



September 2, 2021

Joel Bolduc
Albert Frei & Sons, Inc.
35715 Hwy 40, Building B, Suite 120
Evergreen, CO 80439

Re: Albert Frei & Sons, Inc.; Walstrum Quarry; File No. M-1983-033; Amendment Application (AM-09); Geotechnical Review Memo

Mr. Bolduc:

The Division of Reclamation, Mining and Safety (Division/DRMS) reviewed the content of the Geotechnical Stability Exhibit submitted with the amendment application (AM-09) for the Walstrum Quarry, Permit No. M-1983-033. A copy of the review memo from Zach Trujillo dated August 31, 2021 is attached for review.

If you have any questions, please contact me at peter.hays@state.co.us or (303) 866-3567 Ext. 8124.

Sincerely,

Peter S. Hays
Environmental Protection Specialist

Enclosure – Review Memo

Ec: Jared Ebert; Division of Reclamation, Mining & Safety





COLORADO
Division of Reclamation,
Mining and Safety
Department of Natural Resources

Date: August 31, 2021

To: Peter Hays

CC: Jason Musick, Jared Ebert

From: Zach Trujillo

RE: Walstrum Quarry AM-09, DRMS File No. M-1983-033
Slope Stability Review

Peter,

As requested I have reviewed the Geotechnical Stability Exhibit (Exhibit) for the proposed AM-09 Walstrum Quarry (Walstrum) Spur Amendment on a technical aspect in relation to Section 30 of the Policies of the Mined Land Reclamation Board. AM-09 is proposing to add a total of 464.17 acres to the existing permitted quarry area. A total of 463.6 acres is being included as what has been referred to as the “spur” located to the east of the currently approved permit. Additionally, 0.57 acres is being added to the north of the existing quarry region. This memo and review focuses around the “spur” portion of the proposed AM-09 as no information was discussed regarding the proposed addition of 0.57 acres in the Exhibit.

Under a Division NOI (P-2020-005) and Modification MD-01, Walstrum conducted exploratory drill coring and test pits in the location of the proposed spur area. A total of five coreholes were drilled and six test pits were excavated to help characterize the soil and rock found within the spur expansion area. The location of the coreholes and test pits are shown in Figure No. 5 of the Exhibit. Results of the coreholes are provided in Figure 10 of the Exhibit and the test pits are provided in Appendix A of the AM-09 application.

Based on laboratory testing on the samples produced from the coreholes, site specific geotechnical and physical properties were obtained. Discussion regarding the geotechnical laboratory testing and results are found in Section 5 of the Exhibit. Additionally, geophysical surveying, as discussed in Section 6.1.2 of the Exhibit, was performed to help identify any weak rock zones, fractures, jointing, and strike and dip orientation of the proposed mining area. The combined results and properties were then applied to model slope stability and determine a factor of safety for the proposed mining operation for the spur expansion.

Based on the information provided in the Exhibit and Table 1 of Section 30.4 of the Policies of the Mined Land Reclamation Board, factors of safety will be compared to strength measurements resulting from multiple tests for a critical structure. For static conditions, minimum required factor of safety is 1.3 and for seismic conditions, minimum required factor of safety is 1.15.

Walstrum Quarry AM-09 Slope Stability Review Memo

August 31, 2021



Walstrum performed slope stability modeling on 6 critical sections along the proposed pit walls of the spur area. A total of 14 scenarios were analyzed along the 6 sections which includes a variation of observed lithology, static, pseudo-static and dip orientation conditions along the tallest pit wall of each direction. These results are summarized in Table 5 of the Exhibit.

Per Section, 6.5.2 of the Exhibit, seismic conditions were determined using the National Seismic Hazard Maps prepared by the USGS. Using 2 percent probabilities of exceedance in a 50-year period with a “type A” soil profile, Walstrum applied a 0.12 seismic coefficient for pseudo-static conditions. The Division reviewed and confirmed that a 0.12 seismic coefficient is suitable based on the Walstrum’s rational provided in the Exhibit.

