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

1313 Sherman Street, Room 215
Denver, CO 80203

January 4, 2016

Connie Davis
Aggregate Industries
1687 Cole Blvd., Suite 300
Golden, CO 80401

RE: Lyons Quarry; DRMS File No. M-1977-141; Technical Revision No. 2 – Adequacy Review No. 3

Dear Ms. Davis,

The Division has identified several other comments and questions that must be addressed prior to the Division's decision due date. **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 will deny this Technical Revision.**

6.4.5 Exhibit E – Reclamation Plan

1. The revised HDR Report states under Item 6.0 – Fill Slope Scour Protection, that the scour berm will be designed to withstand a minimum 100 year flood event. Pursuant to Rule 3.1.5, all grading shall be done in a manner to control erosion and siltation of the affected lands, to protect areas outside of the affected from slides and other damage. Please provide the Division with the results of the hydrologic analysis used to determine the proposed design of the scour berm is adequate to withstand a 100 year flood event.

2. The 2008 Kleinfelder Report recommends the use of rock anchors and shotcrete to reinforce the northeast facing slopes against wedge failure. The revised HDR Report does not include any discussion regarding the use of rock anchors or shotcrete. In addition, the Reclamation Cost estimate does not include any costs associated with reinforcing the northeast facing slopes. Please clarify if the recommendations in the 2008 Kleinfelder Report regarding the stabilization of the northeast facing slopes will be followed. If so, the design specifications for the placement of the rock anchors and shotcrete must be provided to the Division for review. If the Operator will not follow the recommendations in the 2008 Kleinfelder Report, then additional stability evaluation may be required.

3. According to the Reclamation Plan, the regevetation will be determined based on the results of Test Plots. The Operator should be aware that if any component of the revegetation plan (seed mix, soil amendments, topsoil type and depth) is altered, then a Technical Revision will be required to implement these changes. Please provide the Division with the following information:

    a. The location of the test plots.
    b. The size and number of test plots.
    c. The timing of planting.
    d. The number of growing seasons before the test plots are evaluated.
    e. The criteria used to evaluate the effectiveness of each test plot.

6.4.6 Exhibit F – Reclamation Plan Map

4. The Reclamation Plan Map which was submitted does not conform to the requirements of Rule 6.2.1(2) or Rule 6.4.6. Please reivse the Reclamation Plan Map to contain the following:

    a. Show the name of the Operator.
    b. Must be prepared and signed by a registered land surveyor, professional engineer, or other qualified person.
    c. Identify and outline the permit boundary.
    d. The acceptable range of map scales shall not be larger than 1 inch = 50 feet, nor smaller than 1 inch = 660 feet.

6.4.12 Exhibit L – Reclamation Costs

5. The original reclamation cost estimate provided for the work proposed under Technical Revision No. 2 was revised from $9,602,780.00 to $9,097,008.00. The items under the reclamation cost estimate which were revised account for a percent of the base cost. Please explain the changes made to the reclamation cost estimate.

6. The Reclamation Plan calls for 300 lbs. of nitrogen and 50 lbs. of phosphorus per acre for a total fetilizer application rate of 350 lbs. per acre. The reclamation cost estimate only accounts for applying fetilizer at a rate of 300 lbs. per acre. Pleaese revise the reclamation cost estimate accordingly.

6.5 Geotechnical Stability Exhibit

7. The Division's Engineering Staff has prepared additional comments regarding the slope stability analysis. Please address the comments included in the attached Comments on Slope Stability Analysis Memorandum.

Please remember the decision date for this Technical Revision is February 28, 2017. As previously mentioned, if you are unable to provide satisfactory responses to any inadequacies prior to this date, it will be your responsibility to request an extension of time to allow for continued review of this Technical Revision. If there are still unresolved issues when the decision date arrives and no extension has been requested, the Technical Revision will be denied.

If you have any questions, please contact me at (303)866-3567 x8116.

Sincerely,

Michael A. Cunningham

Enclosure (1)

CC: Wally Erickson, DRMS
TC Wait, DRMS

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

1313 Sherman Street, Room 215
Denver, CO 80203

December 27, 2016

To: Michael Cunningham, DRMS
From: TC Wait, DRMS
Re: Comments on Slope Stability Analysis: Lyons Quarry/M-1977-141 TR-02

Per your request, I have reviewed the responses to the adequacy review for the TR-02 slope stability analysis for the Lyons Quarry Including the Technical Revision No. 2 Adequacy Reviews No. 1 and No. 2 Responses to DRMS Comments by HDR dated November 28, 2016, and Summary Report of Engineering Stability Analysis prepared by Kleinfelder (February 2008, Project No. 86995) for Aggregate Industries. The 2008 Summary by Kleinfelder includes the Engineering Analysis and Technical Memorandum for Highwall and Rock Slopes (Attachment A), and Engineering Analysis and Technical Memorandum for Fill Slopes (Attachment B).

The quarry highwalls are composed of the Fountain Formation (a reddish sedimentary sequence of sandstone, siltstone, shale, and conglomerate beds) capped by the Lyons Sandstone. Intrusive dacite sills run through the quarry, as well as two faults trending northeast-southwest. The natural existing slopes in adjacent areas to the quarry are 1.75(H):1(V) or flatter, with the steeper slopes in areas where the Fountain Formation is capped by the Lyons Sandstone and where dacite sills are exposed.

