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January 9, 2013

Bob Oswald
Colorado Division of Reclamation, Mining, and Safety
1313 Sherman Street, Rm 215
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RE: Permit No. M-2012-032, Revenue Mine Surface Water Systems Designs – Stormwater Comments – Review of November 29, 2012 Adequacy Response – Soil Unit 112 Details

Mr. Oswald

GLA has received and evaluated the comments regarding the surface water systems at the Revenue Mine that Star Mine received from Bob Oswald at DRMS. Since the runoff calculations of stormwater basins SWB-1 through SWB-4 are all affected by the first comment of the review (along with related designs), please evaluate this response separately.

DRMS Comment

Map G-1:

1. *The Soil Map Unit 112 (Cryorthents-Rock outcrop) is categorized as being hydrologic soil group (HSG) C. The Soil Resource Report for Ouray Area, Colorado, Parts of Gunnison, Hinsdale, Ouray, San Juan, and San Miguel Counties categorizes 112 as HSG D. Please provide rationale for the use of lower runoff potential HSG for Soil Map Unit 112.*

Applicant Response
The Soil Group 112 (Cryothents-Rock outcrop) identified in the Custom Soil Survey generated using the USDA Web Soil Survey covers an area on the south side of Yankee Boy basin uphill from the Revenue Mine. A copy of this soil's description can be found attached to this memo. For the purpose of curve number selection for runoff, the hydrologic soil group (HSG) of C was selected based on the SCS Hydrologic Soil Group definitions.[1] The definitions of HSG C & D are provided below.

Group C soils have a low infiltration rates when thoroughly wetted and consist chiefly of soils with a layer that impedes downward movement of water and soils with moderately fine to fine texture. These soils have a low rate of water transmission (0.06-0.15 in./hr.)

[1] Table 3.15 from *Design Hydrology and Sedimentology for Small Catchments*. Haan, Barfield, Hayes. 1994.

Group D soils have high runoff potential. They have very low infiltration rate when thoroughly wetted and consist chiefly of clay soils with high swelling potential, soils with a permanent high water table, soils with a claypan or clay layer at or near the surface, and shallow soils over impervious material. These soils have a very low rate of water transmission (0-0.05 in/hr).

The Soil Report used in the DRMS application (Appendix 8) did not specify a HSG for this soil type when generated by the USDA web soil survey. In order to determine the HSG, the property *Capacity of the most limiting layer to transmit water* was used. The two elements of the 112 soil (Cryorthents and Rock outcrop) have different value ranges for this property. The Cryorthents has a range for water transmission of 0.06 to 0.20 in/hr while the Rock outcrop has a range of 0.00 to 0.06 in/hr. The complex is listed as being split 50% (Cryorthents), 40% (Rock outcrop). This places the overall soil squarely between Group C (higher water transmission rate) and Group D (lower water transmission rate) for the HSG. In order to determine the appropriate soil group, more site specific details should be applied.

The soil map units used in the web soil survey are drawn from soil surveys conducted over large regions, and therefore do not reflect the specific details at Revenue. The distribution of the sub-units of map units 112 is 50% Cryorthents and 40% Rock outcrop in the regional soil survey. This may not reflect the Revenue area soil types accurately. An examination of photography of the area south of the Revenue Mine shows that the area the 112 soil unit covers has substantial permanent vegetation including large amounts of forest and thick brush communities (Figures 1 - 3). These communities require soils deep enough to allow the infiltration and drainage of runoff. Cryorthents has a soil depth of 10-39 inches according to the soil survey. It is likely that the vegetated areas are the Cryorthents soil type. Rock outcrop has no soil depth to bedrock, and therefore would not support vegetation of the scope seen in the Figures. Based on general areas from maps like Figure 1, the portion of thicker soil (Cryorthents) is closer to 90% than 50%.

WestWater Engineering, while conducting wetlands examinations on site, logged soil depths of 20 inches just south of the old pond. As Figure 1 shows, these sample points are in the middle of the 112 soil map unit. These soil depths support the idea that the vegetated areas south of the Revenue Mine contain soils that are the Cryorthents type, not Rock outcrop.

The Cryorthents soil type is thicker and has a higher water transmission rate than Rock outcrop. This allows it to support substantial vegetation as seen in Figures 1-3. The predomination (90%) of the soil type with the higher water transmission rates (Cryorthents – 0.06-0.20 in/hr), makes it reasonable to classify the 112 soil map unit in the area south of the Revenue Mine as being in hydrologic soil group C.

If you have any questions on this analysis, please contact me at (720) 842-5321 or benl@lewicki.biz.

