Kieling, John, NMENV

From: Rhgilkeson@aol.com
Sent: Friday, September 04, 2009 7:06 AM
To: Kieling, John, NMENV
Cc: Rhgilkeson@aol.com; ABERLYLAW@SWCP.COM; acree.steven@epa.gov; dave@radfreenm.org; jarends@nuclearactive.org; jd@campy.com; mayer.richard@epa.gov; mariann2@windstream.net; msantistevan@doeal.gov; serit@cybermesa.com; wilkin.rick@epa.gov
Subject: Submittal of EPA Kerr Lab Reports to the NMED Public Comment Record
Attachments: Kerr Lab Memo Feb 16, 2006.pdf; Kerr Lab Memo March 30, 2009,.pdf; Kerr Lab Memo, Feb 10, 2006.pdf

September 4, 2009

Dear Mr. Kieling

This e-mail brings to the attention of the New Mexico Environment Department (NMED) the three reports by the Environmental Protection Agency (EPA) Kerr Research Laboratory (EPA Kerr Lab) that describe the deficiencies in the various versions of two LANL reports that were approved by the New Mexico Environment Department.

The two LANL reports that are soundly criticized and found to be not credible by the EPA Kerr Lab are the following:

LANL *Well Screen Analysis Report - Revision 2* (LA-UR-07-2852 May 2007)

LANL *Groundwater Background Investigation Report - Revision 3* (LA-UR-07-2853 May 2007)

The three EPA Kerr Lab reports that describe the reasons the two LANL reports are not credible are the following:

February 10, 2006 Memorandum - *Impacts of [LANL] Hydrogeologic Characterization Well Construction Practices*

February 16, 2006 Memorandum - *Review of LANL Well Screen Analysis Report (LA-UR-05-8615)*

March 30,2009 Memorandum - *Review of LANL Well Screen Analysis Report - Revision 2 (LA-UR-07-2852) and Review of LANL Groundwater Background Investigation Report - Revision 3 (LA-UR-07-2853).*

I am referencing the three above listed EPA Kerr Lab Memoranda in my comments on the LANL Revised Draft Permit. My comments are submitted in a separate e-mail document that will be submitted to NMED today.

I request the three above listed EPA Kerr Lab memoranda to be added to the NMED Public Comment Record and specifically to the NMED Public Comment Record for the LANL Revised Draft Permit. In addition, I request the three memoranda are added to the New Mexico Environment Department Administrative Record for the Los Alamos National Laboratory (LANL). The three EPA Kerr Lab memoranda are in the attachment to this e-mail.

Please provide an answer to this request to confirm that the NMED has added the three above listed EPA Kerr Lab Memoranda to the Public Comment Record for the LANL Revised Draft Permit and to the LANL Administrative Record..

31986

Sincerely

Robert H. Gilkeson, Registered Geologist
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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
NATIONAL RISK MANAGEMENT RESEARCH LABORATORY
GROUND WATER AND ECOSYSTEMS RESTORATION DIVISION
P.O. Box 1198 Ada, OK 74820

OFFICE OF
RESEARCH AND DEVELOPMENT

February 16, 2006

MEMORANDUM

SUBJECT: Los Alamos National Laboratory, Los Alamos, NM (05RC06-001)
Well Screen Analysis Report (LA-UR-05-8615)

FROM: Robert Ford, Ph.D., Environmental Scientist
Subsurface Remediation Branch

Steven D. Acree, Hydrologist
Applied Research & Technical Support Branch

TO: Richard Mayer
U.S. EPA, Region 6

As requested, the referenced document has been reviewed by the above named staff of the National Risk Management Research Laboratory (NRMRL) – Ground Water and Ecosystems Restoration Division. The review and recommendations contained in this memorandum represent a technical evaluation of site-specific conditions based on the current state of the science and are neither policy nor prescriptive guidance. In general, the criteria used to evaluate the representativeness of ground-water samples from well screens installed under the hydrogeologic characterization program still fail to consider impacts that may be present following biodegradation of residual organic drilling additives and the return of oxidizing conditions. This issue and other concerns regarding the evaluation criteria proposed by LANL are discussed in detail below.

1. Tier 2.2 screening analysis for impacts from organic drilling additives focused on assessing removal of organic compounds and the return of oxidizing conditions.

The current focus of the screening process for assessing impact of organic drilling fluids is directed towards determining the persistence of the organic additives and reducing conditions resulting from biodegradation of these compounds. While this is an important objective for the screening analysis, it should not be the sole objective. Specifically, this analysis approach does not address the potential impact of changes to aquifer mineralogy adjacent to the well screen. The changes in aquifer mineralogy resulting from iron- and sulfate-reducing conditions established by biodegradation of organic drilling additives can significantly alter the sorption characteristics for reactive site contaminants. The changes in aquifer sorption properties and, therefore, reactive contaminant movement to impacted well screens will not be adequately reflected by the LANL criteria. It is recommended that this potential impact be evaluated through expansion of the current approach. One possible tool that could be used is expansion of the list of input parameters employed in the principal component analysis (PCA) (Section 5 of the Well Screen Analysis Report) to capture a more representative range of sorption reactivity for site contaminants, as discussed below.

2. Issues concerning the use of multivariate statistical analysis as a screening tool to assess the return of ground-water chemistry to pre-drilling conditions for well screens impacted by residual drilling fluids.

The application of multivariate statistical analysis provides a very useful tool to screen comparability of water chemistry data obtained from characterization wells and from appropriate background locations. However, it needs to be recognized that the ability of this tool to evaluate potential impacts of residual drilling fluids is predicated on the use of a suite of input parameters that captures all potential impacts. In this regard, the current choice of input parameters appears to be sufficiently comprehensive to capture comparative patterns in components that may be leached from residual drilling fluids as well as the persistence of reducing conditions resulting from biodegradation of organic drilling fluids. However, the input parameters do not sufficiently represent the range of sorption characteristics associated with potential contaminants of concern. Thus, the analysis fails to capture the potential impact of changes in aquifer mineralogy that may alter the transport characteristics of potential contaminants of concern adjacent to impacted well screens.

This limitation may be addressed through expansion of the list of input parameters that are implemented in the principal component analysis (PCA). Based on evaluation of data presented in the Groundwater Background Investigation Report (LANL, 2005), there are several analytes that could be added to this list to provide more comprehensive coverage of contaminant reactivity. These candidate analytes include: europium, thorium, and uranium. These analytes provide more comprehensive coverage of sorption affinity for site contaminants (*e.g.*, Bradbury and Baeyens, 2005). Of these three analytes, insufficient or no data currently exist to include europium and thorium into the PCA. It is recommended that consideration be given to the routine inclusion of these analytes for ground-water trace element analyses. Based on analysis of existing ground-water data, it is unclear why uranium was not included in the list of 'metals/trace elements' considered for statistical analysis. Uranium meets the criterion of having less than 50% nondetects for alluvial, intermediate, and regional ground-water samples collected thus far. In addition, while vanadium was included in the list of 'metals/trace elements' input into the PCA, no information is provided to explain why this trace element was not listed in the principal components identified in Table 5-1.

3. Issues concerning the use of only the most recent analytical data in the tiered analysis.

The well screen assessment only utilizes data from the most recent sampling rounds. This approach is appropriate for determining whether oxidizing conditions have been restored but, as noted above, may not be a good indicator of the representativeness of the sample for reactive constituents that may sorb to the minerals formed when reducing conditions were present. For wells that passed the Tier 2.2 evaluation, it is recommended that this assessment also be applied to data obtained soon after well installation to determine whether previous geochemical conditions may have resulted in continuing sorption of contaminants.

There is an additional concern regarding the use of only the three most recent measurements in these assessments without examination of trends that may be present. As noted on page 23 of the Well Screen Analysis Report, well R-16 Screen 3 passed the test criteria but exhibited a declining sulfate trend that clearly indicated continuing impact. Examination of trends provides another line of evidence regarding the condition of impacted well screens and should be formally included in these evaluations.

4. **Issues regarding the strong reliance on uncertain background conditions.**

The LANL criteria rely heavily on comparisons between data obtained from the potentially impacted well screens and data obtained from the Groundwater Background Investigation Report (LANL, 2005). The data used to characterize background conditions appear to be sparse, derived from sources representing mixtures of water that are significantly different from the samples obtained from the hydrogeologic characterization wells, and are representative of significantly different flow paths within the aquifer. Actual background values at the locations of the individual characterization well screens may be significantly different from the proposed values. Therefore, the strong reliance on these uncertain background conditions for the evaluation of the impacts of residual drilling additives increases the uncertainty in these assessments.

5. Inclusion of analogs that represent the full range of contaminant reactivity.

Where applicable, comparison of chemistry data for suspected well screens impacted by bentonite and/or organic polymers to background concentrations should include constituents that represent the full range of reactivity for potential site contaminants of concern. Examples of inorganic constituents that may be anticipated in background ground-water samples that represent a useful range of sorption reactivity (and mechanism) with respect to potential site contaminants of concern include zinc (Zn), strontium (Sr), molybdenum (Mo), cesium (Cs), barium (Ba), europium (Eu), thorium (Th), and uranium (U). The current criteria are structured to make use of comparisons between background values and data obtained from characterization wells for some but not all of these constituents. It is recommended that the utility of the constituents not currently used in the well assessment criteria be considered.

6. Issues related to sample collection and preservation.

Both approaches (the tiered analysis and the principal component analysis) used to evaluate the recovery of well screens to pre-drilling conditions are predicated on the accuracy of field and/or laboratory measurements. The overall accuracy of these measurements relative to representing the water chemistry adjacent to the sample well screen is dependent on two primary factors:

1) the accuracy of instrumental performance relative to quantitation of a given analyte, and
2) the reliability of sample collection and preservation methods to prevent alteration of the chemical conditions of collected ground-water samples.

Validation of achieving the first factor is insufficient to insure that the second factor has been appropriately addressed. Failure to address both factors can ultimately result in water chemistry data that are not representative of the aquifer conditions adjacent to the well screen.

As stated on pg. 4 of the Well Screen Analysis Report, field data 'are not currently subjected to the same level of qualification, beyond verification of instrument calibrations and checks.' This statement is made relative to the level of qualification applied to assessment of laboratory data reliability. This is an important consideration given the stated assumption (Section 3.0, pg. 8) that 'field-based measurements...provide reliable qualitative indicators for the presence of sulfate-reducing conditions...'. For the purpose of this review, it is assumed that field data presented in Table C-4 were derived from instruments that passed verification of instrument calibrations and checks. However, there appear to be significant inconsistencies in the reported field data that bring into question the adequacy of methods employed for water sample collection and preservation to insure that changes in water chemistry have not occurred prior to laboratory analyses. In particular, reported values for ORP, dissolved oxygen, and total sulfide (or combinations thereof) at some well locations conflict with general patterns observed for oxidized or reduced ground water. Two example screen intervals that illustrate this situation are provided in Table 1.

These two examples may provide 'worst case' situations relative to other screened intervals. However, they are not isolated situations. Data from many of the well screens appear to be inconsistent or suspect. The concern is not simply that a given screen was appropriately identified to have 'failed' or 'passed' a specified tier criterion. Rather, these data comparisons raise serious concerns relative to the accuracy of the field data for use in the screening process (even in a qualified sense) and, more importantly, the degree to which laboratory measurements were made on water samples that were no longer representative of the condition that existed within the aquifer adjacent to the well screen. This latter concern would impact the reliability of both the tiered analysis and the multivariate statistical analysis performed by LANL.

Table 1. Comparison of measured ORP, dissolved oxygen, and total sulfide for ground-water samples collected from two screened intervals. Red shading indicates measurements for a given sampling date that are in conflict, while green shading indicates measurements which appear to be internally consistent. Data were obtained from Table C-4 of the Well Screen Analysis Report.

Well Screen	Date	ORP (mV)	Dissolved Oxygen (mg/L)	Total Sulfide (mg/L)
CdV-R-15-3 5	20-Oct-04	--	[redacted]	[redacted]
	5-Apr-05	[redacted]	[redacted]	[redacted]
	20-Apr-05	--	[redacted]	[redacted]
	12-Jul-05	[redacted]	[redacted]	--
R-16 2	18-May-04	[redacted]	[redacted]	[redacted]
	13-Oct-04	--	[redacted]	[redacted]
	2-Dec-04	--	[redacted]	[redacted]
	13-Jun-05	[redacted]	[redacted]	--

7. Use of dissolved zinc as the sole analog for evaluations in LANL criterion 2.1-2c.

It is important to identify analytes that are transported less conservatively than the contaminants of concern. Dissolved zinc is proposed for screening the condition of wells impacted by bentonite relative to the possible loss of cesium-137, cobalt-60, europium isotopes, and neodymium-147 onto residual bentonite solids adjacent to the impacted well screen (LANL criterion 2.1-2c). One significant limitation to this approach is that zinc has not been universally detected in site ground water. LANL (2005) reports non-detectable zinc in about 56% of the samples evaluated. Thus, non-detectable zinc at a given well screen could indicate either sorption onto residual bentonite or the lack of this constituent at measurable concentration in the native ground water at the interval sampled by the well screen. In addition, there are some published ion exchange selectivity series that indicate cobalt partitions more strongly than zinc to clay minerals (including bentonite). Thus, detection of zinc would not preclude loss of cobalt-60 on residual bentonite. LANL criterion 2.1-2 should be re-evaluated in an effort to identify a more reliable replacement or supplemental candidate to zinc. Barium presents a potential alternative/additional candidate (99% detect in area ground water), although it is unclear how prevalent this metal may be as a site contaminant of concern.

8. Inclusion of technetium-99.

It is noted that technetium-99 is not mentioned in Table 4-8. It appears that this potential contaminant should be included. As noted in Table 4-7, samples for technetium-99 obtained from screens impacted by reducing conditions may not be representative of pre-drilling conditions.

9. Criteria validation.

Due to uncertainties in the utility of aqueous chemistry assessments for the determination of whether samples are fully representative of aquifer conditions, it is recommended that laboratory and field studies be designed to validate these or similar criteria.

If you have any questions concerning this review, please do not hesitate to call us (Acree: 580-436-8609; Ford: 580-436-8872) at your convenience. We look forward to future interactions with you concerning this and other sites.

cc: Mike Fitzpatrick (5303W)
Rafael Gonzalez (5204G)
Vince Malott, Region 6
Terry Burton, Region 6

References

LANL, 2005. Groundwater Background Investigation Report, LA-UR-05-2295. Los Alamos National Laboratory, Los Alamos, NM.

Bradbury, M. H. and Baeyens, B. 2005. Modelling the sorption of Mn(II), Co(II), Ni(II), Zn(II), Cd(II), Eu(III), Am(III), Sn(IV), Th(IV), Np(V) and U(VI) on montmorillonite: Linear free energy relationships and estimates of surface binding constants for some selected heavy metal and actinides. Geochimica et Cosmochimica Acta, 69: 875-892.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
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GROUND WATER AND ECOSYSTEMS RESTORATION DIVISION
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OFFICE OF
RESEARCH AND DEVELOPMENT

March 30, 2009

MEMORANDUM

SUBJECT: Los Alamos National Laboratory (LANL), Los Alamos, NM (09RC06-001)
Well Screen Analysis Report (WSAR), Rev. 2 (LA-UR-07-2852)
Groundwater Background Investigation Report (GBIR), Rev. 3 (LA-UR-07-2853)

FROM: Steven D. Acree, Hydrologist
Applied Research & Technical Support Branch

Richard T. Wilkin, Ph.D., Environmental Scientist
Subsurface Remediation Branch

TO: Richard Mayer
U.S. EPA, Region 6

As requested, the referenced documents have been reviewed by the above named staff of the National Risk Management Research Laboratory (NRMRL) – Ground Water and Ecosystems Restoration Division. Additional review was provided by Dr. Bruce Pivetz of Shaw Environmental, Inc. Shaw is an on-site contractor providing technical support services to this laboratory. The review focused on the methods and conclusions of the WSAR. The GBIR was reviewed in the context of its use in the WSAR. The review and recommendations contained in this memorandum represent a technical evaluation of site-specific conditions based on the current state of the science and are neither policy nor prescriptive guidance.

As in the review of previous versions of these documents (Ford and Acree to Mayer, 2/16/06), this review is focused on the evaluation of the effects of drilling additives on the collection of representative samples from wells installed under the hydrogeologic characterization program. It is noted that factors other than the effects of drilling additives (*e.g.*, screen length, position within the hydrostratigraphic section, location with respect to potential contaminant source areas, groundwater sampling methods) may have a greater impact on whether groundwater samples are suitable for the purpose of early detection of contaminant releases or migration. Such location-specific issues are beyond the scope of this review.

Although the current versions of the documents attempt to address several of the issues raised during the previous reviews, there is still a relatively high degree of uncertainty in the results reported in the WSAR. For example, additional species indicative of a range of contaminant reactivity have been incorporated into the evaluations. However, several potential indicators are not routinely measured or available. The uncertainty related to this issue is illustrated by the following example. At locations where bentonite additives were used, the WSAR (Section 4.11) concludes that indicators suitable for directly evaluating the reliability of non-detects of highly adsorbing radionuclides are not available. Consequently, this section of the document concludes that it was not possible to evaluate the affected well screen intervals for detections of strongly adsorbing radionuclides. The document appears to modify this conclusion in later sections and indicates that these non-detect results would be accepted as representative of actual conditions if the well passed all other applicable criteria. Regardless of the conclusion stated in Section 4.11, the WSAR ultimately determines that some well screens drilled using bentonite, such as well R-32, screen 1 (Table 4-5) produce reliable samples for highly sorbing constituents such as plutonium (Table 6-4). Such assessments appear to be contradictory and are, at best, confusing. Given the lack of appropriate indicators, a more conservative and defensible approach would appear to be the one advocated in Section 4.11 rather than the approach ultimately used. Many similar issues contribute to the uncertainty inherent in the screening results.

In general, the criteria used to evaluate wells in the WSAR are complex and may ultimately prove to be unreliable. The most significant concerns noted in review of the current versions of the WSAR and GBIR are related to three areas:

- The results of the WSAR and related assessments have not been fully validated using site-specific data from laboratory and field studies.

- The criteria rely heavily on "background" data obtained from long-screened production wells and springs that do not necessarily represent water quality upgradient of the hydrogeologic characterization monitoring wells.

- The reliability of criteria used to evaluate the representativeness of groundwater samples from well screens following transformations of residual organic drilling additives and the return of groundwater samples to oxidized conditions is uncertain due to a lack of direct assessments of the site-specific mineralogical transformations and the reliance on groundwater sampling data.

Each of these issues increases the uncertainty in the conclusions of the WSAR and is discussed in detail below.

Validation of the Screening Results

As noted by the National Research Council (2007: National Research Council, Plans and Practices for Groundwater Protection at the Los Alamos National Laboratory, Final Report), evidence regarding the conditions surrounding the monitoring well screens is indirect. Additional laboratory and field investigations to better determine the nature and evolution of the interactions between the drilling, well construction, and aquifer materials; quantify sorption parameters; and to demonstrate the accuracy of the screening results presented in the WSAR are recommended to validate the results. Without such validation, assessments of the impacts on the representativeness of groundwater samples should be considered to be of uncertain quality.

Uncertain Background Conditions

The WSAR criteria rely heavily on comparisons between data obtained from the impacted well screens and data reported in the GBIR. The data used to characterize "background" conditions is sparse, derived mainly from sources representing mixtures of water that are significantly different from the samples obtained from the hydrogeologic characterization wells, and are representative of significantly different flow paths and residence times within the aquifer. Actual background values at the locations of the individual characterization well screens may be significantly different from the proposed values.

As noted many times in the GBIR, water chemistry is determined by the lithologies of aquifer materials through which the water migrates and the residence time. Data from springs near the Rio Grande and the long-screened production wells does not necessarily represent the flowpaths monitored by the individual short-screened characterization wells. The GBIR recognizes this limitation. However, it indicates that the appropriate data (*i.e*, data from similarly screened wells immediately upgradient of the regulated units) may never be available. This approach introduces unavoidable uncertainty in evaluations of screens with residual effects because it does not allow for spatially distinctive geochemical zones or variability in groundwater chemistry in different aquifer lithologies.

It is quite possible that constituent concentrations observed in unimpacted monitoring wells may be significantly different from the data provided in the GBIR. For example, it appears the well R-35B was recently installed near the top of the regional aquifer without the use of harmful drilling additives within the screened interval. Concentrations of zinc measured in filtered groundwater samples have varied from approximately 40 ug/l to 60 ug/l. This range is above the maximum value of approximately 32 ug/l reported in Table 4.2-3 of the GBIR and is at or above the maximum value reported in Table 4-3a of the WSAR. This example illustrates the uncertainty inherent in using "background" data obtained from sources that are not constructed to monitor the same flowpaths as the monitoring wells in question.

It is also noted that the current evaluation methods may not fully identify conditions representative of the unimpacted regional aquifer. Footnote K in Table E2 indicates that although screens 6, 7, and 8 of well R-25 had a perfect score in the evaluation, the screens may still be impacted by water from perched zones above the regional water table.

Continuing Impacts to Aquifer Materials after Return to Oxidizing Conditions

The geochemical analysis appears to rely heavily on a determination of the overall redox status of groundwater as inferred from water quality parameters, such as dissolved oxygen, oxidized forms of nitrogen (nitrate) and sulfur (sulfate), low dissolved concentrations of iron and manganese, and detection of contaminants in oxidized forms. Part of the analysis includes an evaluation of potential solid-phase processes (modification of surface-active minerals, changes to carbonate mineral stability) based upon the groundwater chemistry. Modification of in situ redox conditions is clearly an important aspect of the problem being dealt with here. As pointed out, the organic drilling fluids provide a source of carbon for native microbial populations in the aquifer. These organisms can have long-term impacts on water chemistry and aquifer mineralogy in the vicinity of the well screen. In general, anaerobic conditions resulting from the respiration of microbes shift the types of minerals and contaminant-reactivity of mineral surfaces that may be in equilibrium or near equilibrium with the specific water chemistry.

Using criteria established in this report, an undesirable component of uncertainty will persist regarding screen impacts because it is not possible to understand all possible mineral-contaminant interactions solely by evaluating water chemistry. As an example, consider a well that shows redox-status evolution from iron-reducing conditions, linked to residual drilling fluids, to oxidizing conditions comparable to the targeted background conditions. In this case, the geochemical criteria would suggest that water chemistry has achieved or is approaching pre-drilling conditions and, furthermore, that contaminant species can be monitored accordingly for their presence or absence. During the evolution of this system, when native microbes supported mobilization of ferrous iron, it is possible that reactive Fe(II)-bearing minerals formed in the available pore spaces adjacent to the well screen. As portrayed in the conceptual model presented in the WSAR (*e.g.*, Figure 4-9), possible phases include ferrous carbonate, ferrous sulfide (in sulfate-reducing compartments or micro-environments), but also could include green rust minerals, ferrous hydroxycarbonate, and magnetite. These Fe(II)-bearing phases are all known to interact with and possibly sequester potential contaminants of concern (*i.e.*, nickel, cadmium, cobalt, arsenic, zinc, americium, technetium, chromium, uranium). In this scenario, as organic carbon is consumed and levels of dissolved oxygen begin to increase, these previously formed Fe(II)-bearing minerals would be anticipated to undergo oxidative transformation to hydrous ferric oxide or iron oxyhydroxides. It might be further anticipated that these newly formed Fe(III)-bearing phases would be very fine-grained and highly sorbent, again with the ability to sequester contaminant species of concern. So along with the shift to oxidizing conditions, as indicated in water chemistry parameters, comes an anticipated shift in reactive iron mineralogy. Based on the criteria proposed, it is not possible to clearly assess: i) how long reduced, Fe(II)-bearing minerals might persist, and ii) what type of mineral phase or assemblage would result as a consequence of the return to more oxidizing conditions.

The critical point is that the nature of the reactive iron mineralogy cannot be assessed by examining water chemistry alone. In order to have a sense of the reactive nature of the aquifer solids, other testing would be required. At some point, it would be expected that any reactive minerals present in the system may become saturated or modified to the extent that they would no longer influence water chemistry in regions adjacent to the well screen. However, there are no compelling lines of evidence provided in the report that would indicate when this desired point is ultimately reached.

Recommendations to Reduce Uncertainty

Due to uncertainties in the mineralogical alterations induced by the drilling additives, uncertainty in the utility of aqueous chemistry assessments for the determination of whether samples are fully representative of aquifer conditions, and the lack of appropriate data for the assessment of water quality immediately upgradient of the impacted characterization wells, it is recommended that additional laboratory/field studies be designed to reduce uncertainty and validate the results of the WSAR. In this regard, the following studies may significantly improve the understanding of the site-specific impacts of the drilling additives and the potential time frames over which the impacts may be expected to continue.

1. **Upgradient Well Installations.** Install wells immediately upgradient of the regulated units of most concern, screening intervals equivalent to those of monitoring wells located downgradient of the regulated units. If such wells were installed without the use of harmful drilling additives in the screened zone, the data should be useful in better defining pre-drilling conditions within the particular hydrostratigraphic units of interest. The data would also provide insight into the representativeness of the "background" ranges used in the WSAR.

2. **Laboratory Investigations.** Laboratory studies could be performed to more fully understand impacts of the drilling additives on the evolution of redox conditions and secondary mineral formation. Subsequently, impacted materials from the studies could be subjected to redox conditions representative of the unimpacted aquifer allowing investigation of the evolution of mineral phases. Aquifer materials obtained during these studies could be used to quantify interactions with contaminants of concern. The results could be used as a baseline to understand the geochemical behavior of subsurface materials and validate conceptual models for the transformations that are occurring as well as aid in the validation of the criteria proposed in the WSAR. It is noted that similar studies were recommended by the National Research Council (2007: National Research Council, Plans and Practices for Groundwater Protection at the Los Alamos National Laboratory, Final Report). Laboratory studies could also be performed to quantify sorption of the inorganic constituents of concern onto the materials used during well construction at LANL.

3. **Field Studies**. Ultimately, lines of evidence from field studies will be needed to reduce uncertainty in the validation of criteria used in the WSAR. Useful lines of evidence would include: characterization of aquifer solids obtained from impacted wells, evaluation of the effects of well purging prior to sampling of impacted wells, and push-pull tests to directly examine sorption properties at impacted wells. A primary line of evidence would also be the installation of new well(s) drilled without the use of additives in the screened zone near impacted well(s). A comparison of water quality data from the two wells would provide direct evidence of the degree of impact and the effects on water quality. Such installations could be performed near regulatory units of greatest concern to maximize the benefits of the data.

If you have any questions concerning this review, please do not hesitate to call us (Acree: 580-436-8609; Wilkin: 580-436-8874) at your convenience. We look forward to future interactions with you concerning this and other sites.

cc: Mike Fitzpatrick (5303W)
Vince Malott, Region 6
Terry Burton, Region 6

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
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OFFICE OF
RESEARCH AND DEVELOPMENT

February 10, 2006

MEMORANDUM

SUBJECT: Los Alamos National Laboratory, Los Alamos, New Mexico (05RC06-001)
Impacts of Hydrogeologic Characterization Well Construction Practices

FROM: Robert Ford, Ph.D., Environmental Scientist
Subsurface Remediation Branch

Steven D. Acree, Hydrologist
Randall R. Ross, Ph.D., Hydrologist
Applied Research & Technical Support Branch

TO: Richard Mayer
U.S. EPA, Region 6

As requested, various documents concerning well construction practices and water quality evaluations at the Los Alamos National Laboratory (LANL) have been reviewed by Greg Davis, a hydrogeological consultant to Dynamac Corporation, and the above named staff of the National Risk Management Research Laboratory (NRMRL) – Ground Water and Ecosystems Restoration Division. Dynamac is an off-site contractor providing technical support services to this laboratory. The review and recommendations contained in this memorandum represent a technical evaluation of site-specific conditions based on the current state of the science and are neither policy nor prescriptive guidance. This memorandum is provided to clarify issues discussed in our memorandum to you dated September 30, 2005, and contains the material provided in the previous memorandum with modifications intended to better convey the requested information. The current review does not include the recent document entitled, "Well Screen Analysis Report" (LANL, 2005c), which will be reviewed under separate cover.

The focus of this review has been on the questions posed by the Northern New Mexico Citizens' Advisory Board (NNMCAB) in a memorandum from DeLong to Mayer dated 1/4/05. The questions which were posed center on the capability of the existing hydrogeologic characterization wells to provide representative ground-water samples for all site-related constituents of concern. The specific questions are summarized below:

Issue 1: If LANL decides to convert characterization wells to monitoring wells, can wells drilled with bentonite clay or commercial fluids, such as EZ-MUD, Quik-FOAM, TORKEASE, and LIQUI-TROL, ever be developed and cleaned up adequately to provide analytical data representative of the ground water in the aquifer unit being sampled?

Issue 2: Will the use of commercial drilling fluids and bentonite clay preclude any contaminants from being accurately sampled even after well cleanup? If so, which ones?

Issue 3: In public reports, LANL indicates that contamination from LANL operations has not reached certain ground-water regions. LANL bases these statements on analytical results which show that certain fast-moving contaminants, such as tritium, that are not affected by drilling fluids or clays have not been detected in concentrations above background in samples from the wells. Are tritium and other mobile constituents suitable indicators of possible impacts for the entire suite of site-specific constituents at LANL?

Issue 4: (a) Can LANL derive an independent estimate of background concentrations of potential contaminants from accumulated ground-water data without using analytical results from the wells associated with the Hydrogeologic Work Plan? (b) Would such data constitute reliable criteria for judging when wells are suitable as monitoring wells?

The issues which have been raised by the NNMCAB are valid and, in many cases, difficult to reliably answer. The NNMCAB and LANL are correct in identifying intrusion of bentonite and organic drilling fluids as a potential problem for reactive contaminants of concern. The following review attempts to answer the questions, where possible, to provide insight into the scientific aspects of the individual issues, and to recommend additional types of studies that may be useful in filling existing data gaps. It should be noted that this review does not provide a detailed list of contaminants that are affected by the residual drilling additives at each impacted well screen. Examples of constituents that are most likely to be affected are given at appropriate points in the discussion. However, preparation of a comprehensive list for each well screen is beyond the scope of this review and would require better knowledge of the degree of impact at each screen and would be expected to change with time, particularly for the screens impacted by organic additives, as the geochemical environment in the impacted zone changes.

In general, it is often difficult to obtain fully representative samples of subsurface materials, particularly in a highly complex setting such as at LANL. This does not imply that available data are always appropriate regardless of objectives and intended data uses. This review highlights potential data quality problems and uncertainties. Since data quality objectives (DQOs) were not explicitly stated in the limited set of documents available for review, it is recommended that the DQOs addressing the specific requirements for the samples and the intended use of the data from the wells impacted by residual drilling fluids at LANL be reviewed to determine the applicability of the suggestions provided below.

For convenience, the review is divided into an executive summary describing findings related to the core issues of the effects of residual drilling additives on ground-water samples, a discussion of background information describing the effects of the drilling additives used at

LANL in more technical terms, and sections corresponding to the individual issues raised by the NNMCAB followed by a brief summary. Recommendations for additional studies or changes in practices are included under each section, where appropriate.

Executive Summary

One of the central issues to be addressed as part of this review is whether representative ground-water samples can be obtained from wells installed as part of the Hydrogeologic Work Plan, considering the methods and techniques used by LANL to drill the boreholes, install, develop and sample the wells. There are two questions that must be answered in order to provide a complete answer to this question:

1) Has the introduction of drilling fluids, including bentonite and biodegradable organic polymers, resulted in changes in ground-water chemistry from pre-drilling conditions?

2) Will alterations of the aquifer material around a well, either through the introduction of bentonite or changes brought about by the break-down of organic drilling fluids, alter how contaminants move toward the well screen, relative to pre-drilling conditions?

The ability to answer the central question of whether 'ground-water samples are representative' depends on how much we know about existing geochemical conditions next to the well screen and in areas that have not been affected by drilling fluids, further into the formation. Analytical results of ground-water samples indicate that drilling additives have changed the geochemical conditions around numerous wells. As acknowledged by LANL, these well screens should not be considered to currently provide samples representative of reactive contaminants of concern.

The second question cannot be addressed through direct measurements without acquiring samples of aquifer solids in the affected zone adjacent to the well screens. For wells drilled using bentonite additives, the inability to sample and directly measure the level of residual bentonite in sediments adjacent to screened intervals makes the representativeness of water samples for strongly sorbing contaminants uncertain. These contaminants include isotopes of americium, cerium, plutonium and radium. For wells drilled using organic polymer additives, the alteration of aquifer sediments is of particular concern for well screens impacted by biodegradation, since these reactions are known to result in alterations of iron- and manganese-bearing minerals. This is a critical issue, since these minerals often exert a dominant influence on the movement of inorganic contaminants in the subsurface. Changes to the aquifer minerals can result in the removal of many of the more reactive inorganic contaminants of importance to LANL and make water samples from the impacted well screens non-representative of aquifer conditions. The extent and time period of this impact will depend on the types of new minerals that are formed and the persistence of these new minerals after the complete break-down of the organic polymer.

Since determining how much the geochemistry of an aquifer has changed due to drilling, well installation, and sampling activities depends on a *best estimation* based on a range of direct measurements and inferences, the answer to this question is complex and uncertain. The question concerning whether changes in water chemistry have occurred may be answered directly by analyzing water samples and comparing the results with those obtained from suitable background samples. However, using changes in water chemistry to determine changes in aquifer mineralogy and the resulting changes in sorptive properties of the aquifer materials is not as straight forward.

The problem with using water quality data to determine changes in the sorptive properties of aquifer materials is illustrated by the following analogy. Suppose one wanted to determine the temperature of water in a glass sitting on a table. Two approaches to this problem, each with different levels of confidence, are: 1) use a calibrated instrument (*e.g.*, thermometer) to directly measure the temperature of the water with a level of confidence dependant on the accuracy of the thermometer, and 2) use an indirect method to estimate a temperature range. For example, if the water is not solid (*i.e.*, ice) or bubbling (*i.e.*, boiling), then it could be assumed that the water temperature is between 32°F/0°C and 212°F/100°C. However, it would be difficult to accurately determine the water temperature without using a thermometer. Similarly, trying to determine changes in aquifer properties resulting from reducing conditions using only water chemistry data would result in a wide range of possible values. The use of more direct methods would be necessary to determine the extent of mineralogical changes to aquifer materials following the return of oxidizing conditions near the well screen.

Relative to addressing the question of whether ground-water samples are representative of the undisturbed aquifer chemistry, water quality data alone provide an unreliable indication of whether there is sustained impact to sediment sorption characteristics. The margin of error of determining, through measurements of water chemistry, what sediment minerals exist at any given point in time at a well screen is comparable to the level of uncertainty in estimating the temperature of a glass of water solely through visual observations. This is a limitation of the approach proposed for determining the condition of screened intervals at wells for which alterations have been identified by LANL. In many cases, the reducing environment established by the degradation of organic drilling additives has exposed the aquifer minerals to conditions far different from the conditions that have been established by many years of undisturbed ground-water flow. This is a significant limitation for the purpose of using these wells for assessing potential contaminant transport, in light of independent research that documents the extent that iron- and sulfate-reducing conditions may alter sediment mineralogy.

None of the documents available for review provide definitive evidence of the types of new minerals that have been formed or the degree of alteration of the aquifer materials. Consequently, a detailed evaluation of the changes in the degree to which reactive contaminants would be removed from water passing through the screened zone cannot be reliably performed. Further, the altered minerals will remain for some period of time following the return of oxidizing conditions. The time frame for this continuing impact to the representativeness of ground-water samples may be years to decades, depending on the types and degree of alterations. Documents provided for review by LANL do not explicitly acknowledge this potentially long-term data quality limitation.

Background

In order to respond to the issues raised by the NNMCAB, the nature of the impacts due to the presence of residual drilling additives must be understood. The following background information and assessment is provided to facilitate this understanding. The drilling fluids used at LANL can introduce new reactive minerals into the screened interval that may retard contaminant transport relative to un-impacted zones within the aquifer. Alteration of aquifer sediment reactivity results from one of two processes: 1) introduction of a reactive clay mineral, bentonite, that has significant sorption capacity for many of the site contaminants of concern, and 2) alteration of in-situ aquifer mineralogy during degradation of residual organic additives that results in the production of new reactive mineral phases such as Mn/Fe carbonates, Mn/Fe sulfides, and/or reduced Mn/Fe oxides and hydroxides (Figure 1). Based on a review of information presented in Bitner *et al.* (2004), intrusion of organic drilling fluids may have occurred in one or more screened intervals at all of the well locations whereas the intrusion of bentonite-based drilling fluids is likely to have occurred in fewer wells due to the more limited use that was reported (Table 1).

In an attempt to explain the possible impacts of these two classes of drilling fluids, two diagrammatic conceptual models were introduced in Figures 6 and 7 of Bitner *et al.* (2004) to depict the evolution of aqueous and solid phase chemistry within the impacted zone of a well screen. According to Figure 6 and accompanying discussion, degradation of organic drilling fluids leads to reducing conditions that result in dissolution of Mn and Fe (hydr)oxides (with stated concomitant increases in dissolved Mn and Fe) and the reduction of sulfate, nitrate, and some site-specific contaminants of concern (Bitner *et al.*, 2004). These processes will also result in the production of dissolved carbonate from organic carbon biodegradation and dissolved sulfide from microbial sulfate reduction. It is implied that dissolved Mn and Fe derived from reductive dissolution of the original Mn- and Fe-bearing aquifer 'mineral coatings' will be conservatively transported from the zone of influence adjacent to the impacted well screen. However, a more probable scenario is the re-precipitation of Mn and Fe as new mineral phases in the presence of elevated concentrations of carbonate and sulfide produced during biodegradation of organic polymer drilling additives. The amount of these new mineral phases and the time frame over which they may be produced will depend on 1) the amount of organic polymer drilling additive introduced into the aquifer, 2) the amount of sulfate transported in ground water at a particular well screen, and 3) the concentrations of Mn and Fe within the original aquifer sediments. It is not possible to project amounts or time frames at a given well screen with any certainty without knowledge of the amount of organic polymer additives that may have been introduced into the aquifer. Upon recovery of more oxidizing conditions, these newly-formed reactive mineral phases can subsequently be re-oxidized to their oxide forms with no net loss of Fe and Mn from the formation. This overall scenario is presented schematically in Figure 2 with changes in the relative abundance of specific aqueous and solid phase components documented as a function of the evolution of the aquifer adjacent to an impacted well screen.

