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RETURN RECEIPT REQUESTED

July 3, 2006

Mat Johansen
Groundwater Project Manager
Los Alamos Site Office, Department of Energy
528 35th Street, Mail Stop A316
Los Alamos, NM 87544

David McInroy
Remediation Services Deputy Project Director
Los Alamos National Laboratory
P.O. Box 1663, Mail Stop A100
Los Alamos, NM 87545

RE: NOTICE OF DISAPPROVAL FOR THE GROUNDWATER BACKGROUND INVESTIGATION REPORT
EPA ID #NM0890010515
HWB-LANL-05-021

Dear Messrs. Johansen and McInroy:

The New Mexico Environment Department (NMED) is in receipt of the United States Department of Energy (DOE) and Los Alamos National Security, LLC (collectively, the Permittees) document entitled *Groundwater Background Investigation Report* (hereafter, the Report) dated June 2005 and referenced by LA-UR-05-2295/ER2005-0156. NMED has reviewed the Report and hereby issues this notice of disapproval.

General Comments:

1. The Permittees conclude in the Report that "*increasing solution concentrations, in addition to TDS and specific conductance, occurs from alluvial groundwater, to perched-intermediate groundwater, to the regional aquifer*" and "*Increasing groundwater residence times enhances water-rock interactions, including precipitation/dissolution and adsorption/desorption reactions, which produce increasing concentrations of major ions and trace elements within the regional aquifer*" (Section 5.4 Conclusion, page 46). However, NMED's review of the data indicates that these conclusions are in contradiction with the data for most solutes presented in Appendix C. For example, the noted concentration increases from the alluvial groundwater, to perched-intermediate groundwater, to the regional aquifer are not observed for the majority of metals (including aluminum, antimony, arsenic, barium, beryllium, boron, cadmium, calcium,

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total chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, molybdenum, nickel, potassium, selenium, silver, sodium, strontium, thallium, and zinc), most major ions (including ammonium, chloride, fluoride, nitrite and silica), or certain general chemistry parameters (including alkalinity and dissolved organic carbon). The Permittees must correct the conclusions or explain the discrepancy between the conclusions and the data. Any conclusions and illustrations must be based on the monitoring data, even if the data are not consistent with the hydrogeochemical model proposed in the Report.

Indeed, the proposed hydrogeochemical model only accounts for the geochemistry elements and doesn't integrate other important natural processes. For example, microbial processes may play a more important role in controlling groundwater concentrations of certain constituents and solute mobility in the alluvial groundwater because elevated concentrations of organic matter (see DOC data in Appendix C) likely enhance microbial metabolism in the alluvium. In the absence of biogeochemical elements, the proposed conceptual model may not adequately explain the data for some solutes that are subject to microbial transformation (see comment 12 for an example). The Permittees must discuss shortages of the proposed model in explaining some constitutes.

2. The Permittees must provide statistical test results to verify the comparisons among the solute mean concentrations in the alluvial groundwater, perched-intermediate groundwater, and the regional aquifer. Without support of a statistical test, it is difficult to determine whether the differences in solute mean values among the three types of groundwater are statistically significant, or simply result from variations in the solute concentrations from each type of groundwater. The statistical test is especially critical for the data set presented in the Report because the concentrations of most solutes varied over a wide range within each groundwater occurrence and overlapped each other among all three types of groundwater, as shown in Appendix C. The statistical methods and procedures specified in the subtitle C of the Resource Conservation and Recovery Act (40 CFR Part 264.97 *General Ground-Water Monitoring Requirements*) are acceptable to NMED.

3. The Permittees must specify the criteria for determination of outliers in a data set in Section 3.1.5 Decision Rules (pages 18). A large number and in some cases even a majority of data points for some solutes (such as molybdenum, silver, zinc, chloride, nitrite, americium-241, and uranium-235) have been designated as outliers, and thus excluded from the plot analysis in Appendix C. It also appears that inconsistent criteria have been used for different analytes. The Permittees must discuss the criteria used for the definition of outliers with NMED prior to submitting a revised Report. In addition, in Section 4.2.1.2.4 Evaluation of Analytes, the Permittees must list the outlier numbers for all analytes, not just those that only have a small number of outliers.

