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Continental Materials Corp.  
File: Sept 2020 Monitoring Summary

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**Reference: September 2020 Geotechnical Monitoring Summary Pikeview Quarry**

## 1.0 INTRODUCTION

Stantec Consulting Services Inc. (Stantec) has prepared this September 2020 Geotechnical Monitoring Summary for the Pikeview Quarry. The Pikeview Quarry is situated along the foothills of the Rocky Mountains, northwest of Colorado Springs, Colorado. Continental Materials Corp. operates the quarry, which is currently closed, pending reclamation. A geotechnical monitoring program was established to monitor reclamation activities which will affect the geotechnical performance of the existing and reclaimed slopes during and following reclamation grading. This report presents the geotechnical monitoring results for the slope reclamation activities at the site through the month of September 2020.

It is important to note that there is currently little activity at the Pikeview Quarry. Operations are limited to importing fill and preparing the growth medium, and no fill is being placed. Continuous monitoring by the robotic survey system began in 2010 and has continued through the month of September 2020 uninterrupted. Visual inspections of the slopes were performed by Stantec engineers.

### 1.1 PURPOSE

The purpose of this report is to summarize the September 2020 geotechnical monitoring results and verify the geotechnical performance of the existing and reclaimed slopes with respect to the historical performance record. The goals of the geotechnical instrumentation monitoring program can be described as:

- Meet corporate risk management requirements,
- Provide ongoing slope monitoring and advance warning of any changed conditions that could pose a hazard to workers or to the public,
- Document the geotechnical performance of the slope, and
- Document monthly site grading activities and construction quality assurance.

### 1.2 MONITORING SUMMARY

Major components of the instrumentation monitoring program are listed in Table 1 and shown on Figure 1.

**Table 1 Monitoring Frequency**

Monitoring Type	Frequency
Visual inspection	Daily/Monthly
Robotic theodolite/prism	Continuous
Drone inspection	Monthly
Compaction testing	Every 5,000 yd <sup>3</sup> (min.)



## 2.0 VISUAL INSPECTIONS

Inspection are completed daily by site personnel and monthly by Stantec personnel to document visual observations of slope conditions, including conditions of instability (i.e. cracking, slumping, over-steepened slopes, seeps, perched boulders, rock falls, erosion, and areas undercut by construction or maintenance activities). Certain areas of the landslide have been designated as safety exclusion zones, and these areas are inspected from adjacent locations.

When present, site operators inspect their work areas for signs of instability on a daily basis before starting work per MSHA rules and regulations. The limited work performed in September 2020 resulted in the operator visual inspections being limited to stockpiles.

Stantec conducted visual inspections of the Pikeview Quarry slopes on October 13, 2020. The engineering inspections were conducted by traversing each area of the mine and observing the uphill slope and the downhill slope for signs of instability, and areas in need of maintenance. Slopes that have been graded and are 2 horizontal (H):1 vertical (V) or shallower are also traversed on foot. The findings are listed below, and photographs of notable observations are included on Figure 2 in Appendix A.

- Survey Station: The survey station shelter was in good operating condition with clean glass for the station to view the prisms through.
- Prisms: Several prisms were passed along the walking route and appeared to be in their original position and operating normally. Control points are permanently cemented into the ground while some of the monitoring points are cemented into 5-gal buckets to be portable as needed.
- Gullies: Gullies have formed on the slopes above the slide area as well as in the burn areas above the quarry. (Note 6)
- Fresh Cracks: A crack was observed at the crest of the slide area. This feature is located in an area where cracking is expected to occur as a result of ongoing slope settlement and relaxation (Note 4).
- Healed Cracks: A crack was found on the slope adjacent to the slide where cracking had previously been observed. The crack appeared to be “healed” and did not indicate any recent movement (note 5).
- Crack Free: No cracking was observed on the native granite slopes above the extents of the disturbed area.
- Fill: Fill is being imported and temporarily placed on the “production floor”. During the visit, different types of material including mulch and general fill were being deposited here for future placement (Note 2).
- Culverts: A 6-ft culvert was observed to be blocked on the upstream end. There is evidence that water is collecting at the inlet during rain events and likely seeping through the loose material and through the culvert (Note 1).

Visual inspections of the Pikeview Quarry did not reveal any evidence of large-scale instability outside of the landslide areas previously identified. No bulging, rippling, over-steepening, depressions, slumps, or dry slip-offs were observed in areas that have been graded and/or reclaimed.

## 3.0 PRISM SURVEY

A Leica Robotic station is used to continuously survey the prisms onsite to document slope movements. The station records the location of each prism every four hours. There are currently 17 prisms; 3 prisms are control points located outside the slope movement area, 13 prisms are located on the slopes surrounding the landslide area, and one prism is located at the toe of the landslide. As the slope is backfilled and graded,



additional prisms will be installed. The existing and proposed prism locations are shown on the current topography in Figure 3, and the prism locations are shown on the reclamation topography in Figure 4. Both figures are included in Appendix B.