The types of mineral transformations alluded to in the previous discussion have been identified in a number of experimental systems. Examples of the reported observations of transformations in Fe-bearing oxide minerals are documented in Table 2. These experimental systems replicate the type of conditions (*i.e.*, iron- and sulfate-reducing) observed in some of the well screens as documented in Bitner *et al.* (2004). A visual depiction of the impact of iron-reducing conditions on changes in the mineralogy of iron oxide coated sands is shown in Figure 3 (Benner *et al.*, 2002). Thus, the current state of technical knowledge supports the contention that stimulation of microbial processes that lead to iron- and sulfate-reducing conditions within an aquifer can significantly alter the characteristics of redox-sensitive minerals. However, the extent of knowledge relative to the persistence of mineral alteration products following the return to oxidizing (pre-drilling) conditions is limited. No studies have been documented in the scientific literature or within written materials provided for this review to properly assess

1) how long the reduced mineral phases will survive, or
2) to what type of mineral phase(s) they will transform back to following the return of more oxidizing conditions.

The body of research that has examined redox processes active in soils and sediments indicates that significant time periods (years to decades) may be necessary for aquifer sediments to return to a condition that resembles the initial condition that existed prior to a significant change in redox chemistry. For well screens impacted by reducing conditions established during degradation of organic polymer drilling additives, any projections relative to the time to recovery or the characteristics of the 'recovered' aquifer sediments would need to be verified by direct observations in order to reduce the uncertainty associated with establishing whether ground-water samples are representative of pre-drilling conditions within the aquifer. In this respect, any information that could be obtained relative to the amounts and types of minerals produced at impacted well screens due to biodegradation of organic polymer additives would be very useful in the screening analysis of the utility of existing well installations for the collection of representative ground-water samples.

For screened intervals at which aquifer sediments may have been collected and retained during the drilling program, implementing microcosm studies similar to those illustrated in Table 2 could be beneficial. These microcosm studies could incorporate representative amounts of organic polymer drilling additives and, thus, provide an indirect assessment of in-situ aquifer sediment conditions that may exist for those well screens impacted by biodegradation of organic polymer additives introduced during drilling. In addition, the sediments obtained from these microcosm studies would provide a representative material that could be used to evaluate the extent that site contaminants of concern may be sorbed (and thus not detected) at well screens impacted by biodegradation reactions. This would provide a useful constraint to evaluating the extent to which this may be a concern for the various ground-water flow paths being sampled by the existing well network.

The mineralogical alterations depicted in Figures 2 and 3 will result in changes to the chemical reactivity of aquifer solids within the impacted zone adjacent to the well screen. A likely outcome resulting from a change in aquifer solids reactivity is that contaminants of concern will interact with altered aquifer solids to various degrees and some will be retarded or removed from solution (Figure 4). Since the contaminants of concern relevant to LANL's ground-water characterization effort represent a wide range of chemical affinity for sorption onto aquifer solids, the potential exists for inaccurate assessment of the concentrations of contaminants under the given conditions at an impacted well screen.

There is currently no definitive identification of the specific new mineral phases that are being formed and the amounts of mineral alteration products within the impacted zones adjacent to affected well screens. This lack of information increases the uncertainty as to whether a non-detect concentration (or a value below "background") of a strongly-sorbing contaminant of concern is indicative of 1) the absence of the contaminant in that portion of the aquifer being sampled or 2) sorption of the contaminant within the impacted zone surrounding wells where residual drilling additives resulted in significant alteration of the geochemical environment.

Issue 1: If LANL decides to convert characterization wells to monitoring wells, can wells drilled with bentonite clay or commercial fluids, such as EZ-MUD, Quik-FOAM, TORKEASE, and LIQUI-TROL, ever be developed and cleaned up adequately to provide analytical data representative of the ground water in the aquifer unit being sampled?

With respect to screens where bentonite-based additives were used, it is possible that even trace amounts of residual bentonite that remain following development may render ground-water samples non-representative for highly sorbing constituents. This situation would be difficult to accurately characterize. Therefore, the quality of samples for constituents such as isotopes of americium, cerium, plutonium, and radium obtained from these screens will likely remain uncertain even after re-development.

With respect to screened intervals where organic additives were used, it is possible that development procedures used in some wells following installation may have been sufficient to remove enough of the additives to prevent significant alteration of the geochemical environment surrounding the well screen. Vigorous redevelopment may be useful in removing additional quantities of the residual organic materials from some impacted screens and shorten the time frame for the return to oxidizing conditions, particularly if large quantities of additives did not infiltrate the screened zone. However, it is unlikely that the new mineral phases formed during biodegradation of the organic materials would be fully removed during re-development using conventional physical techniques. It is possible that some or all of these impacted wells may be capable of providing representative samples following degradation of the residual organic additives, the return of oxidizing conditions, and transformation of the altered minerals. Sampling methodologies that may aid in ultimately obtaining representative samples from such wells and better assessing the representativeness of those samples include: 1) use of methods that include purging of water prior to sampling to minimize retention time in the impacted zone and 2) sample collection, preservation and analysis procedures that minimize changes in chemical speciation of redox-sensitive parameters. It is recommended that current sampling procedures be critically evaluated and the potential benefits of any possible modifications in these areas be considered.

Resolution of Issue 1 first requires identification of the wells that may be sufficiently impacted by drilling fluids as to affect the chemistry in the aquifer surrounding the well screen. In this regard, LANL proposed draft criteria, dated September 6, 2005, for determining impacts (LANL, 2005b), which have been included in this review. The reviewed criteria are attached to this document and labeled as Appendix A. An evaluation and recommendations concerning the

September 6, 2005, version of these criteria are provided below. It is noted that a recent report (LANL, 2005c) may contain updated criteria and will be reviewed under separate cover.

1. The proposed criteria are based on analysis of water chemistry. It should be noted that while analysis of changes in aqueous chemistry at a given well screen presents one potential tool for characterizing well recovery, there is a high degree of uncertainty associated with this avenue of analysis. Specifically, aqueous chemistry data cannot be used to infer the distribution of contaminant mass (between water and solids) within the impacted zone adjacent to a well screen without knowledge of the initial concentration of the contaminant entering the impacted zone (*i.e.*, background constituent concentrations). In addition, comparison of measured concentrations of indicator parameters (or contaminants of concern) to background ground-water concentrations are useful only when the chosen background condition is representative of the un-impacted aquifer adjacent to the well screen being sampled. Reliance on an uncertain background condition to assess apparent well recovery limits the reliability of this approach (see additional discussion under Issue 4).

In this regard, the data used to characterize background conditions (LANL, 2005a) appear to be too sparse, derived from sources representing mixtures of water that are significantly different from the samples obtained from the hydrogeologic characterization wells, and representative of significantly different flow paths within the aquifer. It is recommended either that additional background data be obtained from monitoring wells screened solely within the specific units of interest and installed without the use of additives within the screened interval or that much less dependence be placed on the use of currently available background data in this evaluation.

2. Due to the relatively large variability observed in the background data set (LANL, 2005a), the trigger values proposed by LANL may not be conservative enough to identify some impacted wells due to uncertainty associated with appropriate background values. For example, LANL criteria 2.1-2a and 2.1-2b (Appendix A) use the minimum background concentrations for strontium and uranium as triggers to flag data as possibly non-representative. Actual background values at the locations of the characterization wells may be significantly different from the proposed values for reasons stated in the discussion under Issue 4 below. In similar fashion, it is not clear that detections of a parameter at concentrations above a maximum background value are a firm indication that bentonite is the source for the elevated constituent, as stated in LANL criterion 2.1-1a.

3. Where applicable, comparison of chemistry data for suspected well screens impacted by bentonite and/or organic polymers to background concentrations should include constituents that represent the full range of reactivity for potential site contaminants of concern. Examples of inorganic constituents that may be anticipated in background ground-water samples that represent a useful range of sorption reactivity (and mechanism) with respect to potential site contaminants of concern include zinc (Zn), strontium (Sr), molybdenum (Mo), cesium (Cs), barium (Ba), europium (Eu), thorium (Th), and uranium (U). The current criteria are structured to make use of comparisons between background values and data obtained from characterization wells for some but not all of these constituents. If present in background water from the monitoring zones of interest, these may be useful indicators in an assessment of the range of

impacts of the drilling additives. It is recommended that the utility of the constituents not currently used in the well assessment criteria be considered.

4. Development of a tiered process to assess the evolution of water chemistry at impacted well screens does provide one of several tools that should be implemented to judge the appropriate disposition of ground-water wells. The decision process should be based on comparison of measured ground-water chemistry to the anticipated chemical conditions derived from the presumed conceptual model of the geochemical evolution of impacted well screens. Based on analysis of the current conceptual model proposed by LANL, it is recommended that the tiered review process be re-evaluated and revised to more appropriately represent the conceptual model depicted in Figures 1 and 2 of this review. It is also recommended that the tiered review process be preceded by a screen-by-screen determination of where organic, bentonite, or both drilling fluids were used and the approximate quantities that were used. Our examination of the data provided by LANL on a borehole-by-borehole basis regarding this issue indicates that all boreholes were drilled using organic drilling fluids, and some boreholes were also drilled using bentonite. If it is determined that all screened intervals were drilled using organic drilling fluids, some re-structuring of the flow of the tiered process may be appropriate.

The following three issues should be considered with respect to the choice of analytes that are used in criteria to assess apparent well recovery:

A. A subset of the analytes chosen for assessing impact of drilling fluid at a given well screen should be a component of the drilling fluid and have concentrations that are much higher than typical for site ground-water background conditions,
B. Analytes chosen to assess geochemical conditions or possible contaminant sequestration should not be susceptible to changes in chemical speciation during sample collection and preservation, and
C. Analytes chosen to assess the possible sequestration of contaminants of concern on aquifer solids surrounding impacted screens should possess a higher affinity for partitioning to the unaltered/altered aquifer solids.

With regard to issue (A), it appears that the currently recommended list of analytes used to assess drilling fluid impact may not be complete. A summary of deionized water extraction data made available for review by LANL is shown in Table 3. Analytes highlighted in yellow for a subset of drilling fluids may serve as appropriate indicators of the continued presence of several of the drilling fluids. It should be noted that no data were available for review for a number of the drilling fluids that were frequently employed during drilling operations (including EZ-MUD, Quik-FOAM, TORKEASE, and LIQUI-TROL). These data should also be obtained and evaluated as part of revisions to the analyte list.

With regard to issue (B), there is concern that sulfate may not be a reliable indicator under reducing conditions. Specifically, it is possible to obtain a false positive for the presence of sulfate due to inappropriate collection and preservation that will result in the oxidation of dissolved sulfide. This problem is magnified by a water collection method using a no-purge technology. Based on our on-site observation of ground-water sampling activities at well R-22 on June 28, 2005, it appeared that there were few controls implemented to limit oxygen intrusion into water samples retrieved from the well screen. First, sampling vessels that are lowered to the well screen are potential sources of oxygen exposure to sampled water, even though the sampling vessels are deployed under vacuum. Quality control data were not available for this review to assess the reliability of this sampling configuration to prevent oxidation of dissolved sulfide [and Fe(II) or Mn(II)] during the timeframe of a typical sampling event. Secondly, oxygen exposure again may occur during transfer of collected water to individual containers prior to submission for laboratory analysis, since sample transfer was not conducted without air exposure. Based on our observations in the field, it did not appear that dissolved sulfide was measured in the field, so there was no analytical mechanism in place to evaluate whether sulfate measured in the laboratory represents the true concentration at the well screen, the concentration following oxidation of dissolved sulfide after sample collection, or some combination thereof. This is of particular concern since sulfate is used as one of the initial criteria (LANL criterion 2.2-2) for screening the impact of residual organic drilling fluids.

It should also be noted that the existence of sulfate-reducing conditions does not preclude the presence of sulfate in water. The concentration of sulfate and dissolved sulfide in ground water within a sulfate-reducing zone will depend on two factors: 1) the kinetics of sulfate reduction relative to the concentration of sulfate (*i.e.*, supply of sulfate may exceed capacity for its reduction leading to continued persistence of sulfate in ground water), and 2) the relative concentrations of dissolved ferrous iron and sulfide produced by sulfate reduction. If ferrous iron is present in molar excess of sulfide (*i.e.*, moles Fe(II) > moles dissolved sulfide), then precipitation of iron sulfides could effectively sequester biologically-produced sulfide and prevent its detection in the dissolved phase (*i.e.*, ground water).

No methods are available to directly measure ferrous iron, sulfate, or dissolved sulfide within the well screen; these parameters require measurement by various analytical techniques following collection of a water sample. Reliable field methods exist for the determination of ferrous iron and dissolved sulfide in ground water. For analytes like ferrous iron or dissolved sulfide that are susceptible to transformations following sample collection (*e.g.*, exposure to air), the most reliable method of sampling usually involves continuous pumping of water from the well screen followed by immediate analysis using these field methods. Continuous pumping (or purging) of the well screen during sample collection helps ensure that the field technician can collect water samples for measurement of these parameters exactly at the time at which the analysis can be made. This also allows the field technician to collect additional fresh samples in the event that some level of dilution is required prior to analysis. Delays in sample processing for field measurements generally result in unreliable water chemistry data. Current uncertainties associated with the no-purge method of water sampling from the impacted well screens and the observed practices used to preserve sample integrity prior to analytical measurements limit the reliability of these parameters for screening the condition of wells impacted by organic drilling fluids.

For issue (C), it is important to identify analytes that are transported less conservatively than the contaminants of concern. Dissolved zinc is proposed for screening the condition of wells impacted by bentonite relative to the possible loss of cesium-137, cobalt-60, europium isotopes, and neodymium-147 onto residual bentonite solids adjacent to the impacted well screen (LANL criterion 2.1-2). One significant limitation to this approach is that zinc has not been universally detected in site ground water. LANL (2005a) reports non-detectable zinc in about 56% of the samples evaluated. Thus, non-detectable zinc at a given well screen could indicate either sorption onto residual bentonite or the lack of this constituent at measurable concentration in the native ground water at the interval sampled by the well screen. In addition, there are some published ion exchange selectivity series that indicate cobalt partitions more strongly than zinc to clay minerals (including bentonite). Thus, detection of zinc would not preclude loss of cobalt-60 on residual bentonite. LANL criterion 2.1-2 should be re-evaluated in an effort to identify a more reliable replacement or supplemental candidate to zinc. Barium presents a potential alternative/additional candidate (99% detect in area ground water), although it is unclear how prevalent this metal may be as a site contaminant of concern.

5. The LANL Tier 2.2 criteria are designed under the assumption that once oxidizing conditions have been re-established the sorption characteristics of the aquifer material immediately adjacent to the well screen have returned to pre-drilling conditions. This is not necessarily the case. As described above, the reducing conditions established by biodegradation of organic drilling fluids are likely to alter the mineralogical composition of the aquifer solids adjacent to impacted well screens. These processes generally increase the mass of reactive minerals resulting in an increase in the sorption capacity of aquifer materials impacted by biodegradation of organic drilling fluids. Thus, contaminant concentration data collected from impacted well screens where oxidizing conditions have returned may still be biased low relative to the actual concentration of contaminants in un-impacted aquifer materials in the same flow path. Without collection and characterization of altered aquifer materials, it is difficult to determine the extent of this problem on a screen-by-screen basis. In this regard, it may be beneficial to attempt removal and analysis of mineral alteration products via physical or even chemical processes that mobilize or dissolve these phases. However, it should be noted that the use of chemical extraction may affect future analyses and may only be appropriate if a well is determined to be too impacted for use in the current monitoring program or is replaced by another well to meet appropriate data quality objectives for that particular monitoring location.

6. There is also concern regarding the use of only the three most recent measurements in these assessments without examination of trends. Although the concentrations of the parameters used as indicators in the LANL criteria may change with time and eventually meet the proposed triggers, this does not imply that the data are now representative of the aquifer for each of the listed parameters for the reasons stated above.

7. It is noted that technetium is not mentioned under these criteria and should be included.

8. Due to uncertainties in the utility of aqueous chemistry assessments for the determination of whether samples are fully representative of aquifer conditions, it is recommended that field studies be designed to validate these or similar criteria. It is possible that push-pull tests using a conservative tracer and surrogates for the contaminants of concern may provide a qualitative evaluation of differences in sorptive capacity, if performed in impacted wells and, possibly, adjacent wells of similar design that were installed without additives in the screened zone or if performed in well screens with different degrees of impact. Although detailed quantitative interpretations of such tests would likely be uncertain in this setting and the test would require injection of surrogates for contaminants of concern, the data may still provide one of the few

available insights into the current well conditions. It is unlikely that this type of invasive test would provide sufficient information to fully understand or characterize the impacts to the representativeness of samples and may negatively impact future analyses of some samples from the tested well screen. However, limited use of this type of test may serve as one line of evidence within a more comprehensive investigation. Push-pull tests designed to characterize various aquifer parameters, including sorption, are discussed in more detail in a variety of references, including Istok *et al.* (1999).

Another line of evidence may be direct comparisons between water samples obtained from impacted screens and new wells installed without additives at locations determined to be critical to the monitoring program. The results may then be used to help evaluate the need for additional studies or well installations at other locations. One possible location for additional study is near well R-22 which demonstrates impacts from polymer-based additives. Comparisons of aqueous chemistry between R-22 and a new well cluster combined with the results of studies such as analyses of altered minerals from microcosms, analysis of aquifer materials extracted from well screens that are too impacted to meet DQOs, and push-pull tracer tests may provide much insight into the magnitude and long-term impacts of the problems associated with residual additives at other locations.

9. The proposed criteria did not specify specific actions to be taken, other than flagging of data, if evaluations indicated impacts due to drilling additives. It is recommended that the criteria be expanded to specify precisely what flagging the data means with respect to data limitations, usability, and corrective actions such as well re-development or replacement, given the DQOs for each monitoring location.

Issue 2: Will the use of commercial drilling fluids and bentonite clay preclude any contaminants from being accurately sampled even after well cleanup? If so, which ones?

Site-specific contaminants of concern include isotopes of americium, cesium, iodine, plutonium, strontium, technetium, and uranium, as well as chlorinated solvents, perchlorate, and others. Whether samples obtained from the hydrogeologic characterization wells following re-development are representative of aquifer conditions will depend on the degree to which residual drilling fluids and altered aquifer materials have been removed or returned to their unaltered states. This question can only be answered following demonstration that the geochemical properties of the aquifer materials surrounding the well screen have not been altered with respect to sorption characteristics for the contaminants for which sorption or geochemical environment is a significant concern. Studies such as those discussed above will be necessary to validate predictions made based on aqueous chemistry.

Other issues affecting whether samples from the hydrogeologic characterization wells are representative of aquifer conditions include the design and construction of these wells. Many of the wells, particularly those constructed at the top of the regional aquifer, use screens as long as approximately 60 ft. This type of construction can result in significant dilution of any contaminants that may be present unless the contaminant is pervasive throughout the entire screened interval, regardless of the location of the contaminated zone within the screened interval. In some instances, interval sampling using a pump/packer or other discrete interval sampling system may provide information concerning differences in water chemistry within the screen and the possible effects of dilution. Although the use of long screens may extend the useful life of the well in a setting where the regional water table is declining and may offer an opportunity to sample a larger portion of the aquifer than possible with a more conventional monitoring well design, it may render early detection of contaminants more uncertain. It is recommended that the DQOs for this type of well be reviewed to determine whether the long-screened construction and associated possibility of significant dilution are acceptable before incorporation into a detection monitoring program.

In addition, the use of a long screen increases the risk of cross connection of different hydrostratigraphic units. Cross connection of different units may result in significant vertical flow within the well and the transport of contaminants, if present, to other parts of the aquifer system. The existence of a vertical flow field within the well may be characterized using a sensitive electromagnetic or heat-pulse borehole flowmeter as described in Young *et al.* (2000). Additional information and advice regarding design and use of borehole flowmeter surveys to characterize both the vertical flow within a well and the zones from which water enters a long-screened well during purging and sampling can be provided, if desired.

Of even greater importance is the choice of screened intervals within the target hydrostratigraphic section. As the focus of the issues raised by the NNMCAB concerned the effects of drilling additives, a detailed evaluation of the individual well constructions and screened intervals was not performed. However, it is recommended that such an analysis be performed before wells are determined to meet criteria normally applied in a detection monitoring program. In summary, factors other than the effects of drilling additives may have a greater impact on whether ground-water samples are suitable for the purpose of early detection of contaminant releases or migration and should be considered during specification of a detection monitoring network.

Issue 3: In public reports, LANL indicates that contamination from LANL operations has not reached certain ground-water regions. LANL bases these statements on analytical results which show that certain fast-moving contaminants, such as tritium, that are not affected by drilling fluids or clays have not been detected in concentrations above background in samples from the wells. Are tritium and other mobile constituents suitable indicators of possible impacts for the entire suite of site-specific constituents at LANL?

The contaminants of concern vary in their mobility in the environment due to differences in their physical/chemical properties. In principle, accurate knowledge of the concentrations of the most mobile contaminants, particularly tritium, can be used as an indicator of the maximum extent of the less mobile contaminants of concern, such as the isotopes of plutonium. However, this type of evaluation assumes that all of the contaminants of concern in a given area were disposed at approximately the same time and location and that the concentration and mass of the mobile contaminant were sufficiently high to allow detection at a given distance from the disposal point. Documents provided for this review did not include information concerning the analyses of historical waste streams or sufficient details concerning site hydrogeology to estimate potential migration pathways and the effects of dispersion. Therefore, this potential use of tritium data at LANL could not be evaluated in detail. Based on experience at other sites, it is quite possible that the available information may only allow a screening-level evaluation to be performed.

Tritium activity is also used as an indicator of the ground-water age or elapsed time since the water entered the subsurface. This evaluation should be useful at LANL in assessing the potential for contaminants of concern to be present based on whether the water entered the subsurface before or after disposal activities began. However, care must be exercised in the interpretation of these data due to the effects of dilution within long-screened wells, uncertainty with respect to the effects of biological processes in impacted well screens sampled using a no-purge technique, and related factors.

It is further noted that Bitner *et al.* (2004) also consider nitrate and perchlorate to be conservative environmental tracers that travel at the speed of the ground water. However, these constituents may be subject to removal under certain conditions, such as in a reducing environment surrounding well screens impacted by polymer-based additives. Therefore, well-specific evaluations using these compounds may be useful at LANL but should be performed with care.

Issue 4: (a) Can LANL derive an independent estimate of background concentrations of potential contaminants from accumulated ground-water data without using analytical results from the wells associated with the Hydrogeologic Work Plan? (b) Would such data constitute reliable criteria for judging when wells are suitable as monitoring wells?

An evaluation of "background" ground-water chemistry is provided in LANL (2005a). In this study, sources for background data determined to reflect conditions in the regional aquifer were limited to a few springs and long-screened water production wells located at significant distances from many of the characterization wells. These types of sources generally produce water that is a mixture of contributions from different lithologic units and different areas. This type of study may provide useful information concerning "background" constituent concentrations for the purpose of siting a water supply well. However, it does not appear to be appropriate for detailed comparisons with water samples obtained from monitoring wells that provide samples from discrete zones and likely represent much smaller volumes of the aquifer and different flow paths within the aquifer. Although the information in LANL (2005a) provides insight into the possible range of "background" conditions, data from monitoring wells located upgradient of waste management units/disposal areas would be needed to allow more reliable comparisons with wells located downgradient of these units. Therefore, the current "background" data should not be used as the sole indicator of whether samples are representative of aquifer conditions.

Summary

Most of the hydrogeologic characterization wells at LANL appear to have been installed using drilling additives that have the potential to impact the quality of data obtained from the affected well screens. Some of these impacts have been documented in various LANL publications. A systematic study to identify impacted screens based on aqueous chemistry has recently been performed (LANL, 2005c) and will be reviewed under separate cover. In general, it is likely that many of these screens may not produce representative samples for constituents that strongly sorb to clays or whose fate in the environment is sensitive to changes in redox conditions for some period of time. In particular, the constituents of concern that may be most affected by the residual drilling additives are certain radionuclides (*e.g.*, isotopes of americium, cerium, plutonium, radium, strontium, uranium), many stable metal cations, and organic compounds that may be degraded in the impacted environment near the well screen.

Predictions of the time frames for the impacted intervals to return to natural conditions are uncertain. It is also likely that the inability to fully remove the additives which were used during drilling has reduced the hydraulic conductivity of many of the impacted screened zones. Due to the difficulty in assessing the damage that may be caused by the presence of residual drilling additives in the screened zone of a well, it is recommended that the need for continued use of additives within the screened interval of monitoring wells be reassessed. The following recommendations for improvement during the drilling and construction of future monitoring wells may allow installation of wells that provide the most representative samples possible for all of the contaminants of concern at LANL. It is noted that many of these techniques are successfully used at the Idaho National Laboratory (INL) to avoid the use of drilling additives, other than water to control heaving, in the screened zone. Although the drilling conditions at no two sites are identical, similar problems, such as heaving materials, consolidated and unconsolidated formations, and depths in excess of 1000 ft are also encountered at INL and successfully drilled using techniques similar to those described below.

1. Strive to drill boreholes using no bentonite or organic additives within screened intervals. Additives may be used in intervals above the target monitoring zone if telescoping casing constructions are used and the hole is adequately cleaned before drilling the final footage within the interval to be screened. Targeting of monitoring intervals prior to drilling should be possible at locations where data from the existing characterization wells are available.

2. Use screen types and well designs that maximize the open area of the screen and allow for the most uniform and effective well development. Use aggressive development methods that result in water movement into and out of the well screen.

3. Minimize the time between drilling and well development, particularly if additives have been used within the screened zone. As indicated in Table 1, many of the hydrogeologic characterization wells were not developed in a timely fashion following well completion. It should be noted that the time between the drilling of any given interval in a multi-completion well and the development of that interval is often longer than the time lag calculated in this table. This time lag will often exacerbate the difficulties in removing residual drilling fluids.

4. At locations determined to be critical to the detection monitoring program, consider replacement of wells that were drilled using bentonite or that exhibit impacts due to organic additives with wells installed without additives in the screened zones, if needed to meet the DQOs for that monitoring location.

The path for resolution of issues concerning the impacts of drilling additives on the quality of ground-water samples should include identification of all well screens impacted by drilling additives, specification of the corrective actions to be taken, and field studies performed to verify these evaluations. Based on the uncertainty in characterizing the condition of aquifer materials adjacent to the well screens and the potentially long time frames that some impacts may last, installation of replacement wells at critical locations should also be considered.

If you have any questions concerning this review, please do not hesitate to call us (Acree: 580-436-8609; Ford: 580-436-8872; Ross: 580-436-8611) at your convenience. We look forward to future interactions with you concerning this and other sites.

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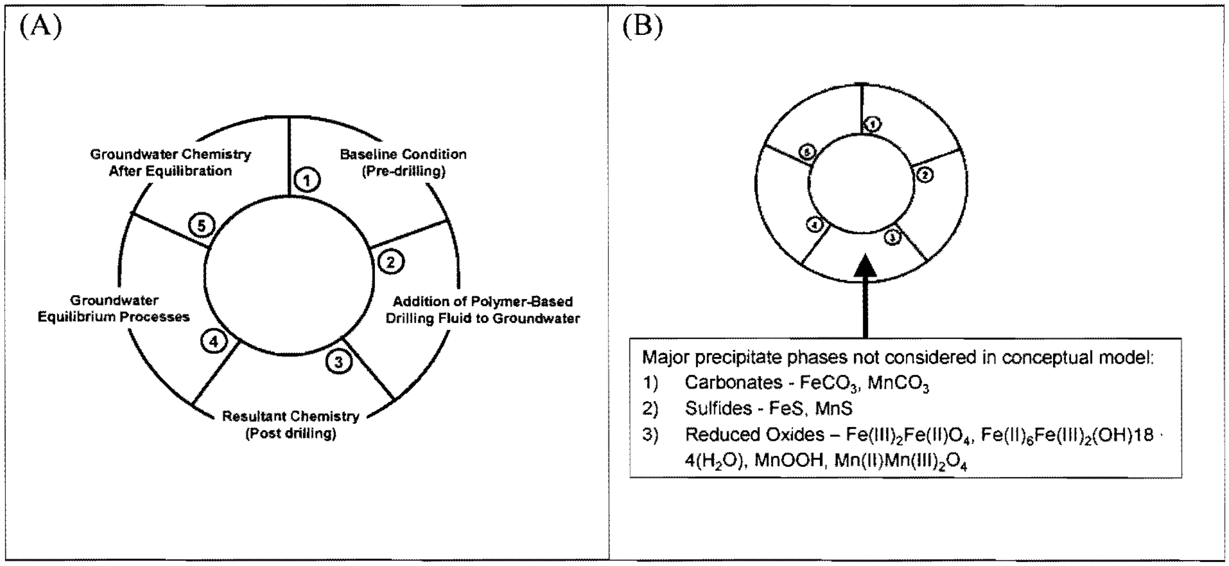

Figure 1. Illustration of certain aspects of solid phase chemistry not considered in the Bitner *et al.* (2004) conceptual model describing the evolution of aqueous and solid phase chemistry at well screens impacted by biodegradation of polymer-based drilling fluids. (A) Simplified depiction of the LANL conceptual model relative to the various stages of geochemical evolution in the impacted zone adjacent to the well screen. (B) Precipitation of major solid phases that can occur during Stage 3 reduction processes.

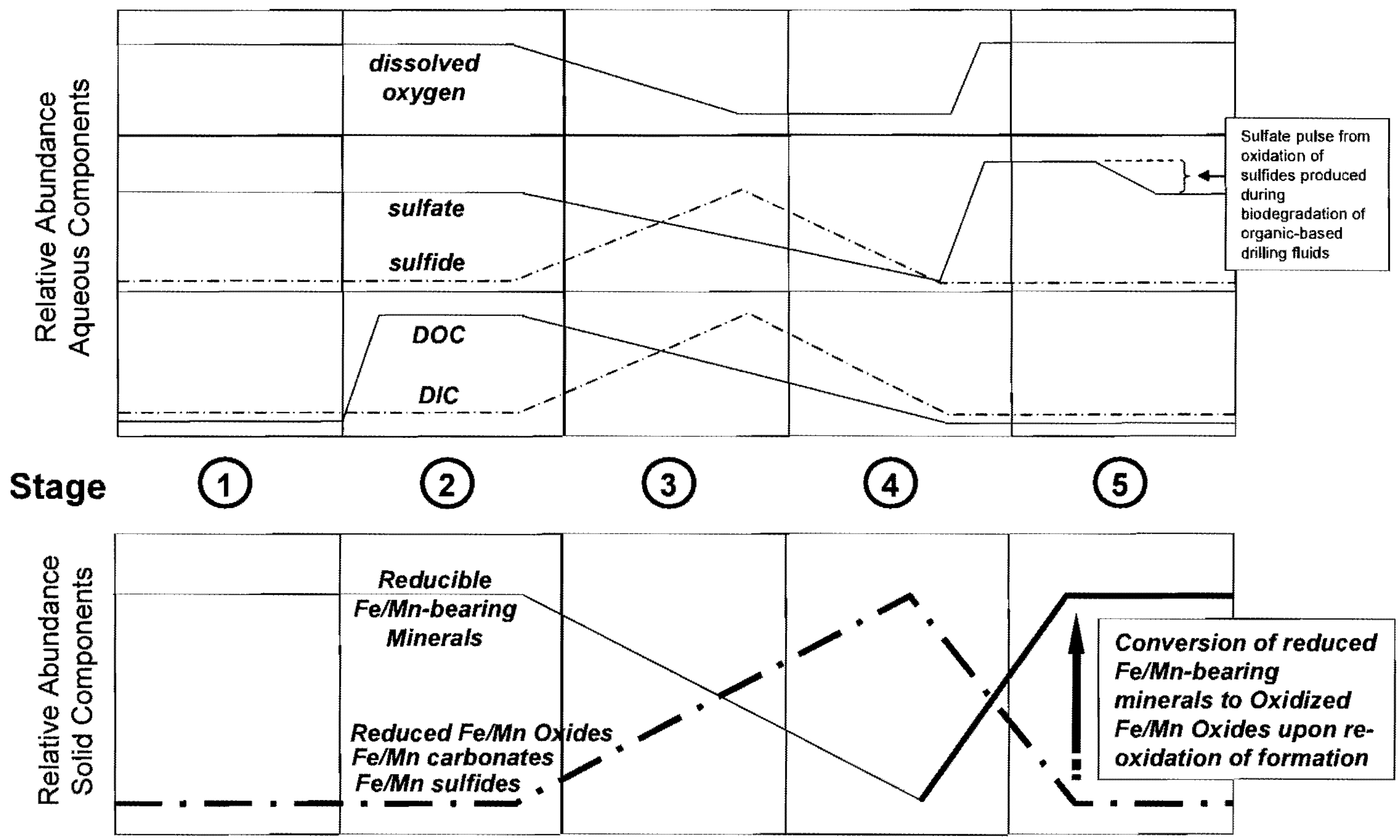

Figure 2. Schematic diagram depicting the evolution of aqueous and solid phase chemical components within the impacted zone of the aquifer adjacent to well screens impacted by the biodegradation of organic-based polymer drilling fluids. Changes in relative abundance of individual chemical components are depicted based on the current state-of-knowledge of mineral alterations that accompany organic biodegradation reactions (*i.e.*, microbially-driven iron-, manganese-, and sulfate-reduction) in subsurface environments.

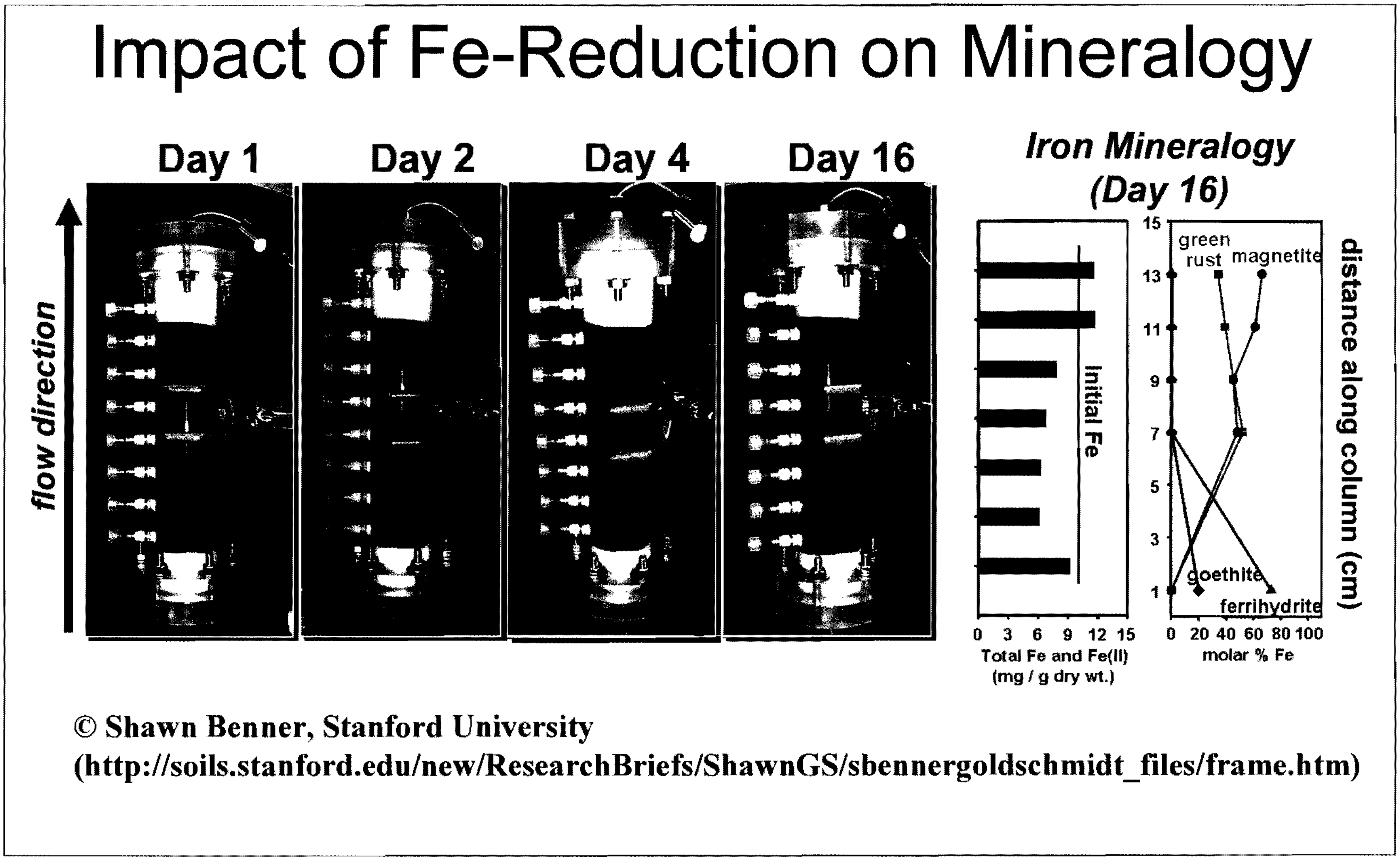

Figure 3. Illustration of transformations in iron oxide mineralogy induced by microbial processes that generate iron-reducing conditions. The starting Fe-bearing mineral was ferrihydrite, which was transformed to a mixture of ferrihydrite, goethite, magnetite, and green rust by day 16. The details of this experimental research are documented within Benner *et al.* (2002).

