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

1313 Sherman Street, Room 215
Denver, CO 80203

Interoffice Memorandum

January 5, 2018

From: Leigh Simmons
To: Zach Trujillo

Subject: Colowyo Mine (Permit No. C-1981-019)
TR-116, adequacy review

You requested that I review the material submitted by Colowyo Coal Company (CCC) with the TR-116 application.

The majority of proposed revisions to the permit text are to the section addressing rule 2.05.6(3) (Protection of hydrological balance), and in particular, predictions of the probable hydrologic consequences (PHC).

The text on most of the revised pages is unchanged (but has been shifted), however the sections subtitled *Changes in groundwater levels during mining* and *Potential effect on existing groundwater users in the area* have been substantively revised, and make reference to a study by Agapito Associates, Inc. that is proposed to be added to Exhibit 7 as Item 22B.

The AAI study reviews the data collected in earlier studies and evaluates their conclusions. It goes on to present the results of a numerical groundwater flow model and a plan as to how the Collom pit may be de-watered, based on the model results.

I have not attempted to replicate AAI's numerical model, but I have the following comments on the study as a whole:

- The AAI study found that the conceptual hydrogeologic model presented in an earlier study by Water Management Consultants, Inc. was valid. The Division has previously concurred with this conceptual model, and continues to do so.
- The AAI study made use of data collected during the WMC study, supplemented with recent water level data collected by Colowyo Coal Company from open and accessible monitoring wells.
- AAI's numerical groundwater flow model was a three-dimensional finite difference type, built in Visual MODFLOW, which is a widely used modeling program throughout industry and academia.
- The model grid was of sufficient extent to minimize boundary effects on the simulated pit, and was constructed with finer cells around the area of interest, so as to balance model accuracy with computational efficiency.

- The stratigraphic column was modeled as 17 layers, which balances the complexity of the physical reality with the need to simplify for computational efficiency. Hydraulic parameters for each layer were clearly presented in a table, and the process by which they were determined was described in the text. (The measured hydraulic conductivity values from the WMC report - tremendously valuable data - were included as an appendix).
- The AAI model was calibrated using data collected during a long term pump/response test conducted by WMC in 2005 (again, an extremely valuable data set). The convergence criterion for the model was given (0.1 ft of head), but the calibration process was described only in general terms and the results were not included in the report.
- Some model parameters were somewhat poorly characterized, but conservative values were chosen and were justified in the report (for example: a recharge rate of 2 inches per year and a hydraulic conductivity of the "impermeable" K_M layer of 10^{-5} ft/day).
- Following calibration, the same model was used to simulate the response to dewatering and hence to optimize the dewatering plan. The starting conditions and pumping rates used were reasonable and justified in the text.
- AAI present two fairly detailed scenarios for the dewatering plan, which are different only in relatively minor details. In their summary of results and recommendations they recommend scenario 2.
- AAI also recommends the installation of 5 monitoring "wells" with 4 vibrating wire piezometers in each "well". Figure 9 of the report presents a schematic diagram showing generalized construction details for these monitoring wells, but it appears to be erroneous (the hole is shown sealed with bentonite grout for its entire depth, whereas a series of filter sand packs with sealed intervals between them would be necessary for the monitoring points to work as intended)

I have the following adequacy review comments regarding TR-116:

<u>Rule 2.05.6(3) – Protection of the hydrological balance</u>

1. The Agapito study submitted with TR-116 is dated October 19, 2017. The study is referred to in the text as "AAI (2016)".
   Please confirm that the Division has the correct study, and update the permit text to refer to AAI (2017) to avoid future confusion.

2. On proposed revised page 115, the final paragraph of text refers to Figures 2.05.6-1 and -2, which are to be deleted with TR-116.
   Please reword the text to remove reference to the deleted figures.

3. On proposed revised page 118, the fourth paragraph refers to a cross section in Exhibit 7 Item 22B, which I am unable to locate.

Please provide a copy of Exhibit 7, Item 22B.

4. The diagram presented in Figure 9 of Exhibit 7, Item 21 (the AAI study) is erroneous and misleading.
   Please append a corrected diagram to Exhibit 7, Item 21, (or insert it into the PAP text, with reference to Exhibit 7, Item 21).

5. At the request of Colowyo Coal Company, and in recognition of the potential conflicts between their construction schedules and the permitting schedules of other state agencies, stipulations 19 and 20 are proposed to be modified, and stipulation 23 is proposed to be added. The proposed text of the stipulations is as follows:

   ST 19: OBTAIN DEWATERING WELL PERMITS AND SUBMIT A MINOR REVISION.
   DEWATERING WELL PERMITS MUST BE IN PLACE, AND A MINOR REVISION BE SUBMITTED AND APPROVED BY THE DIVISION TO UPDATE SECTION 2.03.10 OF VOLUME 1 OF THE PERMIT APPLICATION PACKAGE, BEFORE THE CONSTRUCTION OF ANY DEWATERING WELLS ASSOCIATED WITH THE COLLOM PIT IS ALLOWED TO OCCUR.

   ST 20: OBTAIN A DISCHARGE PERMIT FOR WATER PUMPED FROM THE DEWATERING WELLS AND SUBMIT A MINOR REVISION.
   A DISCHARGE PERMIT FOR WATER PUMPED FROM THE DEWATERING WELLS MUST BE IN PLACE, AND A MINOR REVISION TO THE PERMIT SUBMITTED AND APPROVED BY THE DIVISION TO UPDATE SECTION 2.03.10 OF VOLUME 1 OF THE PERMIT APPLICATION PACKAGE, BEFORE ANY PUMPING FROM WELLS ASSOCIATED WITH THE COLLOM PIT IS ALLOWED TO OCCUR.

   ST 23: OBTAIN A DISCHARGE PERMIT FOR STORMWATER RUNOFF AND SUBMIT A MINOR REVISION.
   A DISCHARGE PERMIT FOR STORMWATER RUNOFF MUST BE IN PLACE, AND A MINOR REVISION TO THE PERMIT SUBMITTED AND APPROVED BY THE DIVISION TO UPDATE SECTION 2.03.10 OF VOLUME 1 OF THE PERMIT APPLICATION PACKAGE, BEFORE ANY DISTURBANCE ASSOCIATED WITH THE COLLOM PIT IS ALLOWED TO OCCUR.

   Note that despite the modification of these stipulations the plan to construct the Collom pit is not valid without the necessary permits to pump and discharge groundwater, and it is in CCC's best interests to obtain the permits as soon as possible.
   Please comment on the proposed stipulations.