Specific Comments:

Section 5.2 Geochemical Variations within Groundwater Types, page 45:

4. Third Bullet. The Permittees must correct the conclusions within the Report that concentrations of calcium, magnesium, sodium, and potassium are the lowest within the alluvial groundwater and highest in the regional aquifer. Figures C-11, C-17, C-25 and C-22 show that there are no obvious differences in the mean concentrations of calcium and sodium between the alluvial and perched-intermediate groundwater. In terms of magnesium and potassium, the mean concentrations are lowest in the regional aquifer.

   The Report's conclusions concerning chloride are contrary to the chloride trends shown in Figures C-34, in which the highest mean concentration was observed in the alluvial groundwater and the lowest in the regional aquifer. Furthermore, the box plot excluded most of the chloride concentrations detected in the perched-intermediate groundwater. The Permittees must provide the rationale for the exclusion of these data, and establish consistent criteria to define any outliers as required in the general comment 3. Sulfate plots are not provided in Appendix C and must be added in the revised Report.

5. Fourth Bullet. The Permittees must correct the conclusions to reflect actual observations from the data, or explain the discrepancy between the two. NMED is unable to discern any difference in the mean nitrate concentrations presented for perched-intermediate groundwater and the regional aquifer in Figures C-36 and C-35. In addition, no obvious difference in fluoride concentrations between the alluvial and perched-intermediate groundwater is observed.

6. Fifth Bullet. Correct the conclusion to conform with Figure C-36, which shows the greatest range of fluoride concentrations in the regional aquifer, not in perched-intermediate groundwater as stated in the Report. Alternatively, explain the discrepancy.

7. Sixth Bullet. The Permittees must correct the conclusion that background concentrations of arsenic, barium, boron, bromide, strontium, and uranium were the lowest within alluvial groundwater and the highest within the regional aquifer. Arsenic, boron and strontium have similar mean concentrations in alluvial and perched-intermediate groundwater (Figures C-6, C-9, and C-26). Barium has the highest mean concentration in alluvial groundwater (Figure C-7). Bromide plots were not provided in Appendix C and must be added in the revised Report. Alternatively, explain the discrepancy.

Section 4.2.1.2.4 Evaluation of Analytes, pages 33-37

8. Aluminum - The Report states that the volcanic rock aquifer appears to have the highest and most variable aluminum concentrations. However, Figure C-4 and the aluminum mean concentrations reported in Tables 4.2-2e, 4.2-3e, and 4.2-4e indicate that the highest and most variable aluminum concentrations were detected in the alluvial aquifer,

followed by the volcanic and regional aquifers. Correct the language to reflect results as shown by the figures and the data, or explain the discrepancy.

9. Chromium - The Report states that there is little difference in chromium concentrations between aquifer types in the study area. However, Tables 4.2-2e, 4.2-3e, and 4.2-4e indicate that the mean chromium concentration in the regional aquifer was approximately four times higher than the mean concentrations in the alluvial and volcanic aquifers. Correct the text or explain the discrepancy.

10. Chromium and Nickel - The Report indicates that the filtered sample concentrations for chromium and nickel were actually higher than the respective non-filtered sample concentrations. Discuss the QA/QC results and how the filtered sample results were determined to be anomalous for both of these metals.

11. Dissolved organic carbon - The Report states that DOC concentrations were the greatest for the volcanic rock aquifer locations. However, Tables 4.2-2e, 4.2-3e, and 4.2-4e indicate that the mean DOC concentration was the highest in the alluvial aquifer. Correct the text or explain the discrepancy.

