MEMORANDUM

Date: August 7, 2012

To: Tim Cazier

From: Berhan Keffelew

Re: Cresson Project; DRMS File No. M-1980-244; AM-10 (MLE2) Geochemistry and Groundwater Adequacy Review

Per your request, I have completed the review of my assigned sections for the amendment.
The amendment application Volumes I thru VII appear to have been submitted in the same format as previous amendments. The amendment proposes to increase the current permit area of 5862.4 acres to 5989.7 acres by adding 127.3 acres. The new proposed leach pad in Squaw Gulch will be constructed with a triple liner design. The operator also proposes to place a large mill for high grade ore recovery in the existing permit area.

As requested, I did a cursory review of the entire application to make sure references to past approvals reflect what was previously approved. The Environmental Protection Plan is in compliance with Rule 6.4.21(5). The list of designated chemicals and the materials handling plan are in compliance with Rule 6.4.21(5). All of the monitoring included for the solution collection systems is in compliance with Rule 6.4.21(5). The amendment is also in compliance with Rule 6.4.21(16). A detailed Quality Assurance and Quality Control Plan, with material specification, is included in the application (Volume V appendix H, Technical Specifications). The detoxification process of the new proposed valley heap leach pad (phase VI) consists of two pore volumes of water and one pore volume of hydrogen peroxide. The numeric limit for the decommissioning of the pad remains at 0.2 mg/l wad CN (weak acid dissociable cyanide). Once this is achieved, the liner will be punctured so it will free drain. The puncturing of the liner serves three purposes: 1) it will allow the Division to detect any metal releases from the pad by monitoring the ground water compliance points during reclamation, 2) it will allow root zones to properly establish below the liner and 3) it will help eliminate build up of hydrostatic head.

Geochemistry Evaluation and Rules 6.4.21(5) and (6)

The geochemistry of the District has been extensively investigated, as it relates to ground water hydrology. The past and ongoing evaluations include, total sulfur and carbonate content, total metal content, Net Acid Generation Potential (NAGP) tests and long term accelerated tests, like the humidity cell tests. The long term geochemistry evaluation includes all areas covered under previous approvals in addition to the current proposed ore processing and overburden placement areas that will be expanded under the proposed amendment. The Division agrees that impacts to the probable hydrologic balance will be negligible if the following conditions exist. Drainage, from all areas previously permitted and currently proposed, is within the diatreme and passes through the preferential flow path, ultimately

discharging at the Carlton Tunnel. This is due to the abundant Net Neutralization Potential (NNP) at depth (within the diatreme) which limits the release of additional metals.

However, in Volume IV , under East Cresson Overburden Storage Area (ECOSA) Evaluation, Section 4.2, Groundwater Potential Impact, the operator states, "In the event that the neutralizing capacity of the overburden materials is exhausted, the water seeping from the base of ECOSA will become acidic, and the concentrations of calcium sulfate, iron, zinc and other metals may increase". The operator continues, "The potential for impact arises as a result of the fate of the water after it flows out of the base of the ECOSA. If the water proceeds down through the diatremal volcanic rocks, contacts the abundant carbonate in the Diatreme and joins the regional ground water system that flows from the Carlton Tunnel, there will be no net impact, as this is the same fate that it would have had naturally. If however, the water does not follow the path, but emerges at the toe of the ECOSA and joins the surface water system in Grassy Valley, then dissolved constituents in it resulting from sulfide oxidation have the potential to cause impact to surface water and shallow ground water resources in Grassy Valley". Assuming the average total sulfur content of the overburden is approximately 1.36%, as stated in section 4.2, the Division has the following comments.

1) Where is the neutralization capacity in the overburden coming from? Is Cripple Creek & Victor (CC&V) going to apply a buffering agent as part of the placement of the overburden in ECOSA? Please explain.

