IAMGOLD

Appendix H Mine Rock Area Stability Analysis

Côté Gold Project
Closure Plan
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1.0 INTRODUCTION

As part of the Côté Gold Feasibility Study, in support of the Mine Rock Area (MRA) design, a slope stability assessment has been carried out for the of the MRA mine rock pile. The long-term static and pseudo-static conditions were analyzed.

Mine rock from the open pit excavation will be stored at the MRA, which is located southeast of the open pit and south of New Lake. About 559 million tonnes of mine rock will be stored in the MRA over the life of the mine.

The stability analyses were carried out using the computer software SLOPE/W (ver. 8.13 Build 9253) developed by GEO-SLOPE International Ltd. General limit equilibrium model with the Morgenstern-Price method was used in the analysis. This appendix presents the methodolgy and results of the analyses carried out.

2.0 MRA CONFIGURATION AND KEY CONSIDERATIONS

The MRA configuration and key considerations made in the stability analysis are as follows:

- The waste rock pile will be constructed on existing ground by end dumping rock in a configuration consisting of benches and inter-bench slopes. All around benches will be provided at 20 m vertical intervals. Each bench will be 25.6 m wide with inter-bench slopes of 1.3H:1V equivalent to the angle of repose of rock;
- The overall slope of the MRA stockpile will be 2.6H:1V in accordance with the EA commitments;
- The maximum allowable crest elevation of the pile is 550 m with the maximum height of the pile not to exceed 150 m;
- The long term phreatic surface was assumed at the ground surface in the toe area of the pile and increasing as the phreatic surface moves towards the center of the pile. This assumption is made due to potential fines content in the mine rock;
- The stratigraphy data in the stability model is based on borehole DH13-WD-01, which represents the critical section due to a thick organics layer and a loose to compact sand with some silt deposit. Based on the borehole information, the strata consists of 3.2 m thick organics overlying a 2.3 m thick sand layer underlain by bedrock. Bedrock was encountered at 5.5 m below original ground surface.

3.0 MODEL INPUT PARAMETERS

The following section summarizes geotechnical parameters used in stability analysis and are based on site specific data obtained from the geotechnical investigations, experience, and industry accepted values. The following effective stress parameters given in Table E2-1 were used for stability modeling.

Table E2-1: Effective Stress Stability Model Parameters

Material	Bulk unit weight γ (kN/m^3)	Effective Cohesion c' kPa	Effective angle of internal friction φ′ (deg)
Organics	17	0	15
Silty Sand to Sandy Silt	19	0	27
Uncompacted mine rock	20	0	40

For seismic loading cases, an applied load equal to half of the 1 in 100 year peak ground acceleration value of 0.011g (Amec Foster Wheeler, 2018) was used in the stability model as recommended by Hynes-Griffin and Arley Franklin for the Department of the Army US Army Corps of Engineers in the paper titled "Rationalizing the Seismic Ground Coefficient", 1984.

The slope at the highest waste rock pile section was analyzed (Section A-A), as shown in Figure E2-1. The following loading conditions were considered:

- Static long-term condition (Overall);
- Static long-term condition (First Bench); and
- Pseudo-static.

4.0 STABILITY ANALYSIS RESULTS

For each loading condition and section model, a number of failure surfaces (e.g., circular, block and composite) were simulated to determine the most critical failure mode, and the lowest calculated factor of safety was considered.

Figures E2-2 to E2-4 show the results of the analyses. Table E2-2 summarize the results of the analyses. To achieve the target factors of safety the first perimeter slope should be placed at 1.8H:1V. The subsequent inter-bench slopes would at the angle of repose of the rock (1.33H:1V). In addition, all organics within a 30 m wide strip along the MRA perimeter should be stripped. In all cases the required factors of safety are met with the above toe stabilization measures.

Table E2-2: Results of Stability Analyses

Loading	Minimum Calculated Factor of Safety	Required Factor of Safety	Reference
Static, long term (Overall)	1.5	1.5	Figure E2-2
Static, long term (First Bench)	1.5	1.5	Figure E2-3
Pseudo-static (Overall)	1.4	1.1	Figure E2-4
Pseudo-static (First Bench)	1.5	1.1	Figure E2-5

5.0 REFERENCES

Amec Foster Wheeler, 2018. Site Specific Seismic Hazard Assessment Report, Cote Gold Project, Gogama, Ontario. Amec Foster Amec Foster Wheeler Environment & Infrastructure, a Division of Amec Foster Wheeler Americas Limited. February 2018.

