KILDUFF
UNDERGROUND
ENGINEERING, INC.

HIGHWALL INSPECTION REPORT

To:	Mr. Kurt Thurman	**From:**	Nathaniel White, EIT
Company:	Holcim - WCR, Inc.	**CC:**	Ryan O'Connel, PE
Project:	8-Mile / Byzantine Quarry	**Date:**	9.17.2024
Location:	Fremont County, CO	**RE:**	Geotechnical Field Report

[ ] Reviewed [x] For Review [x] For Approval [ ] Information Only [ ] Revise & Resubmit

Kilduff Underground Engineering (KUE) is pleased to provide our geotechnical field report for the 8-Mile Quarry (formally known as Byzantine Quarry) in Cañon City, Colorado in accordance with the contract between KUE and Holcim – WCR, Inc. (Holcim) dated July 8th, 2024 to perform annual inspections. This report presents a summary of the field investigations concerning existing and evolving quarry conditions. The data presented is based on our findings from the highwall inspection and cursory data review of the region.

The previous highwall inspection was performed on November 29th, 2023 by HDR, Inc. The primary objective of this inspection is to verify that quarry conditions are within permitted guidelines and to record any new rock failures or changes to the site that have occurred since November 2023.

1. MINE LOCATION AND DESCRIPTION

The 8-Mile Quarry is located approximately six (6) miles north of Cañon City, which was recently acquired by Holcim, formally named Byzantine Quarry and owned by Tezak Heavy Equipment. KUE reviewed HDR's previous report from 2023 to aid in understanding local rockfall and instability events prior to our initial site visit.

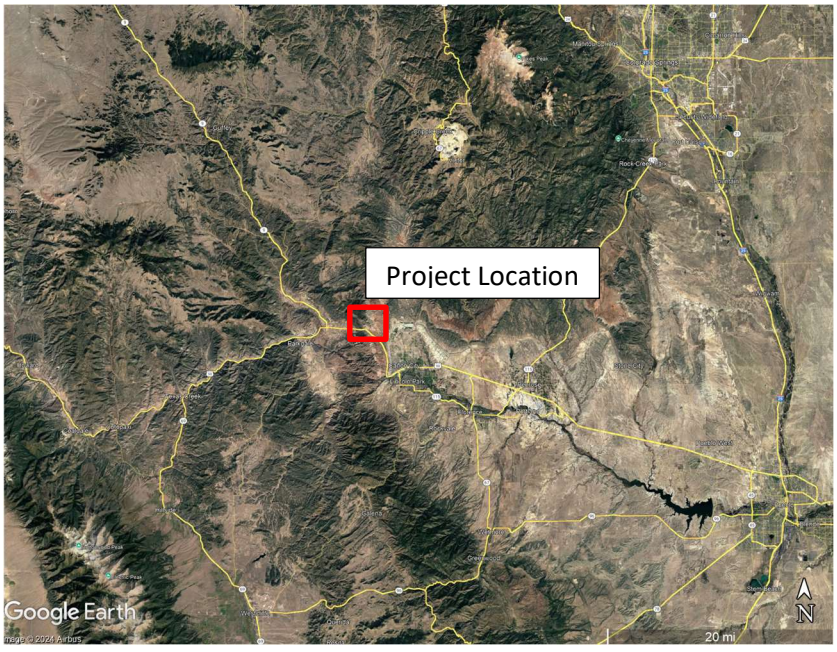

Figure 1: 8-Mile Quarry Mine Project location.

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2. GEOLOGIC CONDITIONS

The 8-Mile Quarry is located at the base of Twin Mountain inside the Eight Mile Creek sub-basin. According to a geological map by Wobus, R.A., Epis, R.C., and Scott, G.R. (1976), two faults are very close to the location of the quarry. These faults are referred to as the North and South Twin Mountain Fault. The presence of these faults are considered a result of the orogenic (mountain building) events in the area and have impacted the geological units in the area.

