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

1313 Sherman Street, Room 215
Denver, CO 80203

MEMORANDUM

To: Dustin Czapla

From: Tim Cazier, P.E.

Date: May 7, 2014

Re: JD-7 Mine Drainage Design – Third Adequacy Review, Permit No. M-1979-094HR / AM-01

The Division of Reclamation, Mining and Safety (Division) engineering staff has reviewed the February 2014 Drainage Design Plan (DDP) for the JD-7 Mine prepared by Whetstone Associates, Inc. The following comments are posed to ensure adequate engineering analyses and design practices are implemented to eliminate or reduce to the extent practical the disturbance to the hydrologic balance expected by the mining operation with respect to water quality and quantity in accordance with Rules 3.1.6(1), 6.4.21(10) and 7.3.1. Please note, as this site is a designated mining operation (DMO), compliance with Rule 7.3.1 is applicable, thus requiring certified designs and specifications for engineered elements associated with the environmental protection plan (EPP).

General Comments:

- The DRMS considers the hydrologic analyses and runoff estimates to be adequate. No further revisions are necessary and that portion of the JD-7 Drainage Design Plan has been accepted.
- The hydraulic analyses, engineered channel and other hydraulic structure designs, and drawings still have deficiencies and inconsistencies which make it difficult to assess the adequacy of the stormwater management system as presented. The following are four examples of these deficiencies and inconsistencies:
    - Section 5.4.2 describes the Pit Diversion East with an 8-foot bottom width, 3:1 side slopes, corresponding to improvements described in Section 4.4.2. Section 4.4.2 describes the Pit Diversion Ditch – East (note different nomenclature) as being modeled with a 2-foot bottom width and 4.6:1 side slopes.
    - The Technical Memorandum dated February 7, 2014 response to Comment 2.b.i indicates channel locations are shown on Plate 3. There are no plan view

locations on Plate 3, and the Division cannot find a location map/drawing that shows the locations of OPWR_Div1 and OPWR_Div2. It appears at least two different labels are used to identify these channels between the text and various drawings. The use of consistent nomenclature would be very helpful in reducing the time necessary to review analyses and designs.

- The first paragraph on p. 56, below Table 25 states "Table 22 indicates that all the improved engineered channels on site meet the design criteria for the 100-year 24-hour storm with the specified D84 grain sizes". Table 22 in fact presents results from the regression analyses.
- Plate 3 does not include design depth(s) for either of the two Cross Sections shown at the top of the drawing, only a generic reference to "100-Yr Flow Stage".

The Division proposes a different approach to addressing the remaining inadequacies. The subsequent submittal package should include two parts:

1. A hydraulic analyses summary package, and
2. A standalone stormwater management drawing package.

The Division requires the following content be addressed in this submittal package. Please be aware that based on information received to date for the JD-7 stormwater system, **the Division will require all engineered and/or constructed diversion channels be improved or reconstructed** such that a consistent prismatic cross-section is achieved that satisfies the Division's requirements for stability (velocity ≤ 5 fps for earth-lined channels/spillways, and appropriate armoring/revetment sizing calculations for armored channels), and capacity (minimum of 0.5 feet or one half the velocity head, whichever is greater, for freeboard):

Hydraulic Analyses Summary Package:

The Hydraulic Analyses Summary Package (or calculation package) should provide enough information that a reviewer could re-create the analyses, given the methods, assumptions and parameters used by the design engineer to arrive at the designs shown in the Standalone Stormwater Management Drawing Package. When a computer model is used for analyses, input and output files should be provided. Specific deficiencies in the February 2014 Drainage Design Package hydraulic analyses include:

a) Table 24 only presents the flow depth. The Division requires the channel/structure minimum design depths as well (drop structures need to be evaluated for conjugate depth/hydraulic jump depths as well),
b) Several different acceptable D_{84} particle sizes are presented in Sections 5.4.1, 5.4.2 and 5.4.3. It is not clear if these acceptable D_{84} sizes exist in the respective channels, or are intended to be a minimum size (for the D_{84}) for riprap armoring. If this is for existing conditions, it needs to be demonstrated that this size particle is in place; and if it is for proposed armoring, a specification needs to be provided. Either way, the method (e.g., Thorne and Zevenbergen) and calculation summaries also need to be provided.