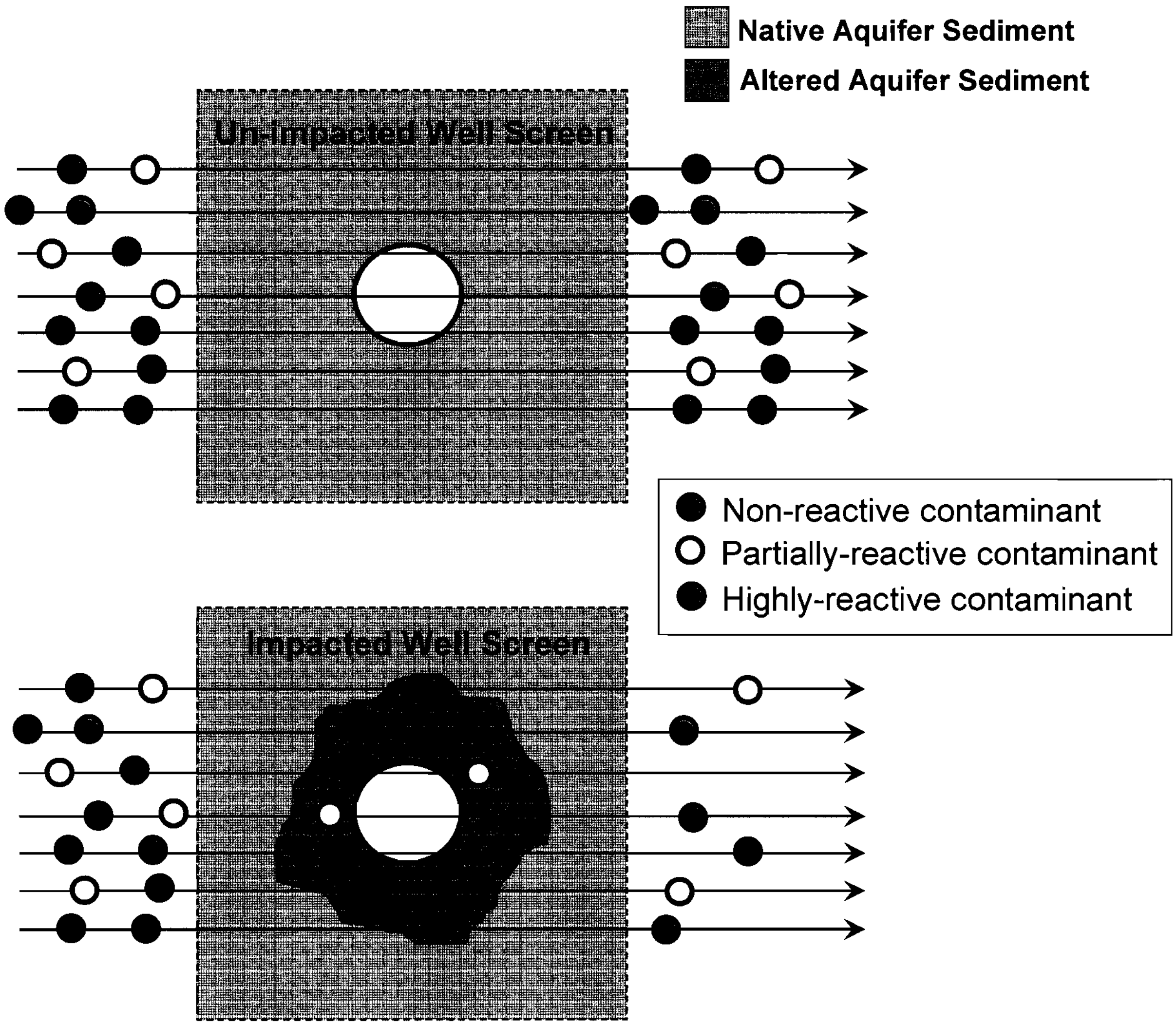

Figure 4. Conceptual schematic illustrating differential transport behavior of contaminants within the impacted zone adjacent to a well screen influenced by biodegradation of organic-based drilling fluids.

Table 1. Listing of drilling additives employed during implementation of the hydrogeologic characterization program at LANL.

Well	Elapsed Time Before Development (Days) **	Drilling Fluid *										Impact Category		
		Polymer-based					Bentonite-based		Other					
		EZ-MUD	QUIK-FOAM	TORKEASE	LIQUI-TROL	PAC-L	Bentonite	QUICK-GEL	N-SEAL	Magma Fiber	Soda Ash	Biodegradation	Bentonite	Both
R-1	11	■	■											
R-2	7	■	■			■	■				■			■
R-4	10	■	■			■	■				■			■
R-5	12	■	■											
R-7	16	■	■											
R-8	11	■	■											
R-9	115	■	■											
R-11	No report	■	■											
R-12	26	■	■	■										
R-13	33	■	■											
R-14	17	■			■		■							■
R-15	Chrono uncertain	■	■	■										
R-16	16	■	■		■			■	■	■	■			■
R-19	Chrono uncertain	■	■											
CdV-R-15-3	~92	■	■											
CdV-R-37-2	~25	■	■											
R-20	9		■		■	■		■	■					■
R-21	8	■	■											
R-22	~40	■	■											
R-23	20		■		■	■	■	■	■	■	■			■
R-25	64	■	■	■										
R-26	12	■	■											
R-28	30	■	■											
R-31	~31	■	■											
R-32	11	■	■		■	■		■	■	■				■
MCOBT-4.4	~23	■	■											
MCOBT-8.5	No well	■	■											
R-9i	Chrono uncertain	■												
CdV-16-1(i)	No report	■	■											
CdV-16-2(i)	No report	■	■											
CdV-16-3(i)	No report	■	■											

* Based on information presented in Table 1 of Bitner *et al.* (2004).

** Determined as the time from completion of the entire borehole to initiation of development activities.

Table 2. Documented examples where microbial degradation of organic compounds resulted in alteration of iron mineralogy under iron- and sulfate-reducing conditions.

Starting Mineralogy	**Reducing Conditions**	**Resultant Mineralogy**	**Reference**
ferrihydrite	Iron-reducing	lepidocrocite, goethite, magnetite	Hansel *et al.*, 2005
ferrihydrite	Iron-reducing	magnetite, green rust, vivianite	Kukkudapu *et al.*, 2004
ferrihydrite	Iron-reducing	goethite, hematite, lepidocrocite, siderite, vivianite, magnetite, green rust	Zachara *et al.*, 2002
goethite, hematite	Iron-reducing	Fe(II) sorbed to goethite/hematite	Hansel *et al.*, 2004
poorly crystalline Fe(III) oxide	Iron- & sulfate-reducing	iron sulfide	Wersin *et al.*, 1991
ferrihydrite, lepidocrocite, goethite, magnetite, hematite	Abiotic reaction with dissolved sulfide	Fe(II) sorbed to iron oxide surface, FeS	Poulton *et al.*, 2004

Table 3. Listing of water-leachable chemical constituents present in drilling fluids employed during implementation of the hydrogeologic characterization program at LANL.

Analyte *	Concentration Unit	Bentonite	EZ-MUD	Quik-FOAM	TORKEASE	LIQUI-TROL	PAC-L	Soda Ash	Quick-gel	magma-fiber	n-seal	Regional Aquifer**	Intermediate Perched Zones**
Ag	ppm	<0.009					<0.2		<0.01		<0.01		
Al	ppm	0.229					3.860		1.006		5.971		
Alk(Lab)	ppm CaCO3	---					85557.377	1052213.087	17595.519		75253.552	150.000	65.000
As	ppm	1.374					<0.2		0.091		<0.01	<0.007	<0.007
B	ppm	1.008					<2		0.302		0.379		
Ba	ppm	0.018					1.103		0.101		0.209		
Be	ppm	<0.009					<0.2		<0.01		<0.01		
Br	ppm	0.275					<4		6.336		<0.2		
C DIC	ppm	---					295.915		156.886		25.779		
C DOC	ppm	---					196663.745		94.232		30.423	<12	<12
C TIC	ppm	---					---		---		---		
C TOC	ppm	---					---		---		---		
Ca	ppm	9.984					115.793		137.778		593.288	38.000	16.000
Cd	ppm	<0.009					<0.2		<0.01		<0.01		
Cl	ppm	116.332					20769.162		65.067		3.981	9.100	71.000
ClO3	ppm	<0.09					<4		<0.2		<0.2		
ClO4	ppm	1.191					---		---		---		
Co	ppm	<0.009					<0.2		<0.01		<0.01		
CO3	ppm	---					0.000	602459.000	886.000		910.000		
Cond.(F)	µS/cm	---					---		---		---		
Cond.(L)	µS/cm	---					---		---		---		
Cr	ppm	0.082					2.941		0.070		0.009		
Cs	ppm	<0.009					<0.2		0.020		<0.01		
Cu	ppm	0.062					3.492		0.131		0.171		
F	ppm	7.236					1630.287		10.560		16.017		
Fe	ppm	<0.09					5.514		0.503		<0.1		
Hardness	CaCO3 ppm	---					---		---		---		
HCO3	ppm	---					104380.000	58700.000	19665.000		89959.000		
Hg	ppm	0.002					<0.02		<0.001		<0.001		
I	ppm	---					---		---		---		
K	ppm	6.046					33.084		15.387		80.084	5.100	7.500
Li	ppm	0.247					<0.2		0.704		0.265		
Mg	ppm	1.282					16.542		13.778		0.853		
Mn	ppm	0.016					0.368		0.080		<0.01		
Mo	ppm	2.473					<0.2		0.825		<0.01		
Na	ppm	1346.520					93553.127		5390.440		64.162	31.000	36.000
NH4	ppm	---					---		---		---		
Ni	ppm	0.016					0.368		0.040		0.019		
NO2	ppm	0.183					<4		<0.2		<0.2		
NO3	ppm	196.940					<4		237.340		<0.2	0.910	0.500
OH	ppm	---					---		---		---		
Oxalate	ppm	4.855					<4		<0.2		<0.2		
Pb	ppm	<0.0009					0.368		<0.01		<0.01		
pH	Lab	---					7.970	11.380	9.090		9.470		
PO4	ppm	6.504					10586.759		<0.5		<0.5		
Rb	ppm	0.011					<0.2		0.040		0.171		
Sb	ppm	0.056					<0.2		<0.01		0.020		
Se	ppm	0.092					<0.2		0.191		0.066		
Si	ppm	204.268					110.279		159.903		211.347		
SiO2	ppm calc	437.134					235.996		342.192		452.283		
SO4	ppm	1007.600					<4		9483.553		95.722	17.200	11.300
S2O3	ppm	---					---		---		---		
Sn	ppm	<0.009					<0.2		<0.01		<0.01		
Sr	ppm	0.030					0.551		2.011		1.137		
Th	ppm	<0.009					<0.2		<0.01		0.023		
Ti	ppm	<0.009					<0.4		<0.02		<0.02		
Tl	ppm	<0.009					<0.2		<0.01		0.023		
U	ppm	0.070					<0.2		0.040		0.023		
V	ppm	0.128					<0.4		<0.02		0.152		
Zn	ppm	<0.009					<0.4		<0.02		<0.02		
TDS	ppm	---					231339.313		36259.586		92184.026		
Acetate	ppm	++					+		-		-		
Formate	ppm	++					+		-		-		

[ ] No data reported for these analytes.
[ ] Indicates analyte with elevated concentration that may serve as a useful indicator for water quality in impacted well screens.

* Data were copied from Excel file (Drilling_Additives.xls) provided by Patrick Longmire/LANL to Richard Mayer/R6 via e-mail on April 19, 2005.

** Maximum background concentration; data were derived from Table 4.3-1 (LANL, 2005b) and/or LANL (2005a), Appendix C.

Appendix A

Screening Tables Template
(LANL, 2005b)

The following tables were provided by LANL via electronic mail and dated September 6, 2005.

Table 4.3-1

Background Values for Key Indicator Species Used in this Assessment

Analyte	Units	Regional Aquifer			Intermediate Perched Zones			Tier criteria
		Minimum	Maximum	Mean	Minimum	Maximum	Mean	
Field parameters								
Field alkalinity (as HCO_3)	mg/L	65	150	103	34	65	54	2.2-3, 2.2-5
Field pH	SU	6.5	8.3	7.6	6.7	8.0	7.4	2.2-3, 2.2-5
Turbidity (nonfiltered)	NTU	0	5.4	2.0	0	27	7.3	2.1-1, 2.1-6
General Inorganics								
Calcium	mg/L	9.1	38	16	5.8	16	9.4	*not used*
Chloride	mg/L	1.7	9.1	3.2	0.53	71	6.9	*not used*
Magnesium	mg/L	0.23	8.4	2.7	1.2	6.1	2.8	*not used*
Nitrate and Nitrite (NO_3+NO_2-N)	mg/L	0.025	0.91	0.32	0.001	0.5	0.3	2.2-4, 2.2-5
Potassium	mg/L	1.4	5.1	2.4	1.5	7.5	3.5	*not used*
Sodium	mg/L	9.4	31	18	4.4	36	9.2	2.1-1, 2.1-6
Sulfate	mg/L	1.8	17.2	4.7	0.95	11.3	4.4	2.1-1, 2.1-6 2.2-2, 2.2-5
Metals								
Barium	µg/L	1.9	110	36	5	110	29	*not used*
Boron	µg/L	4.6	51	23	1	13	7.4	2.1-1, 2.1-6
Iron	µg/L	3.65	131	27	3.65	1560	170	2.2-3, 2.2-5
Manganese	µg/L	0.025	57	4.7	0.05	9	2.4	2.2-3, 2.2-5
Strontium	µg/L	42	510	192	42	164	76	2.1-2, 2.1-6
Uranium	µg/L	0.195	2.8	0.88	0.11	0.84	0.31	2.1-1, 2.1-2, 2.1-6
Zinc	µg/L	0.26	80	13	0.26	33	5.3	2.1-2

SU=standard units, pH=-log[H+]

Table 4.4-1

Tier 1 Questions and Criteria for Effects of Residual Drilling Materials

Tier 1 Issue: Does the screen interval produce groundwater samples that are free of any residual effects from drilling fluids or muds, and that are reliable and representative of the groundwater*?

Note: The assessment criteria in this table are applicable to the three most recent characterization and/or surveillance samples for the screen. If less than three samples are available for this purpose, then the outcome is considered "Preliminary."

Tier	Screening Question	Assessment Criteria	Consequence of "NO" response
1-1	Is residual bentonite mud known to be absent from the screen interval?	• If the well was not drilled using bentonite mud, answer YES. • If the well was drilled using bentonite mud, answer NO.	If NO, then tier 2.1 questions are applicable to identify the extent to which analytes or PCOCs may be affected by residual bentonite.
1-2	Is residual organic drilling fluid known to be absent from the screen interval?	• If the well was not drilled using organic drilling fluids, answer YES. • If the well was drilled using organic drilling fluids, answer NO.	If NO, then tier 2.2 questions are applicable to identify the extent to which analytes or PCOCs may be affected by residual organic drilling fluids or reducing conditions.

If the answer is YES for both questions, then it is concluded that the screen interval produces groundwater samples that are representative of predrilling conditions for all analytes and PCOCs. **It is not necessary to proceed to either of the Tier 2 sets of questions.**

* In this report, "groundwater" refers only to water from perched intermediate zones or the regional aquifer. The methodology used in this report is not applicable to water from alluvial zones.

Table 4.5-1

Tier 2.1 Questions and Criteria for Residual Bentonite

Tier 2.1 Issue: Has residual bentonite been sufficiently removed such that it does not interfere with transport of contaminants into the screen interval[a]?

Note: The assessment criteria in this table are applicable to the three most recent characterization and/or surveillance samples for the screen. If less than three samples are available for this purpose, then the outcome is considered "Preliminary."

Tier	Screening Question	Assessment Criteria[b]	Consequence of "NO" response
2.1-1	Evaluation of bentonite as a potential source term: Have all indicators of bentonite mud been removed from the screen interval?	2.1-1a Are concentrations of the following species all within the upper range of background concentrations in groundwater? For well screens in the regional aquifer: – Is B < 0.051 mg/L? – Is SO_4 < 17 mg/L? – Is Na < 31 mg/L? – Is U < 0.0028 mg/L? For well screens in intermediate perched zones: – Is B < 0.013 mg/L? – Is SO_4 < 11 mg/L? – Is Na < 36 mg/L? – Is U < 0.0008 mg/L?	If NO for any analyte, then flag any detections of the following analytes as possibly elevated above predrilling concentrations due to desorption from residual bentonite: General inorganic analytical suite: Alkalinity, K, Mg, Na, Br, Cl, F, NO_3, Total P, SO_4 Metals analytical suite: As, Ba, B, Cr, Cu, Hg, Mn, Mo, Ni, Sb, Se, U, V Radionuclide analytical suite: U-234, U-235, U-238
2.1-2	Evaluation of bentonite as a potential sink: Are water-quality data reliable and representative for general inorganics, metals, and radionuclides that would adsorb onto residual bentonite if present?	2.1-2a. Is the concentration of dissolved Sr > 0.042 mg/L (the minimum background concentration for groundwater)?	If NO, then flag the following analytes as possibly less than predrilling concentrations due to adsorption onto residual bentonite: Ca, Mo, Sr, V Sr-90
		2.1.2b. Is the concentration of dissolved U above the minimum background concentration for groundwater? For screens in the regional aquifer: – Is U > 0.0002 mg/L? For screens in intermediate perched zones: – Is U > 0.0001 mg/L?	If NO, then flag the following analytes as possibly less than predrilling concentrations due to adsorption onto residual bentonite: U, U-234, 235, 236, 238

Tier 2.1 Issue: Has residual bentonite been sufficiently removed such that it does not interfere with transport of contaminants into the screen interval[a]?

Note: The assessment criteria in this table are applicable to the three most recent characterization and/or surveillance samples for the screen. If less than three samples are available for this purpose, then the outcome is considered "Preliminary."

Tier	Screening Question	Assessment Criteria[b]	Consequence of "NO" response
		2.1.2c. Is the concentration of dissolved Zn above the instrument detection limit? Note: Zn is considered here to be an appropriate indicator species for the adsorption behavior of metal cations and Cs-137, Co-60, Eu isotopes, and Nd-147.	If NO, then flag any <u>nondetects</u> of the following analytes as possibly less than predrilling concentrations due to adsorption onto residual bentonite: Metals: Ag, Be, Cd, Cr, Cs, Co, Cu, Fe, Pb, Hg, Mn, Mo, Ni, Sb, Tl, Zn Radionuclides: Cs-137, Co-60, Eu-152, Eu-154, Eu-155, La-140, Nd-147
		2.1.2d. Some radionuclides adsorb so strongly to clays, including bentonite, that they are rarely detected in groundwater. As a result, we are not aware of any suitable indicator species that are routinely measured and that can be used to evaluate whether or not the nondetects are representative of groundwater concentrations.	Flag any <u>nondetects</u> of the following analytes as possibly less than predrilling concentrations due to adsorption onto residual bentonite: Am-241, Ce-139, Ce-141, Ce-144, Pu-238,239,240, Ra-226, Ra-228
2.1-3	Are water-quality data reliable and representative for HE and HE degradation products?	NO for HE and HE degradation products with an adsorption coefficient (Kd) greater than 1 mL/g. YES for all other relevant HE and HE degradation products because these do not adsorb or partition onto bentonite.	Flag the following HE and HE degradation products: *{to be determined following literature review}*
2.1-4	Are water-quality data reliable and representative for Herbicides, Pesticides, PCBs, Dioxins, and Furans?	NO for herbicides, pesticides, PCBs, and dioxins. These species are assumed to partition or adsorb strongly onto bentonite, with Kd values much greater than 1 mL/g. YES for furans. These species adsorb poorly onto bentonite, with Kd values less than 1 mL/g.	Flag all herbicides, pesticides, PCBs, and dioxins.
2.1-5	Are water-quality data reliable and representative for SVOAs/VOAs (LANL Specific)?	NO for SVOAs/VOAs that have an adsorption coefficient (Kd) greater than 1 mL/g. YES for all other SVOAs/VOAs because these adsorb poorly onto bentonite, with Kd values less than 1 mL/g.	Flag the following SVOAs/VOAs: – Xylene[1,3-] [meta] – Trichlorobenzene[1,2,4-] – Trichlorobenzene[1,2,3-] – Dioxins, PCBs, and pesticides – Polynuclear aromatic hydrocarbons (PAHs)
2.1-6	Are water-quality data reliable and representative for Diesel Range Organics (DROs)?	NO for DRO species. These long-chain aliphatic hydrocarbons are assumed to adsorb or partition strongly onto bentonite, with Kd values greater than 1 mL/g.	Flag all DRO analytes.

[a] In this report, "groundwater" refers only to water from perched intermediate zones or the regional aquifer. The methodology used in this report is not applicable to water from alluvial perched zones.

[b] Responses should be based on analytical results obtained for filtered samples.

Table 4.5-2

Tier 2.2 Questions and Criteria for Residual Organic Drilling Fluids

<table>
<tr><td colspan="4">Tier 2.2 Issue: Have the effects of residual organic drilling fluids been sufficiently removed such that groundwater samples are reliable and representative of the groundwater[a]?

Note: The assessment criteria in this table are applicable to the three most recent characterization and/or surveillance samples for the screen. If less than three samples are available for this purpose, then the outcome is considered "Preliminary."</td></tr>
<tr><th>Tier</th><th>Screening Question</th><th>Assessment Criteria[b]</th><th>Consequence of "NO" response</th></tr>
<tr><td>2.2-1</td><td>Have residual organic drilling fluids been removed from the screen interval?</td><td>Are all of the following conditions met the last 3 times that these analytes were measured?

– Are DOC/TOC < 2 mg/L?
– Is TKN < 0.4 mg/L?
– Is Ammonium (as N) < 0.07 mg/L?
– Are concentrations of acetone and/or isopropyl alcohol below the detection limit?</td><td>If NO, flag any detected concentrations of the following analytes as possibly greater than predrilling concentrations due to the presence of residual organic fluids:

– DOC, TOC, TKN, Ammonia (as N) , acetone, isopropyl alcohol

Note: This flag is not applicable to any non-detects for these analytes.</td></tr>
<tr><td>2.2-2</td><td>Is sulfur present in its oxidized (SO_4) form?</td><td>Is SO_4 detected?</td><td>If NO, then flag the following analytes as possibly less than predrilling concentrations due to chemical transformation, desorption from Fe/Mn (oxy)hydroxides, or mineral precipitation under sulfate-reducing conditions.

General inorganic analytical suite:
Alkalinity, Ca, NO_3+NO_2-N, SO_4, ClO_4

Metals analytical suite:
Ag, As, Ba, B, Be, Cd, Co, Cr, Cu, Fe, Hg, Mn, Mo, Ni, Pb, Sb, Se, Tl, U, V, Zn

Radionuclide analytical suite:
Am-241, Ce-139, Ce-141, Ce-144, Cs-137, Co-60, Eu-152, Eu-154, Eu-155, La-140, Nd-147, Pu-238,239,240, Ra-226, Ra-228, Sr-90, U-234,235,236,238

All HE and HE degradation products
All herbicides, pesticides, PCBs, dioxins, and furans
All Diesel Range Organics
All SVOAs and VOAs</td></tr>
<tr><td colspan="4">If YES for question 2.2-2, then continue to the next question. If NO, there is no need to proceed further.</td></tr>
</table>

Tier 2.2 Issue: Have the effects of residual organic drilling fluids been sufficiently removed such that groundwater samples are reliable and representative of the groundwater[a]?

Note: The assessment criteria in this table are applicable to the three most recent characterization and/or surveillance samples for the screen. If less than three samples are available for this purpose, then the outcome is considered "Preliminary."

Tier	Screening Question	Assessment Criteria[b]	Consequence of "NO" response
2.2-3	Have redox conditions been restored to oxidizing conditions with respect to SO_4, Fe and Mn?	**If YES for 2.2-2 (above),** then are all of the following conditions also met? – Is field pH between 6.5 and 8.3? – Is dissolved Fe < 130 µg/L? – Is dissolved Mn < 60 µg/L? – Is field alkalinity (as HCO_3) < 150 mg/L (for well screens in the regional aquifer) or < 65 mg/L (for well screens in intermediate perched zones)?	If NO, then flag the following analytes as possibly not reliable or representative of predrilling concentrations due to chemical transformation, desorption from Fe/Mn (oxy)hydroxides, or mineral precipitation under reducing conditions. General inorganic analytical suite: Alkalinity, Ca, NO_3+NO_2-N Metals analytical suite: Ag, As, Ba, B, Be, Cd, Co, Cr, Cu, Fe, Hg, Mn, Mo, Ni, Pb, Sb, Se, Tl, U, V, Zn Radionuclide analytical suite: Am-241, Ce-139, Ce-141, Ce-144, Cs-137, Co-60, Eu-152, Eu-154, Eu-155, La-140, Nd-147, Pu-238,239,240, Ra-226, Ra-228, Sr-90, U-234,235,236,238 All SVOAs and VOAs
If YES for question 2.2-3, then continue to the next question. If NO, there is no need to proceed further.			
2.2.4	Have redox conditions been restored to oxidizing conditions with respect to NO_3 and dissolved oxygen (DO)?	**If YES for 2.2-2 and 2.2-3 above**, then are both of the following conditions also met? – Is NO_3+NO_2-N detected? – Is field DO > 0.1 mg/L?	If NO, then flag the following analytes as possibly not reliable or representative of predrilling concentrations: General inorganic analytical suite: Alkalinity, Ca, NO_3+NO_2-N All SVOAs and VOAs
If YES for all of the above criteria, then it is concluded that residual organic drilling fluids have been sufficiently removed, and that redox conditions have been restored, such that there are no residual impacts of these products on analytes in this screen interval.			

Kieling, John, NMENV

From: Rhgilkeson@aol.com
Sent: Tuesday, September 08, 2009 7:56 AM
To: Kieling, John, NMENV
Cc: Rhgilkeson@aol.com; jarends@nuclearactive.org
Subject: Document for the Pumblic Comment Record for the Revised Draft LANL Permit
Attachments: REVIEW of LANL GBIR-3 FINAL.pdf

Dear Mr. Kieling

This e-mail brings to the attention of the New Mexico Environment Department (NMED) the attached report for adding to the Public Comment Record for the Revised Draft LANL Permit and to the NMED LANL Administrative Record.

I was not able to send the attached document on Friday, May 4, 2009. On Friday, the e-mail service at the motel was interrupted so I went to the SRIC Office to send my comment. Unfortunately, I did not have access to the attached document on the computer I took to the SRiC office.

Please provide an answer to this request to confirm that the NMED has added the attached document to the Public Comment Record for the Revised Draft LANL Permit and to the LANL Administrative Record.

Sincerely

Robert H. Gilkeson, Registered Geologist
P.O.Box 670
Los Alamos, NM 87544
505-412-1930
rhgilkeson@aol.com

cc. Joni Arends, Concerned Citizens for Nuclear Safety

Comment on the Failure of the Los Alamos National Laboratory *Groundwater Background Investigation Report - Revision 3* to Provide Useful Information on the Background Water Quality in the Regional Aquifer

- Comment by Robert H. Gilkeson, Registered Geologist on January 5, 2009
P.O. Box 670, Los Alamos, NM 87544
rhgilkeson@aol.com 505-412-1930

Executive Summary. The Los Alamos National Laboratory (LANL) *Groundwater Background Investigation Report - Revision 3* (GBIR-3) was a requirement in the New Mexico Environment Department (NMED) LANL Consent Order. The purpose of the GBIR-3 was to provide background concentrations for naturally occurring metals and general chemistry parameters in groundwater below LANL. However, LANL does not have the required network of monitoring wells to provide knowledge of the background groundwater chemistry.

For the regional aquifer, the GBIR-3 used inappropriate sources for the background groundwater chemistry that included 1). the deep Los Alamos County drinking water wells, 2). springs located miles from LANL, and 3). three of the LANL monitoring wells that were impacted by the organic drilling fluids that were allowed to invade the wells.

The mineralogy of the rocks and sediments control the background chemistry of the groundwater in the regional aquifer. However, the springs and the drinking water wells produce groundwater from rock formations that have a different mineralogy than the sediments and rock formations where the LANL monitoring wells are installed. The comparison of water quality data from the two new monitoring wells (R-35a and R-35b) that were installed as sentry wells for the deep drinking water well PM-3 show the important control of the mineralogy of the sediments at the locations of the wells on the background chemistry of the groundwater produced from the three wells.

The GBIR-3 did not provide useful background water quality data for the assessment of the impact of organic drilling additives and bentonite clay drilling muds on the ability of the LANL monitoring wells to produce reliable and representative water samples for the detection of LANL contaminants. Nevertheless, the LANL scientists used the GBIR-3 for that purpose in the most recent revision of the LANL *Well Screen Analysis Report*. The use of inappropriate background water quality data is one of several reasons for the Department of Energy to order LANL to retract the *Well Screen Analysis Report*.

The GBIR-3 does not replace the requirement for the installation of background water quality monitoring wells at many locations across LANL. The installation of background wells at locations close to the LANL waste disposal sites are a requirement of the Resource Conservation and Recovery Act (RCRA). However, the NMED has not enforced the requirement of RCRA for networks of monitoring wells and background wells at the LANL waste disposal sites known as MDA G, MDA H and MDA L.

The GBIR-3 does not provide the required knowledge of background chemistry of groundwater that is required for wise decisions in the NMED Consent Order. The NMED Hazardous Waste Bureau (HWB) has not enforced the requirements in the Consent Order for DOE to install monitoring wells at LANL that provide reliable and representative water samples for detection of LANL contaminants. There is an inconsistent practice by the NMED HWB for the protection of groundwater at LANL and at the Sandia National Laboratories in Albuquerque.

Comment on the Failure of the Los Alamos National Laboratory *Groundwater Background Investigation Report - Revision 3* to Provide Useful Information on the Background Water Quality in the Regional Aquifer

- Comment by Robert H. Gilkeson, Registered Geologist on January 5, 2009
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Comment on the Failure of the Los Alamos National Laboratory *Groundwater Background Investigation Report - Revision 3* to Provide Useful Information on the Background Water Quality in the Regional Aquifer

- Comment by Robert H. Gilkeson, Registered Geologist on January 5, 2009
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1. Introduction. The Los Alamos National Laboratory (LANL) *Groundwater Background Investigation Report - Revision 3* (GBIR-3) published in May of 2007 was a requirement in the New Mexico Environment Department (NMED) Order on Consent that was signed into law on March 1, 2005. The pertinent excerpt from the Consent Order is pasted below:

> "IV.A.3.d. Background Investigation
> The Respondents shall determine the background concentrations for naturally occurring metals and general chemistry parameters in alluvial, intermediate, and regional groundwater. Within 180 days after the effective date of this Consent Order, the Respondents shall submit to the Department for review and written approval a Groundwater Background Investigation Report to determine Facility background concentrations for naturally occurring metals in groundwater at or near the Facility [emphasis added]. The background investigation shall state the background concentration for each metal and the general chemistry parameters, and state the bases for selecting each such concentration" [page 41].

The requirement by the NMED for LANL to submit the groundwater background report within 180 days after the effective date of the Consent Order was a mistake because the network of monitoring wells to determine the background concentrations for naturally occurring metals and general chemistry parameters in the groundwater in the regional aquifer below LANL did not exist in 2005 and *still* do not exist in 2009.

In addition, a report on background water quality "at or near the facility" could not replace the need for the installation of background monitoring wells at locations close to the discrete LANL waste disposal sites. The background water quality monitoring wells are a requirement of the federal environmental law known as the Resource Conservation and Recovery Act (RCRA). Accurate background water quality data from monitoring wells located close to the LANL waste disposal sites are essential for the investigation and long-term monitoring of groundwater contamination from the disposal sites.

This report is primarily concerned about the failure of the LANL *Groundwater Background Investigation Report - Revision 3* (GBIR-3) to produce the required background water quality data for the regional aquifer for the following purposes:

- 1). The GBIR-3 did not provide the required knowledge of the background concentrations for naturally occurring metals and general chemistry parameters in the groundwater below the LANL waste disposal sites.

- 2). The GBIR-3 did not provide the data that was required to support the findings presented in the LANL *Well Screen Analysis Report - Revision 2* (WSAR-2). The WSAR-2 was a study of the ability of the LANL monitoring wells (80 discrete screened intervals) that were invaded with organic and/or bentonite clay drilling additives to produce reliable and representative water samples.

- 3). The GBIR-3 did not provide the background water quality data that is required by the NMED Consent Order for informed decisions on corrective action.

- 4). The GBIR-3 did not provide the background data that is required by RCRA for investigation and long-term monitoring of groundwater contamination from LANL operations. A background water quality report can not replace the requirement under RCRA to install background water quality monitoring wells close to the LANL waste disposal sites at locations that are hydraulically upgradient from the buried wastes.

- The NMED Hazardous Waste Bureau (HWB) made a mistake to approve of the GBIR-3 as providing the required knowledge of background water quality for decisions in the LANL Consent Order. The failure of the NMED HWB to recognize that the GBIR-3 did not provide the required background water quality data is a serious problem.

2. The sparse and inappropriate sources of data for the regional aquifer that were used in the LANL GBIR-3. For the regional aquifer, the GBIR-3 presents water quality data from the following twenty one (21) sources: eight drinking water supply wells, three LANL contaminant detection monitoring wells and ten springs. The locations of the wells and springs are displayed on Figure 1.

- Drinking water wells G-1A, G-2A, G-3A, G-4A, G-5A, PM-2, PM-4, and PM-5.
- LANL contaminant detection monitoring wells R-1, R-13, and R-21.
- Springs 1, 5B, 6, 6A, 8A, 9, 9A, 9B, Ancho Spring, and Sacred Spring. Ancho and Sacred Spring are not displayed on Figure 1. Ancho Spring is located in Ancho Canyon approximately 1/2 mile northwest of Spring 6. Sacred Spring is located approximately 2 1/2 miles north of Spring 1.

None of the twenty one sources listed above produced water quality data that meet the following requirements:

- 1). The background concentrations in the GBIR-3 did not provide the data that were needed for the statistical study in the LANL WSAR-2 report. This failure is discussed below in Section 5 on page 9 of this report.

- 2). The NMED Consent Order relied on the LANL WSAR-2 report to determine the ability of the large network of badly compromised LANL monitoring wells to produce reliable and representative water samples. However, one reason the findings in the WSAR-2 are not credible was because they were based on the inappropriate background water quality data presented in the GBIR-3.

- 3). The DOE has not met the requirements in RCRA for a network of contaminant detection monitoring wells and background water quality monitoring wells to produce accurate knowledge of groundwater contamination from the large number of waste disposal sites at many locations across LANL.

3.0. The mistake in using the springs and the deep drinking water wells as a source for the background water quality data in the GBIR-3. The cross-sections in Figures 2 through 7 display the complex stratigraphy in the regional aquifer beneath the Pajarito Plateau. The mineralogy of the discrete rock formations have a strong control on the natural background chemistry of the groundwater produced from the monitoring wells installed in the rock formations. The cross-sections show the great changes that occur laterally and vertically in the rock formations in the upper part of the regional aquifer below LANL.

The cross-sections show that the springs and the drinking water wells produce groundwater from the deep rock formation described as the Santa Fe Group Sands. However, the cross-sections show that the network of LANL monitoring wells produce water from rock formations with a different mineralogy that are located above the Santa Fe Group Sands. The fact that practically all of the water quality data in the GBIR-3 were collected from drinking water wells and springs that produced water samples from the Santa Fe Group Sands is an important reason the report is not credible for the background water quality at the locations of the LANL monitoring wells.

3.1. The mistake in using the springs that discharge from the regional aquifer as a source for the background water quality data in the GBIR-3. Figure 1 shows that the springs are located along the Rio Grande and miles from the contaminant sources at LANL. The cross-sections in Figures 2 through 4 show that the springs discharge groundwater from the Santa Fe Group Sands. For comparison, the cross-sections in Figures 2 through 7 show that the LANL monitoring wells produce groundwater from rock formations that are above the Santa Fe Group Sands. The groundwater quality data from the springs are not representative of the background water quality for the naturally occurring metals and general chemistry parameters in the rock formations at the locations of the LANL monitoring wells.

3.2. The mistake in using the deep drinking water wells as a source for the background water quality data in the GBIR-3. The locations of the eight Los Alamos County drinking water wells are displayed on Figure 1. The wells are G-1A, G-2A, G-3A, G-4A, G-5A, PM-2, PM-4, and PM-5. The wells have screens that are greater than 1,000 feet long with the top of the screens at distances greater than 100 feet below the water table and often greater than 200 feet below the water table. The five G-series wells are located in the Guaje Canyon well field a distance greater than two miles north of LANL. The cross-sections in Figures 5 through 7 show that the G-series wells produce groundwater from the deep Santa Fe Group Sands. Figure 7 shows that the drinking water well PM-5 also produces groundwater from the deep Santa Fe Group Sands.

The dominant control of the mineralogy of the rock formation in the sampling zone of the LANL monitoring wells on the natural background chemistry of groundwater is illustrated by the large differences in background water quality in the groundwater produced from the LANL monitoring wells R-35a and R-35b and the drinking water well PM-3. The close locations of the three wells are shown on Figure 8.

Monitoring wells R-35a and R-35b were installed as sentry wells for the deep drinking water well PM-3. The two monitoring wells were installed with casing advance drilling methods that prevented the invasion of any organic or bentonite clay drilling fluids into the screened intervals. However, a mistake during the construction of well R-35a caused the screened interval in the well to be invaded with the bentonite clay grout that was used to seal the annulus between the well casing and the borehole wall. As described below, the bentonite clay has prevented well R-35a from producing reliable and representative water samples for background water quality and for the detection of groundwater contamination from LANL sources.

Well R-35a is the deeper of the two sentry wells and was completed with a well screen in the depth interval corresponding to the top of the screen in drinking water well PM-3. Well R-35b was completed with a screen near the top of the regional aquifer. The depth of the two wells is summarized below:

- The water table of the regional aquifer is at ~ 787 feet below ground surface (ft bgs).
- The R-35b screened interval = 825 to 848 ft bgs or ~ 40 ft below the water table.
- The R-35a screened interval = 1013 to 1062 ft bgs or ~ 230 ft below the water table.

The zinc, barium and strontium concentrations in the groundwater samples produced from the three wells are summarized below in Table 1. Table 2 compares the concentrations measured in the three wells to the background values for zinc, barium and strontium that were published in the GBIR-3.

Table 1. Comparison of the water quality data produced from three wells installed at different depths into the regional aquifer.

- The close locations of wells R-35b, R-35a and PM-3 are displayed on Figure 8.

- <u>Monitoring well R-35b</u> - screened interval near the water table

- Sampling Date	Zinc (ug/L) Filtered	Zinc (ug/L) Unfiltered	Barium (ug/L) Filtered	Barium (ug/L) Unfiltered	Strontium (ug/L) Filtered	Strontium (ug/L) Unfiltered
- 08-29-07	59.9	105	31	31.9	75.3	76.8
- 11-10-07	63.4	105	31.6	32.4	75.1	74.5
- 02-07-08	51.7	86.9	32.7	32	70.2	68.9
- 05-13-08	50.3	54.8	36.1	35.6	67.5	66.2
- 08-12-08	41.9	51.5	35.3	37.6	64.2	64.3

- <u>Monitoring well R-35a</u> - screened interval across the top of the screen in well PM-3

- Sampling Date	Zinc (ug/L) Filtered	Zinc (ug/L) Unfiltered	Barium (ug/L) Filtered	Barium (ug/L) Unfiltered	Strontium (ug/L) Filtered	Strontium (ug/L) Unfiltered
- 08-30-07	185	364	299	300	162	162
- 11-10-07	36.4	44	312	321	163	168
- 02-21-08	26.8	29.2	340	315	174	162
- 05-13-08	2.4 J	5.3 J	319	321	164	165
- 08-12-08	5.2 J	9.6 J	338	335	165	164

- <u>Drinking water well PM -3</u>

- Sampling Date	Zinc (ug/L) Filtered	Zinc (ug/L) Unfiltered	Barium (ug/L) Filtered	Barium (ug/L) Unfiltered	Strontium (ug/L) Filtered	Strontium (ug/L) Unfiltered
- 05-20-04	N.A.	13.8	N.A.	49.5	N.A.	120
- 05-18-05	N.A.	7.2 J	N.A.	50.9	N.A.	125
- 01-19-06	6.32 J	5.6 J	54.3	53.5	129	130
- 05-24-06	N.A.	7.3 J	N.A.	50.8	N.A.	125
- 05-16-07	N.A.	2 J	N.A.	50	N.A.	122

- ug/L = micrograms per liter or parts per billion
- J identifies that the listed concentration is an estimated value.
- NA means the constituent was not analyzed in a filtered water sample

Table 2. Comparison of the water quality data produced from the three wells in Table 1 to the background water quality data in the LANL *Groundwater Background Investigation Report Revision-3* (GBIR-3).