Hynes-Griffin, M. E., & Arley, F. G. (1984). *Rationalizing the Seismic Coefficient Method.* Washington: Department of the Army US Army Corps of Engineers.

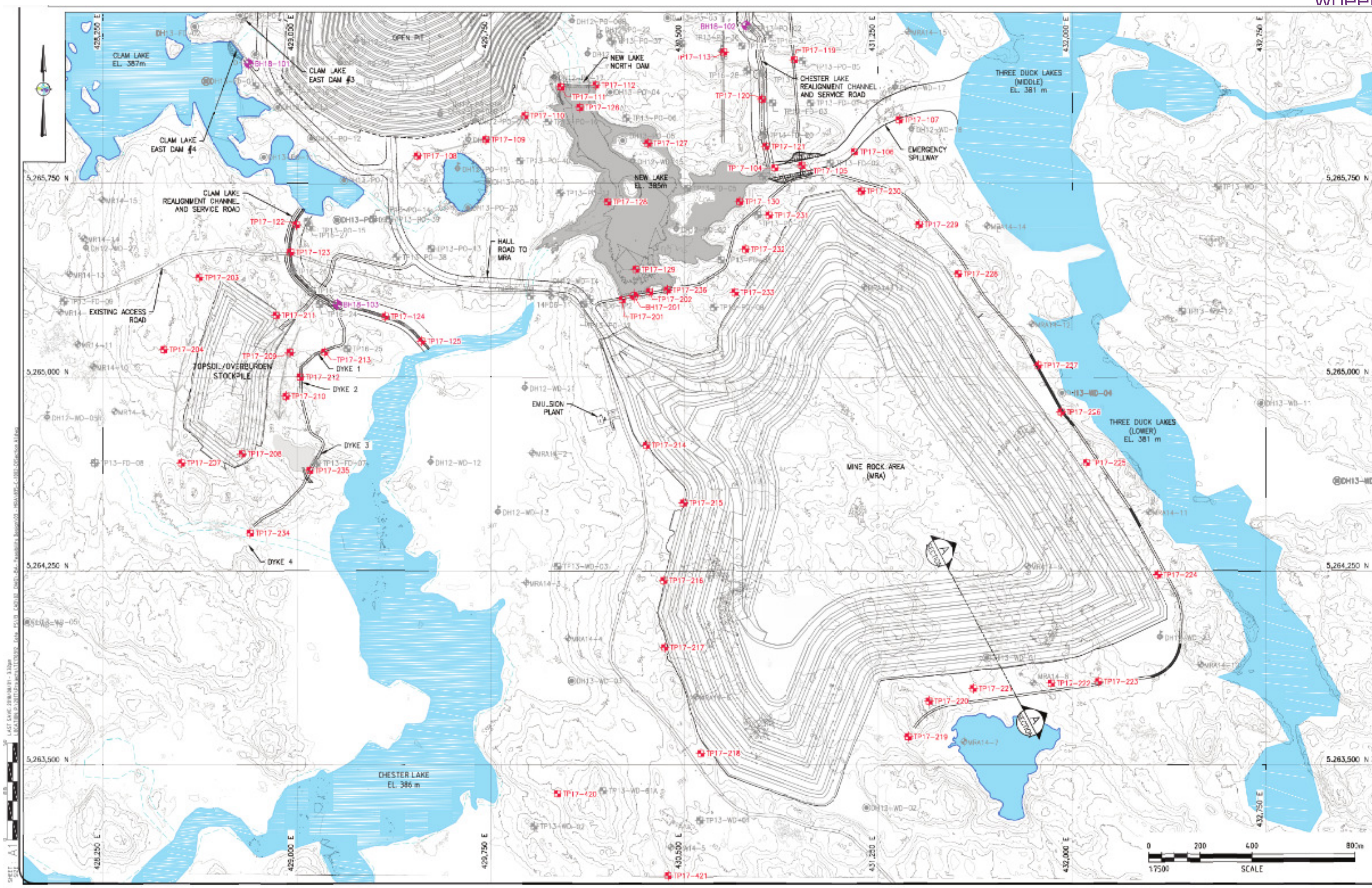

Figure E2-1: MRA Waste Rock Pile – Plan and Stability Analysis Section Location

Color	Name	Model	Piezometric Line	Unit Weight (kN/m³)	Cohesion' (kPa)	Phi' (°)