c) Section 5.6, Culvert Capacity. This section is confusing. The third paragraph indicates Culverts CV1 and CV2 are adequate to convey the 100-yr peak flow. The next sentence states that CV2 can only convey the 10-yr peak flow and is undersized. There is no discussion on Culvert CV3. Furthermore, the analyses in Attachment 4 appear to only analyze the capacity to convey the 10-yr peak flow. All three of these culverts are required to pass the 100-yr peak design flow without overtopping the road.

d) Drop structures: There are two different types of drop structures shown on Plates 3 and 5. The Division could not find any analyses related to the hydraulic performance or references to design methodologies followed for either of these two types of structures. Both the stability and capacity need to be evaluated/demonstrated for both the steep and flat portions of the drop (the flat portion of the jump should consider the conjugate depth, or depth of the hydraulic jump). The Division also noted that the details on Plates 3 and 5 show the existing surface to pinch out to zero or near zero depth at the drop. Adequate depth needs to be determined to prevent channel overtopping through these structures.

e) Rock aprons and spillways: There are several rock aprons and spillways presented on Plates 4, 5, and 7. The Division could not find any analyses related to the hydraulic performance or references to design methodologies followed for either spillway or rock apron riprap sizing of these two types of structures. Both the stability and capacity need to be evaluated/demonstrated for these structures.

The following elements need to be included in the Hydraulic Analyses Summary Package (or calculation package):

I. Conveyance Structure Stability and Capacity. A brief narrative explaining the methods (such as Manning's equation, weir equation, and shear stress approach) and assumptions (such as weir equation, Manning's roughness, and channel lining) used to:
    a. Evaluate each channel and spillway capacity;
    b. Evaluate each channel and spillway stability.
        i. If predicted flow velocities in earth-lined conveyance structures exceed 5 fps, then revetment sizing or shear stress analyses will be necessary.
        ii. If a shear stress approach is used, the presence of, or intent to armor the structure with the appropriate particle size shall be documented or demonstrated.
    c. Other methods used, such as the methodology selected for drop structures. (*Note: if the Division is unfamiliar with the particular method used, we may ask for a copy of the selected reference.*)

II. A design summary table for each structure segment providing the following:
    a. Channel/spillway/structure name (indicating the location and specific segment(s)) {*Note: if a particular structure is used in multiple locations without any change in design parameters (e.g., drop structures), then one analysis is sufficient*},

b. The source of the design peak flow (e.g., the Table and page number in the February 2014 Drainage Design Plan,
c. Estimated 100-year, 24-hour design peak flow,
d. Channel/spillway/structure slope,
e. Channel/spillway/structure geometry (bottom width, side slope(s), and minimum design depth – for use in evaluating freeboard and providing construction information),
f. Channel/spillway/structure lining and segment specific analysis parameters (e.g., Manning's n),
g. Estimated maximum flow depth,
h. Estimated maximum flow velocity,
i. Other relevant results, such as shear stress and stable particle size (if appropriate), and riprap sizing.

Standalone Stormwater Management Drawing Package:

The Stormwater Management Drawing Package should convey most (at least 90 percent) of the design information a construction contractor would need to build the stormwater management system, without having to refer to the drainage design plan. Specifications may be presented on the drawings, or may be in a separate package with references to specific specifications in the specification package.

Specific deficiencies found in the February 2014 Drainage Design Plan Plates include:

Drawing	Detail	Deficiencies
Plate 1	Plan View	The Division suggests the plan view focus on areas where construction is needed and label all the features shown on Plates 2 - 7
Plate 2	Plan View	No contour intervals are given and only 1 pit pool label is provided; No information (dimensions or specific is provided for construction of the Expanded Berm and the Max Height should be Max Elevation; There are 2 lighter contour lines, 1 labeled 5750 running through the pit pool with no explanation
Plate 2	Sections A-A' & B-B'	No riprap specifications or apron thickness is provided
Plate 2	Section B-B' & Rock Spillway Detail	Section B-B' indicates the D50 is 0.75", the Rock Spillway Detail indicates the D50 = 6"; the 6:1 slope is not indicated on the Detail (only break lines) and no dimension is provided for the length of the 6:1 slope; How is the finer soil prevented from piping into the riprap at the upstream crest of the spillway

