State of Utah
GARY R. HERBERT
Governor

GREG BELL
Lieutenant Governor

Department of
Environmental Quality

Amanda Smith
Executive Director

DIVISION OF RADIATION CONTROL
Rusty Lundberg
Director

January 19, 2012

CERTIFIED MAIL
(Return Receipt Requested)

David C. Frydenlund, Vice President, Regulatory Affairs and Counsel
Denison Mines (USA) Corp.
1050 17th Street, Suite 950
Denver, CO 80265

Subject: Nitrate Corrective Action Plan for the White Mesa Mill Site dated November 30, 2011 (Under Cover Letter Dated November 29, 2011): **DRC Review Comments**

Dear Mr. Frydenlund:

The Division of Radiation Control (DRC) review comments regarding the November 30, 2011 Denison Mines (USA) Corporation (DUSA) "Nitrate Corrective Action Plan for the White Mesa Mill Site" are enclosed (via URS Memorandum).

Please review the comments as soon as possible. DRC anticipates that DUSA should be able to respond to the comments and submit a revised CAP on or before Monday, February 27, 2012. If DUSA does not agree with this due date then please request an alternate date, including justification(s) for the extension, on or before close-of-business, January 24, 2012.

If you have questions or concerns regarding the comments, or would like to arrange a meeting or teleconference to discuss the comments, please contact Tom Rushing at (801) 536-0080. Thank you.

Sincerely,

UTAH WATER QUALITY BOARD

Rusty Lundberg

Rusty Lundberg
Co-Executive Secretary

Enclosure: URS Memorandum (4 pp)

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URS

M E M O R A N D U M

To: Tom Rushing (DRC), Loren Morton (DRC), Phil Goble (DRC)

From: Paul Bitter (URS), Jeremy Cox (URS), Rebecca Brown (URS), Jon Luellen (URS)

cc: Robert Baird (URS)

Date: 19 January 2012

Re: Comments on the Corrective Action Plan for Nitrate, White Mesa Uranium Mill Near Blanding Utah dated November 30, 2011

This memorandum contains the comments by URS and the Utah Department of Environmental Quality, Division of Radiation Control (DRC) on the Corrective Action Plan for Nitrate at the White Mesa Mill Site. The Corrective Action Plan was prepared for Denison Mines USA (DUSA) by Hydro Geo Chem, Inc., and was dated November 30, 2011. Comments have been provided by URS as a deliverable for Contract No. 116259 issued through the DRC. This review also is in accordance with the amended Memorandum of Understanding (MOU) between the DRC and DUSA dated December 2011. For purposes of expediency, the URS and DRC comments are edited for conciseness and combined into one memo. Note that format, grammar, and punctuation in the Corrective Action Plan were not reviewed for accuracy and consistency.

The comments regarding the Corrective Action Plan for Nitrate dated November 30, 2011 are presented below. Please note that this document must meet the minimum requirements specified in the September 30, 2011 Stipulated Consent Agreement (SCA). Based on this review, not all of the minimum requirements of the SCA have been met by the Corrective Action Plan for Nitrate dated November 30, 2011. These shortcomings must be addressed to satisfy the SCA.

1. General comment regarding figures: Several well symbols are presented on the figures that do not convey additional information to the reader. Three different symbols are used for monitoring wells, based on when the wells were installed, for example, wells MW-33, MW-34, MW-35, MW-36, and MW-37. Because wells MW-35, MW36, and MW-37 are tailings monitoring wells, they should have the same symbol as the "perched monitoring well" symbol. Wells MW-33 and MW-34 are currently not required to be sampled; therefore, they can have a separate symbol. Furthermore, the identification of wells currently used for groundwater extraction at the site (relative to the chloroform plume) is important information that, though it is discussed in text and tables, is not currently displayed on any of the figures. Please identify the current extraction wells with a unique symbol on the figures where appropriate.
2. General comment: The document repeatedly uses the term permeability interchangeably with hydraulic conductivity. These parameters are not interchangeable. Permeability is a function of the geologic media alone, whereas hydraulic conductivity takes into account the density

and viscosity of the fluid flowing through the geologic media. Since values quoted in the plan are in terms of centimeters/second, which is the unit for hydraulic conductivity, then all references to "permeability" within the document should be replaced with "hydraulic conductivity."

