COLORADO
Division of Reclamation, Mining and Safety
Department of Natural Resources

November 2, 2022

Mr. Ben Langenfeld, P.E.
Lewicki & Associates, PLLC
3375 West Powers Circle
Littleton, CO 80123

RE: Adequacy Review; Technical Revision (TR-11); Gold Hill Mill, Permit No. M-1994-117

Dear Mr Langenfeld,

On August 11, 2022, the Division of Reclamation, Mining and Safety (Division/DRMS) received a request for Technical Revision (TR-11) for a new bulkhead design for the Times Mine as a commitment made in the approval of AM-1 at the Gold Hill Mill, Permit No. M-1994-117. On August 15, 2022 the Division determined the bulkhead design to be complex and extended the decision date to November 9, 2022, pursuant to Rule 1.4.1(7). Please respond to the adequacy items, contained in the attached memo, with a letter summarizing each response in a cover letter titled "Adequacy Review Response TR-11, M-1994-117".

The decision date for TR-11 is November 9, 2022. If additional time is required to respond to these adequacy issues please submit a written request for extension of the review period. The Division reserves the right to further supplement this document with additional adequacy issues and details as necessary.

If you need additional information or have any questions, please contact me by telephone at **303-866-3567 x8114**, or by email at patrick.lennberg@state.co.us.

Sincerely,

Patrick Lennberg
Environmental Protection Specialist

Attachment: TR-11 Bulkhead Design Review Memo by Jeff Graves

cc: Jared Ebert, DRMS

ec: Ben Langenfeld, Lewicki & Associates, PLLC, benl@lewicki.biz
Jerry Jergensen, Colorado Milling Company, jerryjergensen@aol.com

Attachments

COLORADO
Division of Reclamation, Mining and Safety
Department of Natural Resources

November 1, 2022

Patrick Lenneberg

Re: Review of M-1994-117 TR-11; specifically pertaining to hydraulic bulkhead design

I have read through TR-11 and have a good understanding of the bulkhead design proposed by Colorado Milling Company, LLC, for the Times/Wynona Mine through their representative Ben Langenfeld (Lewicki & Associates) and Schnabel Engineering. My comments and questions pertain to the proposed bulkhead design and associated considerations.

Proposed Design

My understanding of TR-11 is that the applicant is proposing to construct a hydraulic seal bulkhead to allow impoundment of up to 103 feet of head of Colorado Milling Company's water rights from Left Hand Creek. Impoundment will occur within the Times/Wynona Mine behind a proposed 6-foot thick reinforced concrete bulkhead located approximately 130 feet inby the portal, and 26 feet below the ground surface.

The applicant evaluated 3 different bulkhead lengths, 8-foot, 6-foot, and 3-foot (existing bulkhead) for viability under an impounding hydraulic load of 103 feet of head. Based on calculations for shear failure around the plug, hydraulic jacking of the surrounding rock mass, excessive seepage or piping past the plug and structural failure of the plug, a bulkhead length of 6-foot was selected due to constructability and results of the corresponding calculations. As the applicant noted, calculated factors of safety for a 6-foot bulkhead thickness exceed all failure mode criteria at maximum head by 1.3 except for evaluation of hydraulic jacking by the Norwegian Tunneling Method.

The applicant noted that the alternative design criteria used to evaluate the potential for hydraulic jacking, the Abel Method, yields a factor of safety of 1.3, which would be considered sufficient, but recognizing the more conservative Norwegian Tunnel Method (NTM) yielded a factor of safety of 0.5 for hydraulic jacking potential, the applicant proposes to formation grout the surrounding rock mass at the bulkhead location to reduce the potential for hydraulic jacking along with utilizing the 6-foot bulkhead length to reduce the pressure gradient drop across the bulkhead zone. Additionally, in an effort to mitigate risk, the applicant proposes to monitor an area highlighted in blue and identified on the Bulkhead Location Map, as a seepage zone, when mine pool elevations are above 57 feet.

Evaluation of Proposed Design

In evaluating a bulkhead design, it is appropriate to consider the assumptions used to calculate various failure modes. Two assumptions requiring additional information are as follows:

1. The applicant should provide supporting documentation for selection of 0.138 g as the Peak Ground Acceleration associated with an earthquake for this geographic location.
2. The applicant should provide additional clarity on the assumption that concrete shear strength is controlling at the bulkhead location. It is noted in the design that both the hanging wall and vein are heavily altered at the bulkhead location, and as such, shear failure may not be controlled by concrete strength. If complete removal of altered material at the bulkhead location prior to installation is not possible how will the punching shear calculation be factored to account for lower strength material controlling shear failure, and what will be the corresponding factor of safety.

Another area of evaluation for the bulkhead design is the appropriateness and comprehensiveness of the failure mode analysis. In this case, the applicant evaluated 7 different failure modes for varying bulkhead thicknesses. The 7 failure modes constitute a comprehensive and appropriate evaluation of multiple bulkhead thicknesses, resulting in factors of safety for each failure mode and thickness.

As noted above, all but one of those evaluations, Norwegian Tunneling Method (hydraulic jacking) yielded factors of safety in excess of 1. When considering hydraulic jacking as a failure mode, the Abel Method has been successfully relied on in the past as the sole means of evaluating the potential for hydraulic jacking. More recently, the NTM has become an additional, and more conservative tool to determine the potential of hydraulic jacking. The applicant recognizes the use of NTM in this case yields a factor of safety of 0.5, thus requiring some mitigation measures. The applicant proposes to formation grout the area surrounding the bulkhead to reduce the potential effects of hydraulic jacking, along with monitoring an identified “seepage zone” when water head on the bulkhead reaches 57 feet. Both of these mitigation strategies are appropriate and potentially effective in avoiding bulkhead failure by hydraulic jacking.

One additional area of evaluation related to bulkhead design and eventual implementation is consideration of offsite impacts related to water impoundment behind a bulkhead. Evaluation of these types of impacts is often complicated in crystalline rock as groundwater flow is typically defined by fracture flow through discrete, open and interconnected fractures, making modelling efforts difficult, and dubious at best. In these instances, a seeps and springs inventory or monitoring plan is developed that incorporates pre-bulkhead observations and accounting of any existing springs and seeps in the general area and hydraulically downgradient of the proposed bulkhead. Once baseline observations have been made, periodic monitoring of that same area typically occurs as water is impounded behind the bulkhead to determine if there are any offsite changes or impacts.

In this case, the applicant does propose to monitor an area for seepage west of the mill, above the adit alignment, between the elevations of 8375’ and 8400’. This is definitely a high priority area to monitor as significant seepage in this zone could have detrimental impacts to the adjacent road. The applicant proposes

to conduct this monitoring weekly for the first 90 days, transitioning to quarterly following that initial time period.

While the current monitoring plan is good, it should be expanded to include the following:

1. Monitoring area for seeps and springs should be expanded to include both sides of the ridge below the mill, not just the western side.
2. Elevation for monitoring seeps and springs should be expanded to include elevations above the Times Adit invert (~8350').
3. Monitor groundwater elevations in existing monitoring wells (MW1, W1, W2, W3 and W4) during bulkhead filling to determine if corresponding changes correlate to mine pool loss to surrounding formation.
4. Clarify when 90 day, weekly monitoring period begins. Does it begin during filling or once steady state is achieved?

Respectfully Submitted,
Jeff Graves