INFORMATION

A geotechnical inspection of the Kemess mine was conducted on June 26, 2014 in the company of Jennifer McConnachie of MEM, and Terry Morton of AuRico Gold. This report summarizes observations made during the inspection, and actions required to follow-up on this inspection report.

The purpose of this inspection was as follows:

- To determine if the mine is meeting the requirements of the Code.
- To determine if the mine is meeting the intent of the geotechnical conditions in Permit M-206.
- To determine if geotechnical practices at the mine are consistent with generally accepted engineering practices at mines in British Columbia.
- To identify potential ground stability hazards or concerns at the mine.
- To provide general comments on geotechnical conditions at the mine.

AMEC Environment & Infrastructure (AMEC) conducts annual dam safety inspections at Kemess, and the 2013 version of this report was reviewed prior to the site inspection. Recommendations contained within this report were discussed with mine staff while on-site.

The following areas were inspected during the mine tour:

- The new sump above the north wall of the pit
- The open pit – from a vantage point at the east end of the flooded pit
- The Main Dam of the TSF including the spillway
- The Sediment Pond and Seepage Collection Pond below the Main Dam
The South Diversion Dam
The Waste Rock Dump

A brief wrap-up meeting was held following the site inspection.

**OBSERVATIONS AND INSPECTION ORDERS**

The following comments are based on a review of existing reports and on observations made during the site inspection. Where applicable, inspection orders have been included in italics. Unless otherwise noted, all geotechnical inspection orders are made under Section 18(a) of the Mines Act and/or under Part 1.1.2 of the Code. For ease of reference, the Mine Manager is asked to respond in red text in the space provided below each inspection order.

**New Sump above the North Wall:**

Ongoing movement of the highwall in the northwest corner of the pit has necessitated the development of a temporary sump and pipeline to replace a severed water diversion ditch. An AMEC letter report dated September 27, 2013 indicates that the prepared subgrade for the excavation “is suitable for the intended purpose…” As-constructed drawings and testing data are included in the letter report. The AMEC inspection report appears to satisfy conditions established in an August 15, 2013 permit amendment to Permit M-206.

At the time of the site inspection, adequate freeboard was being maintained between the water elevation and the invert for the abandoned portion of the water diversion ditch (see LHS of Photo #1). There is a significant setback between the edge of the sump and the pit wall. Provided that the water elevation is closely monitored, I do not have any significant concerns related to operation of the temporary sump. It is understood that the sump is inspected on a daily basis when fuel for the pump generator is delivered to the site.

Inspection Orders: *None.*

**Open Pit:**

The open pit is flooded and pit walls were not closely inspected. The condition of pit walls is generally poor (see Photo #2), but this is of little geotechnical concern given that there is no prolonged work underway below the pit walls. However, it is understood that occasional access to the pit is required to collect water samples. Rock cuts and portions of the pit wall above the access road and sampling location should be inspected on a regular basis. Monitoring data should continue to be collected for any large unstable zones (including the slough in the northwest corner of the pit) as a wall failure of any significance could generate a wave with the potential to endanger workers. A recent wall failure into a flooded pit at another BC mine resulted in significant damage to a pump on the opposite side of the pit, and an increase of several meters in the elevation of the water in the pit. The size of the displacement wave was not observed, but would certainly have posed a risk to any workers at the water’s edge.

Inspection Orders: *Areas of the pit slope above any water sampling locations shall be inspected prior to entry into the pit. Movement trends for any large known potentially unstable zones shall be reviewed prior to pit entry. It is understood that wall prisms are surveyed on a periodic basis. The Mine Manager is asked to provide movement rate trends for one or two select prisms located on or near the northwest slough over the last six months.*
Mine Manager’s Response:

Main Dam of TSF and Spillway:

A brief inspection of the Main Dam of the TSF was conducted both from the ground and by helicopter (see Photo #3). The recently constructed spillway is still dry, but AMEC (in their 2013 Dam Safety Inspection) reports that the spillway is expected to overflow during the 2015 freshet. More recent estimates indicate that this could occur as early as the fourth quarter of 2014 (conversation with Jen McConnachie). The spillway is designed to convey the Probable Maximum Flood.

Permit amendments related to the TSF dated July 1996 and July 2009 were reviewed. Submission requirements under these permits and under the Code appear to have been satisfied. Namely, MEM is in possession of a 2013 Dam Safety Inspection (dated March 7, 2014, an updated OMS Manual (dated March 27, 2013), an Emergency Preparedness Plan (EPP - included in the OMS Manual), and an as-built report for the closure spillway (dated January 2013).