The primary units present are Devonian and Ordovician Era Sedimentary Rocks. This unit is made up of 20-25 feet of Williams Canyon Limestone from the Devonian era, characterized by red to gray, thin-bedded, hard, dense dolomite with travertine inclusions. This is followed by 300 feet of Fremont Dolomite from the Upper and Middle Ordovician eras, featuring light-gray, massive to thin-bedded, fossiliferous dolomite. The Middle Ordovician era is represented by Harding Sandstone, typically 100 feet thick and described as quartzose sandstone, red shale, and quartz. The bottom layer of this unit is the Manitou Limestone from the Lower Ordovician era, varying between 50 and 80 feet in thickness and composed of pink to gray limestone and cherty dolomite. The Harding Sandstone and Manitou Limestone were observed at the 8 Mile Quarry site.

Other notable units in the area include Granodiorite of Boulder Creek Age, Verdos Alluvium, Slocum Alluvium, and the Fountain Formation. Granodiorite of Boulder Creek Age from the Precambrian X era. This material is described as biotite granodiorite to quartz monzonite. The Louviers Alluvium, dating to the Pleistocene or Bull Lake Glaciation, is about 20 feet thick and composed of alluvium that is made up of boulders, pebbles, and much finer material. About half the rocks are metamorphic and igneous, and the other half are of sedimentary origin. The Slocum Alluvium, from the Pleistocene-Sangamon Interglaciation or Illinoian Glaciation, is also about 20 feet thick and contains gravel with layers of clay, silt, sand, and clay balls derived from shaly bedrock, along with abundant boulders. The Fountain Formation, from the Permian and Pennsylvanian eras, consists of arkosic conglomerate and sandstone with thin layers of shale, with a thickness ranging from 0 to 2,000 feet.

3. GEOTECHNICAL INVESTIGATION

KUE personnel visited the quarry on August 13th, 2024 to visually inspect the bench slopes, record rock lithology, and take strike and dip measurements of rock features at safe locations. The field measurements focused on measuring strike and dip for observed joints, fractures, faults, shear zones, and other notable features. A site-specific safety training was conducted and then KUE personnel were escorted around the quarry site. The encountered weather conditions were partly cloudy with a temperature of 85 degrees F. The site conditions were very dry, with no signs of active groundwater flow observed along the highwall/pit floor interface. Dry conditions have persisted throughout the past several months with only minimal precipitation recorded.

The quarry is very small and contains only three relatively short benches (~20-30 feet tall) along the north-south strike of the bedrock and are approximately east facing. The mine is relatively low production, with only 40,000 tons mined a year used primarily for landscape rock. The encountered rockmass consisted of red carbonaceous sandstone and cherty dolomite, with a dip direction of approximately 52 degrees (NE) and a dip of about 26 degrees. An example of the rockmass orientation is shown in Figure 2.

The exposed east-facing benches contain various discontinuity joint sets as shown in Figure 3, characterized by very weak to medium strong rock, slightly to highly weathered, extremely close to very wide spacing, clean to moderately infilled, seamy to wavy joints with a tight to very wide aperature.

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The primary joint set was observed to be joints with a dip direction of approximately 235 degrees and a dip of 59 degrees that exhibits 0.1-3 inch aperture, 1 inch to 10 feet spacing, 1 to 3 feet of persistence, and some silty/clayey infilling. The primary joint set tended to control stability of the benches and relative geometry of the benches, as is shown in Figure 2.

Figure 2: North facing exposure of rockmass dip and dip direction (highlighted in red).