- **Zinc** (filtered)	median (ug/L)	minimum (ug/L)	maximum (ug/L)	Range Factor
- GBIR-3	1.9	< 2	41.1	> 20 times
- R-35b	53.4	41.9	63.4	1.5 times (decrease)
- R-35a	51.2	2.4 J	185	77 times (decrease)
- PM-3 (unfiltered)	7.3	2 J	13.8	7 times (decrease)

- **Barium** (filtered)	median (ug/L)	minimum (ug/L)	maximum (ug/L)	Range Factor
- GBIR-3	21	4.68	69.2	15 times
- R-35b	33.3	31	36.1	1.16 times (increase)
- R-35a	321.6	299	340	1.14 times (increase)
- PM-3 (unfiltered)	50.9	49.5	53.5	no overall change

- **Strontium** (filtered)	median (ug/L)	minimum (ug/L)	maximum (ug/L)	Range Factor
- GBIR-3	55.5	44.88	179.8	4 times
- R-35b	70.5	64.2	75.3	1.17 times (decrease)
- R-35a	165.6	162	174	no overall change
- PM-3 (unfiltered)	124.2	120	130	no overall change

- The three wells show large differences in the measured concentrations of dissolved zinc, barium and strontium because of the properties of the mineralogy of the rock formations in the sampling zones of the wells.

- The zinc values measured in wells R-35a and R-35b are much higher than the background values published in the GBIR-3 and also much higher than the values measured in the deep drinking water well PM-3.

- The barium values measured in well R-35a are five times higher than the maximum value for barium in the GBIR-3. The barium values measured in well R-35a are also much higher than the values measured in wells R-35b and PM-3. The possibility that the high barium values measured in well R-35a are from LANL contamination should be investigated.

- For successive sampling events, the groundwater samples should show a change of not greater than approximately 10% in the measured concentrations for the dissolved constituents. There also should be little or no overall change in the dissolved concentrations through the years of measurement. In Table 1, there is little change for barium and strontium. However, the large decline in dissolved zinc concentrations measured in the groundwater samples produced from well R-35a is an issue that must be investigated.

- In Table 1, the large decline over time in the dissolved zinc measured in the groundwater produced from well R-35a is probably because of the bentonite clay grout that invaded the screened interval. The bentonite clay has strong adsorption properties to remove zinc and many of the LANL contaminants from the groundwater samples produced from well R-35a. The large decline in zinc indicates that well R-35a is not reliable for background water quality data for natural metals. In addition, the zinc data indicate that well R-35a is also not reliable to detect many LANL contaminants. The need to replace well R-35a should be investigated.

- In Table 1, there are many factors that may be responsible for the change in zinc concentrations measured in drinking water well PM-3 including 1). the very long length of the well screen, 2). corrosion of the well screen and well piping, 3). the period of time the well was pumped before collecting the water samples, and 4). practically all of the analytical results are for unfiltered samples. There are many reasons the water quality data from the drinking water wells are not reliable for accurate knowledge of the background concentrations of zinc and other trace metals in the discrete formations in the regional aquifer.

4. The mistake in using the three contaminant detection monitoring wells R-1, R-13 and R-21 as sources for the background water quality data in the GBIR-3. The use of the water quality data from the three contaminant detection monitoring wells R-1, R-13 and R-21 as representative of background water quality for naturally occurring metals was a mistake in the GBIR-3 because of the drilling methods. The three wells were drilled with methods that invaded the screened intervals with organic drilling fluids and -foams that have well known properties to form a new mineralogy in the sampling zones with strong properties to remove the naturally occurring metals from the water samples produced from the wells. The NMED recognized the importance to use chemicals to destroy the organic drilling additives in order to prevent the microbial processes that would form a new mineralogy with a reactive chemistry in the screened interval. The pertinent excerpt from the NMED Consent Order is pasted below:

> - "[o]rganic polymer drilling muds have been observed to facilitate bacterial growth, which reduces the reliability of sampling results. If polymer emulsions are to be used in the drilling program at the Facility, polymer dispersion agents shall be used at the completion of the drilling program to remove the polymers from the boreholes. For example, if EZ Mud® is used as a drilling additive, a dispersant (e.g., BARAFOS® or five percent sodium hypochlorite) shall be used to disperse and chemically breakdown the polymer prior to developing and sampling the well." [page 191]

EZ Mud® was allowed to invade the screened intervals in wells R-1, R-13 and R-21. *However, the NMED did not enforce the requirement in the Consent Order for LANL to use chemicals to disperse and chemically breakdown the organic drilling additives prior to developing and sampling the wells*. Figure 9 displays the new mineralogy (i.e., reactive chemistry) that was formed in the zone surrounding the well screens by the bacterial processes that thrived on the organic drilling additives. The new mineralogy was described in the NMED Notice of Disapproval (NOD) that was issued on September 18, 2006 for the LANL *Well Screen Analysis Report;*

> - "The presence of residual drilling fluids may not only turn groundwater from aerobic into anaerobic water, but also cause composition changes in aquifer solid materials [i.e., the mineralogy] adjacent to well screens. For example, the availability

of organic compounds contained in drilling fluids likely stimulates sequential microbial metabolism, including iron and sulfate reduction. As a result, it is likely that iron sulfides are produced as precipitates, thereby enhancing the reactivity of the aquifer solids adjacent to impacted screens. It has been well-documented that iron sulfides are able to reductively transform organics such as chlorinated solvents, and some oxidizing metals and ions (e.g., hexavalent chromium, perchlorate, nitrate). In addition, the change of mineralogical compositions may also increase the adsorption capability of aquifer materials adjacent to impacted screens. Thus, water samples collected from impacted screens where aerobic conditions have been re-established after rehabilitation may still produce biased concentrations for certain contaminants [and naturally occurring trace metals] in comparison to formation water" [emphasis added]. [page 2 in the NMED NOD]

The organic drilling fluids have caused a new reactive chemistry in the zone where groundwater is produced from the LANL monitoring wells R-1, R-13 and R-21. The zone of reactive chemistry is displayed in Figure 9. The new chemistry prevents the wells from producing reliable and representative water samples for the background concentrations of the naturally occurring metals.

Zinc is an example of a naturally occurring metal that is often present in groundwater in the regional aquifer. The dissolved concentrations of zinc in the groundwater produced from a monitoring well that provides reliable and representative water samples will show little change between successive sampling events. However, a time-series analysis of the groundwater samples produced from the LANL monitoring wells R-1, R-13 and R-21 show a large decline in dissolved zinc. The concentrations of dissolved zinc in the water samples collected from each well are summarized below.

- Dissolved zinc in the groundwater samples produced from well R-1

Sample No. & Date	Dissolved Zinc (ug/L)[B]
1). 11-03	1.4
2). 05-19-05	7.6 J[C]
3). 09-05 / 09-05[A]	2.7 J / N.D.[D]
4). 11-05	N.D.
5). 01-06	N.D.
6). 07-06 / 07-06[A]	5.1 J / 3.9 J
7). 10-06 / 10-06[A]	2.3 J / N.D.
8). 03-07	3.3 J
9). 06-07 / 06-07[A]	2.1 J / 6.6 J
10). 08-07	3.5 J
11). 11-07 / 11-07[A]	2.7 J / 3.5 J
12). 02-08 / 02-08[A]	2.6 J / 3.1 J
13). 05-20-08	N.D.
14). 08-15-08	3.5 J

- **[A] 09-05 / 09-05[A] denotes analysis on a duplicate filtered sample.**
- **[B] (ug/L) = micrograms per liter or parts per billion.**
- **[C] J denotes an estimated concentration.**
- **[D] N.D. denotes that dissolved zinc was not detected in the water sample at an analytical method detection limit of 2 ug/L.**

For well R-1, the time-series analysis shows a decline in dissolved zinc concentrations from 7.6 ug/L for the May of 2005 sample to not detected in the samples collected in November of 2005, January of 2006, and May of 2008. A zinc concentration of 3.5 ug/L was measured in a water sample collected in August of 2008. The time-series data show a minimum decline of greater than 55%. The time series data show the presence of a new reactive chemistry that is efficiently removing zinc from the groundwater produced from well R-1. Well R-1 does not produce reliable and representative water samples for the background concentration of zinc and other naturally occurring trace metals in the regional aquifer at the location of the well.

Well R-1 is in Mortandad Canyon at an important location for monitoring contamination in a permeable zone that is present a short distance below the water table of the regional aquifer. However, the screen in well R-1 was installed in a confining bed of clayey sediments that is located below the permeable zone. The misplaced screen in well R-1 in the clayey sediments is another reason the well does not produce the required background water quality data.

In addition, the new reactive mineralogy from the organic drilling additives and the misplaced screen are reasons that well R-1 is not reliable to detect LANL contaminants in the regional aquifer.

- Dissolved zinc in the groundwater samples produced from well R-13

Sample No. & Date	Dissolved Zinc (ug/L) [B]
1). 10-31-01	N.A. [E]
2). 04-18-02	5.53
3). 07-03-02	5.78
4). 10-02	3.5
5). 01-03	N.D. [D]
6). 05-03	N.D.
7). 12-03	1.5 J
8). 02-06	N.D.
9). 07-06	3 J [C]
10). 10-06	2.3 J
11). 02-07	4 J
12). 06-07	N.D.
13). 08-07	N.D.
14). 11-07	2.7 J
15). 02-08	12.1
16). 05-08 / 05-08 [A]	N.D. / N.D.
17). 08-08 / 08-08 [A]	N.D. / N.D.

- [A] 05-08 / 05-08 [A] **denotes analysis on a duplicate filtered sample.**
- [B] **(ug/L) = micrograms per liter or parts per billion.**
- [C] **J denotes an estimated concentration.**
- [D] **N.D. denotes that dissolved zinc was not detected in the water sample at an analytical method detection limit of 2 ug/L.**
- [E] **N.A. denotes a water sample was not analyzed**

The construction and development of well R-13 was completed by October of 2001 but the first water sample was collected 6 months later in April of 2002. The time-series analysis shows a decline in dissolved zinc concentrations from 5.78 ug/L for a sample collected in July of 2002 to not detected on many of the later sampling dates beginning in January of 2003 and including the samples collected in May and August of 2008 - a minimum decline of greater than 65%. The time series data show the presence of a new reactive chemistry that is efficiently removing zinc from the groundwater produced from well R-13. Well R-13 does not produce reliable and representative water samples for the background concentration of zinc and the other naturally occurring trace metals in the regional aquifer at the location of the well.

Well R-13 is in Mortandad Canyon at an important location for monitoring contamination in a permeable zone that is a short distance below the water table of the regional aquifer. However, the screen in well R-13 was installed 125 feet below the water table and below clayey sediments that are confining beds. In addition, a mistake during the construction of well R-13 invaded the screened interval with bentonite clay. The misplaced screen, the organic drilling additives and the contamination of the screened interval with bentonite clay are all reasons that well R-13 does not produce the required background water quality data.

In addition, the new reactive mineralogy from the organic drilling additives and the bentonite clay and the misplaced screen are reasons that well R-13 is not reliable to detect LANL contaminants in the regional aquifer.

- Dissolved zinc in the groundwater samples produced from well R-21

Sample No. & Date ------ 1). 12-02 2). 03-04 / 03-04 [A] 3). 06-30-04 4). 09-04 5). 12-04
Dissolved Zinc (ug/L) [B] N.A. [E] 7.58 / 4.42 7.81 2.8 J 7.4
6). 06-05 / 06-05 [A] 7). 07-06 8). 11-06 / 11-06 [A] 9). 03-07 10). 06-07 11). 08-07
2.9 J [C] / N.D. [D] 3 J 2.7 J / 5.6 J 2.7 J 6.5 J N.D.
12). 11-07 13). 02-08 14). 05-08 / 05-08 [F] 15). 08-08 / 08-08 [F]
N.D. N.D. 4.4 J / N.D.T [G] 4.2 J / 3 J T [G]

- **[A] 03-04 / 03-04 [A] denotes analysis on a duplicate filtered sample.**
- **[B] (ug/L) = micrograms per liter or parts per billion.**
- **[C] J denotes an estimated concentration.**
- **[D] N.D. denotes that dissolved zinc was not detected in the water sample at an analytical method detection limit of 2 ug/L.**
- **[E] N.A. denotes that a water sample was not analyzed.**
- **[F] 03-06 / 03-06 [F] denotes analyses on a pair of filtered and unfiltered samples.**
- **[G] 4.2 J / 3 J T [G] T denotes analysis on an unfiltered sample.**

The construction and development of well R-21 was completed by December of 2002 but the first water sample was collected 15 months later in March of 2004. The time-series analysis shows a decline in dissolved zinc concentrations from 7.8 ug/L for a sample collected in June of 2004 to not detected in five of the sampling events from June of 2005 to May of 2008 - a minimum decline of greater than 75%. The time series data show the presence of a new reactive chemistry that is efficiently removing zinc from the groundwater produced from well R-21. Well R-21 does not produce reliable and representative water samples for the background concentration of zinc and other naturally occurring trace metals in the regional aquifer at the location of the well.

Well R-21 is in Canada del Buey at an important location for monitoring contamination near the water table of the regional aquifer. However, the screen in well R-21 was installed 90 feet below the water table; a distance too great for the detection of the groundwater contamination that may be present near the water table.

The new reactive mineralogy from the organic drilling additives and the misplaced screen are reasons that well R-21 is not reliable to detect LANL contaminants in the regional aquifer.

- In summary, the water quality data from the LANL monitoring wells R-1, R-13 and R-21 do not produce accurate background concentrations for naturally occurring metals because organic drilling additives were allowed to invade the screened intervals. In addition, the three wells do not meet the requirement in RCRA for knowledge of the background water quality (or the presence of LANL contaminants) in the first productive aquifer zone that is located near the water table of the regional aquifer. The three wells do not produce the required knowledge for wise decisions in the NMED Consent Order.

5. The inappropriate water quality data in the LANL GBIR-3 were used to assess the ability of the LANL monitoring wells to produce reliable and representative water samples. LANL used drilling methods that allowed organic polymer drilling fluids and/or organic foams to invade approximately 100 of the screened intervals in the large network of LANL monitoring wells. Many of the screened intervals were also invaded with bentonite clay. The impacted wells were installed in intermediate zones and in the regional aquifer. *The NMED HWB approved the use of the inappropriate drilling methods that invaded the screened intervals with a new reactive chemistry.*

The organic fluids and -foams and the bentonite clay established a new mineralogy (i.e., reactive chemistry) in the screened intervals with strong properties to prevent the wells from producing water samples that were reliable and representative for the detection of many of the LANL contaminants. The new mineralogy also greatly reduced the permeability of the zone surrounding the well screens which created a stagnant zone where the groundwater was in contact for a long period of time with the new reactive chemistry. The majority of the LANL monitoring wells produce water samples from the stagnant zones surrounding the well screens. The stagnant zone that surrounds the impacted well screens is displayed on Figure 9.

The LANL *Well Screen Analysis Report - Revision 2* (WSAR-2), was a statistical assessment of the ability of eighty (80) of the impacted screened intervals to produce reliable and representative water samples. However, the statistical study was not credible because it compared water quality data from the impacted wells to the inappropriate background water quality data that was published in the LANL GBIR-2 report. The only change from the GBIR-2 to the GBIR-3 is that the GBIR-3 did not use the water quality data from LANL monitoring well R-18 because the groundwater was contaminated with high explosives and did not represent background water quality.

In fact, the LANL scientists were aware that the background water quality data published in the LANL GBIR reports did not meet the requirements for the assessment scheme that was used in the WSAR-2. The pertinent excerpts from the WSAR-2 are pasted below:

> "**2.3 Background Groundwater Chemistry**
> The evaluation process used in this report compares selected geochemical indicators for each individual screen against the range of background concentrations [presented in the LANL background water quality report] that are assumed [emphasis added] to encompass predrilling conditions at that screen. Water-quality data that fall outside the range, and that cannot be attributed to the presence of a contaminant plume may then be identified as potentially unreliable or not representative of predrilling conditions" [page 6].
>
> "The ideal approach to determining representative water quality would be to compare water-chemistry data for each screen against background concentrations specific to the formation lithology [i.e., mineralogy] in which the screen is located. However, this level of distinction for background groundwater chemistry does not exist and is unlikely to ever exist at this level of detail [emphasis added]. Consequently, in this report, the range of background concentrations is limited to that defined in the "Groundwater Background Investigation Report, Revision 2" (LANL 2007, 094856) for the regional aquifer and perched intermediate zones" (page 6).

The statistical assessment in the WSAR-2 required accurate knowledge of the background concentrations for the groundwater in the formations where the impacted screens were installed. However, the fact that the LANL scientists knowingly used inappropriate background data in the WSAR-2 report is one of the mistakes that prevented the findings presented in the WSAR-2 from being credible.

The record shows that the NMED Hazardous Waste Bureau (HWB) has not required the Department of Energy (DOE) to install the network of monitoring wells and background water quality wells at LANL that are required for
1). wise decisions on corrective action in the NMED Consent Order and
2). long-term monitoring for the detection of groundwater contamination from LANL operations.

The required action is for the NMED HWB to order the DOE to retract both the LANL *Groundwater Background Investigation Report - Revision 3* and the LANL *Well Screen Analysis Report - Revision 2* with no opportunity for revision because both reports are not credible and the required data to make the reports credible does not exist. Both reports prevent accurate knowledge of the ability of the LANL monitoring wells to produce reliable and representative water samples. In addition, the two reports prevent identification of the emerging emergency for groundwater contamination of the regional aquifer because of the poor management practices by the DOE for the large inventory of LANL wastes discharged to wet canyon landscapes and buried in unlined pits, trenches and shafts at many unmonitored or poorly monitored disposal sites.

6. The NMED HWB has not enforced the requirement in RCRA for the DOE to install background water quality monitoring wells at the LANL waste disposal sites. Figure 10 shows the network of monitoring wells that are intended for providing information on groundwater contamination below the three waste disposal sites in LANL Technical Area 54 (TA-54). The three waste disposal sites from west to east on Figure 10 are MDA H, MDA L and MDA G. MDA G is a large 63-acre waste disposal site compared to the small 0.6-acre MDA H.

The three disposal sites (MDA G, MDA H and MDA L) are "regulated units" under RCRA because the three sites buried RCRA hazardous waste after July 26, 1982. RCRA requires networks of point of compliance monitoring wells installed as close as possible to the downgradient boundary at each of the three waste disposal sites and monitoring wells for background water quality installed at appropriate locations upgradient of the disposal sites.

The RCRA requirements for networks of monitoring wells at RCRA regulated unit waste disposal sites are published in 40 CFR §§264.91 through 264.100. §264.97 describes the general groundwater monitoring requirements for regulated units including monitoring wells for background water quality. The pertinent excerpts from §264.97 are pasted below:

- (a) The ground-water monitoring system must consist of a sufficient number of wells, installed at appropriate locations and depths to yield ground-water samples from the uppermost aquifer that:
  - (1) Represent the quality of background ground water that has not been affected by leakage from a regulated unit;
  - (2) Represent the quality of ground water passing the point of compliance.

- (3) Allow for the detection of contamination when hazardous waste or hazardous constituents have migrated from the waste management area to the uppermost aquifer.

- (g) In detection monitoring or where appropriate in compliance monitoring, data on each hazardous constituent specified in the permit will be collected from background wells and wells at the compliance point(s).

- RCRA defines the "uppermost aquifer" as the first permeable zone below the water table of the regional aquifer, and the deeper permeable zones.

The NMED HWB has not enforced the requirement in the LANL Consent Order for the LANL monitoring wells to comply with the EPA RCRA guidance. The pertinent excerpt from page 189 of the Consent Order is pasted below:

> The design and construction of groundwater monitoring wells shall comply with the guidelines established in various EPA RCRA guidance, including, but not limited to:
> • U.S. EPA, *RCRA Groundwater Monitoring: Draft Technical Guidance*, EPA/530-R-93-001, November, 1992 [known as the EPA RCRA Manual].

The EPA RCRA Manual describes the networks of monitoring wells that are required at the RCRA "regulated unit" waste disposal sites. Pertinent excerpts from the EPA report are pasted below:

> "5.1.3 Placement of Background (Upgradient) Monitoring Wells
> The ground-water monitoring well system must allow for the detection of contamination when hazardous waste or hazardous constituents have migrated from the waste management area to the uppermost aquifer. A sufficient number of background wells must be installed at appropriate locations and depths to yield ground-water samples from the uppermost aquifer that represent the quality of background water that has not been affected by leakage from a regulated unit." [page 5-10]
>
> "Background and point of compliance [monitoring] wells must be screened in the same hydrostratigraphic position to allow collection of comparable ground-water quality data." [page 5-10]
>
> "To establish background ground-water quality, it is necessary to establish ground-water flow direction(s) and to place wells hydraulically upgradient of the waste management area." [page 5-10]
>
> "Background wells should be located far enough from waste management units to avoid contamination by the units. In the event that background wells become contaminated by a release from the waste management unit(s), new background wells that will not be affected by the release should be installed." [page 5-12]

Figure 11 is a schematic map from the EPA RCRA Manual that shows the networks of monitoring wells that are required at RCRA regulated unit waste disposal sites. Comparison of Figure 11 to Figure 10 shows that the planned networks of monitoring wells at MDA G, MDA H and MDA L do not meet the requirements of RCRA, and accordingly, the networks also do not meet the requirements in the NMED LANL Consent Order. There are no monitoring wells for background water quality and there are no contaminant detection monitoring wells installed along the hydraulic downgradient boundary of the three waste disposal sites.

- Nevertheless, the NMED HWB approved of the deficient network of monitoring wells proposed by LANL on Figure 10 for MDA G, MDA H and MDA L. The network of monitoring wells at MDA G, MDA H and MDA L do not meet the requirements of RCRA. Furthermore, the network of monitoring wells do not provide the knowledge needed for wise decisions in the NMED Consent Order.

7. The inconsistent requirements of the NMED HWB for groundwater protection practices at LANL and at Sandia National Laboratories in Albuquerque. Figure 12 shows the NMED requirements for the network of monitoring wells at the Sandia National Laboratories Mixed Waste Landfill (Sandia MWL dump) in Albuquerque, New Mexico. The 2.6 acre MWL dump has a similar waste disposal history to MDAs G, H and L. Wastes were buried in unlined trenches and pits at the Sandia MWL dump from 1959 through 1988. The NMED has approved a plan to leave the buried wastes at the MWL dump below a dirt cover.

The direction of groundwater flow at the water table below the Sandia MWL dump is to the west-southwest. For the long-term monitoring at the 2.6 acre MWL dump, Figure 12 shows that the NMED requires three downgradient "point of compliance" monitoring wells at locations immediately along the western boundary of the dump, two monitoring wells a distance to the west of the dump, one monitoring well installed inside the dump and one upgradient monitoring well for background water quality.

As at the Sandia MWL dump, the NMED HWB should require a similar design for the networks of contaminant detection monitoring wells and background water quality wells at MDA G, MDA H, MDA L, and the other legacy waste disposal sites at LANL including MDA AB at TA-49, MDA C and TA-50 and the waste disposal sites at TA-21. In addition, the 65-acre size of MDA G requires the installation of monitoring wells at appropriate locations inside MDA G near the unlined trenches and shafts. If there is resistance to installing monitoring wells inside MDA G, then an alternative method for gaining the required knowledge on groundwater contamination would be to install angled monitoring wells below MDA G. The angled wells would be located south of MDA G in Pajarito Canyon and north of MDA G in Canada del Buey.

- Contact Robert H. Gilkeson with questions or comment
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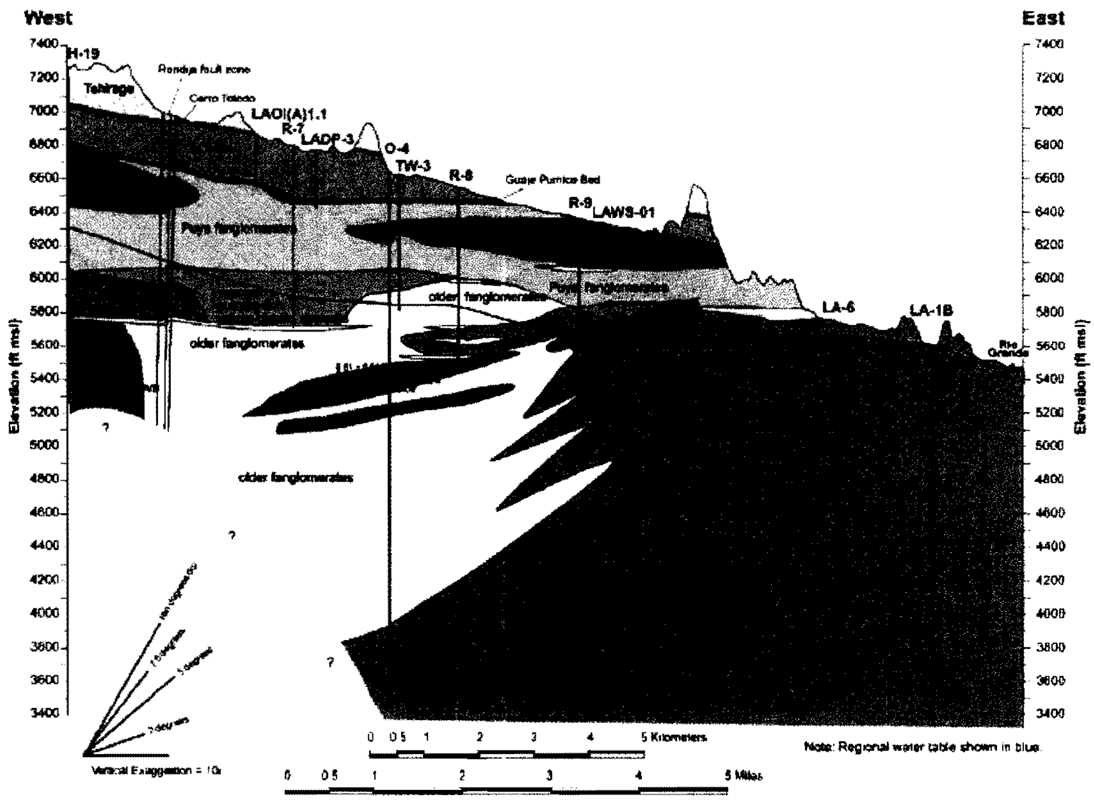
Figure 1. Map showing wells and Rio Grande springs

- On the map, the direction of groundwater flow in the regional aquifer below the Los Alamos National Laboratory is from west to east to the Rio Grande

Source: LANL *Well Screen Analysis Report - Revision 2.*

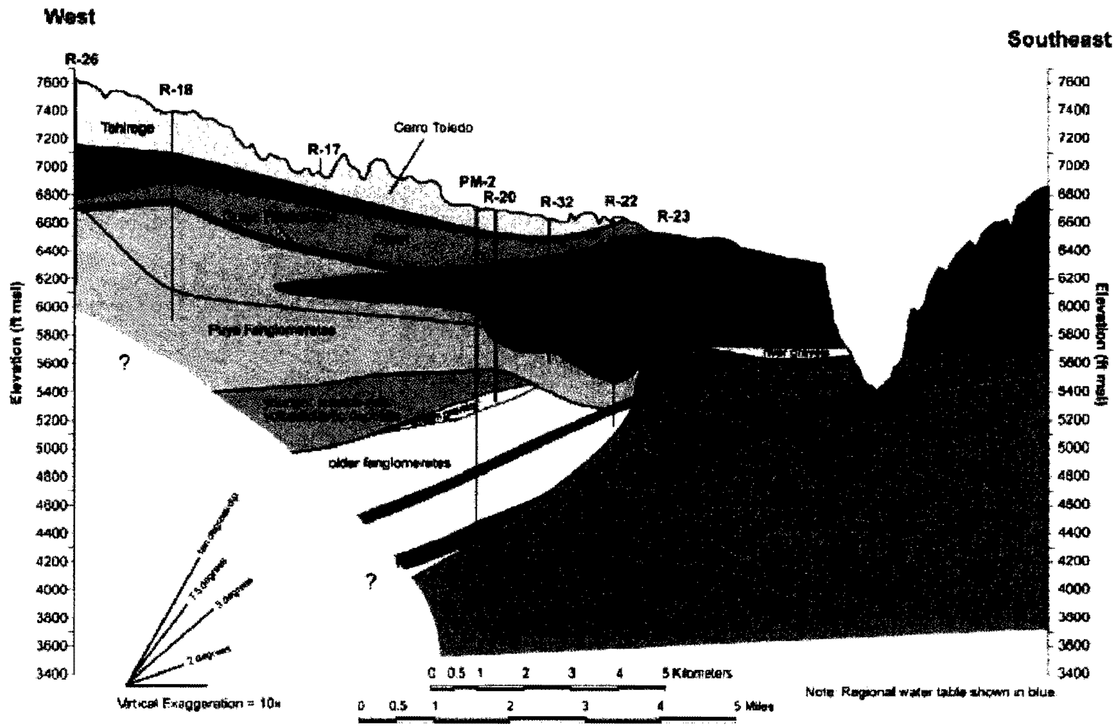
Figure 2. Conceptual west-east cross-section for Los Alamos Canyon in the northern region of the laboratory. The water table of the regional aquifer is shown with the blue line.



Source: LANL *Hydrogeologic Synthesis Report*, December 2005

- **The locations of the wells on the cross-section are displayed on Figure 1.**
- **From west to east on the cross-section -**
  - **The Los Alamos County drinking water well is O-4. LA-6 and LA-1B are abandoned drinking water wells.**
  - **The LANL monitoring wells in the regional aquifer are R-7, old test well TW-3. R-8 and R-9.**

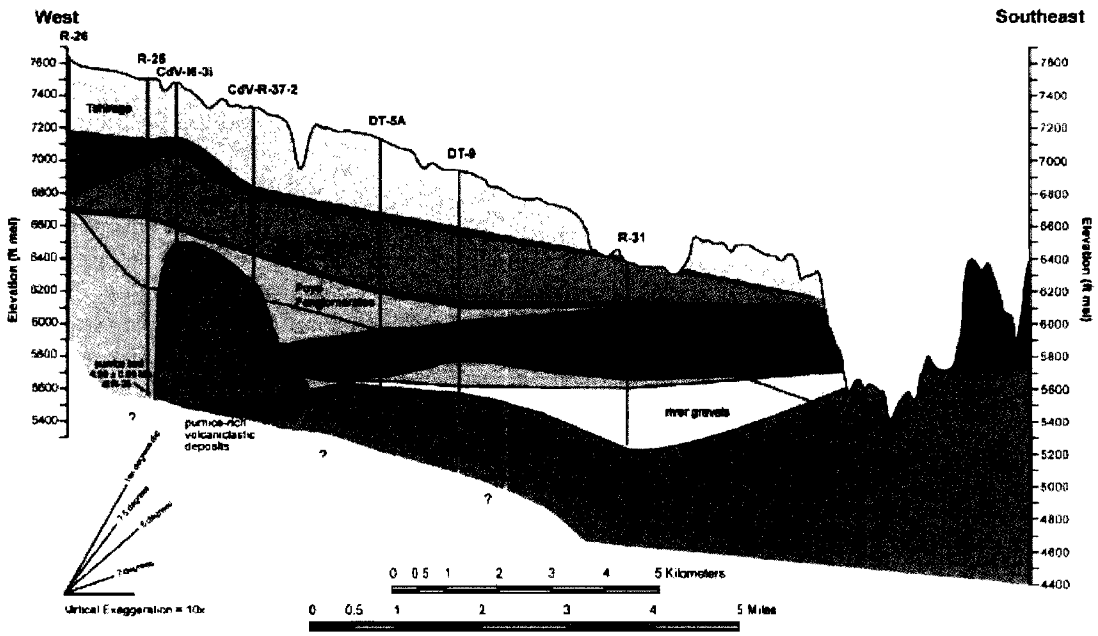
Figure 3. Conceptual west-southeast cross-section for Pajarito Canyon in the central region of the laboratory. The water table of the regional aquifer is shown with the blue line.



Source: LANL *Hydrogeologic Synthesis Report*, December 2005

- **The locations of the wells on the cross-section are displayed on Figure 1.**
- **From west to southeast on the cross-section -**
  - **The Los Alamos County drinking water well is PM-2.**
  - **The LANL monitoring wells in the regional aquifer are R-26, R-18, R-17, R-20, R-32, R-22 and R-23.**

Figure 4. Conceptual west-east cross-section for Water Canyon in the southern region of the Laboratory. The water table of the regional aquifer is shown with the blue line.



Source: LANL *Hydrogeologic Synthesis Report*, December 2005

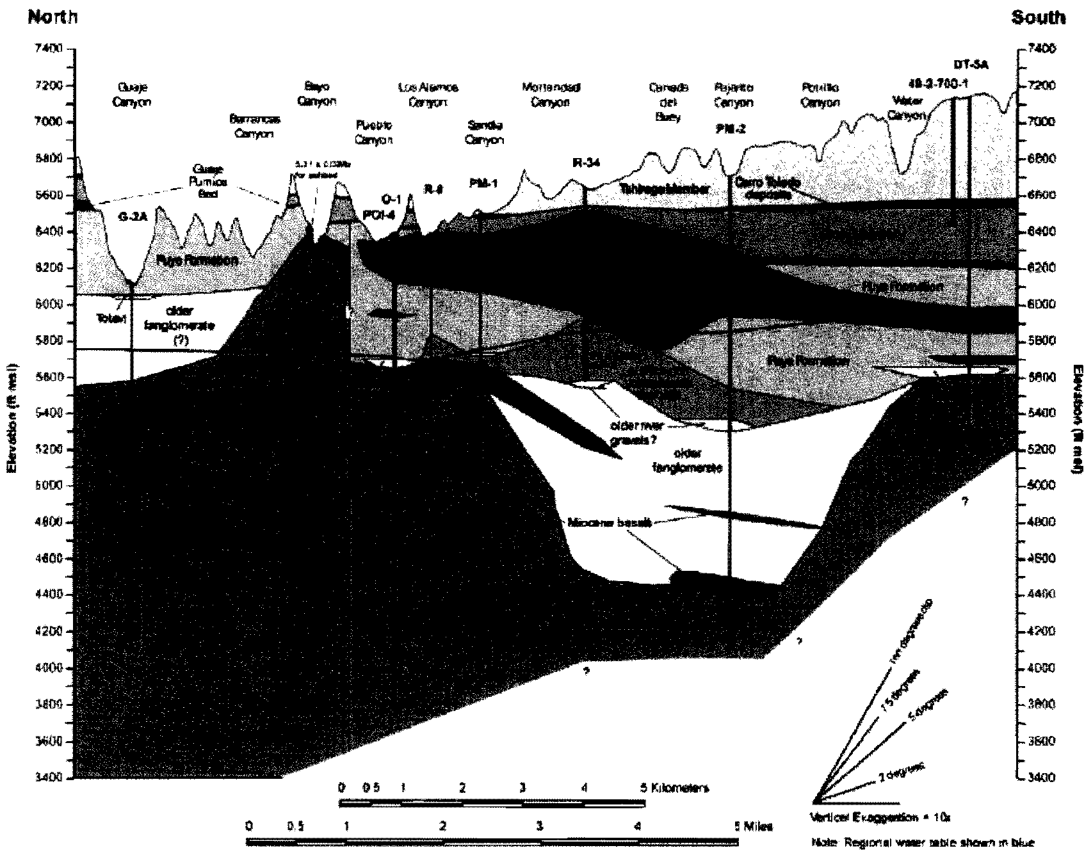
- The locations of the wells on the cross-section are displayed on Figure 1.

- From west to southeast on the cross-section -

- There are no Los Alamos County drinking water wells on the section.

- The LANL monitoring wells in the regional aquifer are R-26, R-25, CdV-16-3i, CdV-R-37-2, old test well DT-5A, old test well DT-9 and R-31.

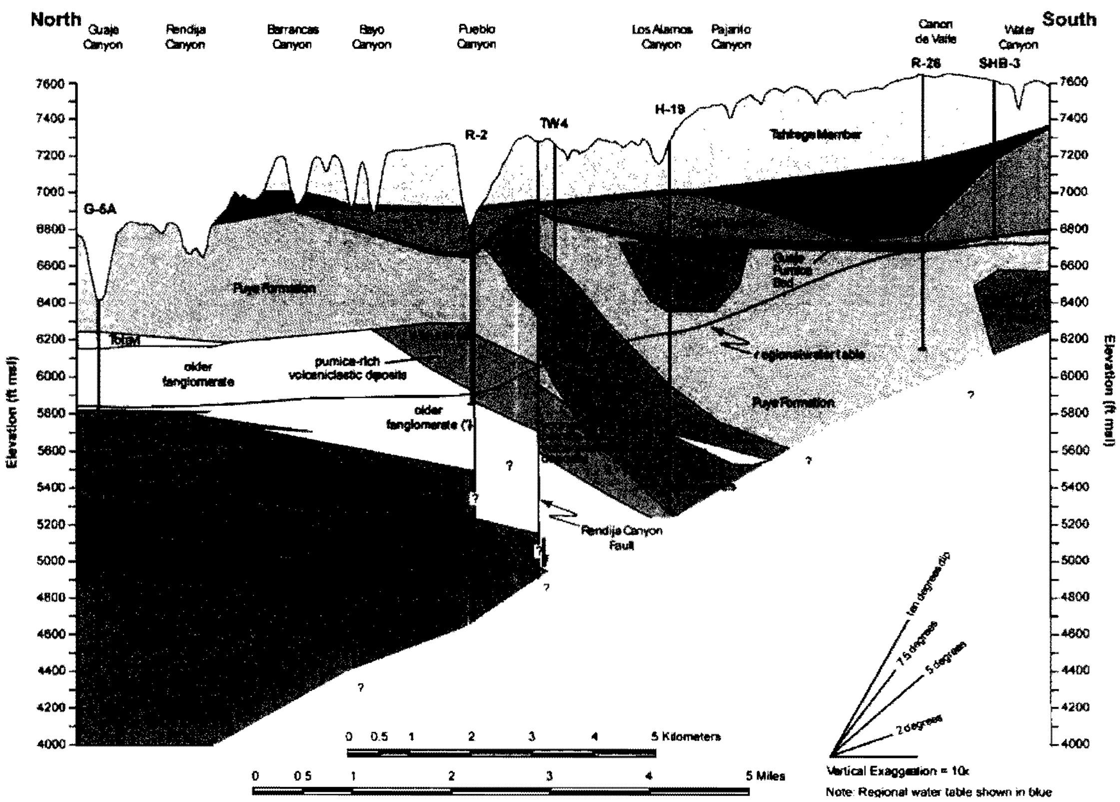
Figure 5. Conceptual northeast-southwest cross-section from the Guaje Canyon well G-2A north of the laboratory through the central part of the laboratory to Water Canyon and Technical Area 49 at the southern boundary. The water table of the regional aquifer is shown with the blue line.



