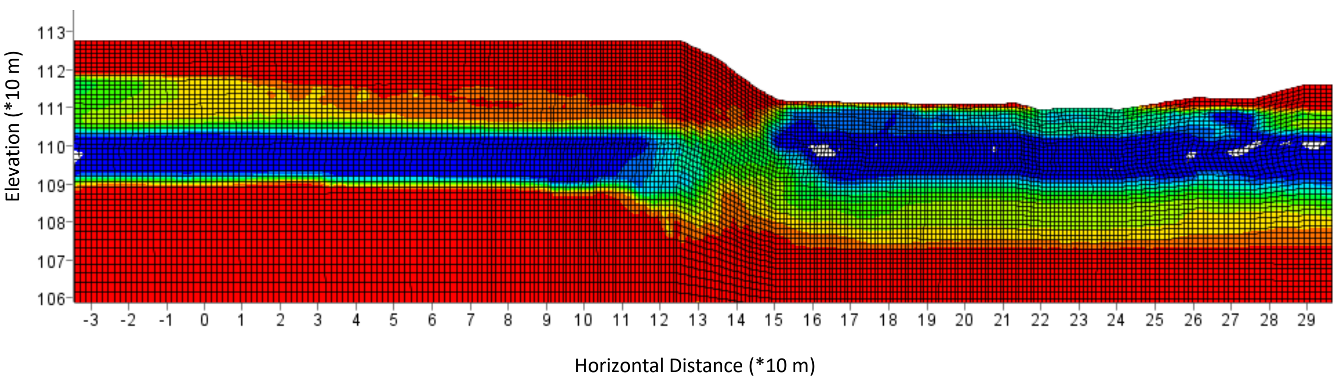
OFFICE	DATE
EBA-VANC	March 2021

Figure E.31

Ru_max, Baseline Section A



Ru_max, Pessimistic Soil Profile TP1/2



LEGEND

0.00E+00
1.00E-01
2.00E-01
3.00E-01
4.00E-01
5.00E-01
6.00E-01
7.00E-01
8.00E-01
9.00E-01
1.00E+00

NOTES

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Geotechnical Assessment of Existing Tailings Facilities, Cantung Mine, NT

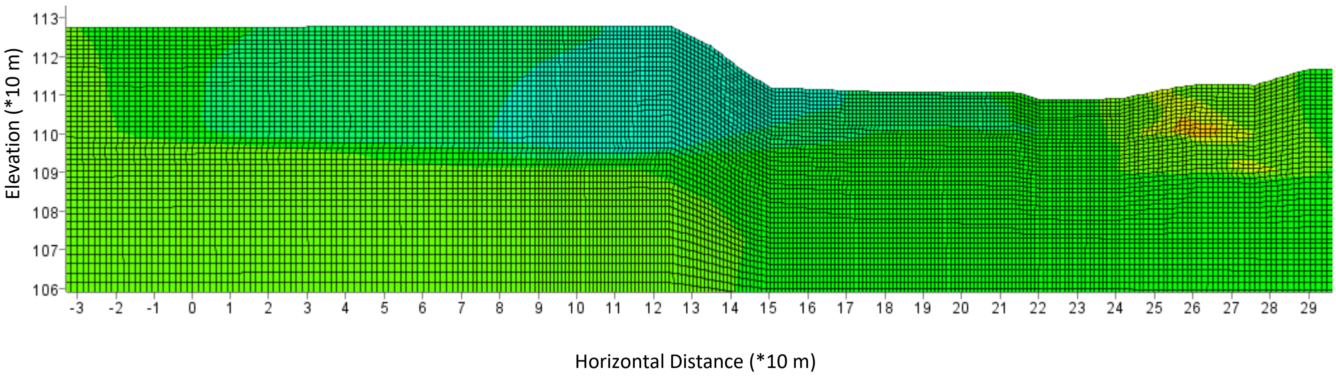
FLAC Model – Section A-A'
Baseline vs. Pessimistic Soil Profiles
Ru_max – IV Record (Max)