Drawing	Detail	Deficiencies
Plate 2	Section A-A'	The riprap pinches out to zero at the 5,855 elevation, it should be a uniform thickness; the 1.5:1 riprap side slopes will be unstable, riprap should be no steeper than 2:1.
Plate 3	PDE & PDW Cross Section	Specific design depth(s) and linings omitted
Plate 3	WRDiv1 & WRDiv2 Cross Section	Specific design depth(s) and linings omitted
Plate 3	Typical Drop Structure Profile	Unspecified slope (max./min.) for steep section of drop; minimum in-run & run-out lengths for armored section omitted; different hatch patterns not identified; no thickness indicated or specification reference provided for armored section
Plate 3	WRDiv1 & WRDiv2 Profile	Specific locations for drop structures or notes on how to field-fit the locations (e.g., as stated in Section 5.4.3 "Where bedrock is currently exposed in the channel bottom new drop structures may not be required", and Section 6.3.2); a call-out for the "Typical Drop Structure Profile"
Plate 3	Notes	Indicates location of PPE & PDW Diversions shown on Plate 5, but channels shown on Plate are not labeled either PPE or PDW; indicates location of WRDiv1 & WRDiv2 Diversions shown on Plate 6, but channels shown on Plate are not labeled either WRDiv1 or WRDiv2 – use consistent nomenclature
Plate 4	Plan View	Contour intervals and labels omitted from 001B-A North & South ponds; flow arrows missing from all but South Catchment inflow line. {*Note: common drafting practice is to refer to details as DETAIL A, or DETAIL 1, and reserve the A-A' nomenclature for sections and profiles to avoid confusion*}
Plate 4	Details C-C' and D-D'	No dimensions are provided; both details callout Sections A-A' and B-B' – this is confusing. Detail D-D': rock apron appears to end at contour 5740 – Why? And is this contour surveyed in on site?
Plate 4	Sections A-A' (North and South)	The riprap is implied by the hatch pattern, pinches out to zero at the crests, it should be a <u>dimensioned</u>, uniform thickness, and specifications provided; the 1.5:1 riprap side slopes will be unstable, riprap should be no steeper than 2:1.

Drawing	Detail	Deficiencies
Plate 4	Sections B-B' (North and South)	No D50 = 0.75" or rock apron specifications are specified; How is the finer soil prevented from piping into the riprap at the upstream crest of the spillway; North Section: what is the flat run-out length? South Section: what is the slope of the12.65'-foot run-out?
Plate 5	Plan view	The beginning and ending points for PitDivW_P and PitDivE_P are not clearly identified; profiles should be called out, e.g., "← See Profile PitDivW_P on Plate 5"
Plate 5	Profile PitDivW_P	No information provided; should show slopes between grade breaks, call out where channel section details can be found, and either station or provide length(s) each segment or reach
Plate 5	Profile PitDivE_P	Limited information provided; should show slopes between grade breaks, call out where channel section and drop structure details can be found, specific locations for drop structures or notes on how to field-fit the locations, and either station or provide length(s) each segment or reach
Plate 5	Outfall Rock Apron	No riprap specifications or apron thickness is provided
Plate 5	Cross Section PitDivE_P	Specific design depth(s) and linings omitted
Plate 5	Drop Structure – Profile	Minimum run-out lengths omitted; different hatch patterns not identified
Plate 6	Plan	Contour intervals and labels omitted; NDP3 not delineated between NDP3a and NDP3b as in Reach Definition Summary Table; each segment should call out the appropriate channel detail
Plate 6	Reach Definition Summary Table	Good information, except it should also state whether each segment/reach is unlined or riprap protected, and what size riprap is required
Plate 6	Cross Section – Unlined Channels	"2-4' Depth" should say "See Depth in Reach Definition Summary Table"
Plate 6	Cross Section – Riprap Protected Channels	"2-4' Depth" should say "See Depth in Reach Definition Summary Table"; Riprap requires a filter layer (non-woven geotextile or granular filter layer) {*Notes: Reach NDP2 may be too steep for a filter fabric; granular filters need to be designed, usually done using Terzahgi criteria; either filter needs to be included in the specifications*}