It is understood that approximately 70,000 trees have been planted on the crest and downstream face of the TSF. Forest cover is an unusual end land use for an earthfill dam. In December 2002, the Association of State Dam Safety Officials prepared a document titled, “Technical Manual on the Effects of Tree and Woody Vegetation Root Penetrations on the Safety of Earthen Dams.” In this report, the authors state that, “…there is no doubt that trees and woody vegetation have no place on the embankment slopes of an earthen dam.” They cite concerns including blowdown of trees with large root balls, internal erosion pathways created by rotting roots, and habitat creation for burrowing animals. I would like to know if any special design features had to be incorporated into the dam to accommodate the end land use of forest cover (particularly in the crest of the dam immediately above the impermeable core).

Inspection Orders:
(1) AMEC included a number of recommendations in Section 8.0 of their Dam Safety Inspection Report. The 2014 Dam Safety Inspection report shall include a summary of the status of the 2013 recommendations including, where appropriate, a schedule for completion of any outstanding items. MEM considers any recommendations relating to Health & Safety or geotechnical stability to be mandatory requirements.

Mine Manager’s Response:

(2) MEM is encouraging all mines with “High” consequence (or greater) dams to undertake a table-top test of the EPPs for these structures. This is required to demonstrate due diligence with respect to emergency preparedness. Testing of EPPs is discussed further in Section 4.5 of the CDA Dam Safety Guidelines (2007). The Mine Manager is asked to indicate when the EPP was last tested, and when the next test will occur.

Mine Manager’s Response:

(3) In addition to annual dam safety inspections (required under Permit M-206 and under Section 10.5.3 of the Code), Dam Safety Reviews (DSR) are required every 5 years for “Very High” consequence structures in accordance with the CDA Dam Safety...
Guidelines. Dam Safety Reviews are typically conducted by someone other than the Engineer of Record (though the EOR should be involved in some capacity) and are considerably more detailed than an Annual Dam Safety Inspection. Recent Professional Practice Guidelines for conducting Dam Safety Reviews are available on the website for APEGBC. The Mine Manager is asked to provide a schedule for when the first DSR will be undertaken.

Mine Manager’s Response:

(4) The Mine Manager is asked to have AMEC comment on how the end land use of forest cover was accommodated in the design of the TSF. At the Mine Manager’s discretion, a response in the 2014 Dam Safety Inspection would be appropriate.

Mine Manager’s Response:

Sediment Pond and Seepage Collection Pond:

The Sediment and Seepage Collection Ponds were viewed (see Photo #4). Both facilities appear to be in good condition with adequate freeboard. At present, there are no significant geotechnical concerns related to either of these facilities.

MEM is developing and updating a list of mining dams on a province wide basis. Most information for the Kemess mining dams is up to date, but there are a few items that we would like to verify.

Inspection Orders: Confirmation of the following items is requested: i.) the crest elevations of the sediment pond and the seepage collection pond, ii.) the height of each facility (measured from the crest of each facility to the toe of the embankment), and iii.) the approximate capacity (volume) of each structure.

Mine Manager’s Response:

South Diversion Dam:

A brief inspection of the South Diversion Dam was conducted. The dam appeared to be in good condition, with ample freeboard at the time of the inspection (see Photo #5). The water elevation is closely controlled by means of pumps. This dam has a “Low” failure consequence as any failure is unlikely to endanger mine personnel, and would simply result in the release of water into the TSF.

Inspection Orders: None.

Waste Rock Dump:

A brief inspection of the waste rock dump was conducted. The vast majority of this dump has been resloped to 2H:1V or shallower, and no signs of instability or deformation were observed. At present, there are no significant geotechnical concerns related to this structure.

Inspection Orders: None.
CLOSURE

Under Section 15 (6) of the Mines Act, a written response is required from the Mine Manager within 15 days of the receipt of this Inspection Report. In addition, Section 30 (1) of the Mines Act requires this Inspection Report to be posted in a conspicuous location at the mine site for 30 days.

Please feel free to contact the undersigned with any questions or comments.

George Warnock, P. Eng.
Manager, Geotechnical Engineering
Ministry of Energy & Mines
Photo 1: New sump above North wall of open pit.

Photo 2: Flooded open pit viewed toward the west.
Photo 3: Main Dam of TSF Viewed toward the East. Completed spillway on RHS.

Photo 4: Tailings Seepage Recycle Pond. Tailings Sedimentation Pond on RHS.
Photo 5: South Diversion Dam – viewed toward the West.

Photo 6: Resloped / Reclaimed NAG Waste Rock Dump.