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

1313 Sherman Street, Room 215
Denver, CO 80203

March 1, 2019

Mr. Joel F. Bolduc
Aggregate Industries (US), Inc
1687 Cole Blvd. Suite 300
Golden, CO 80401

**Re: Morrison Quarry, Permit No. M-1973-021;**
**Preliminary Adequacy Review for Amendment 6 (AM06) Slope Stability**

Dear Mr. Bolduc:

The Division of Reclamation, Mining and Safety (Division) has completed its preliminary adequacy review (PAR) of the geotechnical and slope stability portions of your Morrison Quarry 112c Reclamation Permit Amendment Application (AM06) dated September 2018 and prepared by GEI Consultants, Inc. The current **decision date for the application is March 31, 2019**.

Please be advised that if you are unable to satisfactorily address any concerns identified in this review before the decision date, **it will be your responsibility to request an extension of the review period**. If there are outstanding issues that have not been adequately addressed prior to the end of the review period, and no extension has been requested, the Division may deny this application.

The attached Memorandum from Tim Cazier provides the Division's comments. If you have any questions or need further information, please contact me at (303)866-3567 x8169.

Sincerely,

Timothy A. Cazier, P.E.
Environmental Protection Specialist

ec: Michael Cunningham, DRMS
Eric Scott, DRMS
DRMS file
Jeremy Deuto, GEI Consultants

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# MEMORANDUM

**To:** Eric Scott

**From:** Tim Cazier, P.E.

**Date:** March 1, 2019

**Re: Morrison Quarry – Permit No. M-1973-021, Amendment 6 (AM-06); Geotechnical Slope Stability Preliminary Adequacy Review**

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The Division of Reclamation, Mining and Safety engineering staff (DRMS) have reviewed the Sixth Amendment to Permit M-1973-021, Aggregate Industries (AI) Morrison Quarry, dated September 2018 and prepared by GEI Consultants, Inc.

The review consisted of comparing the application content with specific requirements of C.R.S 34-32.5-116(4)(i), Rule 6.5 of the Minerals Rules and Regulations of the Colorado Mined Land Reclamation Board for the Extraction of Construction Materials, and Policies of The Mined Land Reclamation Board, Section 30.0 – Factors of Safety for Slope Stability/Geotechnical Analyses (MLRB Policy 30). Any inadequacies are identified below along with suggested actions to correct them.

1. Appendix A, Section 1, Introduction – The text on page 1 states the minimum required factor of safety (FOS) is greater than or equal to 1.2 (similar statements are found on pages 3, 4, 29, 38 and Appendix C). Pursuant to MLRB Policy 30 (adopted May 2017) and the DRMS engineering staff's assessment of the consequence of failure along with the source of strength measurements used in the analyses, the required minimum FOS is 1.25 for static conditions. For the record, these statements in the AM-06 application must be changed and the 1.25 minimum FOS for offsite impact acknowledged by the Permittee/Applicant and the preparer (GEI Consultants) in an adequacy response letter. The required 1.25 FOS has additional implications discussed below.

2. Figure 1 – 9 – Figures 1 through 9 were not included in the original submittal, but were supplied via email on January 24, 2019. No response is necessary.

3. Section 4, Highwall Stability Analysis – Subsections 4.1.3 and 4.1.5 include the following recommendation from GEI: "field measurements of the structural discontinuities should

be performed bi-annually and the results compared to the assumptions made as part of the RocPlane/RocTopple kinematic analysis". The DRMS requires AI to commit in writing to performing these field measurements and the subsequent comparison with assumptions used in the analyses on a bi-annual basis.

4. Section 5, Results – The last paragraph on page 27 references Table 4 for "the percentage of poles that could cause a toppling failure or an estimate of the probability of failure". It appears this information is presented in Table 6. Please acknowledge and make the necessary correction.

5. Section 5.3.2 FLAC/Slope – The third paragraph on page 35 discusses Case 18 indicating the factor of Safety is below the incorrect 1.2 reference and states the bench width is 50 feet. Table 10 indicate the bench width for Case 18 is 30 feet. Please:
    a. Acknowledge the minimum FOS for offsite impact is 1.25,
    b. Confirm the whether the bench width is 30 or 50 feet ad make appropriate changes to the text.

6. Section 5.3.2 FLAC/Slope – On page 35 the fourth paragraph discusses Cases 1-1, 3-1 , 5-1 , 7-1 , and 11-1; stating the FOS for these models were consistently around the incorrect 1.20 reference. The fifth paragraph discusses Cases 1-2, 3-2, 5-2, 7-2, and 11-2. Please:
    a. Acknowledge the minimum FOS for offsite impact is 1.25,
    b. Indicate where the results for Cases 1-1, 3-1, 5-1, 7-1, 11-1, 1-2, 3-2, 5-2, 7-2, and 11-2 are presented.

7. Table 10, FLAC Slope Stability Analysis Results – The last column shows a FOS less than 1.25 for Cases 12, 16 and 18. Please provide a discussion on these three cases to include specific conditions, location and the potential for offsite impacts should these particular cases fail.

8. Section 6, Recommendations – The first and fourth paragraphs on page 38 reference the incorrect 1.2 FOS. Please acknowledge the minimum FOS for offsite impact is 1.25, and revise discussions and recommendations on slope stability in subsections 6.1.1.1 and 6.1.1.2 (pp. 38 – 39) accordingly.

9. Appendix A2, Laboratory Testing Results – The copy quality for all the graphs showing "Shear Load vs. Horizontal Displacement" and "Vertical Displacement vs. Horizontal Displacement" is extremely poor making the reading and interpretation of this data difficult to impossible. Please resubmit these graphs with a copy quality sufficient to discern the graphical information.

10. Appendix C – Several Figures showing FOS results for global stability (Figures C-19, C-21, C-23, C-25, and C-27) show a resulting FOS less than the required 1.25. The configurations (i.e., bench widths) need to be changed for these cases or a rationale for why there is no potential offsite impact needs to be provided in order for the DRMS to accept these results.

11. Appendix D – There are several stereonet diagram identifying an "Area of Critical Failure" with respect to global kinematic analyses. The DRMS could not determine where these critical failure areas are located with respect to the south and west quarries in order to make an assessment as to the potential for offsite impact. Please provide some discussion and clarification on the locations and critical nature of these critical areas.

If either you or the applicants have any questions regarding the comments above, please call me at (303) 866-3567, extension 8169.