Source: LANL *Hydrogeologic Synthesis Report*, December 2005

- **The locations of the wells on the cross-section are displayed on Figure 1.**
- **From north to south on the cross-section -**
  - **The Los Alamos County drinking water wells are G-2A, O-1, PM-1 and PM-2.**
  - **The LANL monitoring wells in the regional aquifer are R-9, R-34 and old test well DT-5A.**

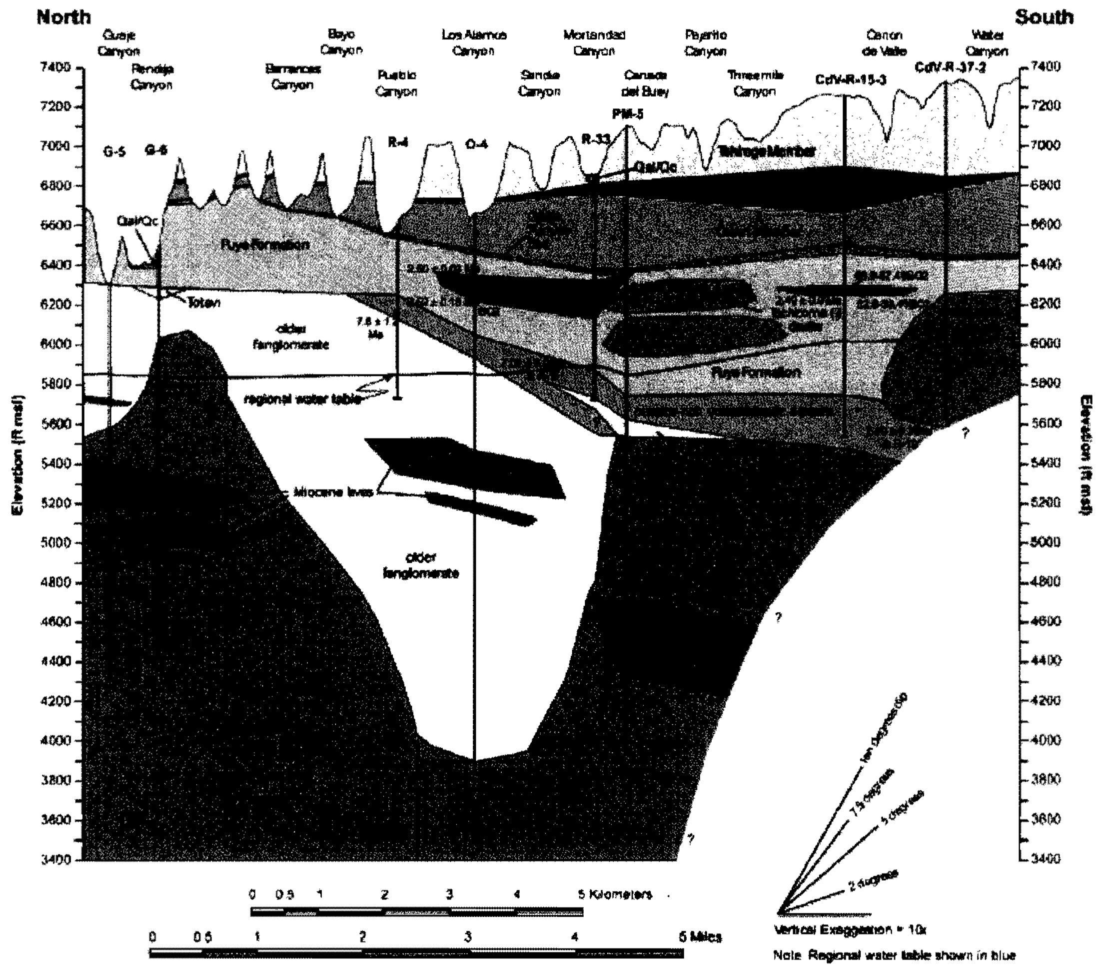
Figure 6. Conceptual north-south cross-section from the Guaje Canyon well G-5A north of the laboratory across the western part of the laboratory. The water table of the regional aquifer is shown with the blue line.



Source: LANL ***Hydrogeologic Synthesis Report*, December 2005**

- **The locations of the wells on the cross-section are displayed on Figure 1.**
- **From north to south on the cross-section -**
  - **The Los Alamos County drinking water well is G-5A.**
  - **The LANL monitoring wells in the regional aquifer are R-2, old test well TW-4 and R-26.**

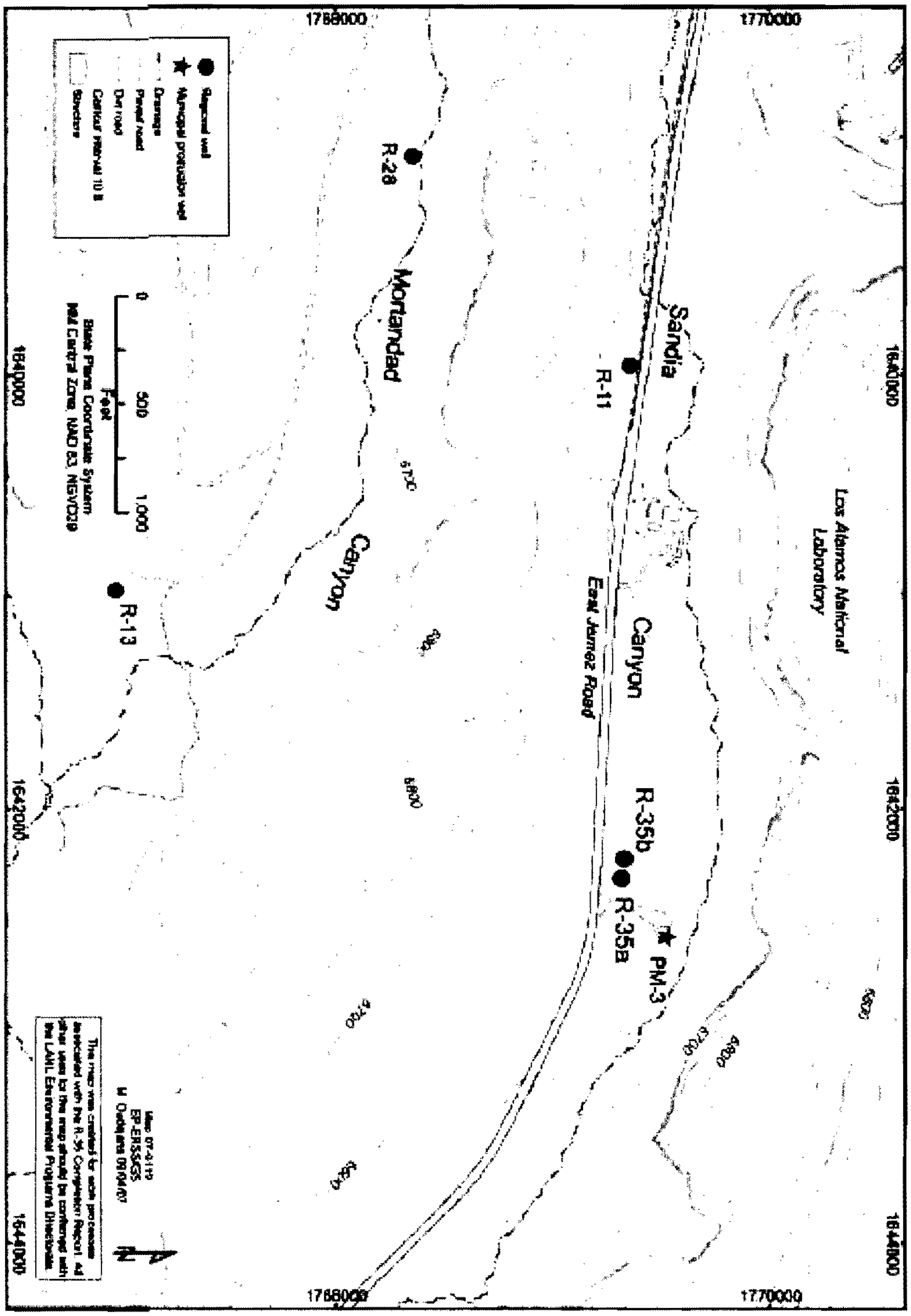
Figure 7. Conceptual north-south cross-section from the Guaje Canyon wells G-5 and G-6 north of the laboratory across the central part of the laboratory. Wells G-5 and G-6 are located approximately 1/2 mile southeast of well G-5a. The water table of the regional aquifer is shown with the blue line.



Source: LANL *Hydrogeologic Synthesis Report*, December 2005

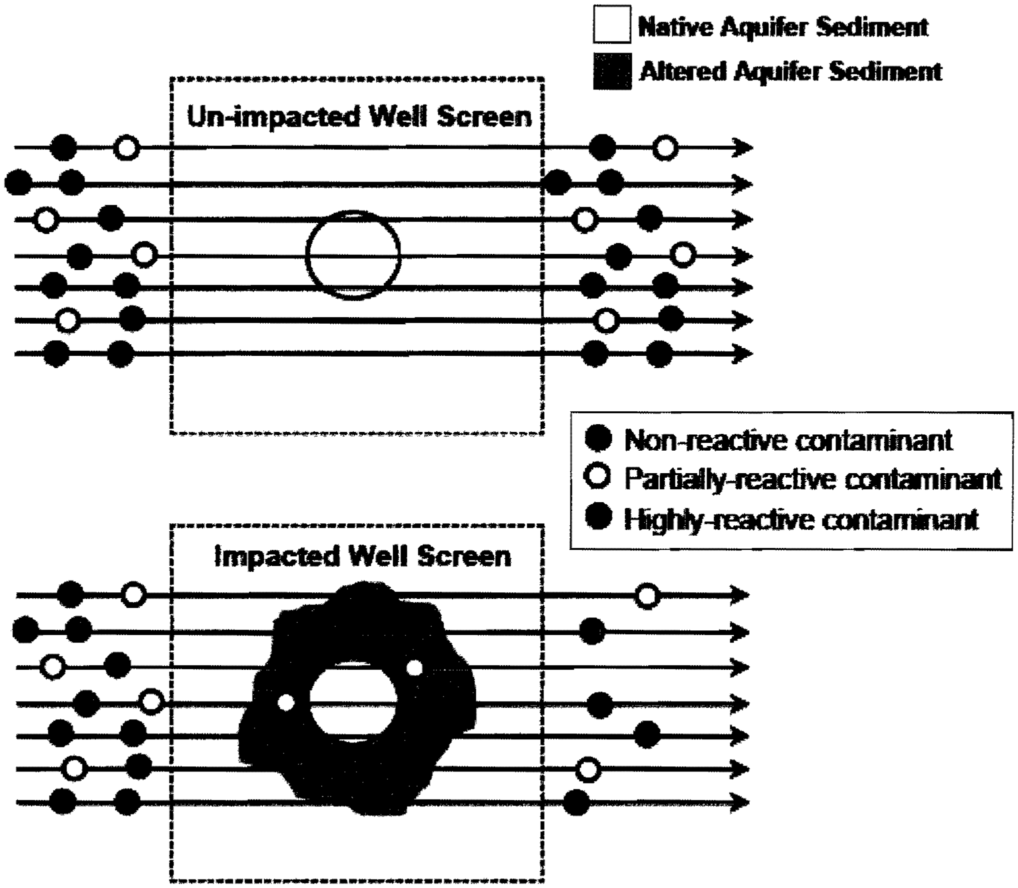
- **The locations of the wells on the cross-section are displayed on Figure 1.**
- **From north to south on the cross-section -**
  - **The Los Alamos County drinking water wells are G-5, G-6, O-4 and PM-5**
  - **The LANL monitoring wells in the regional aquifer are R-4, R-33, CdV-R-15-3 and CdV-R-37-2.**

Figure 8. The close locations of regional aquifer monitoring wells R-35a and R-35b to Los Alamos County drinking water supply well PM-3.



Source: Completion Report for Regional Aquifer Wells R-35a and R-35b. LANL report LA-UR-07-5324, September 2007.

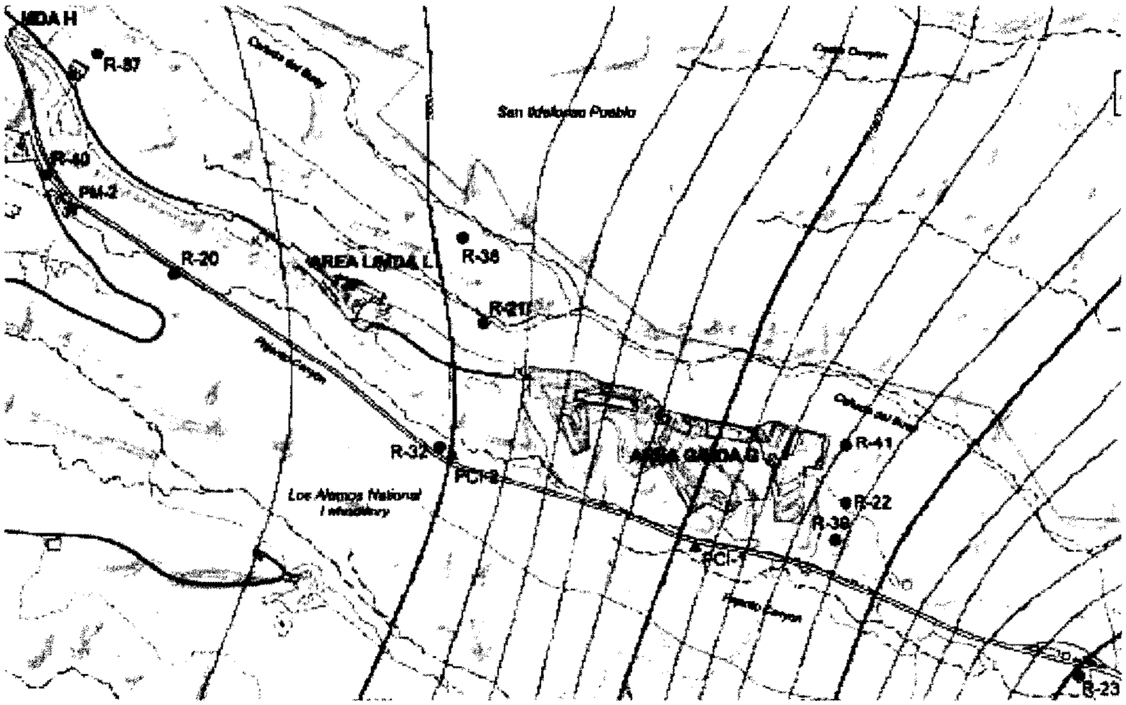
Figure 9. Conceptual schematic illustrating differential transport behavior of contaminants within the impacted zone adjacent to a well screen influenced by biodegradation of organic-based drilling fluids.



Source: Final Report of the EPA Kerr Laboratory on the LANL Monitoring Well Construction Practices, February 10, 2006.

- **Tritium and chloride are examples of Non-reactive Contaminants.**
- **Uranium and chromium may be examples of Partially-reactive Contaminants.**
- **The LANL radioactive contaminants plutonium, americium and cesium are examples of Highly-reactive contaminants.**
- **Zinc is an example of a naturally occurring trace metal that is highly reactive.**

Figure 10. Location of the RCRA "Regulated Unit" waste disposal sites MDA H, MDA L and MDA G atop Mesita del Buey at LANL Technical Area 54

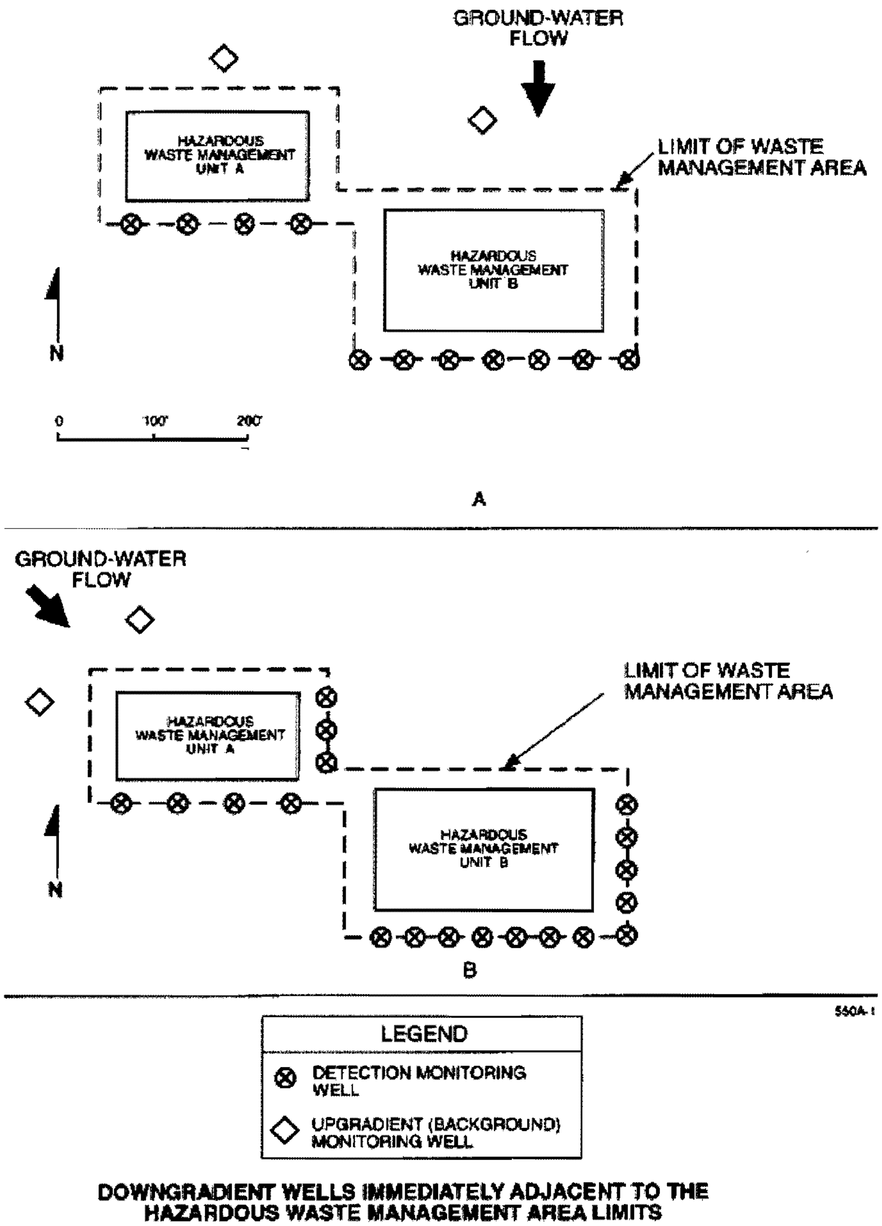


Scale 0-------------------2000 feet

- **Existing monitoring wells in the regional aquifer are shown as black dots**
- **Proposed monitoring wells in the regional aquifer are shown as red dots**

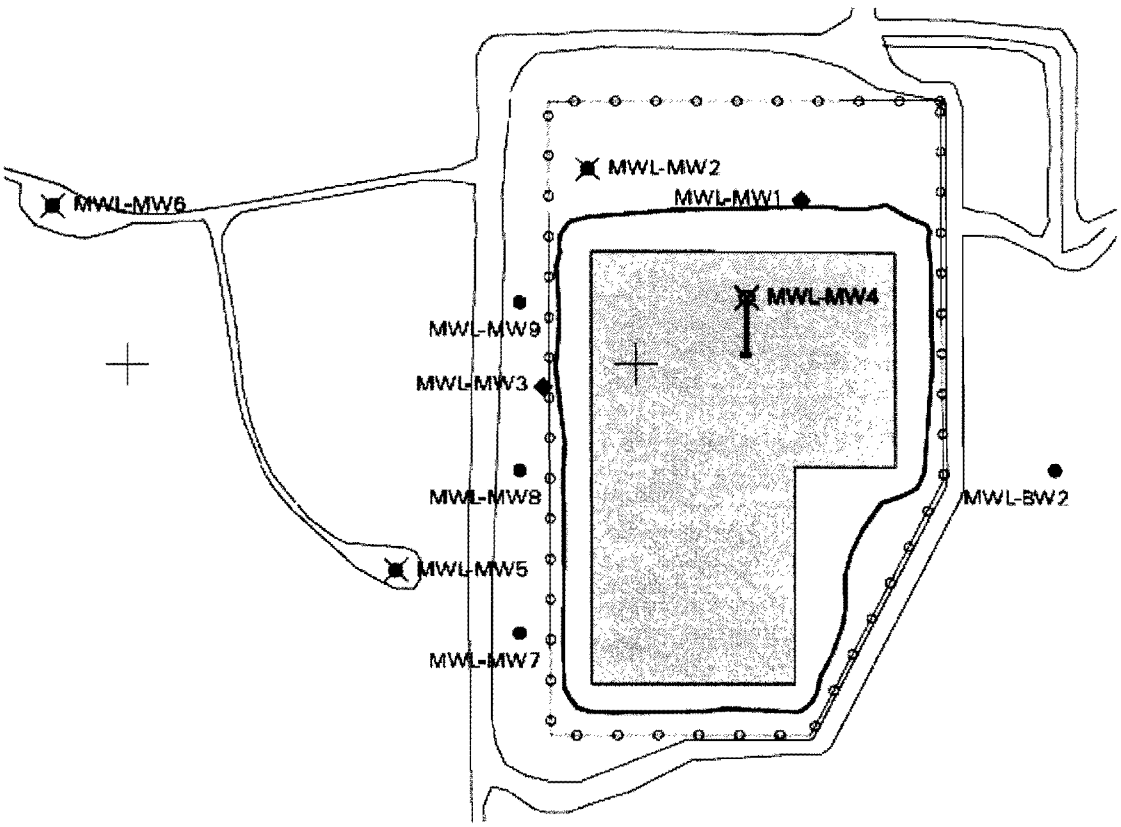
Source: ***TA-54 Well Evaluation and Network Recommendations, Revision 1***

Figure 11. The RCRA requirements for networks of monitoring wells at hazardous waste disposal sites. Background water quality monitoring wells are required to be installed at locations hydraulically upgradient of each disposal site.



Source: US EPA *RCRA GROUND-WATER MONITORING: DRAFT TECHNICAL GUIDANCE (The EPA Groundwater Manual)*, November, 1992

Figure 12. The NMED requirements for the network of monitoring wells at the Sandia National Laboratories Mixed Waste Landfill in Albuquerque, New Mexico.



Source: Sandia National Laboratories *Long-Term Monitoring and Maintenance Plan for the Mixed Waste Landfill*, September 2007.

- The down-gradient detection monitoring wells required for the long-term monitoring program are MWL-MW5, -MW6, -MW7, -MW8 and -MW9.
- Well MWL-MW4 is a detection monitoring well installed inside the Mixed Waste Landfill to monitor groundwater contamination below an unlined trench.
- Well MWL-BW-2 is the background water quality well that is located hydraulically upgradient of the Mixed Waste Landfill.
- The 2.6 acre Mixed Waste Landfill was in operation from 1959 through 1988. The hazardous and mixed waste are buried in unlined pits and trenches. The NMED has approved a plan to leave the wastes buried below a dirt cover.

Kieling, John, NMENV

From: Rhgilkeson@aol.com

Sent: Friday, September 04, 2009 5:54 AM

To: Kieling, John, NMENV

Cc: Rhgilkeson@aol.com; dave@radfreenm.org; mccoydb01@msn.com; Mayer.Richard@epamail.epa.gov; jarends@nuclearactive.org; ABERLYLAW@SWCP.COM; mariann2@windstream.net; serit@cybermesa.com

Subject: RCRA FINAL RULE sent to NMED for R.H. Gilkeson's Comment on LANL Draft Permit

Attachments: RCRAFE~1.PDF

September 4, 2009

Dear Mr. Kieling

This e-mail brings to the attention of the New Mexico Environment Department (NMED) the RCRA Final Rule in the Federal Register titled Standards Applicable to Owners and Operators of Closed and Closing Hazardous Waste Management Facilities:Post-Closure Permit Requirement and Closure Process; Final Rule.

This RCRA Final Rule is in the Federal Register, Vol. 63, October 22, 1998 on pages 56710 to 56735. I am referencing this RCRA Final Rule in my comments on the LANL Revised Draft Permit. My comments are submitted in a separate e-mail document that will be submitted to NMED today.

I request this RCRA Final Rule to be added to the New Mexico Environment Department Administrative Record for the Los Alamos National Laboratory (LANL). The Final Rule is in the attachment to this e-mail.

Please provide an answer to this request to confirm that the NMED has added the RCRA FEDERAL REGISTER FINAL RULE 63 56710 RCRA CLOSURE to the LANL Administrative Record..

Sincerely

Robert H. Gilkeson, Registered Geologist
P.O.Box 670
Los Alamos, NM 87544
505-412-1930
rhgilkeson@aol.com

federal register

Thursday
October 22, 1998

Part II

Environmental Protection Agency

40 CFR Parts 264, 265, 270, and 271

Standards Applicable to Owners and Operators of Closed and Closing Hazardous Waste Management Facilities: Post-Closure Permit Requirement and Closure Process; Final Rule

ENVIRONMENTAL PROTECTION AGENCY

40 CFR Parts 264, 265, 270, and 271

[FRL–6178–7]

RIN 2050–AD55

Standards Applicable to Owners and Operators of Closed and Closing Hazardous Waste Management Facilities; Post-Closure Permit Requirement; Closure Process

AGENCY: Environmental Protection Agency.

ACTION: Final rule.

SUMMARY: The Environmental Protection Agency (EPA) is amending the regulations under the Resource Conservation and Recovery Act (RCRA) in two areas. First, the Agency is modifying the requirement for a post-closure permit, to allow EPA and the authorized States to use a variety of authorities to impose requirements on non-permitted land disposal units requiring post-closure care. As a result of this rule, regulators have the flexibility to use alternate mechanisms under a variety of authorities to address these requirements, based on the particular needs at the facility.

Second, for all facilities, the Agency is amending the regulations governing closure of land-based units that have released hazardous constituents, to allow certain units to be addressed through the corrective action program. As a result of this rule, EPA and the authorized States will have discretion to use corrective action requirements, rather than closure requirements, to address the regulated units. This flexibility will reduce the potential for confusion and inefficiency created by the application of two different regulatory requirements.

Finally, the Agency is specifying the Part B information submission requirements for facilities that receive post-closure permits.

DATES: This rule is effective October 22, 1998.

ADDRESSES: Supporting materials are available for viewing in the RCRA Information Center (RIC), located at Crystal Gateway I, First Floor, 1235 Jefferson Davis Highway, Arlington, VA. The Docket Identification Number is F–98–PCPF–FFFFF. The RIC is open from 9 a.m. to 4 p.m., Monday through Friday, excluding Federal holidays. To review docket materials, it is recommended that the public make an appointment by calling (703) 603–9230. The public may copy a maximum of 100 pages from any regulatory docket at no charge. Additional copies cost $0.15/page. The index and some supporting materials are available electronically. See the Supplementary Information section for information on accessing them.

FOR FURTHER INFORMATION CONTACT: For general information, contact the RCRA Hotline at (800) 424–9346 or TDD (800) 553–7672 (hearing impaired). In the Washington, DC metropolitan area, call (703) 412–9810 or TDD (703) 412–3323.

For more detailed information on specific aspects of this rulemaking, contact Barbara Foster, Office of Solid Waste, Mail Code 5303W, U.S. Environmental Protection Agency, 401 M St. SW, Washington DC 20460, (703–308–7057), foster.barbara@epamail.epa.gov

SUPPLEMENTARY INFORMATION: The index and the following supporting materials are available on the Internet: Economic Assessment. Follow these instructions to access the information electronically:

WWW: http://www.epa.gov/epaoswer/osw/hazwaste.htm#closure
FTP: ftp.epa.gov
Login: anonymous
Password: *foster.barbara@epamail.epa.gov*
Files are located in /pub/epaoswer

Preamble Outline

I. Authority

These regulations are promulgated under the authority of sections 2002(a), 3004, 3005, and 3006 of the Resource Conservation and Recovery Act, as amended, 42 U.S.C. 6912(a), 6924, 6925, and 6926.

II. Background Information

A. Overview of RCRA Permit Authorities

Section 3004 of the Resource Conservation Recovery Act (RCRA) requires the Administrator of EPA to develop regulations applicable to owners and operators of hazardous waste treatment, storage, or disposal facilities, as necessary to protect human health and the environment. Section 3005 requires the EPA Administrator to promulgate regulations requiring each person owning or operating a treatment, storage, or disposal facility to have a permit, and to establish requirements for permit applications. Recognizing that the Agency would require a period of time to issue permits to all facilities, Congress provided, under section 3005(e) of RCRA, that qualifying owners and operators could obtain "interim status" and be treated as having been issued permits until EPA takes final administrative action on their permit applications. The privilege of continuing hazardous waste management operations during interim status carries with it the responsibility of complying with appropriate portions of the section 3004 standards.

EPA has issued numerous regulations to implement RCRA requirements for hazardous waste management facilities. These include the standards of 40 CFR Part 264 (which apply to hazardous waste management units at facilities that have been issued RCRA permits), Part 265 (which apply to hazardous waste management units at interim status facilities), and Part 270 (which provide standards for permit issuance).

1. Closure and Post-Closure Care

The closure regulations at 40 CFR Parts 264 and 265 Subpart G require owners and operators of hazardous waste management units to close these units in a manner that is protective of human health and the environment and that minimizes the post-closure releases to the environment. These regulations also establish procedures for closure: they require owners and operators to submit closure plans to the Agency for their hazardous waste management units, and they require Agency approval of those closure plans.

In addition, Parts 264 and 265 establish specific requirements for closure of different types of units. Under Parts 264 and 265 Subpart N, owners and operators of landfills are required to cover the unit with an impermeable cap designed to minimize infiltration of liquid into the unit; then owners or operators must conduct post-closure care (including maintenance of the cap and groundwater monitoring). Under Subparts K and L of Parts 264 and 265, owners and operators of surface impoundments and waste piles must either remove or decontaminate all hazardous waste and constituents from the unit, or leave waste in place, install a final cover over the unit, and conduct post-closure care. Closure of land treatment facilities must be conducted in accordance with closure and post-closure care procedures of §§ 264.280 and 265.280. As part of the closure plan approval process, the Agency has the authority to require owners and operators to remove some or all of the waste from any type of unit at the time of closure, if doing so is necessary for the closure to meet the performance standard of § 264.111 or § 265.111.

Under Subparts I and J of Parts 264 and 265, owners and operators of non-land based units (e.g., tanks and containers) are required to remove or decontaminate all soils, structures, and equipment at closure. Owners and operators of tanks who are unable to do so must close the unit as a landfill and conduct post-closure care (see, for example, § 265.197(b)).

Where post-closure care is required, owners and operators must comply with the requirements of §§ 264.117–120 or §§ 265.117–120. These provisions establish a post-closure plan approval process, similar to the closure plan approval process, and requirements for maintenance of the RCRA cap during the post-closure care period. Facilities also must comply with the groundwater requirements of Part 264 or Part 265 Subpart F during the same period.

2. Subpart F

The requirements of Parts 264 and 265, Subpart F apply to "regulated units," defined in § 264.90(a)(2) as any landfill, surface impoundment, waste pile, or land treatment unit that received hazardous waste after July 26, 1982 or that certified closure after July 26, 1983. While the standards of Parts 264 and 265, Subparts G (closure and post-closure care) and H (financial assurance) are equivalent for permitted and interim status facilities, Part 265 groundwater monitoring requirements for interim status land disposal units are less comprehensive than those established under the Part 264, Subpart F standards for permitted facilities. Whereas Part 265 sets minimum standards for the installation of detection monitoring wells (e.g., one upgradient and three downgradient wells), Part 264 establishes broader standards for establishing a more comprehensive monitoring system to ensure early detection of any releases of hazardous constituents. The specific details of the system are worked out through the permitting process. Consequently, compliance with Part 264 standards usually results in a more extensive network of monitoring wells. Similarly, Part 265 specifies a limited set of indicator parameters that must be monitored, while Part 264 establishes a more comprehensive approach under which the owner or operator is required to design a monitoring program around site-specific indicator parameters. As a result, monitoring systems designed in accordance with Part 264 standards are specifically tailored to the constituents of concern at each individual site. Additionally, Part 264 compliance monitoring standards are more comprehensive than Part 265 standards both in terms of monitoring frequency and the range of constituents that must be monitored. Finally, the Part 264, Subpart F regulations provide for corrective action for releases to groundwater whereas the Part 265, Subpart F regulations do not.

B. Overview of HSWA Corrective Action Authorities

In the 1984 Hazardous and Solid Waste Amendments (HSWA) to RCRA, Congress expanded EPA's authority to address releases from all solid waste management units (SWMUs) at hazardous waste management facilities. Section 3004(u) of HSWA required that any permit issued under section 3005(c) of RCRA to a treatment, storage, or disposal facility after November 8, 1984, address corrective action for releases of hazardous wastes or hazardous constituents from any SWMU at the facility. Section 3004(v) authorized EPA to require corrective action beyond the facility boundary where appropriate. Section 3008(h) provided EPA with authority to issue administrative orders or bring court action to require corrective action or other measures, as appropriate, when there is or has been a release of hazardous waste or, (under EPA's interpretation) of hazardous constituents from a facility authorized to operate under section 3005(e).

In a December 16, 1985 memorandum entitled *Interpretation of Section 3008(h) of the Solid Waste Disposal Act,* EPA interpreted section 3008(h) to apply not only to facilities that met the requirement for obtaining interim status, but also to facilities that were subject to but did not fully comply with the requirements for interim status, as well as to facilities that lost interim status pursuant to 40 CFR Part 124 or sections 3005(c) or 3005(e)(2) of RCRA. Later, in an August 10, 1989 memorandum entitled *Coordination of Corrective Action Through Permits and Orders* (OSWER Directive 9502.1989(04)), EPA clarified that interpretation by stating that a section 3008(h) order cannot be issued to a facility after final disposition of the permit application.

In practice, the corrective action process is highly site-specific, and involves direct oversight by the reviewing Agency. Unlike the closure process, which provides two options (closure with waste in place and closure by complete removal and decontamination), the corrective action process provides considerable flexibility to the Agency to decide on remedies that reflect the conditions and the complexities of each facility. For example, depending on the site-specific circumstances, remedies may attain media cleanup standards through various combinations of removal, treatment, engineering, and institutional controls.

EPA has codified corrective action requirements at §§ 264.101, 264.552, and 264.553, and currently implements these requirements through the permitting process. EPA also implements corrective action by issuing corrective action orders under section 3008(h) of RCRA. In addition, to facilitate the corrective action process, EPA proposed more extensive corrective action regulations on July 27, 1990, under a new Part 264 Subpart S (*see* 55 FR 30798). The July 27, 1990 Subpart S proposal set forth EPA's interpretation of the statutory requirements at that time. Later, EPA promulgated several sections of that proposal related to temporary units, corrective action management units, and the definition of "facility" (*see* 58 FR 8658, February 16, 1993).

On May 1, 1996, the Agency issued a **Federal Register** notice (61 FR 19432) defining the goals of the corrective action program, and providing guidance on its implementation. The notice also announced the Agency's Corrective Action Initiative and soliciting comment on issues related to the corrective action program. This initiative is a reevaluation effort to identify and implement improvements to the corrective action program, and to focus that program more clearly on environmental results. The notice specified five goals of the Corrective Action Initiative: (1) to create a consistent, holistic approach to cleanup at RCRA facilities; (2) to establish protective, practical cleanup expectations; (3) to shift more of the responsibilities for achieving cleanup goals to the regulated community; (4) to focus on opportunities to streamline and reduce costs; and (5) to enhance opportunities for timely, meaningful public participation.

C. Overview of Proposed Rule

1. Elements of the Proposal That Are Promulgated in This Final Rule

a. Post-closure care under alternatives to permits. The regulations promulgated in this rule were proposed by the Agency on November 8, 1994 (see Standards Applicable to Owners and Operators of Closed and Closing Hazardous Waste Management Facilities; Post-Closure Permit Requirement; Closure Process; State Corrective Action Authority (59 FR 55778)). That proposal was designed to give EPA and the authorized States greater flexibility in remediating RCRA facilities by modifying the regulations in several areas.

First, EPA proposed to allow EPA and authorized States to use a variety of legal authorities when addressing facilities that require post-closure care. Under the proposal, the Agency would continue to impose the same substantive groundwater, post-closure care, and corrective action requirements as it would under a permit, and would provide for adequate public participation.

The Agency proposed this change to provide regulators the necessary flexibility to use the best regulatory approach in addressing these sites. Prior to today's rule, section 270.1 required owners and operators of landfills, waste piles, surface impoundments, or land treatment units that received waste after July 26, 1982, or that ceased the receipt of wastes prior to July 26, 1982, but did not certify closure until after January 26, 1983, to obtain post-closure permits (unless they demonstrated that they met the § 270.1 requirements for closure by removal).

In the case of operating land disposal facilities, the RCRA permit, when first issued, incorporates the closure plan and applicable post-closure provisions. These post-closure conditions become effective after the facility ceases to manage hazardous waste and the closure plan has been implemented. The permit, when issued, also requires compliance with Part 264 Subpart F groundwater monitoring standards. Permits issued after November, 1984 also would impose the facility-wide corrective action requirements of RCRA section 3004(u), if necessary.

