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

August 5, 2022

Bradford Janes
Raptor Materials LLC
8120 Gage Street
Frederick, CO 80516

Re: Two Rivers Sand, Gravel and Reservoir Project, File No. M-2022-013,
112c Permit Application Adequacy Review,
Additional reviews for preliminary adequacy

Mr. Janes -

In my letter of June 24, 2022, I noted that the Division will provide additional reviews of two technical reports associated with this application: "Riverside Berm Failure Analysis and Flood Control Mitigation Plan" (Flow Technologies LLC, 2020) and "Dewatering Evaluation, Varra Two Rivers Mine" (AWES LLC, 2020). Division comments and questions related to these reports (and associated information in the application) are provided as enclosures below.

Please be advised that the Two Rivers, Sand, Gravel, and Reservoir Project application may be deemed inadequate, and the application may be denied unless all adequacy review items are addressed to the satisfaction of the Division (this includes the items in these two enclosures). If more time is needed to complete the reply, the Division can grant an extension to the decision date. This will be done upon receipt of a request for additional time. This must be received no later than the current decision date, which is September 15, 2022.

If you have any questions, please contact me at rob.zuber@state.co.us or (720) 601-2276.

Sincerely,

Robert D. Zuber, P.E.
Environmental Protection Specialist

Enclosures: Division review of Flow Technologies report
Division review of AWES report

Cc: Michael Cunningham, DRMS

ENCLOSURES

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

MEMORANDUM

To: Rob Zuber

From: Tim Cazier, P.E.

Date: August 4, 2022

Re: **Two Rivers Gravel Pit Mine – Permit No. M-2022-013;**
Flood Control Mitigation Plan – Preliminary Adequacy Review

The Division of Reclamation, Mining and Safety engineering staff (DRMS) have reviewed the Two Rivers Riverside Berm Failure Analysis and Flood Control Mitigation Plan provided in Exhibit G, Permit M-2022-013, for Varra Companies, Inc Two Rivers Gravel Pit Mine, dated January 22, 2020 and prepared by Flow Technologies, LLC.

The DRMS acknowledges the novel approach to this analysis stated in the disclaimer on p. 3 of the subject plan. The following comments are intended to address this "innovative methodology" and how it was adapted to berm failure predictions.

1. Hydrograph Development: Paragraph 3.2.3 indicates the 10-year flow was subtracted from the inflow hydrograph because "it is estimated the earthen berm will control a 10-yr flood event". This does not seem to be a straight forward assumption. If the entire site is to be flooded, it seems the water elevation of the flood above the berm elevation would be the controlling flow parameter, much as a hydrograph routed through a reservoir controls the depth of overflow in a dam overtopping failure analysis. Please provide some background on why this assumption is reasonable.

2. Hydrograph proportionment: Paragraph 3.2.3 references FEMA, Flood Insurance Study, January 20, 2016 as validation for having two-thirds flow through the south side of the Site (Central Field) and the remaining one third flow through the north side of the site. Please:
    a. Elaborate on the purpose of splitting the flows,
    b. Explain if this is used directly in the WinDAM C berm failure analyses or n the hydrograph development for determining water elevation, or somewhere else,

c. Explain how it impacts the approach and results (e.g., how sensitive is the analyses to this 2/3 ratio)

3. Hard Armoring: Both paragraphs 3.2 and 4.2 reference Section V, Hard Armoring. Section V is labeled Mitigating Measures and does not discuss any hard armoring. Please provide some discussion on the anticipated hard armoring for reclamation/closure.

4. Variable Water Surface Elevation: As expected for a river flood and depicted in Figure 8, the water surface elevation varies from the upstream to downstream segments of both rivers. The DRMS' understanding of WinDAM C is that it assumes a uniform flow elevation over the embankment being analyzed. How is the fact that the water elevation is not uniform in this scenario accounted for in the modeling?

5. Fill Time Estimates – Central Pit: The fourth column in table on p. 30 suggests a nearly uniform incremental delta for every 10 feet of pit depth. This suggests the pit being analyzed for a depth/storage relationship has nearly vertical side walls. Are the pit walls in the berm failure scenarios being analyzed vertical and is this condition reflected in the WinDAM C analyses?

