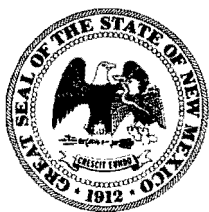


TA36

~~TA~~ ~~Green~~



**NEW MEXICO
ENVIRONMENT DEPARTMENT**

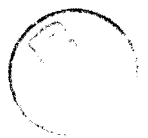


Hazardous Waste Bureau

BILL RICHARDSON
Governor

DIANE DENISH
Lieutenant Governor

2905 Rodeo Park Drive East, Building 1
Santa Fe, New Mexico 87505-6303
Phone (505) 476-6000 Fax (505) 476-6030
www.nmenv.state.nm.us



RON CURRY
Secretary

JON GOLDSTEIN
Deputy Secretary

CERTIFIED MAIL - RETURN RECEIPT REQUESTED

February 11, 2008

David Gregory
Federal Project Director
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 A992
Los Alamos, NM 87545

**RE: DIRECTION FOR FURTHER ACTION
WELL R-20 REHABILITATION AND CONVERSION SUMMARY REPORT
LOS ALAMOS NATIONAL LABORATORY
EPA ID #NM0890010515
HWB-LANL-GROUNDWATER-MISC**

Dear Messrs. Gregory and McInroy:

The New Mexico Environment Department (NMED) is in receipt of the United States Department of Energy and Los Alamos National Security, LLC (collectively, the Permittees) document entitled *Well R-20 Rehabilitation and Conversion Summary Report* (hereafter, the Report) dated January 2008 and referenced by LA-UR-08-0056/EP2007-0805. NMED has reviewed the Report and hereby issues this direction for the Permittees to further rehabilitate R-20.

1. Analysis of Increased Iron Concentrations Using Geochemical Models

In the Conclusion Section of the Report, the Permittees attribute the increases in dissolved iron concentrations measured from Screens 1 and 2 of R-20 during the December 2007 sampling events to three potential conditions. They are: (1) reductive dissolution of iron minerals that are naturally present as components of the local geologic materials; (2) oxidation of iron sulfides that have been accumulated in the vicinity of the



well screens due to drilling fluid impacts; and (3) presence of reduced groundwater in the regional aquifer outside the zones impacted by drilling fluids. Although all three conditions could potentially cause increases in dissolved iron concentrations in groundwater, the site-specific data help eliminate the possibility that the first and third potential occurrences are major factors in raising dissolved iron concentrations in groundwater.

Both reductive dissolution of iron minerals and development of reduced groundwater in the regional aquifer would most likely be caused by the presence of organics including residual drilling fluids. However, total organic carbon (TOC) concentrations measured during the 2007 sampling events are all close to the groundwater background level and passed the criteria established for well screen analysis, as shown in Tables B-1a and B-1b of the Report. In the absence of organic as a driving force, reductive dissolution of iron minerals could not be sustained, and the continuous increases in dissolved iron concentrations in groundwater (as shown in Figure 2.6-6 of the Report) should not be observed.

Furthermore, if the increases in dissolved iron concentrations were due to reductive dissolution of iron minerals or reduced conditions of the formation water, other lines of supporting evidence, such as reduced nitrate concentrations and elevated manganese concentrations, should be observed as a result of the sequence of redox reactions. As documented in the *Well Screen Analysis Report, Revision 2*, iron reduction occurs as one of a sequence of redox reactions after nitrate reduction and manganese reduction. This case is not supported by the data obtained from Screens 1 and 2 of R-20 during the 2007 sampling events because both nitrate and manganese concentrations remained close to their respective background levels and passed the criteria established for the well screen analysis (Table B-1b of the Report).

The possibility that the formation water is directly contaminated by ferrous or dissolved iron is also very low. Ferrous iron, if present in groundwater outside the drilling fluid impact zones, will react with dissolved oxygen (DO) in groundwater since the site-specific conditions (including temperature and pH) favor such a reaction. In terms of dissolved iron and DO concentrations, the formation water should reach an equilibrium condition because of the relatively long residence (reaction) time. As a result, the formation water should maintain a concentration pattern over time that displays an inverse relationship between ferrous iron concentrations in groundwater and DO levels. As shown in Figures 2.6-1, 2.6-2 and 2.6-6, however, the accelerating increases in dissolved iron concentrations during the 2007 sampling events are coupled with steady increases in DO concentrations rather than decreases. These data indicate non-equilibrium conditions for dissolved iron and DO in groundwater, suggesting that the dissolved iron is less likely to come from the formation water outside the drilling fluid impacted zones.