The Grassy Valley drainage is connected to the Wilson Creek drainage, which eventually reports to Four Mile Creek. The surface water quality for the two drainage areas that could be impacted is generally considered to be good. Additional ground water quality and quantity evaluation for Grassy Valley drainage area was submitted under this amendment. Based on the additional data submitted and the similarity of the water quality to the other drainage areas in the district, the Division believes the drainage area to be within the diatreme. As a result, if the ground water preferential flow path joins the Carlton Tunnel drainage, impacts from acid generating potential should be buffered by the abundant calcium carbonate at depth. However, the Division has expressed some concern about the lack of additional deep drill core data to demonstrate if this area is indeed within the diatreme's footprint. Despite the obvious overwhelming acid-neutralization capacity of the rock at depth within the diatreme, it is the Division's responsibility to require detailed geochemical characterization of the Overburden (OB) to be placed in ECOSA, from basic Acid Base Accounting (ABA) through leach testing. In addition, CC & V has raised some doubt about the potential for the preferential flow path to be circumvented, which could adversely impact the surface and shallow perched ground water in Grassy Valley. In order to mitigate this occurrence, the Division believes the addition of a three foot inert low infiltration layer above the overburden would limit moisture contact, thereby minimizing impact to the prevailing hydrologic balance.

2) CC&V must commit to place a minimum of three feet of inert low infiltration soil as part of the reclamation plan for ECOSA. Please revise the reclamation plan for ECOSA, adding three feet of inert low infiltration cover as part of the final reclamation plan.

3) If the potential exists for the preferential flow path to be circumvented in ECOSA, it stands to reason the same low probability could exist in the other existing and proposed overburden storage areas that will be expanded under the proposed amendment. If it is

CC&V's assertion that the same condition will not exist in other overburden storage areas as previously accepted by the Division, CC&V must explain the reasons in detail. If not, CC&V must also place a minimum of three feet of low infiltration cover in all current and proposed overburden storage areas as part of the final reclamation plan. Please provide a detailed response explaining how CC &V will address this concern.

4) In the event of leachate release to the environment, it is always useful to have some knowledge of the expected geochemical interactions between the leachate and the material underlying the pile, whether it is bedrock or unconsolidated material, to assess the attenuation properties of these materials. The Carlton Tunnel drainage system and the overburden stockpiles are in significantly different environments. One being an underground flow system that has been flowing for many decades and appears to have established some level of equilibrium as evidenced by the relatively consistent water quality of the tunnel discharge, the other is a pile of freshly mined and crushed rock that will be exposed to a new environment of weathering and oxidizing conditions. It is unlikely the two sites will weather and leach similarly. The Carlton Tunnel has been in place draining the underground workings for over 60+ years. If an assumption is made that the ground water flow system feeding it has established some kind of stasis or equilibrium, then it might give doubt about the existence of preferential flow paths causing selective dissolution and depletion of available minerals along those flow paths. Additional and ongoing geochemical testing will provide data to help minimize future concerns.

   a. Therefore, the Division requires the operator conduct sequential batch leach tests continually, using ASTM approved methods to document results of such tests. The results must be submitted on a quarterly basis or when enough representative sample data is collected. The tests must be an ongoing process throughout the life of the operation.
   b. Please provide the type(s) of ongoing sequential batch leach tests the operator plans to implement throughout the life of the operation.
   c. For post closure, CC&V must provide a worst case scenario of the quantity and quality of release from the overburden pile based on the results of these tests. Long term worst case scenario with ranges between maximum and minimum releases must be submitted to the Division.

5) Sulfate was selected as a possible indicator for Acid Mine Drainage (AMD) in all the compliance wells. For the past five years, the Division has observed an increase in sulfate concentration in the Arequa Gulch ground water monitoring and compliance points. The current upward trend observed for the past five years in the monitoring wells in Arequa Gulch, has not been associated with lowering of the pH. At present, CC&V is pumping back the water from compliance well CRMW-3A and -3B as make up water for the pad.
   a. The operator must discuss the potential for sulfate dissolution and its potential to exceed existing GW compliance standards in all the compliance wells. The discussion must include possible remedial action(s) and recommendations.
   b. Additionally, if sulfate is not a good indicator for AMD in the district because of its abundant presence in the host rock of the ore body, what other metal(s) would CC&V suggest to monitor in the compliance wells? The selected metal has to be good

indicator for a potential AMD. Please provide a detailed discussion and possible recommendations.