3. Section 1: Please add a statement within this section that all nitrate concentrations in groundwater in this document are expressed as mg/L as nitrogen.
4. Figures 1, 3 – 7, 9 – 10, 12 – 13: Label the Cottonwood Canyon, Corral Canyon and Ruin Spring on the figures since they are referenced in the report. If these features are outside the bounds of the figure, then include another figure that references, on a larger scale, these features with respect to the White Mesa Mill Site.
5. Figure 8: The historical pond is not clearly labeled on Figure 8. It is assumed that the historical pond is the irregularly shaped red figure in the area of TWN-2, but it should be more clearly labeled.
6. Section 1, Paragraph 4: The August 2011 document should be named Nitrate Investigation Revised Phases 2 through 5 Work Plan (not Plau).
7. Figure 13: Please identify on this figure (1) the proposed extraction wells using the same symbol as used on Figure 1, and (2) the current extraction wells in operation at the site.
8. Section 2.2, p. 6: In the third bullet in the first paragraph and the second sentence in the second paragraph in this section, a conclusion is presented that "there are no unaddressed current or ongoing sources of contamination". However, based on the discussion in the last paragraph of Section 2.1, and other statements made in the 2nd and 3rd paragraphs of Section 2.2, Denison and the Executive Secretary have acknowledged that it has not been possible to date to determine the source(s), cause(s), attribution, magnitudes of contribution, and proportion(s) of the local nitrate and chloride in groundwater beneath the mill site. Given the remaining uncertainty associated with potential sources of the elevated nitrate and chloride concentrations in groundwater, it is recommended that the cited conclusion be revised, e.g., to indicate that "there are no known unaddressed current or ongoing sources of contamination". For similar reasons, please delete the text at the beginning of the third paragraph through "That is."
9. Section 2.2, Section 4.5.2: It is doubtful that nitrate plume stability can be assessed with only two years of data, considering the low hydraulic conductivity of the site. It will likely take several years to assess plume stability. It is better to state that "the plume has been stable over the period of seven sampling quarters, but long-term plume stability has not been established." Alternatively, please provide additional years of historical data to demonstrate the stability of the plume.
10. Section 3.2.2 pp. 11-12, Section 7.2 p. 31, Section 8.7 p. 42: DUSA states that Phase II will include a passive strategy of "*relying on natural attenuation processes to reduce nitrate concentrations*." DRC agrees that natural attenuation will occur at the site to some extent; however, DUSA does not clarify whether the identified natural attenuation mechanisms (hydrodynamic dispersion and dilution by recharge) will occur to the degree needed to meet remedial goals. DUSA notes that downgradient portions of the plume will require reduction

in nitrate concentrations to meet the 10 mg/L target. Please clarify how these processes will be substantiated (e.g., monitoring). Also, please discuss the performance measures which will be used to assess natural attenuation (e.g., decreasing trends for nitrate/nitrite at monitoring wells) and projected timeframes to meet the 10 mg/L target.

11. Section 4.3, p. 17, par. 2 and Figures A.1 thru A.4: The cross sections provided do not provide information on the extent and range of concentrations of nitrate (nitrate + nitrite as N) present in groundwater that exceed 10 mg/L in Well MW-30 and in the perched zone in the area between Well MW-30 and MW-31. For example, the concentration of nitrate (nitrate + nitrite as N) shown for Wells MW-30 and MW-31 on Figure A.1 are 16 mg/L and 21 mg/L, respectively, but the 10 mg/L contour on this figure wraps tightly around the wells. Additionally, the interpretive cross section depicted on Figure A.2 indicates that the downgradient (southwestward) lateral extent of nitrate concentrations in groundwater exceeding 10 mg/L extends somewhat beyond the location of Well MW-31. The well bore depicted for Well MW-31 in this cross section also indicates that that wellbore intercepted two conglomeratic zones in the perched water zone portion of the Burro Canyon Formation. Investigations at other locations at the White Mesa Mill Site (e.g., vicinity of Wells MW-4 and TWN-16) have shown that these zones can be more permeable than non-conglomeratic zones in this formation and can thus facilitate groundwater plume migration. No wellbore lithologic log information is provided for Well MW-30. Please provide additional information on specific strata intercepted in wellbore MW-30 and additional information on the potential extent of conglomeratic zones in the perched water zone in the area between Well MW-30 and MW-3. Also, provide additional information to assess whether the zones of capture from proposed pumping of groundwater from Wells TW4-24 and TW4-22 would be sufficiently large to capture the zone of existing impacted groundwater between Wells MW-30 and MW-31 and downgradient of these wells.
12. Section 4.3.2, third paragraph: Figure 4 shows the groundwater mounding around the wildlife ponds that is mentioned in the text. Figure 4 also shows a distinct groundwater mound around well TWN-2. The groundwater mound beneath TWN-2 appears to be unrelated to the recharge from the wildlife ponds because the groundwater elevation in TWN-4, which lies between the wildlife ponds and TWN-2, is less than the groundwater elevation at either TWN-2 or the wildlife ponds. Please explain the apparent groundwater mounding in the area of TWN-2 in this paragraph. Also, in later sections, explain the cause and effects of the apparent groundwater mound at TWN-2 on the planned groundwater extraction.
13. Section 4.5.1, p. 23: In the 2nd and 3rd paragraphs on this page, a conclusion is presented that “there are no unaddressed current or ongoing sources of contamination”. Similar to Comment No. 8 above, it is recommended that the cited conclusion be revised, e.g., to indicate that “there are no known unaddressed current or ongoing sources of contamination”.
14. Section 4.5.2, second paragraph, last sentence: Please remove the statement regarding the “absence of significant continuing sources of nitrate to the perched water.” This claim is unsubstantiated.