Sincerely,

Ben Langenfeld, Project Engineer
Greg Lewicki and Associates

CC: Bob Oswald, DRMS

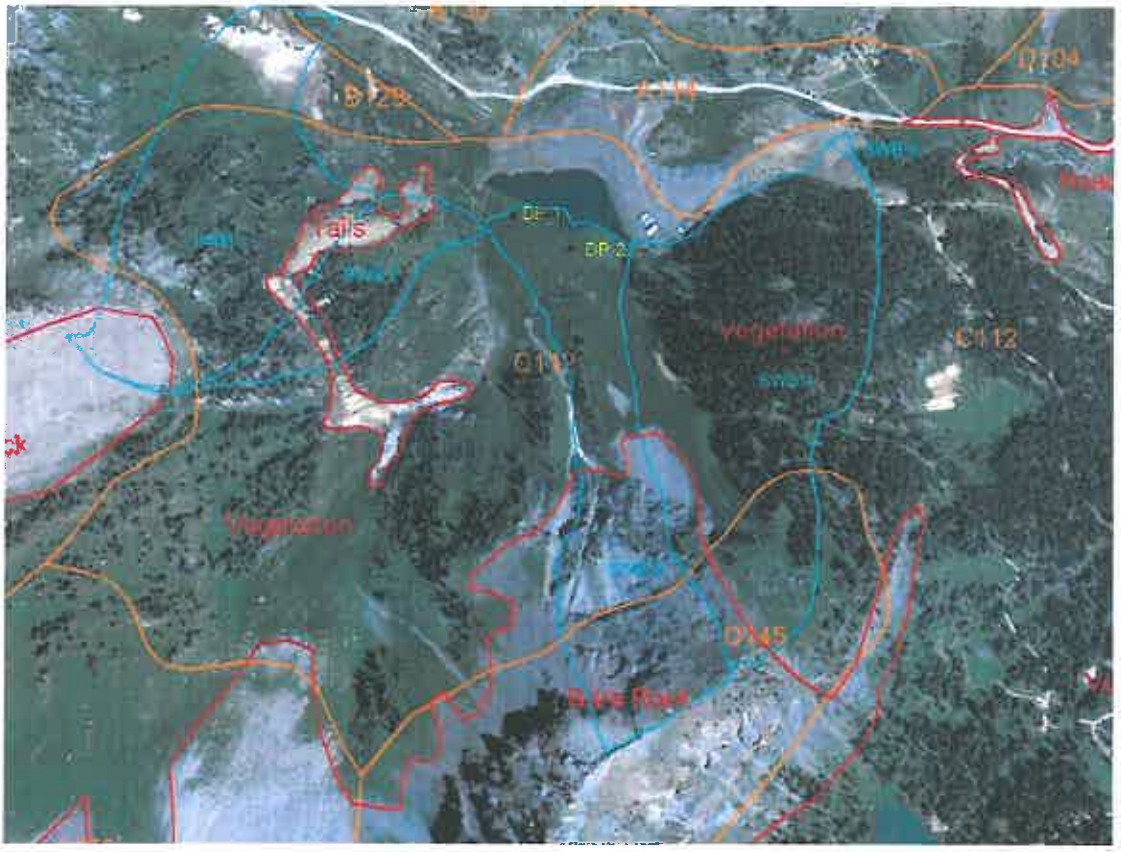

Figure 1 – Revenue Mine and southern area. Encompasses all the SWB that drain to the Revenue Mine area from the south. The orange lines and labels are the soil map units; the red boundaries show bare rock or tails areas; cyan lines show the stormwater basins.

Figure 2 – Looking south across Revenue Mine pond. This photo was taken in October 2012. This shows the strong vegetation community present in the 112 soil, even at the low water times of the year. Rocky mountain top areas in the distance are a different soil map unit.

Figure 2 – Looking southwest across Revenue Mine pond towards Atlas drainage. This photo was taken in August 2011. Some bare rock is visible, but the vast majority of the area is a strong vegetation community.

Soil Map Unit Description

112—Cryorthents-Rock outcrop complex, 50 to 120 percent slopes, extremely stony

Map Unit Setting

Elevation: 8,600 to 12,000 feet
Mean annual precipitation: 24 to 37 inches
Mean annual air temperature: 30 to 41 degrees F
Frost-free period: 40 to 70 days

Map Unit Composition

Cryorthents and similar soils: 50 percent
Rock outcrop: 40 percent

Description of Cryorthents

Setting

Landform: Mountain slopes, ridges
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Mountaintop, interfluve
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Slope alluvium derived from tuff and/or colluvium derived from tuff

Properties and qualities

Slope: 50 to 120 percent
Depth to restrictive feature: 10 to 39 inches to lithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Very low (about 0.6 inches)

Interpretive groups

Land capability (nonirrigated): 8e

Typical profile

0 to 4 inches: Extremely stony silt loam
4 to 12 inches: Extremely cobbly loam
12 to 22 inches: Unweathered bedrock

Description of Rock Outcrop

Setting

Landform: Mountain slopes, ridges
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Free face, interfluve
Down-slope shape: Convex
Across-slope shape: Convex

Properties and qualities

Slope: 50 to 120 percent
Depth to restrictive feature: 0 inches to lithic bedrock
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)

Interpretive groups

Land capability (nonirrigated): 8s

Typical profile

0 to 60 inches: Unweathered bedrock