It appears that oxidation of iron sulfides may be causing the increases in dissolved iron concentrations in groundwater, if contamination of water samples by introduced iron is not an issue. During the 2007 sampling events, the extended pumping likely drew fresh formation water into the two screens of R-20. Once the fresh water passed through the drilling fluid impact zones, iron sulfides as new minerals, that accumulated in the vicinity of Screens 1 and 2, may react with DO in groundwater resulting in the increases in dissolved iron and the decreases in DO in groundwater. The observation (in Screen 2 of R-20) of elevated concentrations of sulfate, the other potential product of oxidizing iron sulfides, also supports the likelihood of the occurrence of oxidation of iron sulfides.

To better understand the geochemical reactions that have occurred in the vicinity of Screens 1 and 2 of R-20, the Permittees must conduct a geochemical modeling analysis of the data collected during the Westbay (before 2006), the July 2006 and the December 2007 sampling events. The geochemical modeling analysis of these data must focus on understanding the reasons for the increases in concentrations of dissolved iron and sulfate during the December 2007 sampling event. The geochemical modeling analysis must investigate the possibility that iron sulfides are oxidized by DO and other potential oxidants under natural groundwater conditions, and identify the limiting factors that could restrict natural oxidation of iron sulfides. These modeling efforts will be useful to develop a rehabilitation strategy to minimize the potential influence of the newly-formed reactive minerals on the quality of water samples collected from well R-20.

2. Rehabilitation of R-20 by Using an Oxygen Release Compound

As discussed in Comment 1, iron sulfides are likely present in the vicinity of Screens 1 and 2 of R-20. The newly-formed minerals are reactive with certain potential contaminants of concern, and therefore may lead to contaminant concentrations measured in water samples that are lower than those present in the formation water. It appears that the mechanical development procedures that have been used for rehabilitating R-20 may not be as effective as necessary to remove these reactive minerals. The geochemical data suggest that natural oxidation may be a promising method for restoring the formation mineralogy or deactivating the newly-formed minerals. Natural oxidation, however, may be too slow to rehabilitate R-20 to timely meet the groundwater monitoring requirements at Technical Area (TA) 54.

The addition of oxygen to groundwater is an economical process to enhance clean up groundwater contamination and restore groundwater to aerobic conditions. A variety of oxygen release compounds that are able to steadily release oxygen to groundwater are available commercially. In terms of R-20, the increased dissolved iron concentrations appear to limit the ability of Screens 1 and 2 to provide reliable data for monitoring certain contaminants of concern (such as volatile organic compounds) identified at TA 54. To expedite restoration of the geologic formation or deactivation of the newly-formed minerals in the vicinity of the well screens, the Permittees must develop a method

for use of oxygen release compounds (such as hydrogen peroxide) as an enhanced rehabilitation technique. An increase in DO concentrations in groundwater surrounding the well screens will enhance the processes for oxidation of not only iron sulfides, but also any residual organic drilling fluids. The Permittees must propose and implement a technique to further rehabilitate both Screens 1 and 2 of R-20 to minimize potential influence of the reactive minerals on the quality of water samples.

3. Installation of Sampling System

Following completion of rehabilitating Screens 1 and 2 of R-20 using an oxygen release compound, the Permittees must install the proposed sampling system and collect water samples to evaluate performance of the rehabilitation.

The Permittees must complete the investigation and rehabilitation activities required in above comments, and then incorporate the results into a revised report and submit it to NMED no later than July 31, 2008. The Permittees must propose the additional rehabilitation approach to NMED no later than March 1, 2008. Should you have any questions or comments, please contact Hai Shen of my staff at (505) 476-6039.

Sincerely,



James P. Bearzi
Chief
Hazardous Waste Bureau

JPB:hs

cc: D. Cobrain, NMED HWB
J. Young, NMED HWB
H. Shen, NMED HWB
T. Skibitski, NMED DOE OB
S. Yanicak, NMED DOE OB, MS J993
B. Olson, NMED GWQB
L. King, EPA 6PD-N
G. Rael, DOE LASO, MS A316
M. Johansen, DOE LASO, MS A316
S. Stiger, LANL ENV, MS J591
P. Huber, LANL ENV, MS M992
A. Simmons, LANL ENV, MS M992

file: Reading and LANL General (Groundwater, TA-54)