In addition to the slope stability modeling based on the proposed mine plan of the spur, two sensitivity analyses were also performed along Section 2. The sensitivity analyses use 10 and 20-foot-thick layer of low strength rock midway down slope at a 45 degree angle under seismic conditions. While this scenario is not observed within the geotechnical investigation of the spur area, the sensitivity analysis was performed to help determine a limiting scenario that would still maintain an allowable factor of safety in the event of an unknown adverse condition being encountered. The results of the sensitivity analyses are also summarized in Table 5 of the Exhibit.

After reviewing the Exhibit, the Division performed a slope stability check along Section 1 and Section 2 under static and pseudo-static conditions using the slope stability software, GALENA. At the request of the Division, Walstrum provided supplemental information which included AutoCAD files for the slope profiles for Section 1 and 2.

The Division reconstructed the slope profile for both sections based on supplemental information provided by Walstrum. Using the material properties provided within the Exhibit, slope stability checks were performed under static and pseudo-static conditions. In addition, the sensitivity analysis was also checked for the 10-foot-thick layer of low strength rock midway down slope at a 45 degree angle under seismic conditions. The resulting factors of safety are summarized below in comparison to the results provided by Walstrum and the requirements of the Division.

Factors of Safety - Walstrum Quarry AM-09				
Section	Seismic Coefficient	Division	Walstrum	Division Requirements
1	0	2.79	2.63	1.3
1	0.12	2.34	2.12	1.15
2	0	2.63	2.42	1.3
2	0.12	2.09	2.12	1.15
*2	0.12	0.86	1.15	1.15
*Sensitivity Analysis - 10 ft. thick low strength rock @ 45 degrees				

As shown by the above table, the Division’s resulting factors of safety are higher or closely resemble that of Walstrum’s results outside of the sensitivity analysis. The factor of safety calculated by the Division for the sensitivity analysis is lower than what was produced by Walstrum and is below the minimum requirements of Section 30 for pseudo-static conditions.

When comparing the Division’s slope profile to that of the provided profiles with the supplemental information, it appears that the angle of slope used for the low strength rock do not match. Using a 45 degree angle for the low strength rock, the Division’s slope profile appears to be angled steeper than that which was provided with the supplemental information. When measuring the provided slope angles within AutoCAD, the maximum angle discovered was 40 degrees. This difference in a higher angle would result in the lower factor of safety as observed with the Division’s results for the sensitivity

analysis. This leads the Division to believe that perhaps there is a typo in Table 5 within the Exhibit and a lesser angle of slope was used for the sensitivity analysis to result in a factor of safety of 1.15 under pseudo-static conditions.

Based on this, please have Walstrum provide the following:

- **Please have Walstrum confirm the angle used for the low strength rock in the sensitivity analyses that result in the factors of safety provided in Table 5 of the Exhibit.**

Finally, no discussion or information was provided about the addition of the 0.57 acres to the existing quarry in the Exhibit. Due to this, it was unsure during the review on whether a technical slope stability review is necessary for this part of AM-09. If deemed applicable and necessary, additional slope stability information on this is required for the Division's review.