The quarry has not been actively mined since since 2009, and has been in Temporary Cessation since 2010. Technical Revision 2 updates the reclamation plan to consist of two proposed Reclamation Areas; Area 1 (40.8 acres) includes the affected areas of the pit and highwall. Area 2 includes the processing and stockpile areas along the flood plain of South St. Vrain Creek that were significantly impacted by flooding events in 2013. *Area 2 is not included in TR-02, but will be described in a future revision.*

The proposed reclamation revision to Area 1 changes the overall final grade from 3(H):1(V) to 1.5(H):1(V) in the Fountain Formation and an overall 2(H):1(V) for fill slopes. Rockfall catchment berms at least 20 feet wide are to be constructed at the base of the Fountain Formation and at the contact of the Fountain Formation and intruding dacite sills. The northeast facing slopes will be reinforced with rock anchors and shotcrete, to be designed by a geotechnical engineer based on detailed geotechnical evaluation and construction plans (not included in the TR-02 submittal).

General comments on Slope Stability Analysis

1. On the whole, the 2008 Kleinfelder report adequately addresses the slope stability and rockfall conditions currently present at the quarry.
    - Recommendations made in this report should be followed.
2. Areas of 1.5(H):1(V) final grading will be covered with a 2-foot talus riprap. This will include about 4.8 acres located primarily at the top portions of the quarry wall.
    - How will the riprap be stabilized to prevent it from falling/rolling and adding to the rockfall hazard?
    - Has the riprap been evaluated for rockfall potential?
    - Are the rockfall catchment berms adequately sized to contain any potential riprap that may fall/roll?
3. Based on the reclamation plan (Exhibit F), no ponds will be included in the final reclamation.
4. The grading plan (HDR Attachment B) identifies a drainage ditch with berm around the upslope perimeter of the quarry and a sediment control and scour berm. **No rockfall catchment berms are indentified on the grading plan or reclamation plan.**
    - The rockfall catchment berms should be shown on the grading plan and cross section and reclamation plan.
    - Areas where reinforcement will be required (see item 8 below) should be shown on the grading plan and reclamation plan.
    - Additionally the grading plan should indicate where fill sections will be located and where native rock slopes will remain.

Comments pertaining to the Kleinfelder Highwall and Rockslope Engineering Analysis (Attachment A)

5. In section 5 and subsequent stability cross sections, the faults identified in figure 4.1 are not included, and presumably not included in the stability evaluation. Faults can convey moisture and contain weak material that can lead to slope failure, similar to that of the Pikeview Quarry in El Paso County.
    - Faults identified at the site should be evaluated for stability considerations.
6. Several seeps and areas of perched subsurface water were described in the report.
    - Have the areas of seeps and perched water been analyzed as they pertain to stability?
    - Has a sensitivity analysis been done for varying groundwater levels in the highwall?
7. Seismic influences were not included in the kinematic or slope stability analysis.
    - How are seismic conditions evaluated as they pertain to stability of the slopes?

8. Based on the site grading plans, it appears that the Template 1 (Section 7.1.1) has been the selected for the final highwall configuration. The recommendations for Template 1 in Section 8 include rockfall catchment berms located at the toe of the Fountain Formation and on top of the dacite sill contact and reinforcement, using rock anchors and shotcrete, on the northeast facing slopes where potential wedge failures are likely.
    - A long-term catchment berm maintenance plan should be developed to provide guidance for periodic inspection, cleaning out, and maintenance of the berms.
    - Determination of the responsible entity to conduct the catchment berm inspection, cleanout, and maintenance should be included.
    - Areas that will be reinforced should be shown on the grading plan and reclamation plans.
9. Section 8.3 includes recommendations for construction monitoring by a geotechnical professional.
    - What parameters will the monitoring entail?
    - What are critical action levels?

<u>Comments pertaining to the Kleinfelder Fill Slopes Engineering Analysis (Attachment B)</u>

10. Two cross sections analyzed for slope stability, but it is not clear what the lateral extents of the proposed fill placement will be for the final site grading.
    - Do the two cross sections adequately evaluate the entire extents and aspects of the final fill placement sections, or will additional analysis be needed?
11. Per Section 6.5, "Critical failure" defined as more than half of the slope height fails.
    - Is this definition for the fill section or entire slope height?
12. Per Section 6.4, the stability analysis does not include pore water pressures (ie, saturated conditions).
    - How are the seep areas and perched water areas identified in the quarry addressed?
13. Dry seismic conditions were evaluated and saturated conditions at the base of the slope (5 feet at base) were evaluated, but not seeps with seismic conditions or saturated conditions along the entire fill slope.
    - How are seeps and perched water areas identified in the quarry, or seasonally wet slopes represented?
    - Was flood and toe-scour evaluated?
    - What size flood event is likely to impact slope stability?
14. Existing fill is already present in the quarry. It is not clear whether this fill is documented/controlled fill to the specifications of the final reclamation plans, or uncontrolled fill.

- What site preparation will occur prior to final fill placement?
- Will existing fill be removed/recompacted?
- The report specifies final fill placement be in maximum 2 foot lifts and compacted to greater than 90% maximum dry density. Does the existing fill meet the standards and recommendations outlined in report?

15. The Kleinfelder report states that it is "valid for 3 years after report issuance" (2008). This statement was not included in the Attachment A report. Technical Revision 02 includes statement from HDR (dated 11/2016) that Technical Revision 2 "meets specifications outlined in the 2008 report", but does not specifically mention anything about the 3-year validity date.
    - It is not clear if the Kleinfelder analysis is still valid for the proposed reclamation revision, or if the revision simply meets the recommendations outlined by Kleinfelder.
16. If the end land use for the site changes from rangeland, additional stability evaluation work may be required, including stability analysis of the entire slope as a whole.