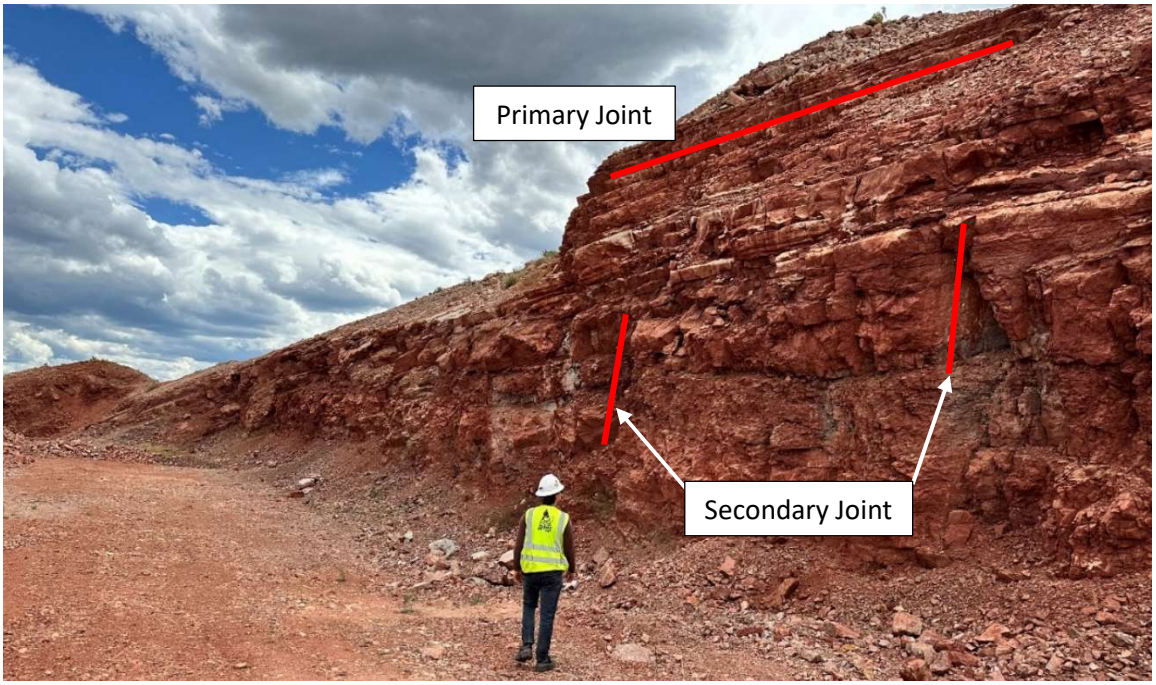

Figure 3: Primary joint sets along exposed east-facing benches.

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The secondary joint set was observed to be joints with a dip direction of approximately 135-200 degrees and a dip of 85 degrees that exhibits 0.5-3 inch aperture, 2 to 10 feet spacing, 5 to 20 feet of persistence, and some silty/clayey and calcite infilling. Figure 4 presents the observed infilling of the sub-vertical secondary joint set. The secondary joint set tended to control localized block failure along the benches and observed blockiness of the exposed rockmass, as is shown in Figure 3.

Figure 4: Silty/Clayey joint infilling along the secondary sub-vertical joint set outlined in red.

4. CONCLUSION AND RECOMMENDATIONS

Minimal changes to the highwall benches were observed since the previous investigation. The working benches along the east-facing highwall appears stable with no water seepage or potential for large-scale block failure. Some raveling and localized block failure was observed, especially along the intersection of the primary and secondary joint sets; however, this behavior was localized and not considered a global stability risk to the 8 Mile Quarry highwalls. As a result, no pending issues regarding rock stability or potential for rockmass failure were found during the inspection. Previous inspection reports noted rock raveling along the top edge of the topmost bench but has been addressed with no signs of further raveling during the most recent site visit.

Holcim plans to continue mining efforts along the N-S direction in the future. Potential failure could occur as the highwalls are mined in the same direction as the bedding planes (primary joint set) strike. Bench planes should not exceed 30-40 degrees to limit rockfall conditions to typical for mining activities and the risk for planar or block toppling failure. Major failures are not expected to occur due to the relatively conservative bench to width ratio, small bench height, and observed stability of the exposed rockmass. Small-scale raveling and block failures may occur throughout the year and benches should be cleaned to limit loading of bench slopes.

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5. REFERENCES

The following documents were relied upon in the preparation of this report:

- Brandenberger & Ray. December 2023. Highwall Inspection of 8-Mile Quarry. HDR.
- Wobus, R.A., Epis, R.C., and Scott, G.R. 1976. Geologic map of the Pueblo 1° X 2° Quadrangle, South-Central Colorado. USGS: Miscellaneous Field Studies Map-775, scale 1:187,500.

CLOSING:

We trust that our findings outlined in this report will be responsive to your needs at this time. We thank you for this opportunity to be of service to you and your team on this exciting and interesting project. Should you have any questions or require additional information, please do not hesitate to contact the undersigned.

Sincerely,

KILDUFF UNDERGROUND ENGINEERING, INC.

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Staff Engineer

Ryan O'Connell, PE
Project Engineer

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