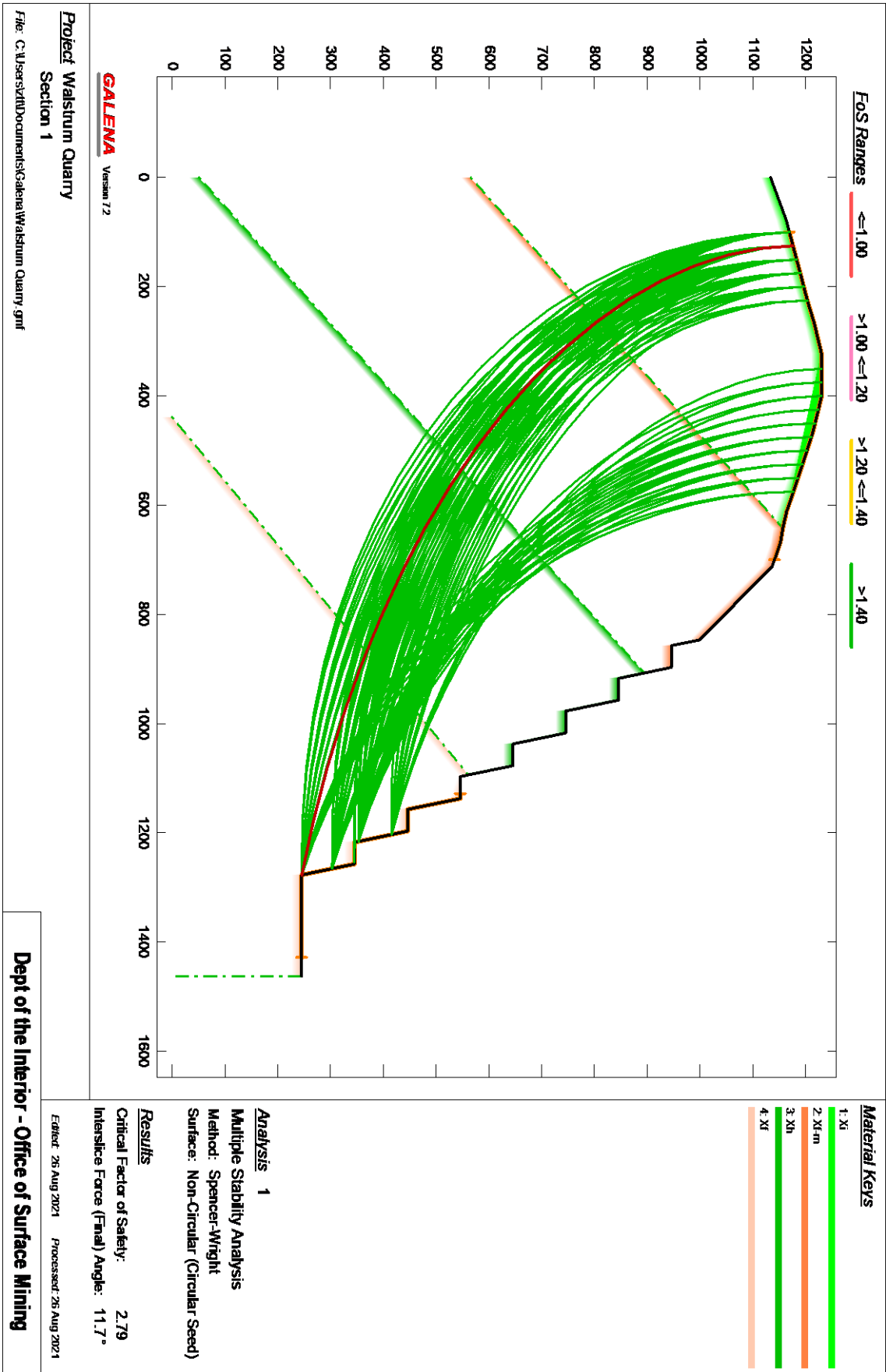
This concludes my review and comments of the Geotechnical Stability Exhibit for the proposed AM-09 Walstrum Quarry Spur Amendment on a technical aspect in relation to Section 30 of the Policies of the Mined Land Reclamation Board. If you have any questions feel free to contact me.