15. Section 5.1: A more rigorous discussion of the historical pond would be helpful, especially since the aquifer beneath the pond has the highest nitrate concentrations. A discussion on the origin and use of the pond would be key to understanding a potential source of the nitrate impacts around TWN-2.
16. Figure 11-1: Add labels for the Mill process building, the V2O5 Mini Lab and Precipitation Area, and Mill's Pulp Storage Tanks to the figure.
17. Section 6, third sentence: Please rephrase so that the sentence indicates that "once the nitrate concentrations in all monitoring wells are 10 mg/L or less. . ."
18. Section 7, fifth paragraph, last sentence: This sentence currently states that the implementation of Phase III will be based on assessments conducted during Phase III. Please clarify this statement.
19. Section 7.1, Step 1: Denison proposes to "construct a sloped, curbed, and drained concrete pad of six inches in depth over an area covering at least twice the extent of contamination identified during the contamination investigation." In Figure 11-2(b), the planned concrete pad appears to extend approximately 37 feet to the east of the existing concrete pad underneath the ammonium sulfate storage tanks; it is not clear exactly where the locations of the two 2011 soil borings would be located underneath the cap. This approach does not comply with the requirements of the SCA dated September 30, 2011. Though the construction of a concrete pad is required by the SCA, the SCA also requires that, during Phase I, DUSA must "determine, to the satisfaction of the Executive Secretary, the physical extent of the soil contamination observed at the Ammonium Sulfate Crystal Tanks" near borings GP-258 and GP-26B, including both an estimate of surface area of the contaminated soil and an estimate of the volume of contaminated soil down to, but not including bedrock. Two sampling locations are insufficient to determine the lateral extent of contamination, and the depth to bedrock is not clearly stated in this section. The CAP must be revised to include (1) a statement regarding the depth to bedrock in the area of the ammonium sulfate crystal tanks, and (2) a plan to delineate, at least approximately, the lateral extent of elevated concentrations of ammonium and nitrate in the soil. The volume of contaminated soil cannot be estimated until these data are available and therefore the pad construction should be deferred until the extent of subsurface contamination is investigated. DRC agrees that soil borings are not practical in areas occupied by structures, but additional soil borings must be performed around those structures in accessible locations. For the portrayal of the delineation of the lateral extent of elevated ammonium and nitrate in soil around the Ammonium Sulfate Crystal Tanks, DRC suggests a screening level equivalent to twenty times the background 95% upper confidence levels (UCLs) derived for ammonium and nitrate in soil during the 2011 investigations. The screening levels would be 42.9 mg/kg for ammonia as N and 43.8 mg/kg for nitrate as N on a dry weight basis. The proposed screening levels are less than three percent of the maximum detected concentrations in GP-25B and GP-26B.
20. Section 7.1, Step 1: The installation of the concrete pad will minimize or prevent infiltration of water originating from precipitation or surface spills. These sources of water, however, could be relatively minor compared to contributions from leaking pipes beneath or near the

pad. If such sources exist, they will continue to transport nitrogen from the vadose zone to the perched groundwater and adversely impact the effectiveness of the proposed groundwater extraction program. The apparent groundwater mound in the vicinity of TWN-2, as shown on Figure 4, could be the result of leaking pipes. DRC requests that DUSA include in the CAP a figure showing all of the known or suspected subsurface piping in the vicinity of the Ammonium Sulfate Crystal Tanks. Furthermore, DRC recommends the installation of water meters (or leak detection devices) on the inlet and outlet of any piping beneath or near the proposed concrete cap. If the water meters or devices indicate a potential leak, the piping should be decommissioned or repaired, thus removing the source of water and the subsequent transport of the ammonium and/or nitrate to the perched groundwater.