6. Central Pit Groin Training Channels Calculations: On p. 41 is a Mannings normal depth flow calculator for a 25-foot bottom width with 1H:1V side slopes. It is unclear as to the purpose of this image. Based on the Mannings n = 0.025, it would appear this is likely an earth-lined channel. As such, a 1H:1V slope is not likely to be stable for long. Please indicate the purpose of this image and justify the channel geometry depicted in it.

7. HEC-RAS Output: Several of the HEC-RAS cross section output results indicate additional cross-sections may be warranted:

   a. The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.

   b. Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.

   Please provide rationale for not including additional cross sections

If either you or the applicants have any questions regarding the comments above, please call me at (303) 328-5229 [mobile #].

COLORADO
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Interoffice Memorandum

August 4, 2022

From: Leigh Simmons
To: Rob Zuber

Subject: **Two Rivers Sand, Gravel and Reservoir Project (Permit No. M-2022-013) Application**

As you requested, I reviewed the material submitted with the Two Rivers Sand, Gravel and Reservoir Project permit application pertaining to groundwater, specifically material submitted as Exhibit G – Water Information.

I realize that my first comment is somewhat redundant in the light of your preliminary adequacy review letter, but I'll leave it in my memo for the sake of completeness. My other comments are all with reference to Rule 6.4.7. Other rules are cited as appropriate.

Comments:

1. The proposed text of Section 6.4.7, Exhibit G, allows for the post-mining lining of the pits but does not commit to it. It is not appropriate for the Division to approve a contingent reclamation plan; the approved text should describe a single reclamation plan. If the decision is made at a later date to change the plan then an amendment application should be submitted at that time.

   Please revise the text of Exhibit G to describe the post-mining plan for the lining or otherwise of the excavated pits.

2. The text also refers to "OMLR" in places, which presumably stands for "Office of Mined Land Reclamation". This office does not exist in Colorado.

   Please replace any reference to "OMLR" in the text with "DRMS".

3. Water level data from piezometers P124-1 through P124-12 has been given in the text of Exhibit G but the locations of the piezometers are not shown on Exhibit G: Water Information Map (or Exhibit C-1: Existing Conditions Map).

   Please add the piezometer locations to Exhibit G: Water Information Map

4. The key of Exhibit G: Water Information Map shows a symbol for wells, but no wells are identifiable on the map. It's not clear whether they were omitted or are not legible.

   Please identify all registered wells on Exhibit G: Water Information Map. Please also add a table to section 6.4.7 with details of these wells including their permit IDs, owners, date of construction and registered use.

5. Exhibit G: Water Information Map shows several symbols that are not included in the map key, and the text in many of the labels on the map is illegible (including what are presumably stream stage elevations).

   Please revise Exhibit G: Water Information Map to improve its legibility and to provide a complete key for map symbols (it may be helpful to remove the aerial imagery base-map). The revised map should be prepared and signed by a registered land surveyor, professional engineer, or other qualified person, as is required by Rule 6.2.1(2)(b).

In 6.4.7(1) the statement is made that "Operations will not adversely affect surface and groundwater systems". In support of the statement, the text refers to a July 27, 2020 study by American Water Engineering Services, LLC of Fort Collins, CO (AWES 2020). American Water Engineering Services, LLC was formed in 2011 and is currently in good standing with the Colorado Secretary of State's office.

The AWES 2020 report presents a hydrogeologic evaluation based on a numerical groundwater flow model built with Visual ModFlow Pro, an industry standard groundwater flow modeling code. Background information is given in the report, followed by assumptions, model parameters, results and conclusions. Figures and plates are appended to the report.

By its nature a numerical groundwater flow model is a simplification of the real system and is built using a series of assumptions and compromises on the part of the modeler, with the goal of answering pertinent questions about the system. The questions that the AWES 2020 model seeks to answer are not specifically defined, but are generally stated as "to estimate the effects of dewatering operations on the surrounding groundwater hydrology". In my review of the AWES 2020 model I have tried to avoid "nit-picking" but to look first at the overall validity of the conclusions that can be drawn from it, and then to evaluate whether those conclusions support the statement that "Operations will not adversely affect surface and groundwater systems". Questions 6 through … below are asked to help the Division better understand the model.