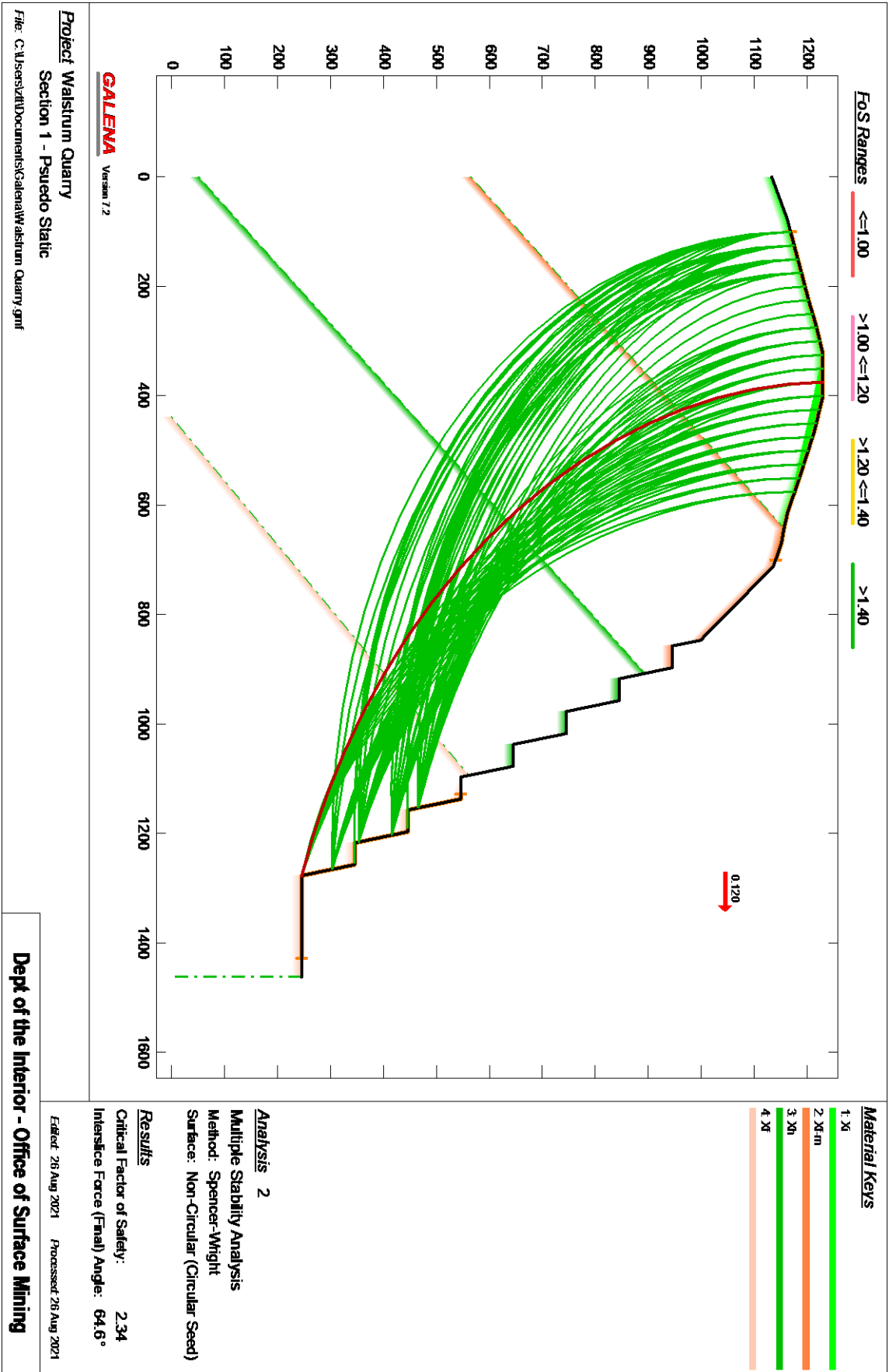
Sincerely,

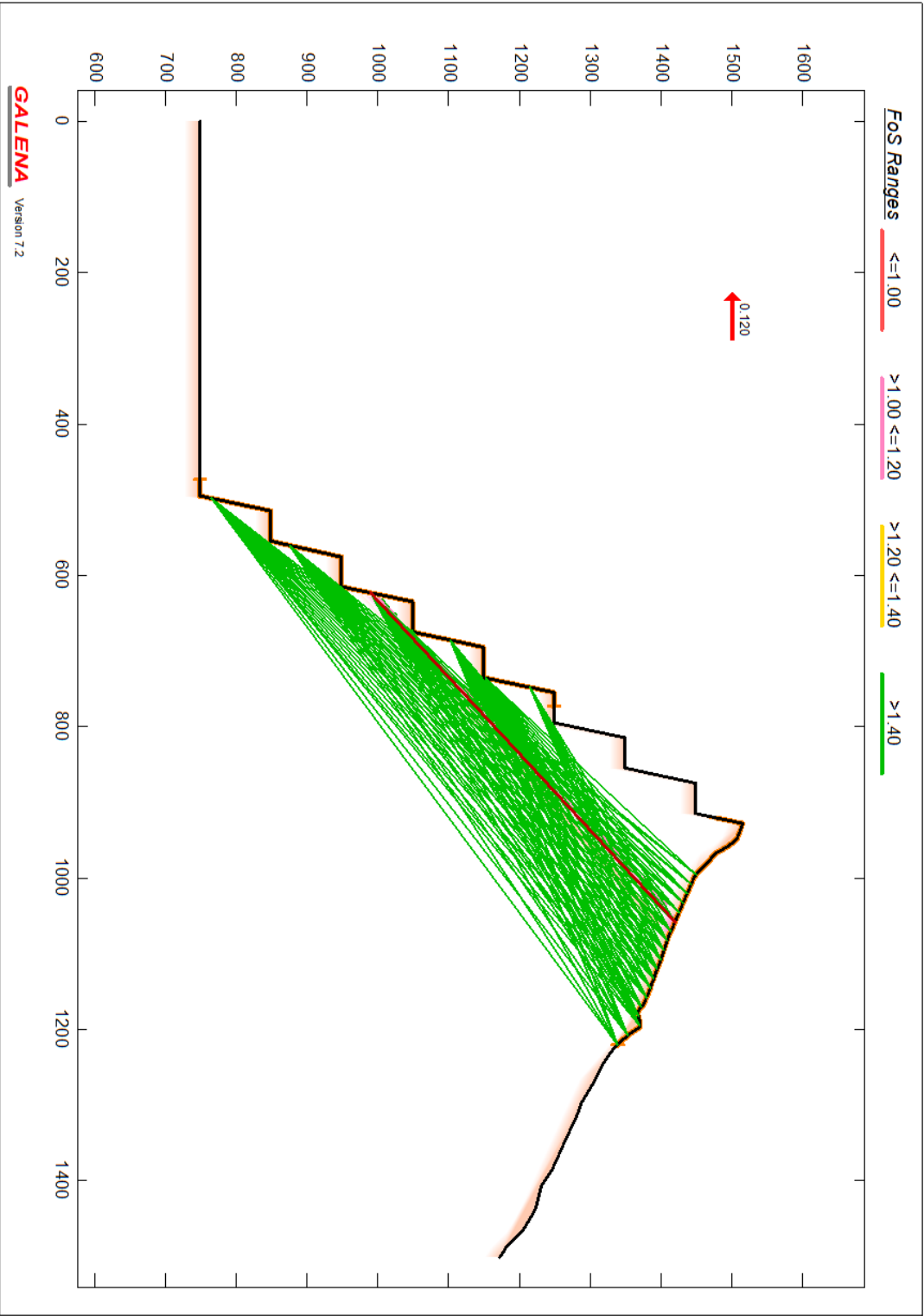
A handwritten signature in black ink, appearing to read 'Zach Trujillo', with a stylized, cursive script.