PROJECT NO.	DWN	CKD	APVD	REV
ENW.WENW03039-05	EW	AA	AA	0

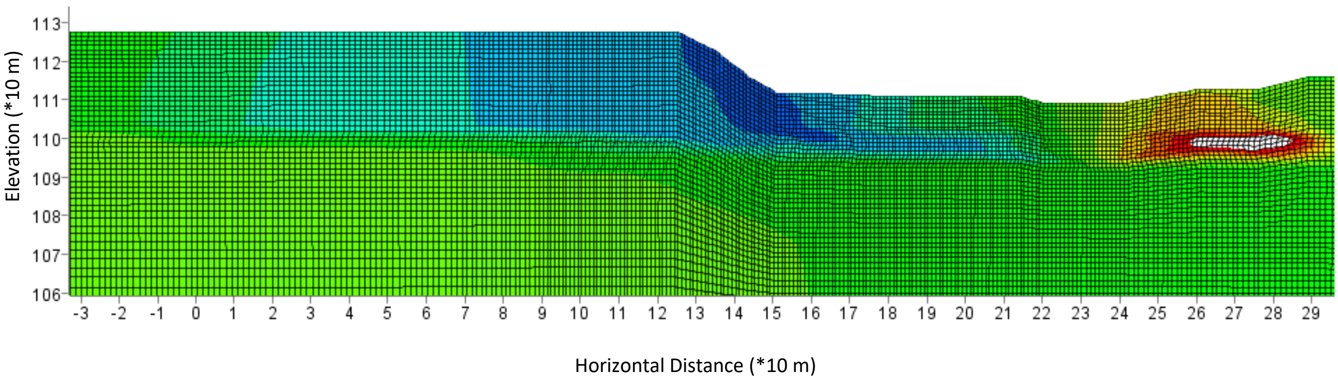
OFFICE	DATE
EBA-VANC	March 2021

Figure E.32

Seismic Horizontal Displacement (m) [End of Shaking], Baseline Section A



Seismic Horizontal Displacement (m) [End of Shaking], Pessimistic Soil Profile TP1/2



LEGEND

Legend
-1.00E+00
-8.00E-01
-6.00E-01
-4.00E-01
-2.00E-01
0.00E+00
2.00E-01
4.00E-01
6.00E-01
8.00E-01
1.00E+00
1.20E+00

NOTES

Positive displacement values: left to right

STATUS

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Geotechnical Assessment of Existing Tailings Facilities, Cantung Mine, NT

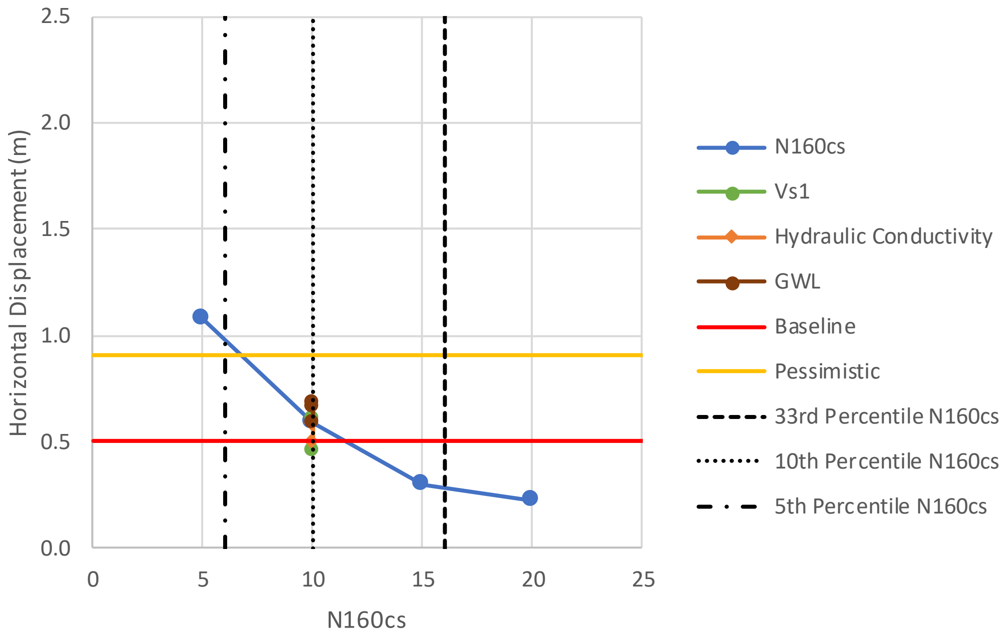
FLAC Model – Section A-A'
Baseline vs. Pessimistic Soil Profiles
Horizontal Displacement – IV Record (Max)