For interim status facilities that close without obtaining an operating permit, the requirement for a post-closure permit (typically issued after completion of closure) performed an important regulatory function. First, to secure a permit, the facility had to meet the permit application requirements of Part 270, which require extensive information on the hydrogeologic characteristics of the site and extent of any groundwater contamination. Second, once the post-closure permit was issued, the facility became subject to the standards of Part 264 rather than Part 265, most significantly to the site-specific groundwater monitoring requirements of Part 264 Subpart F. Third, the post-closure permit imposed facility-wide corrective action to satisfy the requirements of section 3004(u). Finally, the public involvement procedures of the permitting process assure that the public is informed of and has an opportunity to comment on permit conditions.

The requirement for post-closure permits was promulgated in 1982. At the time, the Agency believed that permits would be the most effective means to develop site-specific groundwater monitoring programs tailored to individual waste management facilities (see 47 FR 32366, July 26, 1982). Since that time, the Agency and the authorized States have issued hundreds of permits to closed and closing interim status facilities. In the course of issuing these permits, EPA and the States have encountered many facilities where post-closure permit issuance proved difficult or, in some cases, impossible. Generally, the Regions and States have encountered two major difficulties when issuing post-closure permits. First, some facilities chose to close, or are forced to close, because they cannot comply with Part 265 standards—particularly, groundwater monitoring and financial assurance. If a facility cannot meet these requirements, EPA cannot issue a permit to it because section 3005(c) of RCRA requires facilities to be in compliance with applicable requirements at the time of permit issuance. Second, owners or operators often have little incentive to seek a post-closure permit. Without a strong incentive on the part of the facility owner or operator to provide a complete application, the permitting process can be significantly protracted.

To address environmental risk at facilities such as those described above, Regions and States have frequently utilized legal authorities other than permits. Use of enforcement actions enables the Agency to place these facilities on a schedule of compliance for meeting financial assurance and/or groundwater monitoring requirements over a period of time. And, even where enforcement actions cannot bring about full regulatory compliance (e.g., where the owner or operator cannot secure financial assurance), they enable the

Agency to prescribe actions to address the most significant environmental risks at the facility. For example, EPA has often issued corrective action orders under the authority of section 3008(h) to address releases from regulated units and/or other SWMUs at these facilities. In other cases, Federal or State Superfund authorities have been used to address cleanup at sites. However, prior to this rule, EPA or the State was still required to issue a post-closure permit even where the environmental risks associated with the facility were addressed through other authorities.

EPA is promulgating, with minor revisions, those provisions of the November 8, 1994 proposal that remove the requirement to issue post-closure permits at each facility, and allow post-closure care requirements to be imposed using either permits or approved alternate authorities. Those provisions are promulgated in this rule in §§ 265.121, 270.1(c), and 271.16, and are discussed in sections III.A. and III.B. below.

b. Remediation requirements for land-based units with releases to the environment. The November 8, 1994 proposal also solicited comment on several issues related to the regulatory distinction between regulated units and SWMUs.

In 1982, when the regulatory structure for closure was established, the Agency had little experience with closure of RCRA regulated units. Since 1982, the Agency and authorized States have approved hundreds of closure plans, and overseen the closure activities taking place under those plans. It has become evident that closure of these units is frequently more complex than EPA envisioned in 1982. In many cases, particularly with unlined land-based units, the unit has released hazardous waste and constituents into the surrounding soils and groundwater. In some cases, the unit may be located near SWMUs or areas of concern that also have released hazardous constituents to the environment. As a result, the cleanup of similar releases may be subject to two different sets of standards and two different sets of procedures. EPA is concerned that this dual regulatory structure may unnecessarily impede cleanups.

In the November 8, 1994 proposal, the Agency addressed this issue by requesting comment on giving discretion to the Agency or the authorized State to impose requirements developed for corrective action in lieu of the requirements of Subparts F (groundwater), G (closure and post-closure), and H (financial assurance) at certain regulated units. After reviewing the comments, which largely supported the concept, EPA has decided to promulgate provisions providing that discretion for certain regulated units, both permitted and interim status, that appear to have released to the environment, if SWMUs also appear to have contributed to the same release. Those provisions are promulgated in this rule in §§ 264.90(f), 264.110(c), 264.140(d), 265.90(f), 265.110(d), and 265.140(d), and are discussed in sections III.A. and III.C. below.

c. Post-closure permit information submission requirements. In the November 8, 1994 rule, EPA proposed to add a new § 270.27 to identify that subset of the Part B application information that must be submitted for post-closure permits. Under that provision, an owner or operator seeking a post-closure permit would have to submit only that information specifically required for post-closure permits under that section, unless otherwise directed by the Regional Administrator. Under the proposal, the information required under § 270.27 would be submitted upon request by the Regional Administrator.

Proposed § 270.27 is promulgated in § 270.28 of this final rule.

2. Elements of the Proposal That Are not Promulgated in This Final Rule

a. State equivalent—corrective action enforcement authority for interim status facilities. The November 8, 1994 proposal also would have required States to adopt enforcement authority equivalent to section 3008(h) corrective action authority as part of their authorized program. Though many commenters supported this portion of the proposal, many State commenters strongly objected to it for several reasons.

Although EPA has the authority to require authorized States to have adequate enforcement programs, the Agency, after considering public comment, has decided not to proceed at this time with the requirement that States adopt section 3008(h)-equivalent authority as part of their authorized enforcement program. EPA believes the States raised significant issues that would need to be resolved prior to promulgation. This is not a final decision on this issue—the Agency may determine at a future date to adopt such a requirement.

EPA notes that States seeking authorization to issue enforceable documents in lieu of post-closure permits will need to submit their alternative legal authorities to EPA for review. As part of that review, EPA will determine whether the State authorities are broad enough to impose facility-wide corrective action at interim status facilities. Submission of these alternative authorities will be required only for States seeking authorization for this rule. It will not be required of all States.

b. Timeframes for closure. The November 8, 1994 proposal requested comment on whether the Agency should make modifications to the closure process, in particular, to the timeframes for closure. The Agency recognized that the current timeframes may, in some cases, not be adequate where the closure is really a cleanup activity, rather than the more straightforward capping or waste removal activities contemplated in 1982.

Though public comment generally agreed that the closure timeframes are not adequate, the Agency is not promulgating this provision of the November 8, 1994 proposal at this time. EPA, however, is promulgating a rule that will allow overseeing agencies to replace closure requirements—including closure timeframes—with requirements developed under corrective action, at some facilities. EPA expects that these revisions will allow site-specific flexibility for timeframes for some of the complex closures, thereby providing, in part, the relief intended by the proposal.

III. Section-by-Section Analysis and Response to Comment

A. Overview of Final Rule

1. Post-Closure Care Under Alternatives to Permits

This final rule creates an optional, new procedural mechanism for imposing requirements on units or facilities that closed without obtaining a permit. It ensures that these units have to meet the same substantive requirements that apply to units receiving post-closure permits.

The post-closure requirements for permitted facilities in Part 264 are more extensive than the analogous Part 265 interim status requirements in three areas: (1) the requirements for submission of information under Part 270; (2) Part 264 Subpart F requirements for groundwater management and corrective action for releases to groundwater; and (3) facility-wide corrective action requirements for releases from SWMUs under § 264.101. To impose equivalent requirements at interim status facilities, EPA or an authorized State must issue an enforceable document that performs many of the functions of a permit. Thus, the enforceable document must impose: (1) the requirements of new

§ 265.121(a)(1), which imposes information requirements that are relevant to closed facilities needing permits only for post-closure care; (2) the requirements of new § 265.121(a)(3), which applies Part 264 groundwater standards to the regulated unit; and (3) the requirements of new § 265.121(a)(2), which imposes facility-wide corrective action consistent with § 264.101.

The remaining requirements that apply during the post-closure care period relate to the maintenance of the closed unit and financial responsibility. The permitting and interim status standards for these requirements are virtually identical. Consequently, these requirements need not be addressed in the enforceable alternative to the permit—rather, the relevant portions of Part 265 Subparts G and H will continue to apply. Post-closure care requirements will normally continue to be set out in the facility's approved closure plan. Financial responsibility requirements are self-implementing. (Of course, EPA or an authorized State may chose to incorporate the Part 265 requirements for post-closure care and financial responsibility into an enforceable document, if they wish.)

The new, non-permit mechanisms provide opportunities for public participation, which differ somewhat from those set out in the permit issuance and modification procedures of Parts 124 and 270. EPA's new requirements reflect the Agency's efforts to provide as much public participation as possible, but also reflect the Agency's awareness that most of the alternate mechanisms used to address corrective action will be enforcement orders.

The current procedures for issuing post-closure permits first provide an opportunity for public comment at the time the permit is issued. This typically means that the public is able to comment on the plan for investigating suspected releases at the facility. Permit modification procedures then provide opportunities to comment at the time the permit authority selects a remedy for the facility. They also provide an opportunity to comment when the permit authority concludes that corrective action is complete. Under the Federal rules used by EPA, opportunities to file administrative appeals are available after each of these steps. (EPA, however, does not require States to provide for administrative appeals of permits).

The new public participation requirements for enforceable documents are codified at § 265.121(b). They require the overseeing agency to provide public notice and an opportunity to comment: (1) when the Agency becomes involved in a remediation at the facility as a regulatory or enforcement matter; (2) on the proposed remedy and the assumptions upon which the remedy is based; and (3) prior to making the final decision that remedial action is complete at the facility. They do not require either EPA or the States to provide opportunities for administrative appeals. EPA recognizes that, at least at the Federal level, this changes the opportunities for public involvement in the requirements that will govern closed hazardous waste facilities. EPA believes these requirements equal, and in some respect exceed, the current permitting requirements for public participation. On the other hand, the new requirements do not require an opportunity for administrative appeal. While this approach to a certain extent lessens the public's opportunity to challenge a decision, EPA believes that rights to administrative appeals (which can be exercised by a regulated facility as well as the public) are inappropriate in an enforcement context.

The final rule defines "enforceable document" at § 270.1(c)(7). Generally, Federal orders under section 3008(h) of RCRA and section 106 of CERCLA will fall within this definition and be eligible, as well as State orders issued under authorities reviewed and approved by EPA. Fund-financed actions under section 104 of CERCLA also will be eligible. Closure and post-closure plans, and State enforcement authorities analogous to RCRA section 3008(a) enforcement authority also will be appropriate mechanisms.

Table 1 summarizes these requirements.

TABLE 1.—ENFORCEABLE DOCUMENTS IN LIEU OF POST-CLOSURE PERMITS

Subject	Regulations for permits	Regulations for enforceable documents
Facility Information	§ 270.28	§ 270.28 (*see* § 265.121)
Groundwater Protection	Part 264, Subpart F *	Part 264, Subpart F (*see* § 265.121) *
Corrective Action	§ 264.101	§ 264.101 (*see* § 265.121)
Public Participation	Parts 124 and 270	§ 265.121
Financial Responsibility	Part 264, Subpart H *	Part 265, Subpart H *
Post-Closure Care of Regulated Unit	Part 264, Subpart G *	Part 265, Subpart G *

* For certain land-based units suspected of contributing to releases to the environment, these requirements may be replaced by site-specific requirements developed under corrective action. *See* new §§ 264.90(f), 264,110(c), 264.140(d), 265.90(f), 265.110(d), and 265.140(d) of this final rule.

2. Remediation Requirements for Land-Based Units With Releases to the Environment

The second portion of this final rule provides flexibility to regulators in another area of the RCRA regulations. As described above, two different sets of RCRA requirements arguably apply to a single release if both regulated units and SWMUs have contributed to the release. This rule provides flexibility to harmonize the two sets of requirements by substituting corrective action requirements for requirements for regulated units set out in Part 264 (for permitted facilities) or Part 265 (for interim status facilities). These optional, new provisions are available to regulators at a broad range of RCRA facilities, including, but not limited to, those covered by the change to post-closure permitting described above.

This portion of the rule provides EPA and authorized States with discretion to prescribe alternative groundwater monitoring, closure and post-closure, and financial responsibility standards at both operating and closed facilities, where EPA (or a State) finds that a release of hazardous waste or hazardous constituents has occurred, and both a regulated unit and one or more SWMUs (or areas of concern [1]) are likely to have contributed to the release.

For permitted facilities, the alternative standards will be issued in the permit (or issued in an enforceable document (as defined in § 270.1(c)(7))), which is referenced in the permit). EPA and authorized States may develop the cleanup requirements for the regulated unit and SWMUs under non-permit authorities, such as CERCLA or a State superfund statute, but they must incorporate them into the permit, or incorporate them into an enforceable document, which is referenced in the permit.

For interim status facilities, EPA or States authorized to implement this portion of this final rule must impose alternative closure, groundwater monitoring, and/or financial responsibility standards for interim status facilities in an enforceable document. "Enforceable documents" for this rule include RCRA section 3008(h) orders, actions under sections 104 or 106 of CERCLA, or State actions under authorities reviewed and approved by EPA as described below. If EPA or an authorized State issues alternative closure standards, the facility's closure plan and/or post-closure plan must be amended to set forth the alternative provisions, or to reference the enforceable document that sets forth those provision.

3. Post-Closure Part B Permit Information Submission Requirements

To ensure substantive equivalency of authorities used in lieu of post-closure permits, this final rule requires owners and operators to submit the same information specifically required for post-closure permits, upon request by the Agency, when an alternative authority is used in lieu of a post-closure permit. Section 265.121(a)(1) requires owners and operators obtaining enforceable documents in lieu of post-closure permits to submit the information required in § 270.28.

Section 270.28,[2] which is promulgated in this final rule, establishes information submission requirements for post-closure permits. As is discussed in detail in section III.D. of this preamble, § 270.28 specifies information that the Regional Administrator will request to issue a post-closure permit, and requires owners and operators to submit that information. It includes information the Agency believes will be important for all post-closure permits, that is, groundwater characterization and monitoring data, information related to long-term care of the regulated unit and monitoring systems, and information on SWMUs and possible releases. In addition, recognizing that additional information may be needed on a site-specific basis, § 270.28 also allows the Regional Administrator to require any of the Part B information specified in §§ 270.17, 270.18, 270.20, and 270.21. Section 265.121(a)(1) adopts this approach for alternative mechanisms as well.

B. Post-Closure Care Under Alternatives to Permits

1. Use of Alternative Mechanisms To Address Post-Closure Care (§ 270.1(c))

a. Detailed discussion of final rule. Section 270.1(c), amended by this rule, requires owners and operators closing unpermitted regulated units with waste in place either to: (1) obtain a post-closure permit, or (2) comply with the alternative post-closure requirements of § 270.1(c)(7). Prior to this rule, owners and operators of regulated units requiring post-closure care had to obtain permits for the post-closure period. This rule, by allowing another alternative to post-closure permitting, provides regulators with flexibility to address the post-closure period at RCRA facilities using a variety of legal authorities, including enforcement mechanisms.

Facilities that close with waste in place, without obtaining a permit, and then use non-permit mechanisms in lieu of a permit to address post-closure responsibilities, will have to meet three important requirements that apply to facilities that receive permits: (1) the more extensive groundwater monitoring required under Part 264, as they apply to regulated units; (2) certain requirements for information about the facility found in Part 270 that enable the overseeing agency to implement the Part 264 monitoring requirements; and (3) facility-wide corrective action for SWMUs as required under § 264.101. These requirements are set out in new § 265.121, which applies to interim status facilities requiring post-closure care.

EPA and States authorized for this rule must impose these requirements in enforceable documents, as defined in § 270.1(c)(7) of this rule, if they are being issued in lieu of permits. Federal enforcement orders issued under sections 3008(a) and 3008(h) qualify as enforceable documents. Post-closure plans issued by EPA under § 265.118, which are enforceable under section 3008(a), also will qualify. Orders issued under section 106 of CERCLA will also be eligible, as will decision documents describing response actions under CERCLA section 104. Although response actions under section 104 are often carried out by EPA using monies from the Superfund, rather than by responsible parties under orders, it is reasonable to rely on them because EPA is responsible for carrying out the cleanup work. EPA does not intend this rule to revise the existing policy to defer from listing on Superfund's National Priorities List (NPL) those facilities that are subject to RCRA corrective action. However, since the policy permits the listing of some RCRA facilities on the NPL (such as bankrupt or recalcitrant facilities), some of the facilities subject to this rule may also be eligible for cleanup under CERCLA section 104, and EPA (or an authorized State) may wish to rely on the CERCLA action to discharge the facility's cleanup responsibilities.

States obtaining authorization for this rule will be able to use enforceable cleanup orders similar to EPA's section 3008(h) orders, as well as State superfund authorities. EPA has not yet formally reviewed these State cleanup authorities, so it will require States that wish to use them to submit them for review as part of the State authorization process. EPA will determine whether they provide: (1) the substantive requirement of adequate authority to compel cleanup of all releases from SWMUs within a facility's boundary, as needed to protect human health and the environment (*see* new § 265.121(a)(2)), and (2) procedural requirements to ensure compliance (i.e., adequate penalty and injunctive authority to address failures to comply) (*see* new § 271.16(e)). EPA does not anticipate that plans for truly "voluntary" cleanups will meet the enforceability requirement, although it is willing to look at mechanisms called "voluntary" plans or agreements to determine whether the State has adequate authority to compel compliance. (EPA emphasizes that this rule does not preclude the use of State "voluntary" authorities to address cleanup at RCRA facilities and, indeed, EPA encourages their use under the appropriate circumstances. Nor does it affect the ability of EPA Regions to enter into memoranda of agreement or other mechanisms promoting the use of State voluntary programs at RCRA facilities, where appropriate. This rule only

[1] Area of concern means any area of a facility under the control or ownership of an owner or operator where a release to the environment of hazardous wastes or hazardous constituents has occurred, is suspected to have occurred, or may occur, regardless of the frequency or duration (*see* final RCRA section 3008(h) Model Consent Order, December 15, 1993).

[2] This provision was promulgated as § 270.72.

addresses the question of whether the State uses these authorities to satisfy the post-closure permit obligation.)

EPA expects that, in some cases, the overseeing agency or agencies will choose to use more than one mechanism to ensure that the substantive post-closure requirements in new § 265.121 are imposed. For example, if EPA were addressing a facility with releases at SWMUs and a regulated unit with no release, it could issue a section 3008(h) order to address the releases from the SWMUs. EPA, however, might decide that such an order would not be the most effective means of imposing long-term groundwater monitoring requirements for the non-leaking regulated unit. The new requirements could be imposed on the regulated unit in a revised interim status post-closure plan. Alternatively, EPA could issue a section 3008(a) order to enforce the new requirements (codified in this rule at § 265.121). Sometimes, multiple agencies may be involved. For example, a State that does not have a cleanup order authority could revise an interim status post-closure plan (or issue a State enforcement order analogous to section 3008(a)) to address a regulated unit, and rely on an EPA section 3008(h) order to address any releases from SWMUs.

Facilities subject to the new § 265.121 will remain subject to all other applicable interim status requirements, including requirements for financial assurance. These remaining interim status requirements are virtually identical to permit requirements, so there is no need to address them in the new alternatives to post-closure permits. These interim status requirements will continue to be enforceable under section 3008(a) and analogous State authorities.

Facilities subject to the new § 265.121 also will remain subject to section 3008(h) authority unless or until EPA or the authorized State issues a final disposition of a permit application under § 270.73, thereby terminating interim status at the facility. It should be noted that in a **Federal Register** notice dated May 1, 1996 (61 FR 19432, at 19453–4) EPA erroneously stated that facilities at which the regulated units clean closed under interim status no longer have interim status. EPA corrects that statement in this rule and restates the Agency's longstanding position that interim status is terminated only by a final disposition of a permit application, or by the methods outlined in § 270.73, which do not include clean closure. The May 1, 1996, **Federal Register** notice correctly stated that section 3008(h) continues to apply at clean closed facilities where there has been no final disposition of a permit application. Similarly, section 3008(h) continues to apply at facilities addressed through an approved alternate authority until final disposition of a permit application under § 270.73. Issuance of an alternate mechanism does not terminate interim status authorities.

b. Response to comment. Commenters on the proposed rule largely supported the provisions that would remove the permit requirement. Many commenters agreed with the Agency that the rule allows flexibility to regulators, yet maintains protection of human health and the environment.

Some commenters objected that the Agency should have the authority to issue an order or a permit, but should not be able to issue an order, and later to issue a permit to the facility. EPA disagrees. The Agency currently has the authority to issue a permit after the facility is addressed through an alternate authority, such as an enforcement order. This rule does not modify the Agency's authority to issue permits in this situation. Rather, it takes away the permitting obligation in cases where the facility is addressed through an alternate mechanism, by making the permit one of several options to address the facility. EPA believes this approach makes sense, and allows EPA to chose the best available mechanism, while retaining authority to use whatever authority is necessary to protect human health and the environment. EPA notes, however, that it is not likely to issue a permit to impose requirements that a facility has already satisfied under an alternate, enforceable document. Rather, it would limit a permit to requirements that, for some reason, had not been fully satisfied.

Several commenters expressed concern over discussion in the preamble of the November 8, 1994 proposal related to uncooperative facilities. The preamble explained that where the owner or operator is financially incapable of meeting the threshold requirements for permit issuance, such as compliance with the financial assurance requirements, or where the owner or operator may be uncooperative and an enforcement action is necessary, the post-closure permit is likely not the best mechanism to use. The preamble further explained that a post-closure permit will generally be the preferable mechanism for cooperative facilities capable of meeting financial assurance requirements.

Several commenters interpreted this discussion to limit the use of alternate mechanisms to uncooperative facilities not in compliance with applicable financial assurance and groundwater requirements. Commenters objected that facilities should not be rewarded for non-compliance, and that the proposal was making the post-closure care process more burdensome for compliant facilities. Other commenters thought the Agency was proposing to exempt non-compliant facilities from certain requirements.

The Agency did not intend to limit the use of alternate authorities to facilities not in compliance with applicable RCRA requirements. EPA only identified these facilities as examples of where an enforcement mechanism was more appropriate than a permit. Furthermore, EPA does not consider the imposition of alternative enforcement authorities to be a "reward," since such authorities might often include stipulated penalties and, in any case, would impose the same substantive standards as a permit. EPA will retain section 3008(a) authority to enforce against closed interim status facilities that have failed to meet Part 265 financial assurance requirements. As to groundwater monitoring, this rule will substitute the stricter Part 264 requirements for the original Part 265 requirements. EPA will retain authority to use section 3008(a) to enforce past violations of the Part 265 monitoring requirements and to assure that the facility complies with Part 264 requirements once they are put in place by a revised interim status post-closure plan (or other enforceable mechanism). The rule will also require facility-wide corrective action as required under permits. More important, EPA notes that the new authority to use alternatives to post-closure permits is not limited to facilities that are out of compliance with Part 265 requirements. All facilities that have closed (or that, in the future, will close) with waste in place without obtaining a permit are eligible.

Many commenters objected that this preamble discussion appeared to remove the interim status groundwater and financial assurance requirements at facilities not in compliance with the regulations. However, the Agency did not eliminate interim status financial assurance requirements. Facilities addressed through alternate mechanisms remain subject to the financial assurance requirements of Part 265 Subpart H. They become subject to the more prescriptive groundwater requirements of Part 264 Subpart F. Rather than waive requirements at non-compliant facilities, as commenters believe, this rule continues to require compliance with upgraded requirements.

Some commenters believed that the choice of mechanism should be left to the facility, or that the options should be discussed at length to achieve consensus. These commenters believed that an otherwise reluctant owner or operator is more likely to commit resources to meet agency goals if regulatory alternatives and consequences are clearly discussed and understood up-front.

Other commenters believed that the regulations should specify when an alternative authority would be used in lieu of a permit, and remove some of the Agency's discretion.

EPA did not take either approach suggested by these commenters. EPA agrees with commenters that the owner or operator generally should be involved in discussions related to the selection of mechanisms. This is particularly true of cooperative facilities in compliance with applicable requirements and eligible for post-closure permits. EPA intends to take into consideration the preference of facility owners and operators in deciding how to address these facilities, and it encourages authorized States to do so as well. However, EPA believes that it is important to provide the Agency and authorized States flexibility to consider all factors when deciding what authority to use to address a site. These factors will include conditions at the site, the availability of alternate State authorities, availability of resources, preference of the owner or operator and the local public, and the compliance status of the owner or operator. The Agency believes that by attempting to establish criteria in this rule, it would unnecessarily limit the flexibility to make the decision that best ensures protection of human health and the environment at each site.

Some commenters believed the owner or operator should have opportunity to challenge the Agency's or authorized State's choice of mechanism. EPA disagrees, and believes that the choice of mechanism to use to address a facility is an inherently governmental decision that should not be subject to challenge. EPA believes this approach is consistent with longstanding policy on enforcement discretion, and is vital to an effective enforcement program.

This rule limits the use of alternate mechanisms to facilities that have not received permits. Some commenters believed that the Agency should modify the rule to allow permits to be converted to orders and allow owners or operators of permitted facilities to address the post-closure period through another mechanism.

EPA has not adopted the commenter's suggestion, as this rulemaking deals only with alternative mechanisms for closed facilities that have not yet received post-closure permits. It should be noted that existing §§ 264.117(a)(2)(i) and 265.117(a)(2)(i) address commenters' concern to some extent by allowing the Agency to shorten the post-closure period upon a determination that the shortened period is protective of human health and the environment.

Another commenter suggested that EPA should be allowed to use alternative authorities at closed facilities, needing post-closure permits, that have submitted a Part B permit application. The Agency agrees that it should not be precluded from using alternative mechanisms at these facilities so long as it has not issued a Part B permit.

Some commenters objected to the provisions of the rule that would remove the requirement that EPA use the post-closure permit as the vehicle to impose Part 264 requirements for post-closure care. One commenter believed that the Agency should use enforcement orders to overcome the obstacles to permitting it described (such as non-compliance with financial assurance requirements). This commenter believed that post-closure permitting is protracted because EPA has not used its enforcement authority to move facilities through the permitting process, and has not made issuing post-closure permits a priority.

EPA disagrees with this commenter. There are many facilities in the RCRA universe that are not able to meet the financial assurance requirements of Subpart H. While EPA can take enforcement actions against these facilities to bring them into compliance to the extent possible, there are some facilities that never will be able to meet those requirements, despite an enforcement order. As was explained above, EPA will not be able to issue permits to such facilities. Further, the Agency believes that the flexibility provided by this rule is important, not only to address non-compliant facilities, but to allow regulators to use the most appropriate authority available to them at all facilities. This choice may be based on many factors, including the specific conditions at the facility, availability of approved alternate State cleanup authorities, and recalcitrance of the facility. Thus, while the Agency agrees with the commenter that it is important to take enforcement actions against facilities to bring them into compliance whenever possible, and that enforcement authorities should be used to expedite the permitting process, it does not agree that post-closure permits should or can be issued to all facilities. Further, EPA is more interested in obtaining environmental results than in the choice of mechanism used, and in eliminating redundant processes.

Other commenters believed that the Agency remains subject to the permit deadline for land disposal facilities in RCRA section 3005(c)(2)(A)(i). Those commenters believed that revisions to the rules that reduce the existence of or scope of this mandatory duty to issue post-closure permits in a timely manner violate section 3005(c) of RCRA, and that Congress enacted the permit deadlines based upon the rules then in effect.

EPA agrees that section 3005(c) of RCRA required the Administrator to issue or deny a final permit for each applicant for a land disposal permit by November, 1988. EPA also agrees that, so long as its regulations require it to issue post-closure permits to land disposal facilities, those post-closure permits are subject to the statutory deadline. EPA, however, does not agree that section 3005(c) deprives it of authority to determine whether post-closure permits are necessary or desirable means of imposing post-closure care requirements. Section 3005(c) imposes a deadline for permitting, but does not define the scope of the permitting requirement.

In 1982, when EPA promulgated the post-closure permit requirement, it had discretion under the statute to choose a procedural mechanism for imposing post-closure care requirements on facilities that closed while in interim status. It selected permits rather than interim status closure plans or other alternatives. The fact that Congress enacted a deadline for issuing permits to land disposal facilities in 1984 did not change that discretion. Nothing in the statute or the legislative history of the section 3005(c) indicates that Congress was aware of or concerned about EPA's use of permits to impose post-closure care requirements at facilities closing under interim status. The legislative history of other portions of the 1984 amendments suggests that Congress was concerned that EPA's 1984 regulations for land disposal facilities imposed more stringent requirements for ground-water monitoring and closure on permitted facilities than on interim status facilities. EPA, however, has eliminated this discrepancy, amending the rules for closure on March 19, 1987 (*see* 52 FR 8704), and the rules for groundwater monitoring today.

Essentially, this commenter argues that Congress "ratified" EPA's 1982 post-closure permit rule, making it part of the statute so that EPA could no longer revisit it. EPA does not agree with this interpretation of section 3005(c). Nothing in the statute or the legislative history suggests that Congress wanted to prohibit EPA from revising this part—or, indeed, any part—of the rules defining the scope of the permit requirement. The same is true for the requirement for public participation in permitting set out in section 7004(b)(1) of RCRA. There is no evidence that Congress intended the public participation requirements to create a statutory duty to issue post-closure permits.

EPA acknowledges that it could deny post-closure permits for all of the land disposal facilities that obtain enforceable documents in lieu of post-closure permits. Permit denials would satisfy the requirement of section 3005(c) to issue or deny final permits. EPA, however, does not believe that Congress intended it to impose a deadline on the denial of permits for facilities no longer obligated to have them. The Agency believes it is simply not reasonable to interpret the statute to require EPA to spend scarce resources on actions with so little environmental significance.

Other commenters questioned whether issuance of an alternate mechanism would terminate interim status. This rule does not modify the requirements to terminate interim status, which are outlined in § 270.73. Thus, facilities that have units that closed with waste in place under interim status, and do not receive a post-closure permit as a result of this rule, will remain in interim status until there is final disposition of a permit application (in the case of these closed facilities, a permit denial) under § 270.73(a). EPA recognizes that owners and operators may want to terminate interim status when all RCRA activities are complete at a facility to bring finality to those activities, and that this is an important issue not only to facilities subject to post-closure requirements, but to all facilities that closed without obtaining a RCRA permit. EPA plans to issue guidance related to denial of permit applications for purposes of terminating interim status at closed facilities that have completed all RCRA activities, including facility-wide corrective action.

The Agency agrees that some integration of the closure and facility-wide corrective action requirements is warranted. The Agency has taken steps in this final rule to address the situation where two units are involved in the same remedy and there is potential for the two sets of requirements to conflict.

Other commenters raised concerns that the rule would affect EPA's current policy of using only one authority—CERCLA or RCRA—at a site. Another commenter conditioned support for the proposal on EPA clarifying that it does not intend to modify its current Superfund policy that defers remediation activities to RCRA corrective action authority. On June 10, 1986, EPA published a final policy that allowed the Agency to defer listing RCRA-related sites on Superfund's National Priorities List (*see* 51 FR 21054). This commenter is concerned that if the Agency adopts the rule as proposed, which would allow use of Superfund orders as an alternative mechanism for RCRA post-closure permits, then the Agency would begin to deviate from that policy. The commenter believes that the reasons for deferral to RCRA authority cited in the deferral policy are still valid.

This rule does not modify the Agency's current policies related to the applicability of CERCLA and RCRA at hazardous waste sites. For example, the rule does not affect CERCLA listing policy. The Agency expects that RCRA facilities will, generally, continue to be handled under RCRA, rather than CERCLA. Rather, the result of this rule is that once the Agency decides to address a site under CERCLA authority, EPA is no longer required to issue a post-closure permit at the site, as long as the CERCLA cleanup has the same scope as a corrective action cleanup would have.

2. Requirements for Alternative Mechanisms

Under the provisions of this rule that remove the requirement for post-closure permits, regulated units that do not obtain a post-closure permit generally will remain subject to the requirements for interim status units throughout the post-closure care period. However, because the interim status post-closure care requirements are in some respects less stringent than post-closure permit requirements, the Agency is promulgating § 265.121. This section recognizes the difference in substantive requirements applicable to permitted and interim status post-closure units, and assures that this rule will not result in less stringent requirements at units addressed through alternate mechanisms.

Specifically, § 265.121 requires owners and operators of regulated units addressed through an alternate mechanism to comply with the groundwater requirements of Part 264 Subpart F (with respect to that unit), to submit information required under Part 270, and to address facility-wide corrective action. EPA will review State order authorities to ensure that they are capable of imposing these requirements before authorizing States to use them.

a. Part B Information Submission Requirements (§ 265.121(a)(1)). i. *Overview.* To ensure substantive equivalency of authorities used in lieu of post-closure permits, this rule requires owners and operators to submit the Part 270 information specifically required for post-closure permits, upon request by the Agency, when an enforceable document is issued in lieu of a post-closure permit. The information submission requirements for post-closure permits are promulgated in this final rule in § 270.28, and are discussed in detail in section III.D. of this preamble. Section 270.28 specifies information the Agency believes will be important for all post-closure permits, and, in turn, for all enforceable documents issued in lieu of post-closure permits, that is, groundwater characterization and monitoring data, information related to long-term care of the regulated unit and monitoring systems, and information on SWMUs and possible releases.

In addition, recognizing that additional information may be needed on a site-specific basis, § 270.28 also allows the Regional Administrator to require any of the Part B information specified in §§ 270.17, 270.18, 270.20, and 270.21. Section 265.121(a)(1) adopts this approach for enforceable documents issued in lieu of post-closure permits as well.

ii. *Response to Comment.* One commenter asked EPA to state explicitly in the rule that facilities pursuing the alternative approach would not be required to submit the information required in § 265.121(a)(1) any earlier than they would otherwise be required to submit a Part B application. EPA agrees with the commenter that the information would not be required earlier in the case of an alternate authority than it would be in the case of a permit. In the case of post-closure permits, the Agency typically calls in Part B information when it is ready to begin working on the permit application. This has become the Agency's practice because the Agency recognizes that, if information is submitted earlier, it can become outdated and have to be replaced when it is time to work on the permit. The Agency is extending this practice to instances where a non-permit mechanism is used to address post-closure care. As in the case of the post-closure permit, the information required by § 265.121(a)(1) for non-permitted facilities need not be submitted to the Agency until the Agency requests it.

b. Subpart F Groundwater Monitoring and Corrective Action Program (§§ 265.121(c)(3) and 264.90–264.100). i. *Overview.* This rule requires owners and operators of facilities with regulated units addressed through a non-permit mechanism under § 270.1(c)(7) to meet the requirements of Part 264, Subpart F. Section 265.118(c)(4) requires that the post-closure plan include provisions that implement the Part 264 Subpart F requirements.[3] This approach is designed to ensure equivalent protection of human health and the environment at all facilities, regardless of which legal authority used to address post-closure care. Commenters generally supported this approach, and the Agency is promulgating this provision as proposed.

ii. *Response to Comment.* Though many commenters supported the proposed provision, others argued that it was an illegal expansion of the Agency's statutory authority. EPA disagrees. The statute does not limit EPA's ability to impose more stringent groundwater monitoring requirements on interim status facilities. EPA developed the current regulations based on the premise that facilities would remain in interim status only temporarily and ultimately would receive permits and become subject to the requirements of Part 264 for groundwater. As a result of this rule, however, some facilities that closed while still under interim status standards will not receive a permit. EPA believes it is within the Agency's statutory authority to modify the regulations and assure that those facilities ultimately comply with the more stringent requirements of Part 264, whether a permit is issued or an alternate authority is used to address post-closure care.

One commenter conditioned support for the proposal on EPA removing Part 264 groundwater requirements for regulated units, and requiring instead that they have a groundwater monitoring and response program that is necessary to protect human health and the environment.

In the second part of this rule, EPA is providing discretion to waive Part 264 groundwater monitoring only in cases where corrective action will provide opportunities for oversight by the implementing Agency. In other cases, the Agency continues to believe that it needs the detailed requirements of Part 264, with interaction with the overseeing agency, to ensure protection of human health and the environment. In proposing to modify the requirement for post-closure permits, the Agency did not intend to remove or modify the groundwater requirements applicable to regulated units under post-closure permits—only to allow regulators to use a variety of mechanisms to impose those requirements. Thus, EPA believes that commenter's request extends to issues that are outside the scope of this rulemaking.

c. *Facility-Wide Corrective Action (§ 265.121(a)(2)).* i. *Overview.* This rule requires that authorities used at post-closure facilities as alternatives to post-closure permits impose corrective action requirements consistent with the statute and § 264.101 of the regulations. The rule does not specify the authorities that EPA or a State could use to impose corrective action as an alternative to a post-closure permit—only that the authority must be consistent with RCRA corrective action requirements. Certainly, RCRA section 3008(h) orders are appropriate, but EPA has not limited alternative authorities to this section. State enforcement authorities analogous to section 3008(h) or State cleanup or superfund authorities also would be appropriate, if they were used consistently with the requirements of § 265.121 (*see* requirements for State authorization in section IV.D.1. of this preamble).

In requiring facility-wide corrective action consistent with RCRA section 3004(u) and (v) provisions, EPA does not intend to require that cleanup programs relying on alternative authorities use the procedures of EPA's Subpart S proposal (which the Agency significantly revised in its May, 1996 ANPR) or permit requirements. Rather, the authorities must be broad enough to meet the performance standards of § 264.101. For example, compliance with the National Contingency Plan (NCP) procedures for remedy selection would satisfy these proposed requirements. EPA wishes to emphasize, however, that an alternative approach to corrective action at a facility, used in lieu of a permit, must include a facility-wide assessment, must address releases of hazardous wastes or constituents to all media from all SWMUs within the facility boundary (as well as off-site releases to the extent required under section 3004(v)—as necessary to protect human health and the environment), and must be protective of human health and the environment. Anything less than that, in EPA's view, would not meet the basic requirements of RCRA sections 3004(u) and (v) or § 264.101. EPA believes that this proposed approach is appropriate because it provides reasonable flexibility for regulatory agencies using available authorities to address environmental problems at RCRA sites.

ii. *Response to Comment.* Commenters generally supported this provision, and many commenters agreed that the Agency should not require corrective action procedures identical to those in EPA's Subpart S proposal.

Some commenters objected to the principle that corrective action be consistent with the Subpart S proposal. These commenters believe that because the Subpart S requirements and procedures are not final, it is legally indefensible to base a rule on them. Another commenter believed that until Subpart S regulations are codified and adopted, corrective action clean-up standards should meet the RCRA closure performance standard.

EPA agrees that alternative authorities used to address corrective action should be consistent with promulgated standards and with the statute. EPA did not intend this rule to require compliance with portions of the Subpart S proposal that have not yet been made final. Rather, this rule requires that the authorities must be consistent with promulgated § 264.101. It should be noted that authorities consistent with § 264.101 include provisions originally proposed under Subpart S, that is, provisions allowing designation and use of corrective action management units (§ 264.552) and temporary units (§ 264.553).