21. Section 7.1, Step 1: In either the revised CAP or within a revised Discharge Minimization Technology (DMT) Monitoring Plan, DUSA must include a plan for periodic inspection and photographic documentation of the condition of the pad. At a minimum, the inspections should occur annually, and the inspection reports should include a record of any repairs that are needed for the pad; repairs must occur prior to the subsequent inspection. The inspection criteria should be similar to those for other facilities, such as the New Decontamination Pad. If discrepancies are identified [i.e., crack in the concrete with greater than 1/8 inch separation (width) or any significant deterioration or damage of the pad surface], repairs should be made prior to resuming use of the Ammonium Sulfate Crystal Tanks. The inspection findings, any repairs required, and repairs completed should be included in the 2nd Quarter DMT Monitoring Report due September 1, of each calendar year; which is also required by facilities that go through an annual inspection of concrete integrity.
22. Section 7.2, second paragraph on Page 32, seventh sentence: Please remove the statement regarding the "absence of significant continuing sources of nitrate to the perched water." This claim is unsubstantiated.
23. Section 7.2: It is doubtful that TWN-2 will yield 400 feet of downgradient capture zone due to the low transmissivity in the area. This potentially leaves an area of impacted groundwater between TWN-2 and TW4-24 that will not be captured by pumping. An additional pumping well between TWN-2 and TW4-24 is therefore needed.
24. Section 7.2: Pumping tests can be conducted to help establish the capture zone. DRC recommends that an effort be made to model the anticipated capture zones of the nitrate pumping wells, especially in conjunction with the chloroform pumping wells.
25. Section 7.2: The plan states that hydraulic capture will be considered successful if the concentrations of nitrate in MW-30 and MW-31 remain stable or decline, and if concentrations of nitrate in downgradient wells MW-5 and MW-11 do not exceed the 10 mg/L standard. Based on the present position of the plume, the downgradient wells MW-5 and MW-11 presently do not exceed the 10 mg/L standard. Therefore, by the above reasoning, we could say that hydraulic capture is successful even without pumping. Please refine the criteria for MW-5 and MW-11 to state that hydraulic capture will be considered successful if the nitrate concentrations in these wells do not exceed their respective Ground Water Compliance Limit (GWCL) of 2.5 mg/L.

26. Section 7.2: The plan states that neither biologically mediated decomposition of nitrate nor abiotic chemical decomposition are expected to be significant mechanisms in reducing nitrate concentrations, and that nitrate is not expected to be retarded by adsorption onto aquifer solids. Please provide specifics as to why these processes are not expected to occur at the site.
27. Section 7.2.1: Please include specifics of well abandonment procedures and applicable rules and regulations in the plan. The DRC agrees that is appropriate to abandon some nitrate wells, as they are not needed; however, please add to this section "The wells ultimately abandoned will require prior approval by the Executive Secretary." The DRC believes that some wells should be left in place for historical head monitoring data. Head monitoring data are collected from these wells on a quarterly basis and is submitted in DUSA's Quarterly Ground Water Monitoring Reports.
28. Sections 7.2.4, 8.1, and 10.2.3: Please provide additional information in these sections regarding the current sampling frequency for nitrate (Nitrate + Nitrite as N) for monitoring wells located downgradient of the "leading edge" (downgradient limit) of the current 10 mg/L iso-concentration contour (e.g., Wells MW-05 and MW-11) to assess the possible need to obtain and provide routine (e.g., quarterly) analytical data to confirm the spatial and temporal stability of the nitrate plume's downgradient extent.
29. Sections 7.2.4, 7.2.5, 8.1, 8.2, 10.2.3, and 10.2.6: Please provide additional information that assesses the need for analyzing and providing (in quarterly reports) analytical data from selected on-site wells for other groundwater quality parameters that, based on the results of site investigations into possible contaminant source areas, published results from other facilities (e.g., see Goering et al., 1992; Waugh et al., 2010), and requirements contained in the White Mesa Mill Groundwater Discharge Permit GWDP UGW370004, could likely or potentially be considered relevant to this CAP and the associated CAP monitoring and reporting program, including the following:
    - Ammonia (total ammonia = some of unionized ammonia [NH_3] form + ionized ammonium ion [NH_4^+] form);
    - pH;
    - DO;
    - Temperature; and/or
    - Other potentially relevant data.

    Analysis and reporting of groundwater samples for ammonia/ammonium is consistent with groundwater compliance criteria listed in Table 2 of the Groundwater Discharge Permit UGW370004 and with likely or potential on-site sources of contaminants that have been identified for the nitrate plume (e.g., ammonium sulfate crystal tanks). If sufficient natural attenuation is not observed in the concentrations of nitrate in the selected monitoring wells during Phase II, additional analyses (e.g., stable isotope analyses) should be performed during Phase III to better characterize the attenuation processes at the site.