(grey)	Bedrock	Bedrock (Impenetrable)	1			
(dark green)	Organics	Mohr-Coulomb	1	17	0	15
(brown)	Rockfill	Mohr-Coulomb	1	20	0	40
(light green)	Silt and Sand	Mohr-Coulomb	1	19	0	27

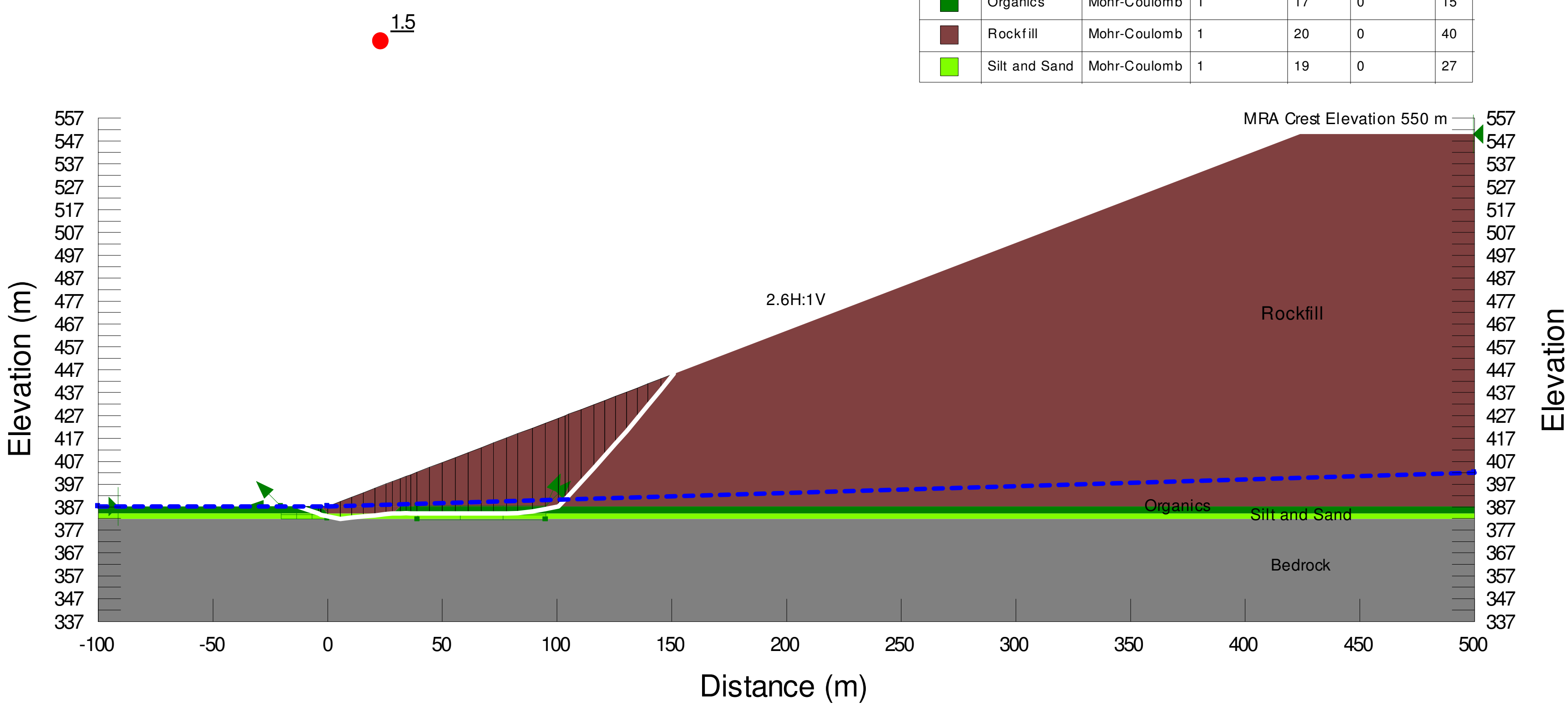

Figure E2-2: MRA Waste Rock Pile – Long Term Static Stability (Overall)