3. Public Involvement (§ 265.121(b))

a. Overview. The public involvement provisions proposed in the November 8, 1994 rule are modified in this final rule. In the November 8, 1994 rule, the Agency proposed to require a minimum level of mandatory public participation for all facilities where alternate authorities were used in lieu of post-closure permits. Proposed § 262.121(b) would have established the following requirements at the point of remedy selection: (1) public notification of the proposed remedy through a local newspaper; (2) opportunity for public comment (at least 30 days); (3) availability of a transcript of the public meeting; (4) availability of a written summary of significant comments and information submitted, and the EPA or State response; and, (5) if the remedy is significantly revised during the public participation process, a written summary of significant changes or opportunity to comment on a revised remedy selection. The Agency proposed an exception to these requirements in

[3] Note that §§ 264.90(f) and 265.90(f) of this rule amend the requirements of Subpart F to allow the Regional Administrator to replace Subpart F requirements at regulated units with requirements developed through a corrective action process, in some cases (see section III.B. of this preamble).

§ 265.121(b)(2), whereby if a delay in the implementation of the remedy would adversely affect human health or the environment, EPA could delay the implementation of the public involvement requirements.

This final rule requires the Regional Administrator to assure that a meaningful opportunity for public involvement occurs, which includes, at a minimum, public notice and opportunity for comment, at three key stages—when EPA or the authorized State agency first becomes involved in the cleanup process as a regulatory or enforcement matter, when EPA or the authorized State Agency is ready to approve a remedy for the site (this opportunity must include a chance to comment on the assumptions on which the remedy is based), and when EPA or the authorized State is ready to decide that remedial action is complete at a facility. The rule does not limit public involvement to these stages of cleanup; rather, it encourages early, open, and continuous involvement of the public when alternate authorities are used at a facility in lieu of post-closure permits, similar to the public involvement provided by the permitting process. In addition to notifying the public at these three key stages, EPA believes meaningful public involvement includes regular updating of the community on the progress made cleaning up the facility.

Additionally, it is the Agency's expectation that owners and operators conducting cleanups prior to the Agency's or authorized State's involvement will involve the public in decisions throughout the remediation process. Owners and operators should provide notice and opportunity to comment prior to selecting a remedy if they wish to later rely on that remedy as part of an enforceable document issued in lieu of a post-closure permit. The Agency took this approach based on several considerations.

First, it is EPA's policy to encourage public involvement early and often in the permitting process, in its remediation programs, as well as in other Agency actions. EPA wanted this rule to be consistent with that policy.

Second, EPA recognized that the post-closure permit process assures opportunity for public involvement at the time of permit issuance, and through the permit modification procedures. EPA wanted this rule to provide similar opportunities when an alternate authority is used to address a facility.

Third, EPA recognized that existing State and Federal authorities provide for public involvement through widely varying processes. EPA wanted to provide sufficient procedural flexibility to minimize the likelihood that States would have to modify the public involvement provisions of their existing cleanup programs to qualify for authorization, yet EPA wanted to assure, at the same time, that those programs provided for meaningful public participation at key stages of the remediation process.

Fourth, EPA recognizes that many cleanup activities have taken place prior to promulgation of this rule and others will take place prior to the adoption of the State's program for this rule through Federal, State, and facility-initiated actions, and EPA recognizes that those cleanups may or may not have involved the public in the way specified in the final rule. In cases where the cleanup began prior to the effective date of the rule, EPA did not want to require post-closure permits to be issued simply because the early stages of public involvement procedures of this rule were not met.

Finally, EPA recognized that in some cases, where delay in a cleanup might have an impact on human health and the environment, public involvement may not be possible prior to implementation of the remedy. EPA did not want to delay cleanup in those cases, but wanted to assure that the public was involved in the process as promptly as possible after the emergency was addressed. EPA wanted this rule to allow cleanups to take place immediately in these cases, but assure that public involvement would follow at the earliest opportunity. As explained below, the final rule authorizes EPA or the authorized State to modify public involvement requirements in those circumstances.

This rule encourages early public involvement by requiring public involvement (which at a minimum includes public notice and opportunity for comment) as soon as the authorized regulatory agency becomes involved in the cleanup process as a regulatory or enforcement matter (unless this might lead to a delay in the cleanup that would adversely affect human health and the environment). In most cases, the Agency anticipates, this will be very early in the process, prior to remedy selection—certainly before any Agency-prescribed remedies occur (except in cases of emergency). For example, the affected community should be notified and given an opportunity to comment prior to the initiation of any activity to assess contamination or prior to the implementation of any interim measure. By requiring early public notice of activities at a site, the Agency intends this rule to encourage involvement of the public throughout the cleanup process.

EPA proposed to require public involvement during the remedy selection process. EPA is retaining this requirement in the final rule. EPA has, however, made the requirement more specific by requiring public notice and comment on both the proposed remedy and the assumptions upon which it is based, including site characterization and land use.

The Agency understands "remedy selection" as a term of art in the RCRA corrective action or in the Superfund process, where the regulatory agency either selects or approves a remedy proposed by the owner or operator. In some cases an owner or operator may implement an action that could be considered a "remedy" prior to the Agency or State's involvement or oversight. The owner or operator should provide notice and opportunity to comment on the prospective remedy and its underlying assumptions, otherwise, any enforceable document developed later may not be eligible to substitute for a post-closure permit. In those cases, the owner or operator may have to follow the permit process to obtain a post-closure permit or to obtain a permit denial (if no further action is necessary).

This rule also requires public involvement to assure that notice and opportunity to comment take place prior to the Agency or authorized State deciding that remedial action is complete at a facility. When additional corrective action is no longer needed, the Agency could terminate an enforcement order or terminate interim status at the facility through the permit denial process in Part 124. Either process would ensure full opportunity for public participation, including permit appeal provisions. The rule, however, would allow alternative mechanisms, as long as the Agency or the authorized State provided public notice of its actions, and opportunity to comment prior to making the final decision that remedial action is complete at the facility.

This rule also requires that all public involvement be meaningful. Meaningful public participation is achieved when all impacted and affected parties have ample time to participate in the facility cleanup decisions. In many cases meaningful public involvement will require careful planning and more than notice and opportunity for comment. In some cases, meaningful public notice may require bilingual notifications or publication of legal notices in city or community newspapers (or other media, such as radio, church organizations and community newsletters). EPA recommends that parties responsible for involving the public provide information at all key milestones in the remediation process, and site fact sheets. Existing forums of community communication such as regular community meetings and electronic bulletin boards can be used to provide regular progress reports on the facility cleanup. Additionally, EPA recommends that parties responsible for involving the public update the community regularly on the progress made cleaning up the facility.

Often, the level of public involvement will depend on the significance of the action—for example, the Agency may simply notify the public of a decision to remove a small quantity of waste, but higher levels of involvement would be called for at remedy selection in a major remedial action, or when a decision is made that may impose significant restrictions on land use. For these reasons, EPA believes that public involvement should be tailored to the needs at the site, and has provided flexibility in this rule.

EPA has long recognized that the level of public involvement should be determined by the significance of the action taking place. For example, in a final rule dated May 24, 1993 (*see* 58 FR 29886), EPA promulgated regulations to govern modification of permits. Those regulations established different levels of public involvement depending on the significance of the permit modification. Class 1 modifications require minimal public involvement—the permittee must send a notice of the permit modification to all persons on the facility mailing list, and to the appropriate units of State and local government. Persons may request review of the permit modifications. Class 3 modifications, on the other hand, require far more extensive involvement of the public—publication in a local newspaper, a public meeting, and a public comment period. To assist owners and operators in implementing the rule, in Appendix 1 to § 270.42, EPA classified different activities as class 1, 2, or 3 modifications, based on the significance of the action.

EPA also issued guidance on public involvement which complements the approach in this rule (*see* the RCRA Public Participation Manual, September, 1996, EPA 530-R-96-007). This manual provides guidance on addressing public participation in the permit process, including permitting and enforcement remedial action activities. It emphasizes the importance of cooperation and communication, and highlights the public's role in providing valuable input. It stresses the importance of early and meaningful involvement of the public in Agency activities, and of open access to information. In addition to the manual, EPA fully endorses The Model Plan for Public Participation, developed by the Public Participation and Accountability Subcommittee of the National Environmental Justice Advisory Council (a Federal Advisory Council to the U.S. Environmental Protection Agency). The Model Plan encourages public participation in all aspects of environmental decisionmaking. It emphasizes that communities, including all types of stakeholders, and regulatory agencies should be seen as equal partners in any dialogue on environmental justice issues. The model also recognizes the importance of maintaining honesty and integrity in the process by clearly articulating goals, expectations and limitations. EPA encourages regulators and owners and operators implementing the provisions of this final rule to refer to these guidances.

It should be noted that the Agency proposed in § 265.121(b)(2) to allow the Regional Administrator to delay or waive the public participation requirements upon a determination that even a short delay in the implementation of the remedy would adversely affect human health or the environment. EPA believes this flexibility is important to assure protection of human health and the environment, and has promulgated that provision, with minor revisions, in this final rule.

It also should be noted that the Agency proposed a § 265.121(b)(3), which would have allowed EPA to address a facility using an approved alternate authority where cleanup activities were conducted prior to the effective date of this rule, but the public involvement procedures of this rule were not met. That provision would have required the Agency to conduct public involvement before considering the facility fully addressed under § 270.1(c)(7)(ii). The Agency has retained this provision.

b. Response to Comment. EPA received a variety of comments on the public involvement provisions of this rule. Some commenters believed the Agency had not gone far enough to assure public participation when alternate authorities are used in lieu of permits; others agreed with the Agency's approach; and others believed the public participation provisions of the proposal were too stringent. EPA considered those comments in developing the public involvement provisions of this final rule. Those comments are discussed below.

i. *The proposed rule did not preserve public involvement procedures when an alternate mechanism is used.* Many commenters believed that, despite statements in the preamble to the contrary, the Agency had not gone far enough in the proposed rule to preserve the public involvement procedures when alternate authorities are used in lieu of post-closure permits. These commenters believed that if the Agency allows alternate authorities to replace post-closure permits, it should assure that the public involvement procedures of the alternate authority are equivalent to that of a permit. These commenters believed that the proposal failed to do so in several respects.

First, these commenters noted that public participation was required by the proposal only at the time of remedy selection. Commenters pointed out that remedy selection occurs at a later stage of the remedial action process, following the development of schedules of compliance, and the preparation and evaluation of plans, reports, and remedial investigations. They pointed out that many decisions have already been made by the point of remedy selection, and that earlier public involvement allows more meaningful opportunity to affect those decisions. Commenters noted that when remedial action is implemented through a permit, these steps are subject to public participation requirements, through either permit issuance or permit modification procedures.

EPA agrees with the concerns raised by these commenters and that the public should be included in the decisionmaking process as early as possible. EPA agrees that early public participation provides the community a more meaningful role in the process.

To address these concerns, this rule requires public involvement to begin when the authorized agency first becomes involved in the cleanup process as a regulatory or enforcement matter. The Agency anticipates that, in most cases, this will be very early in the cleanup process, prior to proposed remedy selection.

Second, several commenters objected that no rights of appeal are provided or guaranteed when an alternative mechanism is used in lieu of a permit, even though such rights are provided in the permitting process. These commenters believed that these appeal rights must be preserved as part of the final rule for alternative mechanisms to be as protective as the post-closure permit. These commenters pointed out that under existing procedures, a hearing is available under Part 124 procedures to challenge a permit, while

EPA hearing procedures established for the respondent only under section 3008(h), Part 24 are less formal and comprehensive. Also, no pre-enforcement review is available for CERCLA 106 orders. These commenters believe that an alternate authority used in lieu of a post-closure permit should be reviewable under Part 124.

EPA recognizes that this rule does not guarantee pre-enforcement review of remedies implemented through alternate authorities. However, neither RCRA nor the Administrative Procedure Act require EPA to provide opportunities for the public to obtain judicial review of enforcement orders. For example, no such review is required under section 3008(h). Further, EPA believes that the ability to require prompt cleanup is important to assuring protection of human health and the environment. The new rule will make it easier to require cleanup at facilities where permit issuance would have been difficult or impossible. Thus, on balance, the rule promotes environmental protection. Finally, issuance of these alternatives orders does not terminate interim status. To terminate interim status, the Agency must make a final permit determination under the procedures of Part 124, and that decision, like a decision to issue a permit, is reviewable. Members of the public who believe that additional cleanup is required to meet the requirements of § 264.101 can raise that issue at that time.

One commenter objected that the proposal is at odds with Executive Order 12898, which instructs EPA to ensure greater public participation by minority and low-income populations at hazardous waste sites. This commenter expressed concern that the rule as proposed would further isolate vulnerable populations from the decisionmaking process.

EPA disagrees with commenter that the effect of this rule will be to isolate minority and low-income populations from the decisionmaking process. EPA has promulgated requirements in this final rule that assure meaningful involvement of the public in cleanups at post-closure facilities regardless of the mechanism used. These requirements will apply to all post-closure facilities, and will benefit all populations, including minority and low-income. In addition, EPA emphasizes that it will implement the rule in full compliance with Executive Order 12898. Other commenters pointed out that Part 124 requires a 45-day public comment period, while the proposal required only 30 days. Some commenters believed that the procedures associated with alternative post-closure mechanisms should follow the public participation procedures associated with permit issuance to make sure coverage is adequate and consistent. One commenter suggested that the rule specify a minimum comment period, and allow a longer period, at the Regional Administrator's discretion. Another commenter believed that since EPA has not demonstrated that public involvement procedures are hindering cleanups, there is no justification for lesser procedures.

EPA disagrees with the commenters that minimum comment period times or specific procedures are necessary, and did not establish detailed procedural requirements for public involvement in this final rule. However, EPA does expect the public to be given an opportunity to get involved early in the process and ample time to participate in the facility cleanup decisions. EPA took this approach because it recognizes that many different approaches to public participation have proved successful, and it did not wish to restrict existing State or Federal programs unnecessarily. The approach in this rule allows States to implement their own established procedures—as long as they provide for public notice and comment at the key stages in the process required by this rule.

ii. *The public involvement procedures of the proposed rule were adequate.* Other commenters believed that the level of public participation proposed by the Agency was adequate, and would provide an effective mechanism for adequately informing the public with regard to proposed remedies, and allowing public comment and public involvement in the remedy selection process.

Other commenters who generally agreed with the Agency's approach, requested some modifications in the final rule. One such commenter supported the requirement for public participation during the remedy selection process, but believed that the rule should also include a requirement for a brief description of the scope of the contamination to be remediated, if any, and a requirement for the placement of supporting documents in a local information repository. Another commenter believed that the rule must explicitly require that public access to information submitted for alternative mechanisms should be provided as if the information were contained in the Part B permit application.

EPA agrees that this type of information should be made available to the public, and anticipates that it will, where appropriate. However, as discussed above, the Agency is not prescribing detailed procedural requirements for public involvement in this final rule. The Agency intends this rule to provide meaningful public involvement while, at the same time, provide maximum flexibility to States to implement their cleanup programs. The Agency recognizes that, clearly, public involvement cannot be meaningful if there is not adequate access to information and, therefore, the Agency encourages regulators and owners or operators to make information regarding the site available to the public. At the same time, the Agency does not want to prescribe in detail in this final rule when and how the regulatory agency should provide information to the public. By requiring meaningful involvement of the public, the Agency believes that this final rule addresses commenter's concerns by requiring meaningful public involvement, which includes adequate access to information, and that detailed regulations prescribing access to specific information are not necessary.

One commenter agreed with the provision of the proposal that would allow EPA to waive public involvement procedures where immediate action is necessary to protect human health or the environment, but believed that public involvement should not be waived for long-term actions. EPA agrees with this commenter and the rule reflects this approach. In proposing the waiver provision of § 265.121(b), EPA intended to allow regulatory agencies to delay public involvement and get cleanup underway immediately, where necessary to protect human health and the environment, but not to remove the requirement for public participation. In response to this comment, EPA has modified the regulatory language of § 265.121(b) in this final rule to clarify the Agency's intent.

iii. *The public involvement procedures of the proposed rule were too stringent.* A third group of commenters believed that the public involvement requirements of the proposal were too stringent, and did not provide enough flexibility to the States. For example, one commenter stated that the proposed public participation requirements for alternative mechanisms were excessive, unnecessary, and inconsistent with existing public participation requirements. Another stated that there is no need for public participation for remedial action orders and closure plan approval to be equivalent to the requirements of Part 124 and Part 270, and that alternate, less stringent procedures would suffice.

EPA believes that public involvement is important in all agency actions, including enforcement orders. Consequently, EPA is requiring public participation at three key stages.

Some commenters believed that EPA should defer to State programs for public involvement as long as they provide basic due process and reasonable public input. These commenters believed that States should have reasonable flexibility to make site-specific determinations regarding the level of public participation that is appropriate at a site, and to adopt public involvement procedures that meet the needs of their own State. They believed that the benefits of public comment are preserved by requiring the States to provide public notice, and that specific differences in process are of differences of degree, and not substance.

EPA agrees that many States have developed cleanup programs with appropriate public involvement, and has tried to balance the need to ensure adequate public participation against requirements that constrain States. EPA believes the approach in the final rule strikes an appropriate balance. EPA, for example, allows States to decide how much notice must be given, and how long comment periods must last.

Some commenters believed that the proposal would expand the current requirements for public involvement. According to these commenters, when post-closure permits are modified to incorporate a proposed remedy, the current requirements for permit modification require publication in a newspaper for seven days, a public hearing, and a 60-day public comment period, regardless of how the action is changed based on public comment. The proposal would require much more at remedy selection, thus would be more expansive than the existing regulations. To maintain consistency, commenters believed the rule should mirror the public involvement procedures of § 270.41.

EPA acknowledges the commenter's concern, and believes that it has addressed them by leaving the details of the notification process and the length of the comment period to the discretion of the overseeing agency.

Some commenters did not agree that public involvement procedures should apply to actions taken under section 3008(h), because public comment on an enforcement proceeding would be inappropriate and would unnecessarily complicate and confuse the process, while increasing costs and delaying the process. One commenter pointed out that the public currently has no assurance it will have opportunity to participate in the remedial action process when remedial action is implemented through an enforcement order, as the Agency's enforcement programs have discretion to limit public participation, yet there is no evidence that the lack of public participation in enforcement orders has been detrimental to the process.

EPA disagrees with this commenter that public involvement unnecessarily complicates and confuses the cleanup process—in fact, the Agency believes that the public is an important contributor to the cleanup process. It helps ensure that remediation does, in fact, protect human health and the environment, and that remedies are based upon reasonable assumptions, including assumptions of future land use. EPA is committed to public involvement in its oversight of cleanup decisions, and the Agency's policy is to provide for meaningful public notice and comment with every section 3008(h) order. The requirements promulgated in this final rule are consistent with current EPA guidance on section 3008(h) orders.

Another commenter believed that EPA should recognize the wide array of actions that may occur, from small to significant, and the increasing tendency to accomplish remedial action through a series of interim measures, rather than a single major action. This commenter believed that the Agency should tailor public participation measures to ensure participation during significant actions without slowing the conduct of the program by requiring extensive administrative procedures for each and every small action that may be taken. The commenter believed that the public participation measures should be flexible enough to ensure adequate public involvement and avoid serving as yet another brake on the system.

EPA believes that the approach to public involvement in this final rule addresses this commenter's concern. The rule requires public involvement when the Agency becomes involved in a remediation at the facility as a regulatory or enforcement matter; on the proposed preferred remedy and the assumptions upon which the remedy is based, in particular those related to land use and site characterization; and prior to making the final decision that remedial action is complete at the facility. EPA expects that these requirements will be applied flexibly, and it does not expect "extensive administrative procedures for each and every action." For example, in some cases, public comment might be provided on a general strategy, which included interim measures as well as specific final cleanup standards. In other cases, the public might prefer monthly or quarterly updates to activity-by-activity notice. The point is that the public must have early involvement and must have an opportunity to comment before the regulatory agency commits itself to a final remedy or decides final remedial action is complete at the facility. Within this framework, EPA believes the regulatory agency has opportunity to structure a reasonable approach based on the needs at the site. At the same time, the public is put on notice early in the process that activities are taking place.

4. Enforceable Documents Issued Prior to the Effective Date of This Rule (§ 265.121(b)(3))

a. Overview. It is likely that, prior to final promulgation of this rule EPA and authorized States will have required site assessments or cleanup under a variety of authorities, other than post-closure permits, at facilities currently subject to post-closure permit requirements. Most of these actions, if taken after promulgation, would have satisfied the requirements of this rule. EPA proposed and is taking final action to provide a means to give credit to such prior cleanup actions by soliciting public comment on the activities conducted before the effective date of the rule.

Under § 265.121(b)(3), EPA must provide an opportunity for public comment if the enforceable document imposing those remedies is intended to be used in lieu of a permit. Depending on public comment, EPA may impose additional requirements either by amending the existing order, issuing a new order, modifying the post-closure plan, or requiring a post-closure permit.

b. Response to Comment. Several commenters objected to this provision of the rule.

According to one commenter, the proposed approach, if designed to provide finality to owners or operators, was a good idea in that it could provide them with early assurance that they would not have to repeat closure, post-closure, cleanup or investigations at a later date. However, this commenter strongly opposed this provision to the extent that it contemplates any such *post hoc* adequacy determinations would be the impetus to reinvestigate and/or require additional remedial actions with respect to prior closure/post-closure activities. In addition, the commenter believed that when an owner or operator receives an adequacy determination under proposed § 265.121(c) for prior closure/post-closure activities under an alternative legal authority, these activities should be expressly recognized as adequate in any subsequently-issued permit to assure the finality of any prior closure/post-closure determinations.

Another commenter opposed any effort to retroactively apply new, more restrictive standards (for public involvement or selection of remedies) to past remedial actions, and to approved closures. According to the commenter, actions undertaken in good faith by the owner or operator with Agency approval should be done with reasonable assurance that they will be considered completed. The commenter believed that uncertainty would discourage remedial actions.

Another commenter believed that this provision is beyond EPA's statutory authority. This commenter believed that EPA cannot conveniently ignore agreements entered into by it or States that were presumably within their authority. This issuance of a new regulation does not allow EPA to void binding agreements. Owners that have encouraged the Agency to use an order or consent agreement to oversee remedial action could be required to implement different remedial actions simply because EPA promulgates a new regulation. The commenter believed that this provision would impose more onerous requirements for responsible owners and operators of facilities that are currently implementing remedial action.

Another commenter suggested that before reopening an action, EPA should be required to demonstrate that the cleanup was not protective of human health and the environment. Another commenter expressed concern that any action undertaken in the past would be unlikely to meet current regulatory requirements, yet was likely taken by a cooperative facility aggressive in fulfilling its regulatory obligations at the time. According to the commenter, to reevaluate these facilities without any indication of potential environmental harm would create a costly administrative burden to both the Agency and the owner or operator, without any benefit to human health and the environment.

EPA agrees with the commenters that expressed concern about any uncertainty that might arise for owners and operators due to this provision. However, EPA disagrees that this is the effect of this provision. This provision does not impose new requirements on owners and operators retroactively, since owners and operators were subject to RCRA permit requirements (including section 3004(u)) prior to this rule. Instead, § 265.121(e) would extend the benefits of this rule to post-closure activities or cleanups conducted under enforceable documents issued before the rule was in effect even where these documents had not included public involvement. (Where the public had already had an opportunity to comment on the mechanism, there would be no need to invoke this provision.) EPA does not intend this provision to result in duplicative regulatory action, or to allow reopening of decisions that had already been made. Instead, it would simply ensure the public's opportunity to comment on a mechanism being used in lieu of a permit, if the public had not had an opportunity up to that point.

EPA can understand the commenter's concerns about re-opening past cleanups. EPA and authorized States certainly do not expect to re-open acceptable remedies where they are already underway. EPA believes that, in most situations, the public would have been involved in the remedy selection. In cases where the public was involved, the Agency does not intend this provision to provide an opportunity to revisit issues that already were raised and addressed. Rather, the provision is designed to make this final rule available to facilities that may have begun cleanup prior to the effective date, while, at the same time, assuring that the public has had opportunity to raise issues prior to the Agency's final decision that corrective action is not needed or is no longer need at the site. Even under the current corrective action process, remedies undertaken before the permit is issued are typically incorporated into the permit through the permit procedures. Owners and operators of closed interim status facilities or non-RCRA State programs currently may conduct cleanups outside the post-closure permit process. When EPA or a State issues a post-closure permit, it must determine that any prior cleanup meets the requirements of RCRA section 3004(u). If it does not—that is, if the cleanup is not protective of human health and the environment, or there are significant areas it does not address—EPA or the State may impose permit requirements requiring additional remediation work. Citizens may also raise the same issues in comment periods on draft post-closure permits and in challenges to permits that are issued. Thus, facilities face these issues regardless of whether or not EPA allows older cleanups to be recognized under this new alternative to post-closure permits.

In any case, EPA expects owners and operators conducting cleanups without involving EPA to involve the public at an early stage. EPA strongly discourages owners and operators from waiting until the end of the process to involve the public. If concerns are raised by the public regarding the actions taken under the alternative mechanism, EPA may require additional action through an order or permit. Therefore, EPA is promulgating § 265.121(b)(3).

C. Remediation Requirements for Land-Based Units With Releases to the Environment

1. Overview

In the 1994 notice, EPA requested comment on the possibility of allowing the Regional Administrator to establish groundwater monitoring, closure and post-closure, and financial assurance requirements on a site-specific basis at regulated units addressed through the corrective action process (*see* 59 FR 55778 at 55787–88). EPA specifically requested comment on this prospect for regulated units clustered with non-regulated units, all of which were releasing hazardous constituents to the environment, because of the concern that two different regulatory regimes would apply—for example, the regulated units could be subject to the detailed requirements of Part 264 (which were developed as a preventive requirement), while the non-regulated units could be subject to the more flexible remedial requirements for corrective action under § 264.101 and associated guidance.

EPA is promulgating in this notice final rules that will provide flexibility where a regulated unit is situated among SWMUs (or areas of concern), a release has occurred, and both the regulated unit and one or more SWMUs (or areas of concern) are suspected of contributing to the release. The final rule described in this section allows EPA and the authorized States to replace the regulatory requirements of Subparts F, G, and H at certain regulated units with alternative requirements developed under a remediation authority. This portion of the rule is designed to eliminate some of the problems Regions and States have encountered where two sets of requirements apply at a cleanup site—requirements for closure at the regulated unit, and corrective action requirements at the SWMUs. It applies to both permitted and interim status units. It also applies to both operating and closed facilities. Further, it can be used at closed facilities using alternative authorities in lieu of post-closure permits.

The closure process in Parts 264 and 265 was promulgated in 1982, before the Agency had much experience with closure of RCRA units. Since that time, EPA has learned that, when a unit has released hazardous waste or constituents into surrounding soils and groundwater, closure is not simply a matter of capping the unit, or removing the waste, but instead may require a significant undertaking to clean up contaminated soil and groundwater. The procedures established in the closure regulations were not designed to address the complexity and variety of issues involved in remediation. Most remediation processes, on the other hand, were designed to allow site-specific remedy selection, because of the complexity of and variation among sites.

Similarly, the groundwater monitoring requirements designed for regulated units do not provide sufficient flexibility for complex cleanups. The requirement to place wells at the downgradient edge of a regulated unit often would not make sense if there are SWMUs further downgradient. Also, the Part 264 regulations contain specific requirements for the selection of cleanup levels for hazardous constituents released to groundwater, and do not provide for considerations of technical practicability, which are critical in a remediation context. Corrective action and other remediation authorities provide more flexible (yet protective) regimes for selecting cleanup levels.

Financial responsibility for closure or post-closure care may also work at cross purposes with financial responsibility for corrective action. It makes sense to allow a facility with funds set aside for closure of a regulated unit to spend those funds on a broader corrective action, when the regulated unit is being addressed in that corrective action.

This portion of this rule revises the requirements of Parts 264 and 265 Subparts F, G, and H, by adding new §§ 264.90(f), 264.110(c), 264.140(d), 265.90(f), 265.110(d), and 265.140(d). Those provisions allow EPA to address environmental needs at certain closing regulated units with more flexible, but protective, site-specific requirements developed through a remediation process. EPA is providing flexibility where a Regional Administrator (or State Director) finds that a regulated unit is situated among SWMUs (or areas of concern), a release has occurred, and the regulated unit and one or more of the SWMUs (or areas of concern) are likely to have contributed to the release.

To provide greater flexibility for the cleanup of regulated units in this situation, EPA is giving the Regional Administrator (or State Director) discretion to replace the requirements for closure, groundwater monitoring, and financial responsibility set out in Parts 264 and 265 with standards tailored specifically for the cleanup. For closure, the new "generalized" standard is protecting human health and the environment by meeting the closure performance standard in either § 264.111(a) and (b) or § 265.111(a) and (b). For groundwater monitoring and financial responsibility, the new standard is protection of human health and the environment. The Regional Administrator can use these new standards to integrate the cleanup requirements for the regulated unit into the requirements for the SWMUs developed under remediation authorities. In addition, to reduce duplicative administrative processes, EPA is not requiring that the alternative requirements be incorporated into the permit, closure plan, and/or post-closure plan in all cases. In the case of permitted facilities, alternative requirements for a regulated unit might be included in the permit where related SWMUs were being addressed under RCRA section 3004(u), the permitting corrective action authority. EPA, however, wants the Regional Administrator to be able to use other authorities to develop the requirements for regulated units and related SWMUs, such as RCRA section 3008(h), CERCLA, and approved State remediation authorities. This rule, therefore, allows the Regional Administrator (or an authorized State) to determine that there is no need to impose the unit-specific requirements of Part 264 or Part 265 because alternative requirements developed under an approved remediation authority will protect human health and the environment. The requirements for the regulated unit and the SWMUs developed under that authority can be set out in the permit or in an approved closure plan and/or post-closure plan, or can be set out in another enforceable document (as defined in § 270.1(c)(7)), and referenced in the permit or approved closure plan and/or post-closure plan.

For permitted facilities, EPA is modifying the requirements for content of the closure plan and closure plan modification by adding new § 264.112(b)(8) and (c)(2)(iv), and post-closure plan content and post-closure plan modification at § 264.118(b)(4) and (d)(2)(iv) to require owners and operators to incorporate the alternative requirements into the closure plan and/or post-closure plan, or to incorporate into those plans a reference to the enforceable document (or permit section) that sets forth those requirements. To do so, the owner or operator would use the existing procedures for closure plan and post-closure plan approval and modification in Part 264, and for permit modifications in Part 270. EPA expects that any such decision would be a "class 3" modification.

For interim status facilities, EPA is similarly adding new §§ 265.112(b)(8) and (c)(2)(iv) and 265.118 (c)(5) and (d)(1)(iv)to require owners and operators to incorporate alternative requirements into the closure plan and/or post-closure plan, or to incorporate into those plans a reference to the enforceable document that sets forth those requirements. To do so, the owner or operator would use the existing procedures for closure plan and post-closure plan approval and modification in Part 265.

Members of the public may also utilize current procedures to challenge either the specifics of how EPA is addressing a regulated unit as part of corrective action (for example, if the corrective action is imposed through a RCRA permit), or the decision by EPA or the State to address the regulated unit under alternative requirements set out in an enforceable document. Under EPA's federal rules, members of the public may file administrative appeals for permits; they may challenge closure or post-closure plans in court.

The Regional Administrator (or State Director) may use existing procedures for modifying permits or closure plans to revisit corrective action requirements for regulated units set out in permits or to revisit cleanups under alternative enforceable documents. EPA's rules allow permits, closure plans, and post-closure plans to be modified when significant new information arises after the issuance of the plan or permit. Some developments during remediation may justify use of this authority. For example, if a non-RCRA agency in charge of an alternate authority selected a very different remedy which, in the RCRA authority's judgement, would not adequately protect human health and the environment, the RCRA authority might consider this to be new information warranting reconsideration of the decision to defer existing RCRA requirements for regulated units.

Because the concept of deferring closure, groundwater monitoring, and financial responsibility requirements is new, EPA is limiting the range of authorities that can be used to craft alternate requirements. First, a Regional Administrator (or State Director) may defer regulated unit requirements in favor of requirements crafted under corrective action for permits under RCRA section 3004(u) and corrective action orders for interim status facilities under RCRA section 3008(h). The Regional Administrator (or State Director) may also defer to requirements established in actions under CERCLA section 104 and 106. EPA is familiar with the scope of these legal authorities and the enforcement mechanisms that accompany them. Any Regional Administrator (or State Director) wishing to defer to regulated unit requirements developed under these authorities need only consider whether the requirements will, in fact, protect human health and the environment.

EPA also wants State Directors to be able to defer to State remedial authorities outside of RCRA. EPA, however, is less familiar with these authorities and their enforcement mechanisms. EPA, therefore, is requiring any State that wishes to use a non-RCRA authority to craft alternative regulatory requirements to submit that authority to EPA for review in the State authorization process. EPA will review the scope of the legal authority. It will determine for example, whether the authority can provide for cleanup of releases from a regulated unit to all media, as required under §§ 264.111(b) and 265.111(b). EPA will also review the State's mechanisms for enforcing the alternative requirements. Where a State will not be incorporating the new regulated unit requirements directly into a permit or closure plan enforceable under RCRA, EPA needs to have some assurance that it will be able to enforce them, if necessary. EPA is, in this notice, amending the existing requirements for enforcement of State programs in § 271.16 to add a new requirement regarding the enforceability of these new, alternative regulated unit requirements. Recognizing that effective enforcement mechanisms may vary greatly from State to State, EPA is promulgating a general standard, rather than a list of specific enforcement requirements.

This rule also allows the Agency to transfer the financial assurance requirements of Part 264 or Part 265 Subpart H to the corrective action process, when the regulated unit is addressed through corrective action. This provision does not allow the Agency to waive the requirements for financial assurance at a regulated unit. Owners and operators of regulated units remain subject to the requirement to provide financial assurance to address cleanup at the unit—however, this rule allows EPA or the authorized States to develop site-specific financial assurance requirements for corrective action at the unit, and transfer funds set aside under Subpart H for closure, post-closure, and third-party liability requirements to address corrective action. This provision may be invoked by EPA or by a State authorized for this rule only in cases where the alternative cleanup authority requires financial assurance for the corrective action.

In addition to the financial assurance requirements for closure and post-closure care, Parts 264 and 265 Subpart H require owners and operators to provide assurances that they can pay claims for damages to third-parties arising from accidental occurrences at the facility. The Agency, however, typically has not required third-party liability coverage as part of financial assurance for corrective action. (The general third-party funds required by Parts 264 and 265 would, of course, apply to accidents involving hazardous waste management occurring during corrective action.) This rule allows the Regional Administrators and authorized States to release funded third-party liability assurances, or to relieve owners and operators from the obligation to provide third-party liability assurance, where all regulated units at the facility are being addressed under §§ 264.90(f), 264.110(c), 264.140(d), 265.90(f), 265.110(d) or 265.140(d). EPA expects this action would be warranted under limited circumstances—for example, it might be warranted where all regulated units at the facility are being addressed through corrective action, and the Regional Administrator finds that it is necessary to use the third-party liability funds to pay for the cleanup. It should be noted that where a facility is subject to third-party liability requirements because of regulated units other than those being addressed under §§ 264.90(f), 264.110(c), 264.140(d), 265.90(f), 265.110(d) or 265.140(d), the facility remains subject to the requirement for third-party liability coverage.

2. Response to Comment

In the preamble of the proposed rule (*see* 59 FR 55778 at 55787 and 55688), EPA requested comment on the need for provisions allowing regulated units to be addressed through a remediation process. The Agency described a situation where a collection of adjacent SWMUs and a regulated unit are releasing hazardous constituents to the environment. Prior to this rule, EPA would have been required to impose the requirements of Part 264 or Part 265 for financial assurance, closure, and groundwater monitoring and remediation of the regulated unit, and to select remedies for the SWMUs through the RCRA corrective action process. This situation was inconsistent with a major objective of EPA's Subpart S initiative discussed above, that is, to create a consistent, holistic approach to cleanup at RCRA facilities.

Many commenters supported the approach described by EPA in the preamble to the proposal. Commenters on the proposed rule agreed with EPA that regulated units and non-regulated SWMUs are often indistinguishable in terms of risk, and most supported integration of the closure and corrective action programs.

Many commenters had encountered situations similar to those described by the Agency, and believed that the closure process prevented the best remedy at those sites. Several commenters agreed that it is often difficult to identify the source of contamination, particularly when many SWMUs are located near each other. Commenters cited situations where the boundaries of regulated units and non-regulated units overlap, or where contaminant plumes have commingled as situations where the regulatory distinction between regulated and non-regulated SWMUs is particularly troublesome.

Some commenters believed that the corrective action process, which was specifically designed to address remediation, rather than the closure process, which has preventative goals, should be used to address all units at a facility.

EPA does not believe that the closure process is inappropriate for all regulated units with releases. However, it does believe that it does not make sense to have two separate remedial processes working to clean up a single release, so it is providing relief where a regulated unit and one or more SWMUs appear to have contributed to the same release. EPA believes the Regional Administrator should be able to choose, on a case-by-case basis, whether to apply the current Part 264 and 265 requirements to the SWMUs or the more flexible remediation requirements to the regulated unit. This final rule provides the Regional Administrator with the discretion needed to make this choice.

Several commenters mentioned that having two regulatory programs for RCRA units is complicated by State authorization issues—some States are authorized for the base RCRA program, thus are responsible for closure, but are not authorized for corrective action. In these States, two agencies are responsible for reviewing plans, and making decisions. Another commenter's regulatory agency has taken the position that any detectable levels of organics left in soil or groundwater during closure will require capping and post-closure monitoring of the unit, whereas the corrective action program uses risk-based cleanup standards. Thus, there is potential for different areas of a facility to be cleaned up to different sets of standards, even if the areas are adjacent to each other, and exposure patterns are identical. Commenters believed that a single, uniform set of cleanup standards should be established for all units regardless of the time the waste or contaminant was placed in the unit, and regardless of the regulatory program that has jurisdiction.

EPA cannot eliminate all of the complexities caused by the State authorization requirements. However, States that are authorized for the base program will be able to request authorization for this rule. They may request authority to address regulated units as part of corrective action. EPA also notes that there is no Federal requirement that facilities cap any detectable levels of organics left in soil or groundwater during closure.

Other commenters raised concerns about EPA's proposal that closure and cleanup standards be integrated. Some commenters expressed concern that the Agency's proposal might be an attempt to extend the closure requirements to non-regulated units, rather than to address all SWMUs through the corrective action process. Some commenters said that they have had to close non-regulated units as regulated units because they could not identify the source of contamination at a site. These commenters believe that the corrective action process, not closure requirements, should be the applicable requirements at SWMUs requiring remediation.