The monitoring software, GeoMos, has been programed to provide automatic alarms if there is a movement recorded that is greater than 0.35 feet or if a prism cannot be located. The alarm notes and actions taken are logged, and the alarms are summarized in Table 2. All alarms were determined to be caused by rain, fog, an obstruction, or temporary system malfunction. There were no alarms caused by slope movements.

**Table 2 Alarm Summary**

Date	Notes	Actions taken	Issue Resolved
9/8/2020	Multiple prisms missing on 8AM and 12PM scans	Heavy fog	9/8/2020
9/9/2020	Multiple prisms missing on 8AM, 12PM, 4PM, and 12AM scans	Heavy fog	9/09/2020
9/11/2020	Multiple prisms missing on 12AM, 4AM, and 8AM scans	Rain, smoke, and fog	9/11/2020

The prism monitoring results for transverse and height displacements, monthly change, and cumulative change are summarized in Table 3 below. The transverse displacement measures the change in the horizontal distance from the robotic station to the prism; positive displacements indicate less distance between the station and prism. The height displacement measures the change in the vertical distance from the robotic station to the prism; positive displacements indicate more distance between the station and prism. The values for the last reading in the month are included in Table 3. The monthly delta is the most recent reading cumulative delta displacement (horizontal, lateral, and vertical) subtracted from the last reading from the previous month. The cumulative delta values are a total displacement and are not associated with a direction. The transverse, height, and cumulative delta displacements are the total displacement over the life of the monitoring, which has been several years for all the prisms except P69. Prism P69 was moved on June 20, 2020, and the displacements included in Table 3 are the displacements since that date. According to Leica documentation, the survey accuracy is +/-4 mm+1.5 ppm for prisms located greater than 500m from the station; these equates to an accuracy of +/-0.016 ft. The data show stable conditions with no movement for 16 of 17 prisms with recorded displacements limited to data scatter and not actual movements. Prism P63 is located at the toe of the landslide, and this location shows slope creep movements at slow velocities (<0.001 ft per day). Plots of the transverse and height displacements for each prism are included in Appendix B.



**Table 3 Prism Summary**

Prism ID	Transverse Displacement (ft)	Height Displacement (ft)	Monthly Delta (ft)	Cumulative Delta (ft)	Needs / Recommendations
CP1	0	0.007	0.0194	0.0073	
CP2	-0.063	0.001	0.0137	0.403	
CP3	0.266	-0.214	0.0002	0.3455	
NP1	0.035	0.018	0.0219	0.0461	
NP2	-0.018	-0.056	0.0189	0.0625	
NP66	0.059	-0.128	0.0618	0.1752	
P1	0.331	-0.049	0.0094	0.3374	
P2	0.157	-0.028	0.0018	0.221	
P25	-0.01	0.038	0.01	0.1464	
P32	-0.067	-0.079	0.0022	0.2596	
P33	-0.103	-0.042	0.0071	0.2133	
P35	0.051	-0.172	0.0065	0.4257	
P4	0.358	-0.124	0.0009	0.4771	
P5	0.388	-0.138	0.0022	0.6129	
P63	15.204	-6.216	0.0225	16.4258	Prism at toe of slide. Movements are within expected range.
P69	-0.047	-0.028	0.0058	0.0337	
P70	0.349	-0.291	0.0084	0.5791	

## 4.0 DRONE SURVEY

The site was flown for aerial imagery using an unmanned aircraft system (UAS or 'drone') on September 12, 2020. The imagery was inspected for signs of instability and used to supplement the onsite visual inspections. Features noted in the aerial imagery review were inspected during Stantec's engineering inspection and are summarized in Section 2 above. The imagery was also used create site topography.

In future reports, each month's topography will be compared to the previous drone data to identify changes in the site topography. For this report, the site was flown twice on the same day (September 12, 2020), and the results of the two surveys were compared to identify limitations in the method. The drone data indicate minor changes in the slopes along each of the reclamation benches, buildings, and areas with trees or shrubs



with changes in elevation ranging from +5 feet to -5 feet. These areas are stable, and the changes are the result of survey limitations on near vertical slopes. The current imagery and topography are included in Figure 1, and the comparison surface is included as Figure 5 in Appendix C.

## 5.0 COMPACTION TESTING

Fill is currently not being placed at the Pikeview Quarry; therefore, no compaction testing was performed in September 2020. Once fill placement starts, the fill will be placed in one-foot thick lift, moisture conditioned as necessary, and compacted. Compaction testing will commence at the rate of at least one test per 5,000 yd<sup>3</sup> placed.

Per CMC, imported material is being stockpiled onsite for placement at a later date. The material will be tested for compaction level and areas failing compaction testing will either be further compacted until the specification is met or removed and replaced in a compacted manner.

## 6.0 CONCLUSIONS

None of the data collected in September 2020 indicate evidence of any large-scale movements that increase risk to workers or to the public. The landslide area continues to show slope creep movements with slow velocities. Shallow surface erosion continues to occur requiring ongoing maintenance and cleanup.

- Restricted access to the ungraded landslide slopes should continue.
- All monitoring should continue at current frequencies.