Color	Name	Model	Piezometric Line	Unit Weight (kN/m³)	Cohesion' (kPa)	Phi' (°)
	Bedrock	Bedrock (Impenetrable)	1			
	Organics	Mohr-Coulomb	1	17	0	15
	Rockfill	Mohr-Coulomb	1	20	0	40
	Silt and Sand	Mohr-Coulomb	1	19	0	27

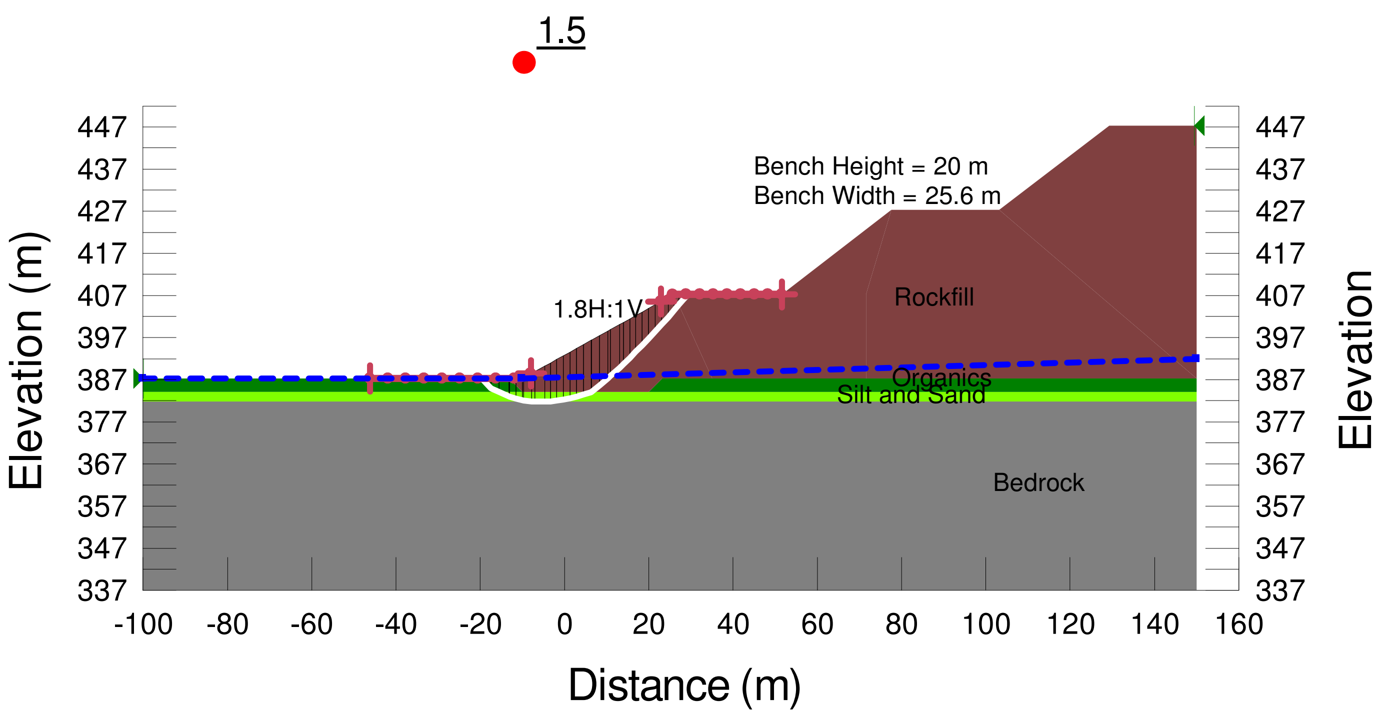

Figure E2-3: MRA Mine Rock Pile – Long Term Static Stability (First Bench)