Drawing	Detail	Deficiencies
Plate 6	Profile OPWRDP	Segment/Reach slopes & lengths should be provided, or the channel should be stationed; channel details (Cross Sections) should be called out for each segment/reach
Plate 6	Profile NDP	Segment/Reach slopes & lengths should be provided, or the channel should be stationed; channel details (Cross Sections) should be called out for each segment/reach
Plate 7	Plan View	No riprap specifications or apron thickness is provided; Berm detail should be provided and called out, including material and compaction specification
Plate 7	Section A-A'	Extend section in the outlet flow direction to where the spillway reaches native soil

The following elements need to be included in the Stormwater Management Drawing Package:

I. Plan view(s). A sufficient number of plan views should be provided to locate and label all channels (diversion, collection, intercept, spillway chutes, etc.), ponds (sediment control, water storage, etc.), culverts, and any other appurtenances related to the stormwater management system within the permit boundary. Labels should match those from the hydrologic analyses and/or models. If this is impractical, a table should be included in the Hydraulic Analyses Summary Package. All plan view drawings should be to scale.
    a. Each segment or reach (indentified by a change in slope, geometry, design flow, and/or lining material) of linear structures (e.g., channels or pipelines) should be identified. Segment identifiers can be channel stationing (e.g., Sta. 0+00 to Sta. 72+00), or labels (e.g., PitDiv-a, PitDiv-b; Coll#1.1, Coll#1.2, etc.)
    b. Culverts should have individual identifiers on the plan view(s).
    c. Ponds should have individual labels on the plan view(s).
    d. Drawings where additional design information can be found should be called out on the plan view(s). This can be done using drawing callouts (preferred) or in the Notes section on the drawing.

II. Profiles. Linear features such as channels and pipelines should have profiles showing the existing grade and finished/constructed grade. The different segments or reaches should also be identified in a manner consistent with that in the Hydraulic Analyses Summary Package. Drop structures, grade control structures, armored sections, etc. should be called out with references to drawings/detail sheets where details are shown. All profile drawings should be to scale.

III. Pond Details. The pond drawings should include a plan view with contour elevation lines and labels. The following information also needs to be provided for pond details:

a. Stage-storage table to compare with estimated runoff volume.
b. Drawing(s) (to scale) with contours demonstrating pond capacity, spillway location, and spillway erosion protection.
c. Design drawing(s) and specifications showing the impoundment's embankment. This should include at least one cross-section that shows elevations of the embankment crest, spillway invert, and native ground at both the upstream and downstream toes of the embankment. Embankment compaction specifications should also be provided.
d. Design drawing(s) and specifications showing the spillway designs. The drawings should include cross-sections perpendicular to and parallel to the flow direction; armoring revetment type (with specifications), thickness, and extent to be placed; and energy dissipation design at the toe of the spillway.

IV. Detail Sheet(s). Details should be called out from Plan Views and/or Profiles. Details should provide enough views and dimensions for a typical construction contractor to build the feature without having to refer to reports or other text, with the exception to Specifications. Specifications should be called out from Details as well.

V. Specifications. Specifications need to be developed or written on Drawings where appropriate for all materials (e.g., filter fabric, structural fill, riprap, culverts, etc.) and construction methods (e.g., compaction density and lift thickness for earthworks). The specifications should describe the material in enough detail to make sure the material will perform and be installed as intended by the design engineer.

Responses to the New Comments from the Division's January 13, 2014 Memorandum: The following summarizes the adequacy of the responses to the Division's January 13, 2014 Second Adequacy Review comments received from Whetstone on February 7, 2014.

3. Section 4.1 and Figure 10. The response is adequate.
3. Section 4.2, p. 24. The response is adequate.
4. Section 4.7, p.42. The response is adequate.
5. Section 5.0, Model Results. The response is adequate.
6. Section 5.3 and Table 21, pp. 47-48. The response is adequate.
7. Section 5.5, p. 49. The response is adequate, given that the Division acknowledges the design drawings are on Plate 4, instead of Plate 3.
8. Section 6.3.2 (p. 63) and Plate 2. The response is adequate.
9. Plates 1 through 4. The response is adequate.
10. Plate 3. The response is adequate.

11. Plate 4. The response to this Comment is inadequate. The Division could find no riprap specifications on any of the revised Plates.

If either you or the applicants have any questions regarding the comments above, please call me at (303) 866-3567, extension 8169.