12. Nitrate - The Report states that the concentrations of nitrate varied by location, but did not vary significantly between aquifer types. However, Figure C-36 shows that the alluvial aquifer concentrations were much lower than the concentrations in the volcanic and regional aquifers. The much lower concentrations of nitrate in the alluvial groundwater are very likely attributed to microbial denitrification. The observation of the highest DOC concentrations in the alluvial groundwater implies the probability of the most active denitrifying activities in the alluvial groundwater. Correct the discrepancy between the text and data, and discuss the potential impact of microbial activities on the difference in nitrate concentrations between aquifer types.

13. Isotopic uranium – A review of Figures C-48 and C-50 reveals that the concentrations of U-234 and U-238 were much higher at La Mesita Spring than at the other sample locations. Revise the text to include a plausible explanation for the elevated uranium concentrations at the spring.

14. The Permittees must discuss sulfate and bromide in this section because both are important constitutes for characterization of groundwater background.

Section 4.2.1.2.5 Low-Level Perchlorate, page 37

15. Recent findings (e.g., *Environmental Science & Technology*, 2006, 40, 1757-1763) that atmospheric processes could be one source of naturally occurring perchlorate in groundwater may explain the widespread and consistent detection of low-levels of perchlorate in the Laboratory's groundwater. The Permittees must modify this section by incorporating the newest findings.

Sacred and Apache Springs

16. NMED staff have observed that Sacred Spring has historically been sampled at a "cow pond," not from the actual spring source. The Permittees must ensure that all historical data used in the evaluation of background concentrations in groundwater for Sacred Spring were collected from the spring source. Samples not collected from the spring's source may not be used in the evaluation of background concentrations in groundwater.

17. The Permittes must discuss methods to protect the Apache Spring samples from being influenced by road-salt runoff/recharge in the revised Report.

Well LAO-B

18. The Permittees must discuss the potential impact on well LAO-B data from Los Alamos Reservoir water located upstream.

Figures

19. The cross-section in Figure 2.1-2 does not reference or include a map to indicate the line and section. Provide a map that clearly presents the location of the cross-section in Figure 2.1-2.

20. Figure 2.1-3 presents a simplified regional map, which uses several acronyms (including CCFZ, EFZ, NFZ, PFZ, PPFZ, and VC) that are not explained on the figure. Provide the meanings of the acronyms in Figure 2.1-3.

21. Figure 2.1-6 illustrates a depression in the potentiometric surface at an elevation of 5700 feet. The depression is shown on the figure as being located approximately two miles north-northwest of White Rock. Another 5700-foot elevation contour is shown down-gradient of the depression. There are no groundwater elevation data presented on the figure between the two contour lines at 5700 feet. As such, there is no reason to present two 5700-foot contours. The potentiometric surface may be simplified by illustrating a 5700-foot elevation contour that parallels the 5750-foot elevation contour. Verify whether additional elevation data were used in developing the potentiometric surface map in the area of the depression and, if so, provide the elevation values on the figure. If no additional data were used, then provide the basis for including the depression in the potentiometric surface as depicted. Redraw the potentiometric surface elevation contour(s) in the area of the depression as appropriate.

22. Add mean values for all the box plots in Appendix C. The mean value is part of the box plots to statistically illustrate the data. Also, add the values for the y-axis scale in Figure C-48.

The Permittees must address the above comments and submit the revised Report within 60 days of receipt of this letter, unless otherwise specified in this letter. As part of the response letter that

accompanies the revised Report, the Permittees must include a table that details where all revisions have been made to the Report and cross-references NMED's numbered comments. All submittals must be in the form of two paper copies and one electronic copy in accordance with section XI.A of the Consent Order (Order). Should you have any questions or comments, please contact Hai Shen of my staff at (505) 428-2539.

Sincerely,

James P. Bearzi
Chief
Hazardous Waste Bureau

JPB:hs

cc: J. Young, NMED HWB
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