Color	Name	Model	Piezometric Line	Unit Weight (kN/m³)	Cohesion' (kPa)	Phi' (°)
	Bedrock	Bedrock (Impenetrable)	1			
	Organics	Mohr-Coulomb	1	17	0	15
	Rockfill	Mohr-Coulomb	1	20	0	40
	Silt and Sand	Mohr-Coulomb	1	19	0	27

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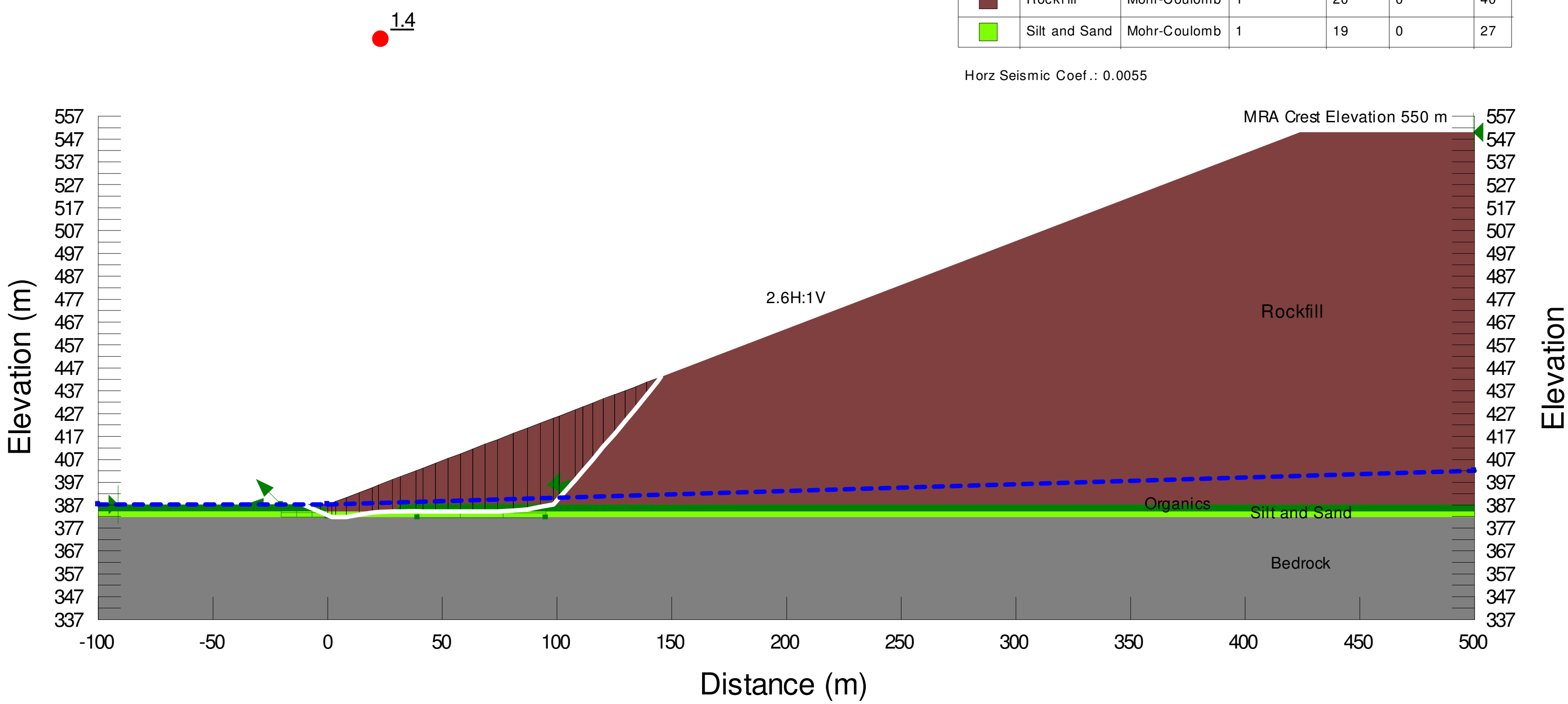

Figure E2-4: MRA Waste Rock Pile –Pseudo-Static Stability (Overall)

Color	Name	Model	Piezometric Line	Unit Weight (kN/m³)	Cohesion' (kPa)	Phi' (°)	Phi-B (°)
	Bedrock	Bedrock (Impenetrable)	1				
	Organics	Mohr-Coulomb	1	17	0	15	0
	Rockfill	Mohr-Coulomb	1	20	0	40	0
	Silt and Sand	Mohr-Coulomb	1	19	0	27	0