PROJECT NO.	DWN	CKD	APVD	REV
ENW.WENW03039-05	EW	AA	AA	0

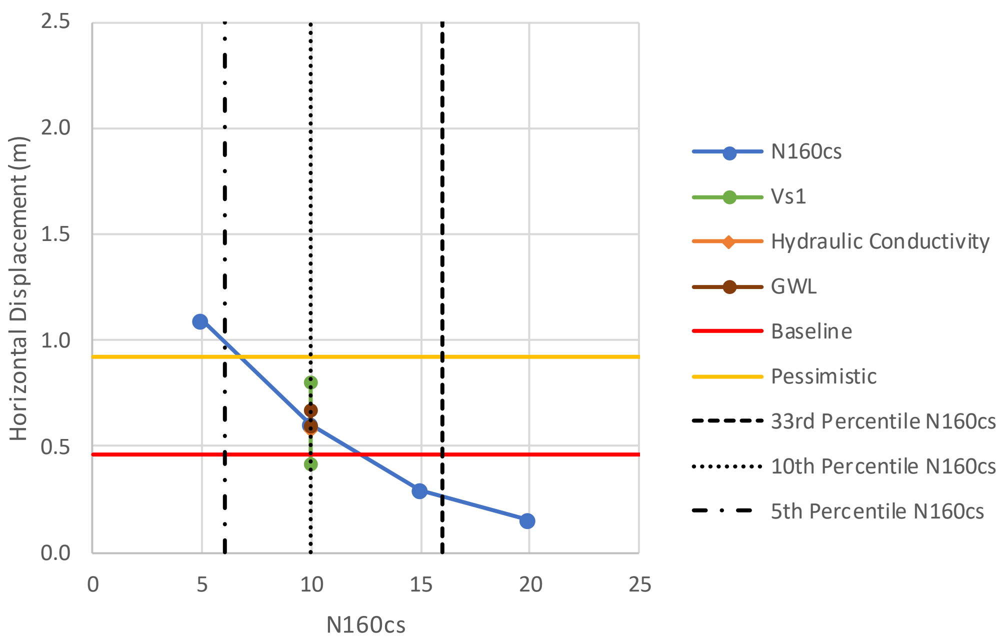
OFFICE	DATE
EBA-VANC	March 2021

Figure E.33

Seismic Horizontal Displacement (m) at Crest [End of Shaking]



Seismic Horizontal Displacement (m) at Toe [End of Shaking]



LEGEND

NOTES

Sensitivity Parameters
N160cs: 5 – 20
Vs1: 200 – 400 m/s
Hydraulic Conductivity: 1e-6 – 1e-4
GWL: El. 1117 – 1121 m within Tailings

STATUS
ISSUED FOR USE

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NORTH AMERICAN TUNGSTEN CORPORATION LTD

TETRA TECH

Geotechnical Assessment of Existing Tailings Facilities, Cantung Mine, NT

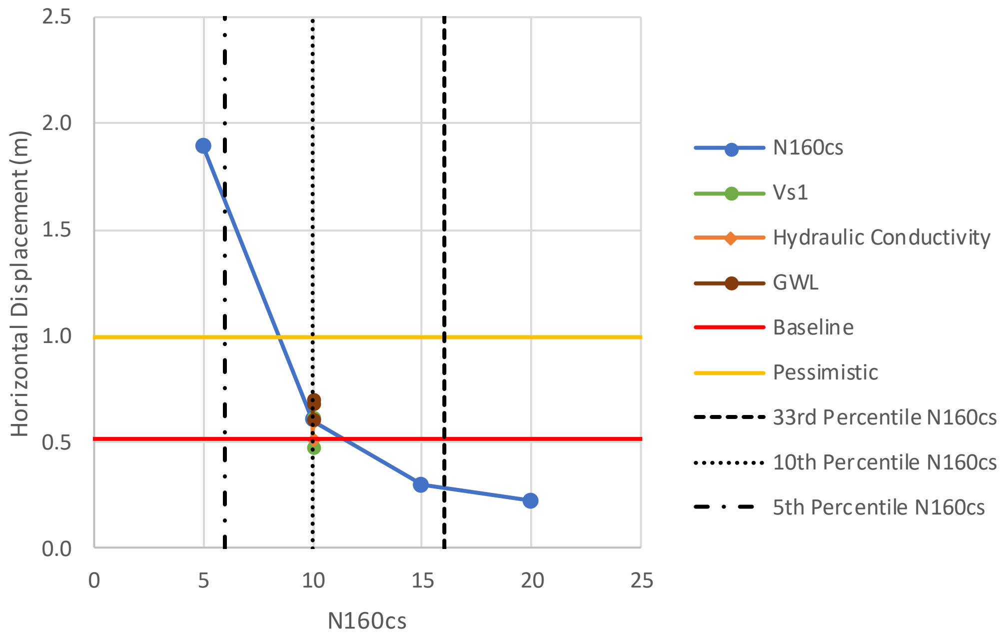
FLAC Model – Section A-A'
Sensitivity Displacement Summary
End of Shaking – IV Record (Max)