30. Section 7.2.4, p. 35; and Section 10.2.6, p.46: The discussion in these sections (Reporting) for Phase II of the CAP indicates that certain information relating to the detailed design and construction of the remediation system, and information on maintenance procedures to be used during remediation system operation would not be provided to the State DEQ for review. This information needs to be provided for review to comply with conditions listed in Item 11.B.5.b. of the SCA. Examples of types of information that should be included in these reports for review include, but are not limited to the following:
    - Details regarding proposed groundwater tubing and piping conveyance systems (e.g., for conveying extracted groundwater from the pumping wells to the disposal cell);
    - Information on /specification sheets for inline flow meter or flow totalizers to be used;
    - Information on/specification sheets for groundwater pumps to be used; and/or
    - An Operation and Maintenance Manual (required in Phase II)

    Please revise the text in these sections to include all necessary information for the quarterly reports as required by the SCA.
31. Section 7.2.4, p. 35; and Section 10.2.6, p.46: The discussion in these sections (Reporting) for Phase II of the CAP indicates that the quarterly reports would not include certain types of important information that would allow State DEQ personnel to (independently) verify findings that will presented in the reports with regard to remediation system performance. This information should be provided for review and verification purposes and to comply with conditions listed in Item 11.B.5.c. of the SCA. Examples of types of information that should be included in these reports for review include, but are not limited to the following:
    - Tabular compilations of groundwater level measured in non-pumped wells through time as recorded on a routine basis;
    - Water level data from pumped wells over time as recorded on a routine basis;
    - Running and cumulative groundwater volumes removed from each pumping well as recorded on a routine basis; and
    - Calculations and/or spreadsheets documenting calculated nitrate mass removal rates.

    Please revise the text in these sections to include all necessary information for the quarterly reports as required by the SCA.
32. Section 8.1 pp 39-40 and Section 8.2 p. 40: Please specify all wells within the plume to be used for the evaluation of concentration trends. As a measure of pumping performance, DRC would expect that all effected well data will indicate a decreasing trend for nitrate + nitrite (as N) for all wells within the plume, and if other results are shown then DUSA would conform to an approved contingency plan. Such contingency plan would include timely evaluation of criteria to determine successful/unsuccessful pump performance and timeframes (from recognition of unsuccessful performance) to evaluate the need for additional pumping wells or an alternate remediation technology (Phase III). Please include such a contingency plan with schedules in the CAP.

33. Section 8.6 p. 42: Determination of whether the CAP will have a permanent effect is required to be based on appropriate long term groundwater monitoring and is dependent on effectiveness of Phase I and II implementation as well as studies and evaluations for Phase III (affirmative and defensible demonstration) in conformance with *Utah Administrative Code R317-6-6.15(D and E)*. Please remove the second sentence "*As concentrations will then continue to be reduced by natural attenuation, the corrective action will have a permanent effect"* and include language that demonstration that the action will produce a permanent effect will be based on appropriate future evaluations.
34. Figures 7 and 13: The area of the nitrate plume shown on these figures should be dashed. This is an approximate area of the nitrate plume.
35. Figure 11-1: Please supply all results in the table as mg/kg on a dry weight basis instead of the current units of mg/L for aqueous extract.

[End of comments]

References cited in comments:

Goering, T.J., A. Groffman, and B. Thomson, 1992. *Denitrification in Groundwater at Uranium Mill Tailings Sites.* Waste Management Symposium, 1992, 4pp. URL: http://www.wmsym.org/archives/1992/V1/122.pdf

Hyman, M., and R.R. Dupont, 2001. Groundwater and Soil Remediation: Process Design and Cost Estimating of Proven Technologies. American Society of Civil Engineers Press, Reston, VA. 517 pp.

Utah Water Quality Board, 2011. Docket No. UGW09-03-A. *Amended Stipulated Consent Agreement in the Matter of Denison Mines (USA) Corp., 1050 17th Street, Suite 950, Denver Colorado 80265*. 30 September 2011.

Waugh, W.J., D.E. Miller, S.A. Morris, L.R. Sheader, E.P. Glenn, D. Moore, K.C. Carroll, L. Benally, and M. Roanhorse, 2010. *Natural and Enhanced Attenuation of Soil and Groundwater at the Monument Valley, Arizona, DOE Legacy Waste Site—10281*. WM2010 Conference, March 7–10, 2010, Phoenix, AZ. URL: http://www.wmsym.org/app/2010cd/wm2010/pdfs/10281.pdf