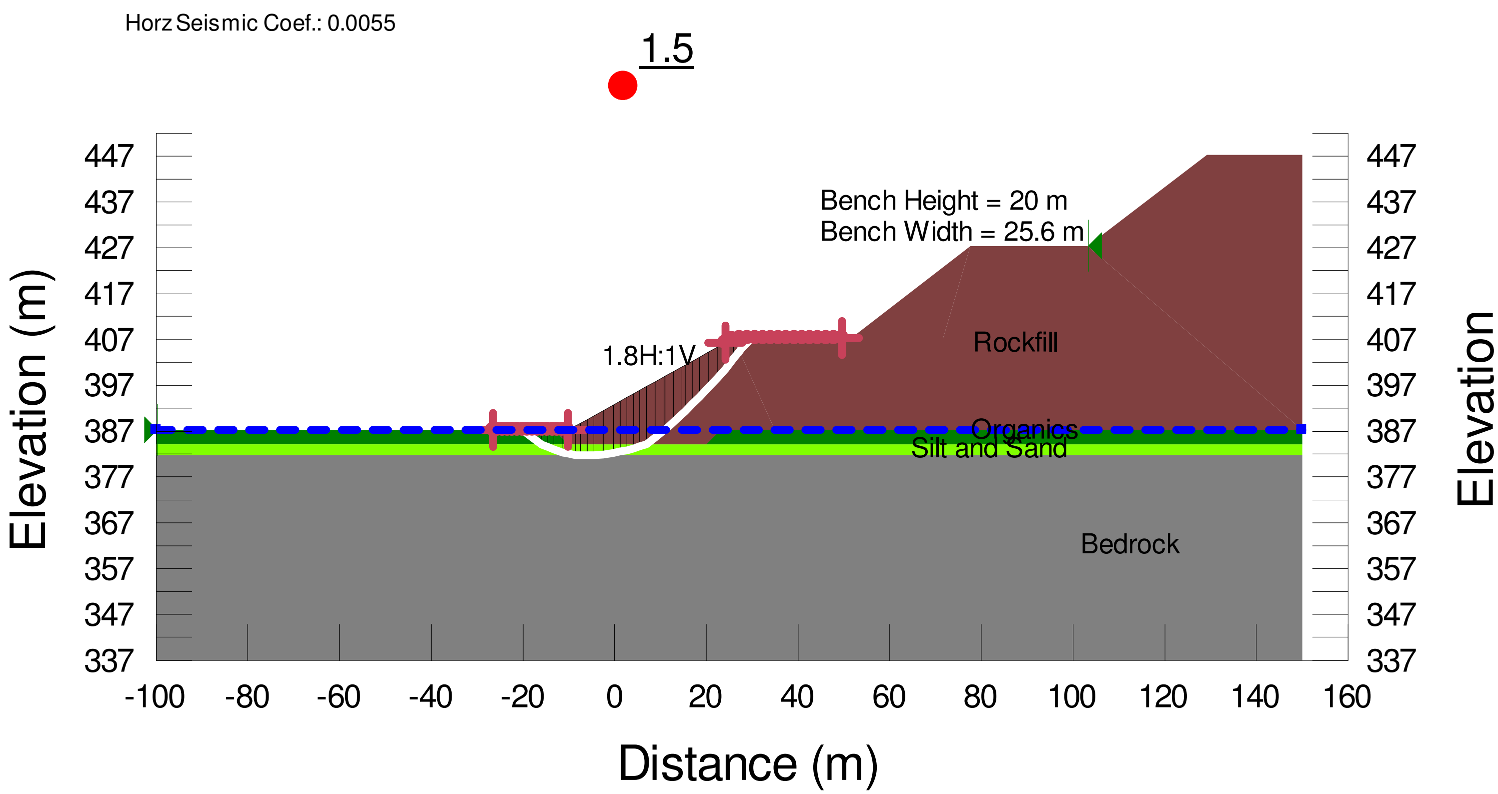

Figure E2-5: MRA Waste Rock Pile –Pseudo-Static Stability (First Bench)