PROJECT NO.	DWN	CKD	APVD	REV
ENW.WENW03039-05	EW	AA	AA	0

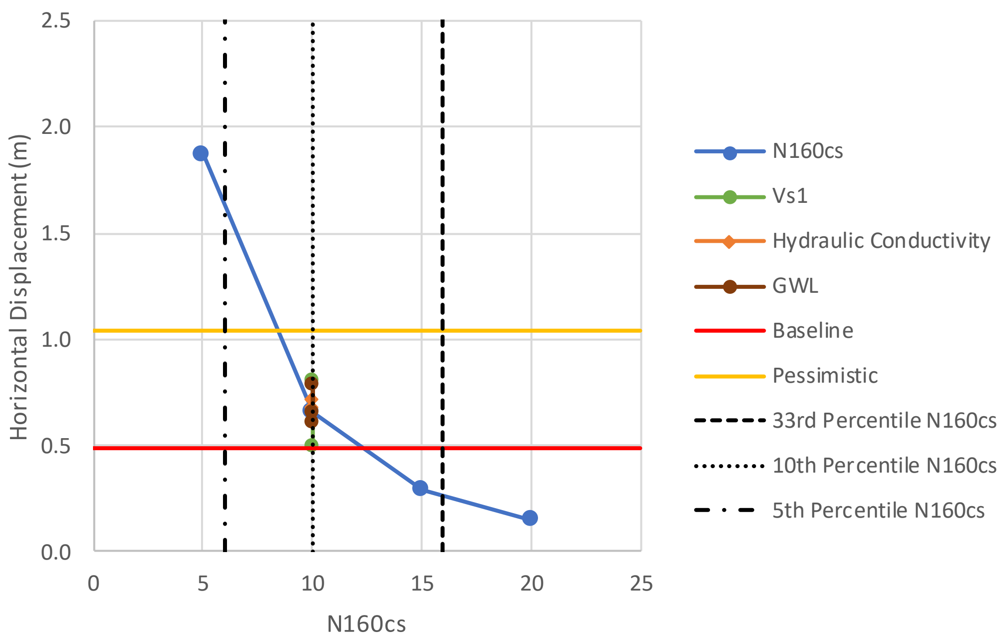
OFFICE	DATE
EBA-VANC	March 2021

Figure E.34a

Post-Seismic Horizontal Displacement (m) at Crest [Liquefied Residual Strength]



Post-Seismic Horizontal Displacement (m) at Toe [Liquefied Residual Strength]



LEGEND

NOTES

Sensitivity Parameters
N160cs: 5 – 20
Vs1: 200 – 400 m/s
Hydraulic Conductivity: 1e-6 – 1e-4
GWL: El. 1117 – 1121 m within Tailings

STATUS
ISSUED FOR USE

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NORTH AMERICAN TUNGSTEN CORPORATION LTD

TETRA TECH

Geotechnical Assessment of Existing Tailings Facilities, Cantung Mine, NT

FLAC Model – Section A-A'
Sensitivity Displacement Summary
Post-Seismic – IV Record (Max)

PROJECT NO.	DWN	CKD	APVD	REV
ENW.WENW03039-05	EW	AA	AA	0

OFFICE	DATE
EBA-VANC	March 2021

Figure E.34b