Ground Water Information- Rules 3.1.5(6), 3.1.6(4), 3.1.7, 6.4.7 (1) and (2), 6.4.21 (8), (9) & (12)

The ground water quality and depth to ground water are monitored and will continue to be monitored in Arequa Gulch, Squaw Gulch, Wilson Creek, Vindicator Valley, Grassy Valley and Poverty Gulch. Because the ground water is not classified, the Division set numeric protection levels in accordance with the provisions of the Rules and the Act. All the compliance wells are nested and developed in both the shallow and deep perched water bearing zones. These wells cover each of the drainage areas in the district that have the potential to be impacted by the operation. CC&V monitors many more wells within the drainage areas in addition to the compliance wells for their own record and to monitor trends. At present, CRMW- 3A, (Arequa Gulch), SGMW- 4A (Squaw Gulch), VIN -1A (Vindicator Valley), GVMW- 8A (Grassy Valley), MCMW- 6 (Wilson Creek), PGMW- 1A (Poverty Gulch) and ESPMW-1 (external storage pond sampled only for pH and wad CN), are compliance wells with numeric protection levels. The data collected are submitted to the Division each quarter. The post closure monitoring of the ground water is as approved in previous amendments. Based on the information submitted the Division has the following request.

6) **Grassy Valley**: The Division proposes that CC&V choose different well sites than the ones selected (GVMW -16 and GVMW-24 A and B) and listed in table 11-2. The new wells must have continuous data for at least three years, with all the usual parameters analyzed. The two wells proposed by CC&V do not meet this standard. Once the new compliance wells are agreed upon, the Division will set numeric protection levels in compliance with Rule 3.1.7(iv) and Rule 6.4.24 as applicable. Please provide your selection for the other two compliance wells that will meet the Division's minimum requirements.

7) **Arequa Gulch:** As stated above, the compliance well in Arequa Gulch (CRMW- 3A) is being pumped back to the pad (as is monitoring well CRMW-3B) as make up water because the sulfate standard has been exceeded on a couple of occasions and is expected to exceed the set numeric standards on a continuous basis once the foot print of the pad is expanded. The current yield of the well is approximately 2 to 3 gallons per minute (gpm). The operator, at the request of the Division, completed a deeper well in the bed rock at a depth of approximately 100 feet for additional monitoring. This well is in addition to CRMW- 3B, which is also completed in the bedrock at a depth of 63 feet. The wells are still being monitored for all the other parameters including sulfate, as they are compliance well locations. With the exception of the sulfate, all other parameters are within or below the set numeric protection levels. The detailed geochemistry evaluation conducted by CC&V for Arequa Gulch indicates that as the foot print of the pad increases, the sulfate concentrations is also expected to increase. What is the post closure plan to remediate sulfate, once the water is no longer used as make up water for ore processing? What remedial action(s) is planned post closure if the upward trend continues to exceed the numeric protection levels in the other compliance wells? Please explain in detail.

8) **Squaw Gulch**: This area is poorly represented with ground water quality data. The current monitoring wells consists of SGMW-3A (diatreme), SGMW- 3B (alluvium shallow diatreme) and SGMW-5 (bedrock outside diatreme) wells. In addition, there is a shallow piezometer designated as SG-04PZ. Since construction SGMW-5 has been recorded as dry with no water quality data. According to the limited water quality data available, the water quality is characterized as calcium-sulfate dominated. Sulfate values range from 423 mg/l in the alluvium to 595 mg/l in the shallow bedrock. The proposal under this amendment is to place a large pregnant solution collection system up gradient of these wells. The location is also in close proximity to Cripple Creek which is a perennial stream. In addition, there is already a very large overburden stockpile up gradient of these wells. Therefore, CC&V must drill additional monitoring wells in Squaw Gulch. Upon completion, these wells have to produce enough water to complete a full suite analysis for five consecutive quarters. Once the five quarters worth of data is submitted, the Division will set numeric protection levels for the selected metals, as indicators in accordance with Rule 3.1.7(iv) and Rule 6.4.24 as applicable.

9) **Wilson Creek**: The location of the phase V pregnant pond required the addition of a new compliance well in Wilson Creek (WCMW3-134) for early detection. The Division set the following numeric protection levels for the compliance well: pH 6 to 9, wad cyanide 0.2 mg/l, sulfate 250 mg/l, zinc 2.0 mg/l and manganese 0.5 mg/l. Since the Division never sent a formal letter addressing the new compliance well and the numeric protection levels, please acknowledge this well as a new compliance well, in addition to WCMW-6 in Wilson Creek, with the above numeric protection levels.

The other monitoring and compliance wells in Vindicator Valley and Poverty Gulch appear to be adequate at this time.

CC: Tom Kaldenbach
Tony Waldron