



COLORADO
**Division of Reclamation,
Mining and Safety**
Department of Natural Resources
1313 Sherman Street, Room 215
Denver, CO 80203

Date: May 8, 2019

To: Peter Hays; Division of Reclamation, Mining & Safety

From: TC Wait; Division of Reclamation, Mining & Safety

**Re: Empire Aggregate, Inc.; Douglas Mountain Mine; M-2018-016;
112c Permit Application Amendment (AM-01) Additional Stability Analysis Memo**

I have reviewed the information you provided pertaining to the stability analysis for the Douglas Mountain Mine (M-2018-016). The specific documents I reviewed include:

- Geologic Hazards and Geology Study by Kumar and Associates, Inc. revised Feb. 26, 2003
- Douglas Mountain Ranch Reservoir Figure 2 (Existing Conditions and Test Hole Locations) and Figure 3 (Summary Logs of Exploratory Borings) by Deere & Ault Consultants, Inc. dated Nov. 23, 2009
- Engineering Geology and Geologic Hazards Report by Greg Lewicki and Associates, PLLC dated Aug. 29, 2018
- Land Use Review Letter from Colorado Geological Survey (Jill Carlson) dated Aug. 17, 2018
- Amendment (AM-01) Second Adequacy Review letter from Division of Reclamation Mining and Safety (Peter Hays) dated Apr. 18, 2019
- Amendment (AM-01) Geotechnical Model Adequacy Review letter from Division of Reclamation Mining and Safety (Peter Hays) dated Apr. 24, 2019 and GALENA analysis data

Based on the above information and the geologic information available, the slope stability pertaining to the mapped landslide and potential landslide susceptibility as a result of mining activity has not been adequately addressed.

- 1) It was not clear from the information provided which section(s)/orientation of the slope was evaluated during the stability analysis. It is important to evaluate the slope through the section of known failure (mapped landslide) as well as any other areas that could potentially slide, or where a slope failure may potentially impact areas beyond the permit boundary.
- 2) The boring logs and location map were very difficult to read due to the size of the figures, making it difficult to derive much insight to the subsurface conditions across the site. The applicant should provide this information in a different format in the future.
- 3) The assumed use of a homogeneous granular material through the modeled material is not adequate. The test boring logs indicate lenses of silts, clays, and silty sands that were not included in the analysis. This is an important factor given the presence of known landslides



and slope failures on the site and in the area. It is likely that the mapped landslide failure surface was along a layer of fine-grained material, and therefore should be included in analysis using *remolded* (post-failure) friction angle and cohesion values for these materials.

- 4) The slope stability analysis did not address the global stability of the site, including effects of the adjacent stream channel erosion, and the larger slope conditions of Douglas Mountain.
- 5) Post-mining, long-term stability considerations should take into account seismic impacts to the site as well as elevated water conditions that could occur during wetter conditions and slope changes that occur as the adjacent stream channel changes.