6. Key assumptions of the model are that the aquifer is unconfined, homogenous and anisotropic, with a horizontal hydraulic conductivity (K_h) of 125 ft/day and a vertical hydraulic conductivity (K_v) of 12.5 ft/day. The K values are at the lower end of the expected range of 2000-100 ft/day (Robson, 1989).

   Please justify the assumption of anisotropy and the chosen K values for the sand and gravel aquifer.

7. The piezometers referred to in (3) are described as monitoring wells in AWES 2020.

   Please describe how these wells were used for pre-mining aquifer characterization (besides the collection of water level data).

8. No information is presented about the vertical extent of the model.

How many vertical layers are used in the model? What are the layer thicknesses?

9. No information is presented about recharge from precipitation.

   Is recharge from precipitation accounted for in the model, or is its impact assumed to be negligible?

10. The Mine Area Map presented as Figure 2 shows a different pit configuration from that presented elsewhere in the permit application packet (PAP) – it shows three pits, whereas Exhibit G: Water Information Map, for example, shows just two. The Model Boundary Conditions presented as Plate 1 reflect the configuration shown in Figure 2.

    Please discuss the validity of the model boundary conditions in the light of the final pit configuration (which is assumed to be that shown on maps in the PAP).

11. According to the literature, water table gradients in the alluvial aquifers of the region are typically in the range 0.002 to 0.007 (Arnold, Langer & Paschke, 2003). The water table contour map presented as Plate 3 shows a generally easterly gradient of 0.002 across the center of the proposed permit area. A single data point (MW-1, which is presumably the same as P124-1) exists north of the Big Thompson River, with a significantly higher water level. This distorts the water level contours in the north of the study area, suggesting a far steeper gradient (0.01) and a south-easterly flow direction.

    Please discuss the characterization of the pre-mining water table. How reliable is the data from MW-1? How do you account for the steeper gradient? Are there any other data points in the north of the study area to improve the characterization?

12. The model was calibrated using model-assigned observation wells outside of the proposed excavations, (presumably the points shown with green and white symbols on Plates 6 and 7). The first two sentences of the final paragraph on Page 3 of the AWES 2020 report suggest that water levels were measured at these locations, but I think that these are simulated wells.

    Plates 5 and 5A show the calibration results. They appear to show identical data.

    Water level contours showing initial conditions in the calibrated model are presented as Plate 4. The contours suggest a gradient of 0.06 to the SSE in the north of the study area.

    Please clarify the initial calibration process. Please discuss the validity of the model in the north of the study area.

13. The results of the dewatering simulation are presented as Plate 6. This is presumably a steady state simulation. It simulates dewatering of the central and north-west pits only.

    Please simulate the dewatering of the full extent of the mined area. Please estimate the time to achieve steady state conditions.

14. Table 1 presents the predicted water levels at the 4 simulated wells before mining and following the lining of the mined pits.

    Please add a column to Table 1 showing the predicted water levels under the pit de-watering scenario. The table should show the fullest extent of the potential drawdown caused by the mine operation.

15. In the conclusions section on Page 4 of the report, the statement is made that "The results of analytical and numerical solutions indicate…" however no analytical solutions are presented.

    Please update the report to present any relevant analytical solutions that support the conclusion.

I have not addressed the requirements for water monitoring in this memo, but I note that you discussed it in item 46 of your preliminary adequacy review letter. Water monitoring data will be important to validate model predictions in the future.

References:

Robson, S.G., 1989, Alluvial and Bedrock Aquifers of the Denver Basin Eastern Colorado's Dual Groundwater Resource, U.S. Geological Survey Water Supply Paper 2302
https://pubs.usgs.gov/wsp/2302/report.pdf

Arnold, L.R., Langer, W.H. and Paschke S.S., 2003, Analytical and Numerical Simulation of the Steady-State Hydrologic Effects of Mining Aggregate in Hypothetical Sand-and-Gravel and Fractured Crystalline-Rock Aquifers, U.S. Geological Survey Water Resources Investigations Report 02-4267
https://pubs.usgs.gov/wri/2002/4267/report.pdf