Zach Trujillo
Environmental Protection Specialist
(303) 866-3567 ext. 8164
Zach.Trujillo@state.co.us

Galena Slope Stability Results







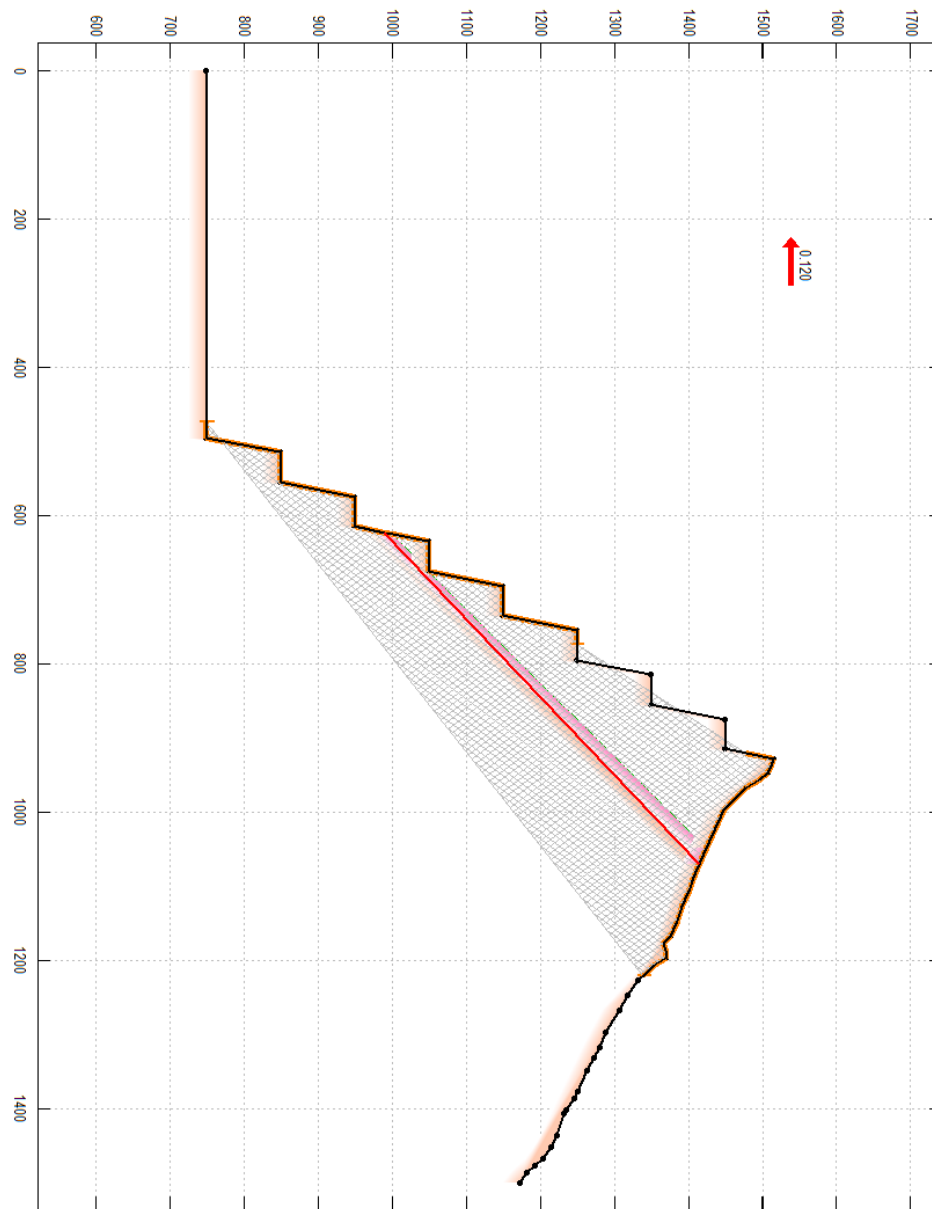
Material Keys

4: XI	—
5: Poor Rock	—

Analysis 5
Multiple Stability Analysis
Method: Spencer-Wright
Surface: Non-Circular

Results
Critical Factor of Safety: 0.86
Interslice Force (Final) Angle: 44.7°

Edited: 31 Aug 2021 Processed: 31 Aug 2021



Section 2 sensitive analysis model profile without results.