W. W. WHEELER
& ASSOCIATES, INC.
Water Resources Engineers
WWW.WWWHEELER.COM

3700 S. Inca Street | Englewood, CO 80110-3405
303-761-4130 | fax 303-761-2802

TECHNICAL MEMORANDUM

September 11, 2018

To: Geoff Niggeler
Climax Molybdenum Company, Henderson Mill
Parshall, Colorado

From: Steven M. Maly, P.E. and Trevor Mugele, P.E.
W. W. Wheeler & Associates, Inc.

Re: 1333.01.13
Henderson Mill Seepwater Detention Berm Road Raise
Hydrologic Design Basis

The purpose of this memorandum is to present the design basis for upgrades to the 1 Dam Primary Seepwater Detention Area (SDA) at the Henderson Mill (Henderson).

Background

Based on the 2014 TRB recommendations, Henderson contracted Wheeler to perform evaluations of the volumetric and flow rate capacity to handle rain flood and snow flood events of the primary SDA at the toe of the Henderson 1 Dam. The seepage collection and detention system at the base of 1 Dam is formed by a berm that also serves as an access road. Raising the level of this Seep Road would increase the storage capacity in the area upstream of the berm, referred to as the 1 Dam Primary SDA. The additional storage capacity would then be available to contain various hydrologic events or for emergency storage during an upset condition associated with the pumping system.

System Evaluation Results and Conclusions

The evaluation included hydrologic and hydraulic modelling of the SDA and the downstream face of 1 Dam. The evaluation determined the SDA has sufficient capacity to completely detain (temporarily store, then gradually release to the Ute Park Pump Station) seepage and runoff from

the governing 100-year average recurrence interval (ARI) rainstorm (24-hour duration) under both existing and projected life of mine (LOM) conditions. However, the primary 1 Dam SDA does not have sufficient capacity to store seepage and runoff from either a 100-year ARI snowmelt event or a 3-hour duration summer PMP storm. Henderson has selected the criteria of detaining the 100-year ARI snowmelt under life of mine conditions, approximately 68 acre-feet, by raising the Seep Road to a minimum elevation of 8591.9 feet (without freeboard allowance).

Design Basis

Henderson has contracted with Wheeler to provide a civil design for construction of the SDA Seep Road raise of approximately 2.5 feet. The current storage capacity of this area is 27.6 acre-feet at a low point roadway elevation of 8589.1 feet. The average elevation of the top of the roadway is approximately 8590 feet, with a storage capacity of 40 acre-feet. The planned raise of nominally 2.5 feet will result in a top of Seep Road elevation of 8592.5 feet to the provide adequate available storage capacity to accommodate the 100-year snowmelt event under life of mine conditions with about 0.5 feet of freeboard. The storage capacity at an elevation of 8592.0 is approximately 70 acre-feet, which also provides about 2.5 times more emergency storage space for upset conditions.

The raise is expected to consist of compacted soil placed on top of and on the downstream side of the existing Seep Road. The nominal side slope of the Seep Road raise is two horizontal feet for every one vertical foot. The average existing Seep Road width of 35 feet will be preserved or extended with the raise as needed for wider road sections. The raise will tie into the existing road at the north end of the SDA as the road climbs up the left abutment of 1 Dam. The raise will transition down to the existing seep road surface on the south end of the SDA. The transition will occur approximately 150 feet north of the intersection with the right abutment roadway of 1 Dam. At this location, there is an existing roadside berm that will be rebuilt to continue the impoundment up to the design elevation. The roadside berm is anticipated to extend approximately 250 feet and will tie into the edge of the right abutment road.

Existing gravel road base material will be stripped up to a depth of approximately 2.5 feet below the existing seep road surface and 0.5 feet of depth will be stripped on the downstream slope and toe for topsoil removal. Subgrade preparation is required prior to fill placement. The embankment fill materials for the raise will come from onsite borrow sources. Approximately 15,000 bank cubic yards of fill is estimated to complete the project, of which 2,000 cubic yards is estimated as

roadbase material. Henderson plans to purchase and import Class 5 road base from a local supplier for the roadbase material. An impermeable barrier is not included in the design due to the expected short duration of the high-water condition impounded by the detention berm. However, a region of select embankment fill with a minimum of 15% passing the No. 200 sieve is specified.

There are two gate operated culverts under/through the Seep Road that feed the channels into the Ute Park Seepwater Pump Station (UPPS). The length of the north feeder channel culvert currently restricts the width of the roadway at the crossing to prevent inundation of the culvert outlet. This culvert will be extended approximately 25 feet on the downstream end in conjunction with the raise to prevent burial of the downstream end.

The south feeder channel culvert was previously extended approximately 20 feet on the downstream end to include the intake piping to the Emergency Diesel Pump System (EDPS) adjacent to the culvert and thus does not require modification as a part of the raise. The location of the EDPS concrete pad and flow meter at the downstream toe of the existing Seep Road require the installation of two levels of a Mechanically Stabilized Earth (MSE) block walls on the berm side of the pad to prevent placement of fill on the system components. The wall will be constructed without modifications to the EDPS and to allow for ease of access to components for future maintenance and repair.

Henderson will also raise the gate operator electronics above the new high-water line that will be performed in conjunction with the road raise. New buried conduit for the gate communications cabling will be installed across the roadway by Henderson personnel at the same time as the Seep Road raise.

The schedule is for this work to be performed by Henderson personnel and equipment in September and October 2018. The existing safety berms on the roadway are jersey barriers that will have to be removed during construction. A collection of 15 photos have been attached to this memorandum to provide an idea of the existing site conditions for construction.

Henderson Mill
1 Dam Seepwater Detention Berm
Road Raise
Design Basis Photos

Photo 1. View of the seepwater detention berm from the south end, looking north. June 21, 2018

Photo 2. View of the seepwater detention berm from north end, looking south. June 21, 2018

Photo 3. View of the seepwater detention berm and downstream slope at South feeder channel, looking north. June 21, 2018

Photo 4. View of the seepwater detention berm and downstream slope at north feeder channel, looking south. June 21, 2018

Photo 5. View of the roadside fill berm area beyond existing road at the south end (looking west). The 1 Dam right abutment road is on the left. The area where the raise will transition from the entire berm to roadside berm is to the right of the power pole. April 19, 2018

Photo 6. View of the seepwater detention berm and downstream slope at north feeder channel, looking north. April 19, 2018

Photo 7. View of emergency diesel pump system from seepwater detention berm road. September 25, 2015

Photo 8. View of Emergency Diesel Pump System and downstream slope of berm, looking north. April 19, 2018

Photo 9. View of coupling for culvert extension downstream end of culvert during construction for diesel pump system intake. April 19, 2018

Photo 10. View of culvert extension downstream end of culvert and coupling for diesel pump at south feeder channel. April 19, 2018

Photo 11. View of upstream gate for north feeder channel culvert from detention berm road, looking north. April 19, 2018

Photo 12. View of upstream gate for north feeder channel culvert from detention berm road, looking west. April 19, 2018

Photo 13. View of north feeder channel culvert crossing and road intersection, looking south. April 19, 2018

Photo 14. View of downstream end of north feeder channel culvert from detention berm road, looking northeast. April 19, 2018

Photo 15. View of downstream end of north feeder channel culvert from detention berm road, looking west. April 19, 2018