The Agency agrees that regulated unit standards were not designed for SWMUs subject to corrective action. The Agency intends this rule to provide Regional Administrators and State Directors with discretion to choose whether to apply current Part 264 and 265 standards to regulated units closed as part of a broader corrective action, or to address them through cleanup requirements. This rule is not intended as a way to bring SWMUs under Part 264 or Part 265 unit-specific standards.

A few commenters supported retaining the distinction between regulated units and other SWMUs. One commenter believed the Agency should retain the closure process at all regulated units because the regulatory timeframes of that process result in a quicker remedy selection than the open-ended corrective action process. This commenter feared that removing closure requirements at regulated units would delay cleanups. Another commenter objected that site-specific determinations delay any process because they are an open door to extended negotiations, disputes, and litigation, and allow inconsistent decisions. This commenter believed that the closure regulations provide consistent requirements.

The Agency agrees with the commenter that the closure requirements, including the timeframes incorporated in the closure process, are generally appropriate where a release has not occurred. EPA, however, does not agree that these procedures are well-suited to remediation of environmental releases. EPA believes that, where a regulated unit is located among SWMUs (or areas of concern), and releases have or are likely to have occurred, applying two sets of regulatory requirements can slow, rather than hasten the cleanup. Thus, in this final rule, EPA is allowing regulators discretion to apply alternate requirements to the closing regulated unit developed under a remediation authority.

Another commenter suggested retaining the closure requirements if the regulated unit is a landfill, because, according to commenter, landfills typically are large and isolated. The commenter also suggested the closure requirements be retained in situations where routine monitoring is necessary, or in situations where waste in the regulated unit is very hazardous. This commenter suggested that the closure standards be retained where the units contain similar wastes, but were used at different times, and where there are multiple adjacent sources of contamination with overlapping parameters of concern.

This rule retains the closure requirements for isolated units. This final rule allows the Regional Administrator to replace the requirements of Subparts F, G, and H with alternative requirements developed for corrective action only where a regulated unit is situated among SWMUs (or areas of concern), a release has occurred, and both the regulated unit and one or more SWMUs (or areas of concern) are likely to have contributed to the release.

EPA disagrees that the type of waste involved or the need for monitoring should determine which set of regulatory requirements must be used to address the unit, or that routine monitoring can be imposed only through the closure process. EPA believes that remediation processes can be used to provide protective cleanups for all types of wastes, and can be used to impose sufficient groundwater monitoring requirements.

Another commenter suggested that the timeframes for initiating corrective action (§ 264.99(h)(2)) and other administrative and reporting requirements of Part 264 Subpart F be retained in all cases. However, EPA disagrees with this commenter and has chosen to allow greater flexibility provided by alternate remedial authorities for regulated units surrounded by SWMUs that are both suspected to have released to the environment.

One commenter conditioned its approval of this change on due process rights of owner or operator being maintained. EPA believes the existing rights available to an owner or operator in federal enforcement actions appropriately address due process rights and this rule does not modify these rights.

Some commenters asked for clarification of how integration of closure and corrective action would work administratively. EPA has provided this information in the preamble discussion above.

Another commenter stated that the proposal contradicted itself by first claiming that protections imposed through alternative mechanisms would be equivalent to those of a post-closure permit, and then proposing that closure standards be developed on a site-specific basis under the corrective action process. The commenter requested EPA to clarify its intention in this regard, and to ensure that the regulatory requirements were truly the same for closure and post-closure activities conducted with or without a permit.

In response to this comment, EPA clarifies that it intends for the closure of regulated units to be subject to consistent substantive standards, regardless of whether that closure is addressed under a permit or under an alternate authority. EPA believes the requirements of § 265.121 make this point clearly. The commenter's concern derives from EPA's proposal (and decision in this final rule) to amend the closure standards to allow the integration of closure and corrective action at certain specified closed or closing units. These new standards apply equally to all eligible regulated units, regardless of whether they are subject to permits or interim status. Thus, while EPA has amended the closure standards as they apply to certain regulated units, it has retained a consistent approach to closure under the permit process and under alternate authorities. To the extent that the commenter is objecting to EPA's decision to allow use of alternative, site-specific requirements in lieu of the generic requirements of Subparts F, G, and H, EPA, as explained above, believes that the need to coordinate the cleanup of "mingled" releases outweighs any perceived benefits of the more specific requirements for regulated units.

In the preamble of the proposed rule, the Agency described a second remedial situation where the closure standards might not be appropriate—where waste has been removed from a unit but contaminated soils remain, and the remedy that might best prevent future releases from the unit would be precluded by the requirement for a RCRA cap.

Many commenters agreed with the Agency that the requirement for a RCRA cap may impede remedies. Several commenters agreed that the closure regulations do not consider remediation as an alternative to capping the unit, yet many currently available remedial technologies are more protective to human health and the environment in the long term than is capping, and that the Agency should provide flexibility to pursue such options in the closure of regulated units. Many commenters also agreed that required RCRA caps are very expensive and often provide little additional environmental protection where most waste has been removed from the unit.

However, the Agency is not proceeding with revisions to the closure requirements that would modify the requirement for a RCRA cap (or other closure, groundwater, or financial assurance requirements) beyond the situations outlined in §§ 264.90(f), 264.110(c), 264.140(d), 265.90(f), 265.110(d), and 265.140(d). Thus, the unit described by commenters could be addressed under corrective action procedures only if it was situated among SWMUs or areas of concern, and was part of a broader corrective action. EPA was not prepared, at the time this rule was made final, to make a final decision on this issue. EPA will consider additional action in this area if, in implementing this final rule, the Agency identifies further opportunities for integrating closure and corrective action.

D. Post-Closure Permit Part B Information Submission Requirements (§ 270.28)

1. Overview

EPA is promulgating § 270.28, which establishes information submission requirements for post-closure permits. Prior to this rule, the information submission requirements of Part 270 did not distinguish between operating permits and post-closure permits, and facilities seeking post-closure permits were generally expected to provide EPA, as part of their Part B permit applications, the facility-level information specified in § 270.14 as well as relevant unit-specific information required in §§ 270.16, 270.17, 270.18, 270.20, and 270.21.

However, EPA recognized that certain of the Part 270 information requirements are important to ensuring proper post-closure care, while others are generally less relevant to post-closure. The Agency believes the most important information for setting long-term post-closure conditions are groundwater characterization and monitoring data, long-term care of the regulated unit and monitoring systems (e.g., inspections and systems maintenance), and information on SWMUs and possible releases. Therefore, EPA is adding a new § 270.28 to identify that subset of the Part B application information that must be submitted for post-closure permits.

As a result of this provision, an owner or operator seeking a post-closure permit must submit only that information specifically required for such permits under newly added § 270.28, unless otherwise specified by the Regional Administrator. The specific items required in post-closure permit applications are:

—A general description of the facility;
—A description of security procedures and equipment;
—A copy of the general inspection schedule;
—Justification for any request for waiver of preparedness and prevention requirements;
—Facility location information;
—A copy of the post-closure plan;
—Documentation that required post-closure notices have been filed;
—The post-closure cost estimate for the facility;
—Proof of financial assurance;
—A topographic map; and
—Information regarding protection of groundwater (e.g., monitoring data, groundwater monitoring system design, site characterization information)
—Information regarding SWMUs at the facility.

In many cases, this information will be sufficient for the permitting agency to develop a draft permit. However, since RCRA permits are site-specific, EPA believes it is important that the Regional Administrator have the ability to specify additional information needs on a case-by-case basis. Accordingly, to ensure availability of any information needed to address post-closure care at surface impoundments (§ 270.17), waste piles (§ 270.18), land treatment facilities (§ 270.20) and landfills (§ 270.21), § 270.28 of this rule authorizes the Regional Administrator to require any of the Part B information specified in these sections in addition to that already required for post-closure permits at these types of units. This approach enables the Regional Administrator to require additional information as needed, but does not otherwise compel the owner or operator to submit information that is irrelevant to post-closure care determinations.

2. Response to Comment

Commenters generally supported the provisions of the proposed rule related to information submission requirements, and EPA is promulgating the provisions as proposed. Some commenters suggested that additional information be required by § 270.28 (e.g., one commenter suggested the Agency require the chemical and physical analysis of § 270.14(b)(2), and the training plan information required by § 270.14(b)(12)). However, after considering these comments, EPA is promulgating the proposed requirements because the Agency believes they will provide the Agency with the information it needs to address post-closure care in most instances. The information suggested by commenter is not, in the Agency's experience, routinely needed for post-closure permits. For example, § 270.14(b)(2), suggested by commenter, requires a chemical and physical analysis of waste to be handled at the facility—but, in the case of post-closure permits, the regulated unit is closed, and will not be handling wastes. Similarly, § 270.14(b)(12) requires the owner or operator to train persons who will be operating the facility—but, in the case of a post-closure permit, the facility will not be operating.

If for some reason this information is needed by the Agency, this rule does not preclude the Agency from requiring it. As was discussed above, this rule provides the Agency authority to obtain additional information on a case-by-case basis, as needed, but, for most situations, requires only the minimum information necessary for all post-closure situations. This approach, the Agency believes, provides sufficient information to the overseeing agency to ensure adequate post-closure care, while minimizing the information submission requirements for all owners and operators. However, as a result of this final rule, EPA will request information for post-closure permit applications beyond the information specified in § 270.28 only when necessary on a case-by-case basis.

IV. State Authorization

A. Authorization of State Programs

Under section 3006 of RCRA, EPA may authorize qualified States to administer and enforce the RCRA program within the State (*See* 40 CFR Part 271 for the standards and requirements for state authorization).

Prior to the Hazardous and Solid Waste Amendments of 1984 (HSWA), a State with final authorization administered its hazardous waste program entirely in lieu of the Federal program. The Federal requirements no longer applied in the authorized State, and EPA could not issue permits for any facilities in a State where the State was authorized to permit. When new, more stringent Federal requirements were promulgated or enacted, the State was obligated to enact equivalent authority within specified timeframes. New Federal requirements did not take effect in an authorized State until the State adopted the requirements as State law.

In contrast, under section 3006(g) of RCRA, the new requirements and prohibitions of HSWA take effect in authorized States at the same time they take effect in unauthorized States. EPA is directed to carry out those requirements and prohibitions in authorized States, including issuance of permits, until the State is granted authorization to do so. While States must still adopt more stringent HSWA-related provisions as State law to retain final authorization, the HSWA requirements apply in authorized States in the interim. In general, § 271.21(e)(2) requires States that have final authorization to modify their programs to reflect Federal program changes and to subsequently submit the modifications to EPA for approval. It should be noted, however, that authorized States are only required to modify their programs when EPA promulgates Federal standards that are more stringent or broader in scope than the existing Federal standards. For those Federal program changes that are not more stringent or reduce the scope of the Federal program, States are not required to modify their programs (*see* § 271.1(i)). Section 3009 of RCRA allows States to impose standards more stringent than those in the Federal program.

B. Enforcement Authorities

Since 1980, certification of adequate enforcement authority has been a condition of State authorization. EPA's authority to use its own enforcement authorities, however, does not terminate when it authorizes a State's enforcement program. Following authorization, EPA retains the enforcement authorities of sections 3008, 7003, and 3013 of RCRA, although authorized States have primary enforcement responsibility.

C. Effect of this Rule on State Authorizations

This rule promulgates revisions to the post-closure requirements under HSWA and non-HSWA authorities. The requirements in §§ 264.90(e), 265.110(c), 265.118(c)(4), 265.121 (except for paragraph 265.121(a)(2)), 270.1, 270.14(a), and 270.28, which remove the post-closure permit requirement and allow the use of alternate mechanisms, are promulgated under non-HSWA authority. Thus, those requirements are immediately effective only in States that do not have final authorization for the base RCRA program, and are not applicable in authorized States unless and until the State revises its program to adopt equivalent requirements. These new standards are not more stringent than current requirements and, therefore, States are not required to adopt them.

Sections 264.90(f), 264.110(c), 264.140(d), 265.90(f), 265.110(d), 265.140(d), and 271.16(e), which allow the Agency to address closing regulated units through the corrective action program, are promulgated under HSWA authority. Except for § 271.16(e) these provisions provide additional options to regulators, and, therefore, are not more stringent than the current base RCRA program requiring closure of all regulated units. Authorized States are required to modify their programs only if the new Federal provisions are more stringent.

Further, because these HSWA provisions in this rule are not more stringent, they are immediately effective only in those States not authorized for the base RCRA program. In States authorized for the RCRA base program, these HSWA provisions cannot be enforced until and unless the State adopts them. Once a State adopts these provisions, they can be implemented by EPA before the State is authorized for the regulation change because they are promulgated pursuant to HSWA authority, and are thus immediately effective in the State.

D. Review of State Program Applications

1. Post-Closure Care Under Alternatives to Permits

Sections 264.90(e), 265.110(c), 265.118(c)(4), 265.121, and 270.1 of this final rule remove the requirement for post-closure permits, and allow EPA and the authorized States to address facilities needing post-closure care using alternate authorities. All States seeking authorization for the above provisions of this rule must submit an application that includes regulations at least as stringent as these provisions, as well as the information required under § 271.21. In all States, this information will include copies of State statutes and regulations demonstrating that the State program includes the provisions promulgated in this rule in the sections listed above. EPA will review this information to determine that the State has adopted provisions to assure that authorities used in lieu of post-closure permits are as stringent as the Federal program.

In addition, States must submit an application that includes copies of the statutes and regulations the State plans to use in lieu of the section 3004(u) provisions of a post-closure permit to address corrective action at interim status facilities. For example, many States authorized for corrective action have cleanup authorities, which they apply at interim status facilities. EPA will review those statutes and regulations to determine whether the alternate authority is sufficient to impose requirements consistent with § 264.101. At a minimum, that authority must be sufficiently broad to allow the authorized authority to: (1) require facility-wide assessments; (2) address all releases of hazardous wastes or constituents to all media from all SWMUs within the facility boundary as well as off-site releases to the extent required under section 3004(v) (to the extent that releases pose a threat to human health and the environment); and (3) impose remedies that are protective of human health and the environment. This review by EPA will assure that actions taken at closed facilities under an alternate authority are as protective as those that would be taken under a post-closure permit. In addition, EPA is promulgating in this final rule a revision to § 271.16 to ensure that these alternate authorities are adequately enforceable. EPA will review the State's authority to determine whether it includes the authority to sue in court, and to assess penalties.

2. Remediation Requirements for Land-Based Units With Releases to the Environment

Sections 264.90(f), 264.110(c), 264.140(d), 265.90(f), 265.110(d), and 265.140(d) of this rule allow EPA or the authorized State to replace requirements of Part 264 or 265 Subpart F and G with analogous requirements developed through the corrective action process. When regulated units are addressed through the corrective action process, these provisions allow the Agency to transfer financial assurance requirements to corrective action as well. Sections 264.112(b) and (c), 264.118(b) and (d), 265.112(b) and (c), and 265.118(c) and (d) contain procedures for owners and operators to implement this flexibility.

To obtain authorization for §§ 264.90(f), 264.110(c), and 264.140(d), which apply at permitted facilities, States must be authorized for section 3004(u) or submit an application that includes copies of the statutes and regulations the State plans to use to develop a remedy at regulated units. To obtain authorization for §§ 265.90(f), 265.110(d), and 265.140(d), which apply at interim status facilities, States must submit an application that includes copies of the statutes and regulations the State plans to use to develop a remedy at regulated units. As in the case of alternate authorities submitted for approval to be used in lieu of post-closure permits, authorities to be used to implement §§ 265.90(f), 265.110(d), and 265.140(d) must impose corrective action consistent with § 264.101, and must be sufficiently broad to impose minimum requirements. They must allow the regulatory authority to: (1) include facility-wide assessments; (2) address all releases of hazardous wastes or constituents to all media from all SWMUs within the facility boundary as well as off-site releases to the extent required under section 3004(v) (to the extent necessary to protect human health and the environment); and (3) be protective of human health and the environment. Further, they must include authority to sue in court, and to assess penalties, consistent with § 271.16. For § 265.90(f), the authority must allow the State to require financial assurance.

3. Post-Closure Permit Part B Information Submission Requirements

Section 270.28, which specifies information that must be submitted for post-closure permits, is promulgated under non-HSWA authority and is not more stringent than the current RCRA program. Therefore, § 270.28 does not become effective in an authorized State until and unless the State obtains authorization for that provision. Further, authorized States are not required to modify their programs to adopt § 270.28.

V. Effective Date

This final rule is effective immediately. Section 3010(b)(1) of RCRA allows EPA to promulgate an immediately effective rule where the Administrator finds that the regulated community does not need additional time to come into compliance with the rule. Similarly, the Administrative Procedures Act (APA) provides for an immediate effective date for rules that relieve a restriction (*see* 5 U.S.C. 553(d)(1)).

This rule does not impose any requirements on the regulated community; rather, the rule provides flexibility in the regulations with which the regulated community is required to comply. The Agency finds that the regulated community does not need six months to come into compliance.

VI. Regulatory Assessments

A. Executive Order 12866

Under Executive Order 12866, which was published in the **Federal Register** on October 4, 1993 (*see* 58 FR 51735), the Agency must determine whether a regulatory action is "significant" and, therefore, subject to OMB review and the requirements of the Executive Order. The Order defines "significant regulatory action" as one that is likely to result in a rule that may:

(1) have an annual effect on the economy of $100 million or more, or adversely affect in a material way the economy, a sector of the economy, productivity, competition, jobs, the environment, public health or safety, or State, local, or tribal governments or communities;

(2) create a serious inconsistency or otherwise interfere with an action taken or planned by another agency;

(3) materially alter the budgetary impact of entitlement, grants, user fees, or loan programs or the rights and obligations of recipients thereof; or

(4) raise novel legal or policy issues arising out of legal mandates, the President's priorities, or the principles set forth in the Executive Order.

Under the terms of Executive Order 12866, OMB has notified EPA that it considers this a "significant regulatory action" on the basis of (4) within the meaning of the Executive Order. EPA has submitted this action to OMB for review. Changes made in response to OMB suggestions or recommendations are documented in the public record for this rulemaking (*see* Docket # F-94-PCPP-FFFFF).

This final rule establishes two main changes to the procedures required for closure and post-closure care. First, it allows EPA and the authorized States the option of either issuing post-closure permits or using alternative mechanisms for ensuring the proper management and care of facilities after their closure. Second, it amends the regulations governing closure of regulated units to allow, under certain circumstances, the regulatory agency to address regulated units through Federal or State cleanup programs, instead of applying Part 264 and 265 standards for closure.

The first provision benefits the regulated community by providing a potential avoidance of the permit process for post-closure, as well as eliminating duplication of effort in cases, where EPA and the States have already issued enforcement orders to ensure expeditious action by facility operators. The cost savings for this change are estimated to be a total of $507,000, and are discussed in further detail in the Economic Impact Analysis background document, which has been placed in the docket. The second gives EPA and States discretion to replace regulatory requirements applying to closed regulated units with site-specific requirements developed through cleanup authorities. It does not affect any authority EPA and authorized States have to impose the closure requirements. Further, the requirements for corrective action are not more stringent than those required for closure under Parts 264 and 265. Consequently, no cost assessment was prepared for the second main provision of the rule.

B. Regulatory Flexibility Act

Under the Regulatory Flexibility Act (5 U.S.C. 601 *et seq.*, as amended by the Small Business Regulatory Enforcement Fairness Act (SBREFA) of 1996), at the time the Agency publishes a proposed or final rule, it must prepare and make available for public comment a Regulatory Flexibility Analysis that describes the effect of the rule on small entities. However, no regulatory flexibility analysis is required if the Administrator certifies that the rule will not have significant adverse impact on a substantial number of small entities.

SBREFA amended the Regulatory Flexibility Act to require Federal agencies to provide a statement of the factual basis for certifying that a rule will not have a significant economic impact on a substantial number of small entities. The following discussion explains EPA's determination.

The first portion of this final rule would provide regulatory relief by expanding the options available to address post-closure care so that a permit would not be required in every case. No new requirements would be imposed on owners and operators in addition to those already in effect. The Agency estimates a cost savings of $500,000 as a result of this portion of the rule. Additional details related to this cost savings are included in the Economic Impact Analysis, which can be found in the docket. The second part of the final rule makes available more flexible standards regarding closure, groundwater monitoring, and financial assurance for some facilities. It also imposes no new requirements. Therefore, pursuant to 5 U.S.C. 601b, I certify that this regulation will not have significant economic impact on a substantial number of small entities.

C. Unfunded Mandates Reform Act

Title II of the Unfunded Mandates Reform Act of 1995 (UMRA), P.L. 104-4, establishes requirements for Federal Agencies to assess the effects of their regulatory actions on State, local, and tribal governments, and on the private sector. Under section 202 of the UMRA, EPA generally must prepare a written statement, including a cost-benefit analysis, for proposed and final rules with "Federal mandates" that may result in expenditures by local, and tribal governments, in the aggregate, or by private sector, of $100 million or more in any one year. Before promulgating an EPA rule for which a written statement is needed, section 205 of the UMRA generally requires EPA to identify and consider a reasonable number of regulatory alternatives and adopt the least costly, most cost-effective, or least burdensome alternative that achieves the objectives of the rule. The provisions of section 205 do not apply when they are inconsistent with applicable law. Moreover, section 205 allows EPA to adopt an alternative other than the least costly, most cost-effective, or least burdensome alternative if the Administrator publishes with the final rule an explanation why that alternative was not adopted. Before EPA establishes any regulatory requirements that may significantly or uniquely affect small governments, including tribal governments, it must have developed under section 203 of the UMRA a small government agency plan. The plan must provide for notifying potentially affected small governments, enabling officials of affected small governments to have meaningful and timely input in the development of EPA regulatory proposals with significant Federal intergovernmental mandates, and informing, educating, and advising small governments on compliance with the regulatory requirements.

EPA has determined that this rule does not include a Federal mandate that may result in estimated costs of $100 million or more to either State, local, or tribal governments in the aggregate, or the private sector in any one year. Neither portion of this rule is more stringent than the current Federal program, therefore, States are not required to adopt them (see section V of this preamble). In addition, this rule imposes no new requirements on owners and operators, but, rather, allows flexibility to regulators to implement requirements already in place. As stated above, EPA estimates a cost savings of $500,000 for the provisions of the final rule. EPA also has concluded that this rule will not significantly or uniquely affect small governments. Small governments will not be responsible for implementing the rule. Although they may be owners or operators of facilities regulated by the rule, the rule does not impose any new requirements.

D. Paperwork Reduction Act

The Office of Management and Budget (OMB) has approved the information collection requirements contained in this rule under the provisions of the Paperwork Reduction Act, 44 U.S.C. 3501 *et seq.* and has assigned OMB control number 2050-0009 (EPA ICR Number 1573.05).

EPA believes the changes to the information collection do not constitute a substantive or material modification. The recordkeeping and reporting requirements of this rule would replace or reduce similar requirements already promulgated and covered under the existing Information Collection Request (ICR). There is no net increase in recordkeeping and reporting requirements. As a result, the reporting, notification, or recordkeeping (information) provisions of this rule will not need to be submitted for approval to the Office of Management and Budget (OMB) under section 3504(b) of the Paperwork Reduction Act, 44 U.S.C. 3501 et. seq..

The current ICR expires on December 31, 1999. During the ICR renewal process, EPA will prepare an ICR document with an estimate of the burden reduction resulting from the decreased reporting provisions of this rule, and will publish in the **Federal Register** a Notice announcing the availability of that ICR and soliciting public comments.

Burden means the total time, effort, or financial resources expended by persons to generate, maintain, retain, or disclose or provide information to or for a Federal agency. This includes the time needed to review instructions; develop, acquire, install, and utilize technology and systems for the purposes of collecting, validating, and verifying information, processing and maintaining information, and disclosing and providing information; adjust the existing ways to comply with any previously applicable instructions and requirements; train personnel to be able to respond to a collection of information; search data sources; complete and review the collection of information; and transmit or otherwise disclose the information.

An agency may not conduct or sponsor, and a person is not required to respond to, a collection of information unless it displays a currently valid OMB control number. The OMB control numbers for EPA's regulations are listed in 40 CFR Part 9 and 48 CFR Chapter 15.

E. Executive Order 13045: Protection of Children From Environmental Health Risks and Safety Risks

Executive Order 13045, entitled "Protection of Children from Environmental Health Risks and Safety Risks" (*see* 62 FR 19885, April 23, 1997) applies to any rule that EPA determines: (1) is "economically significant" as defined under Executive Order 12866, and (2) the environmental health or safety risk addressed by the rule has a disproportionate effect on children. If the regulatory action meets both criteria, the Agency must evaluate the environmental health or safety effects of the planned rule on children, and explain why the planned regulation is preferable to other potentially effective and reasonably feasible alternatives considered by the Agency.

This final rule is not subject to E.O. 13045 because this is not an "economically significant" regulatory action as defined by E.O. 12866. In addition, the rule does not involve decisions based on environmental health or safety risks.

F. National Technology Transfer and Advancement Act

Under section 12(d) of the National Technology Transfer and Advancement Act, the Agency is directed to use voluntary consensus standards in its regulatory activities unless to do so would be inconsistent with applicable law or otherwise impractical. Voluntary consensus standards are technical standards (e.g., materials specifications, test methods, sampling procedures, business practices, etc.) that are developed or adopted by voluntary consensus standard bodies. Where available and potentially applicable voluntary consensus standards are not used by EPA, the Act requires the Agency to provide Congress, through the Office of Management and Budget, an explanation of the reasons for not using such standards.

EPA is not promulgating technical standards as part of today's final rule. Thus, the Agency has not considered the use of voluntary consensus standards in developing this rule.

G. Executive Order 12898: Environmental Justice

Under Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations," as well as through EPA's April 1995, "Environmental Justice Strategy, OSWER Environmental Justice Task Force Action Agenda Report," and National Environmental Justice Advisory Council, EPA has undertaken to incorporate environmental justice into its policies and programs. EPA is committed to addressing environmental justice concerns, and is assuming a leadership role in environmental justice initiatives to enhance environmental quality for all residents of the United States. The Agency's goals are to ensure that no segment of the population, regardless of race, color, national origin, or income, bears disproportionately high and adverse human health and environmental effects as a result of EPA's policies, programs, and activities, and all people live in clean and sustainable communities. To address this goal, EPA considered the impacts of this final rule on low-income populations and minority populations and concluded that this final rule will potentially advance environmental justice causes. The process for public involvement set forth in this final rule encourages all potentially affected segments of the population to participate in public hearings and/or to provide comment on health and environmental concerns that may arise pursuant to a proposed Agency action under the rule. EPA believes that public involvement should include regular updating of the community on the progress made cleaning up the facility. Public participation should provide all impacted and affected parties ample time to participate in the facility cleanup decisions. In many cases, public involvement should include bilingual notifications or publication of legal notices in community newspapers.

H. Executive Order 12875: Enhancing Intergovernmental Partnerships

Under Executive Order 12875, EPA may not issue a regulation that is not required by statute and that creates a mandate upon a State, local or tribal government, unless the Federal government provides the funds necessary to pay the direct compliance costs incurred by those governments. If EPA complies by consulting, Executive Order 12875 requires EPA to provide to the Office of Management and Budget a description of the extent of EPA's prior consultation with representatives of affected State, local and tribal governments, the nature of their concerns, copies of any written communications from the governments, and a statement supporting the need to issue the regulation. In addition, Executive Order 12875 requires EPA to develop an effective process permitting elected officials and other representatives of State, local and tribal governments "to provide meaningful and timely input in the development of regulatory proposals containing significant unfunded mandates."

This rule does not create a mandate on State, local or tribal governments. The rule does not impose any enforceable duties on these entities. It provides more flexibility for States and tribes to implement already-existing requirements. Accordingly, the requirements of section 1(a) of Executive Order 12875 do not apply to this rule.

I. Executive Order 13084: Consultation and Coordination With Indian Tribal Governments

Under Executive Order 13084, EPA may not issue a regulation that is not required by statute, that significantly or uniquely affects the communities of Indian tribal governments, and that imposes substantial direct compliance costs on those communities, unless the Federal government provides the funds necessary to pay the direct compliance costs incurred by the tribal governments. If EPA complies by consulting, Executive Order 13084 requires EPA to provide to the Office of Management and Budget, in a separately identified section of the preamble to the rule, a description of the extent of EPA's prior consultation with representatives of affected tribal governments, a summary of the nature of their concerns, and a statement supporting the need to issue the regulation. In addition, Executive Order 13084 requires EPA to develop an effective process permitting elected and other representatives of Indian tribal governments "to provide meaningful and timely input in the development of regulatory policies on matters that significantly or uniquely affect their communities."

This rule does not significantly or uniquely affect the communities of Indian tribal governments. In addition, this rule imposes no new requirements on owners and operators, but, rather, allows flexibility to regulators to implement requirements already in place. Accordingly, the requirements of section 3(b) of Executive Order 13084 do not apply to this rule.

J. Submission to Congress and the General Accounting Office

The Congressional Review Act, 5 U.S.C. 801(a)(1)(A), as added by the Small Business Regulatory Enforcement Fairness Act of 1996, generally provides that before a rule may take effect, the agency promulgating the rule must submit a rule report, which includes a copy of the rule, to each House of the Congress and to the Comptroller General of the United States. EPA will submit a report containing this rule and other required information to the U.S. Senate, the U.S. House of Representatives, and the Comptroller General of the General Accounting Office prior to publication of the rule in this **Federal Register**. A major rule cannot take effect until 60 days after it is published in the **Federal Register**. This rule is not a "major rule" as defined by 5 U.S.C 804(2).

VII. Brownfields

In February 1995, EPA announced its Brownfields Action Agenda, launching the first Federal effort of its kind designed to empower States, Tribes, communities, and other parties to safely cleanup, reuse, and return brownfields to productive use. To broaden the mandate of the original agenda, in 1997 EPA initiated the Brownfields National Partnership Agenda, involving nearly twenty other Federal agencies in brownfields cleanup and reuse. Since the 1995 announcement, EPA has funded brownfields pilots, reduced barriers to cleanup and redevelopment by clarifying environmental liability issues, developed partnerships with interested stakeholders, and stressed the importance of environmental workforce training. In implementing the Agenda, EPA, to date, has focused primarily on issues associated with CERCLA. Representatives from cities, industries, and other stakeholders, however, have recently begun emphasizing the importance of looking beyond CERCLA and addressing issues at brownfield sites in a more comprehensive manner.

This final rule furthers the Administration's brownfields work by removing barriers posed by RCRA regulations. Modifying the post-closure permit requirement and allowing the use of an alternative authority to clean up regulated and solid waste management units, expedites the clean up of RCRA facilities and makes such property available for reuse.

List of Subjects

40 CFR Part 264

Environmental protection, Hazardous waste, Closure, Corrective action, Post-closure, Permitting.

40 CFR Part 265

Hazardous waste, Closure, Corrective action, Post-closure, Permitting.

40 CFR Part 270

Hazardous waste, Post-closure, Permitting.

40 CFR Part 271

State authorization, Enforcement authority.

Dated: October 15, 1998.

Carol M. Browner,

Administrator.

For the reasons set out in the preamble, Chapter 1 Title 40 of the Code of Federal Regulations is amended as follows:

PART 264—STANDARDS FOR OWNERS AND OPERATORS OF HAZARDOUS WASTE TREATMENT, STORAGE, AND DISPOSAL FACILITIES

1. The authority citation for part 264 continues to read as follows:

Authority: 42 U.S.C. 6905, 6912(a), 6924, and 6925.

2. Section 264.90 is amended by adding new paragraphs (e) and (f) to read as follows:

§ 264.90 Applicability.

* * * * *

(e) The regulations of this subpart apply to all owners and operators subject to the requirements of 40 CFR 270.1(c)(7), when the Agency issues either a post-closure permit or an enforceable document (as defined in 40 CFR 270.1(c)(7)) at the facility. When the Agency issues an enforceable document, references in this subpart to "in the permit" mean "in the enforceable document."

(f) The Regional Administrator may replace all or part of the requirements of §§ 264.91 through 264.100 applying to a regulated unit with alternative requirements for groundwater monitoring and corrective action for releases to groundwater set out in the permit (or in an enforceable document) (as defined in 40 CFR 270.1(c)(7)) where the Regional Administrator determines that:

(1) The regulated unit is situated among solid waste management units (or areas of concern), a release has occurred, and both the regulated unit and one or more solid waste management unit(s) (or areas of concern) are likely to have contributed to the release; and

(2) It is not necessary to apply the groundwater monitoring and corrective action requirements of §§ 264.91 through 264.100 because alternative requirements will protect human health and the environment.

3. Section 264.110 is amended by adding a new paragraph (c) to read as follows:

§ 264.110 Applicability.

* * * * *

(c) The Regional Administrator may replace all or part of the requirements of this subpart (and the unit-specific standards referenced in § 264.111(c) applying to a regulated unit), with alternative requirements set out in a permit or in an enforceable document (as defined in 40 CFR 270.1(c)(7)), where the Regional Administrator determines that:

(1) The regulated unit is situated among solid waste management units (or areas of concern), a release has occurred, and both the regulated unit and one or more solid waste management unit(s) (or areas of concern) are likely to have contributed to the release; and

(2) It is not necessary to apply the closure requirements of this subpart (and those referenced herein) because the alternative requirements will protect human health and the environment and will satisfy the closure performance standard of § 264.111 (a) and (b).

4. Section 264.112 is amended by adding new paragraphs (b)(8) and (c)(2)(iv) to read as follows:

§ 264.112 Closure plan; amendment of plan.

* * * * *

(b) * * *

(8) For facilities where the Regional Administrator has applied alternative requirements at a regulated unit under §§ 264.90(f), 264.110(d), and/or § 264.140(d), either the alternative requirements applying to the regulated unit, or a reference to the enforceable document containing those alternative requirements.

(c) * * *

(2) * * *

(iv) the owner or operator requests the Regional Administrator to apply alternative requirements to a regulated unit under §§ 264.90(f), 264.110(c), and/or § 264.140(d).

* * * * *

5. Section 264.118 is amended by adding new paragraphs (b)(4) and (d)(2)(iv) to read as follows:

* * * * *

§ 264.118 Post-closure plan; amendment of plan.

(b) * * *

(4) For facilities where the Regional Administrator has applied alternative requirements at a regulated unit under §§ 264.90(f), 264.110(c), and/or §§ 264.140(d), either the alternative requirements that apply to the regulated unit, or a reference to the enforceable document containing those requirements.

* * * * *

(d) * * *

(2) * * *

(iv) The owner or operator requests the Regional Administrator to apply alternative requirements to a regulated unit under §§ 264.90(f), 264.110(c), and/or § 264.140(d).

* * * * *

6. Section 264.140 is amended by adding a new paragraph (d) to read as follows:

§ 264.140 Applicability.

* * * * *

(d) The Regional Administrator may replace all or part of the requirements of this subpart applying to a regulated unit with alternative requirements for financial assurance set out in the permit or in an enforceable document (as defined in 40 CFR 270.1(c)(7)), where the Regional Administrator:

(1) Prescribes alternative requirements for the regulated unit under § 264.90(f) and/or § 264.110(d); and

(2) Determines that it is not necessary to apply the requirements of this subpart because the alternative financial assurance requirements will protect human health and the environment.

PART 265—INTERIM STATUS STANDARDS FOR OWNERS AND OPERATORS OF HAZARDOUS WASTE TREATMENT, STORAGE, AND DISPOSAL FACILITIES

1. The authority citation for part 265 continues to read as follows:

Authority: 42 U.S.C. 6905, 6906, 6912, 6922, 6923, 6924, 6925, 6935, 6936, and 6937.

2. Section 265.90 is amended by adding new paragraph (f) to read as follows:

§ 265.90 Applicability.

* * * * *

(f) The Regional Administrator may replace all or part of the requirements of this subpart applying to a regulated unit (as defined in 40 CFR 264.90), with alternative requirements developed for groundwater monitoring set out in an approved closure or post-closure plan or in an enforceable document (as defined in 40 CFR 270.1(c)(7)), where the Regional Administrator determines that:

(1) A regulated unit is situated among solid waste management units (or areas of concern), a release has occurred, and both the regulated unit and one or more solid waste management unit(s) (or areas of concern) are likely to have contributed to the release; and

(2) It is not necessary to apply the requirements of this subpart because the alternative requirements will protect human health and the environment. The alternative standards for the regulated unit must meet the requirements of 40 CFR 264.101(a).

3. Section 265.110 is amended by adding new paragraphs (c) and (d) to read as follows:

§ 265.110 Applicability.

* * * * *

(c) Section 265.121 applies to owners and operators of units that are subject to the requirements of 40 CFR 270.1(c)(7) and are regulated under an enforceable document (as defined in 40 CFR 270.1(c)(7)).

(d) The Regional Administrator may replace all or part of the requirements of this subpart (and the unit-specific standards in § 265.111(c)) applying to a regulated unit (as defined in 40 CFR 264.90), with alternative requirements for closure set out in an approved closure or post-closure plan, or in an enforceable document (as defined in 40 CFR 270.1(c)(7)), where the Regional Administrator determines that:

(1) A regulated unit is situated among solid waste management units (or areas of concern), a release has occurred, and both the regulated unit and one or more solid waste management unit(s) (or areas of concern) are likely to have contributed to the release, and

(2) It is not necessary to apply the closure requirements of this subpart (and/or those referenced herein) because the alternative requirements will protect human health and the environment, and will satisfy the closure performance standard of § 265.111 (a) and (b).

4. Section 265.112 is amended by adding new paragraphs (b)(8) and (c)(1)(iv) to read as follows:

§ 265.112 Closure plan; amendment of plan.

* * * * *

(b) * * *

(8) For facilities where the Regional Administrator has applied alternative requirements at a regulated unit under §§ 265.90(f), 265.110(d), and/or 265.140(d), either the alternative requirements applying to the regulated unit, or a reference to the enforceable document containing those alternative requirements.

(c) * * *

(1) * * *

(iv) The owner or operator requests the Regional Administrator to apply alternative requirements to a regulated unit under §§ 265.90(f), 265.110(d), and/or 265.140(d).

* * * * *

5. § 265.118 is amended by adding new paragraphs (c) (4) and (5), and (d)(1)(iii) to read as follows:

§ 265.118 Post-closure plan; amendment of plan.

* * * * *

(c) * * *

(4) For facilities subject to § 265.121, provisions that satisfy the requirements of § 265.121(a)(1) and (3).

(5) For facilities where the Regional Administrator has applied alternative requirements at a regulated unit under §§ 265.90(f), 265.110(d), and/or 265.140(d), either the alternative requirements that apply to the regulated unit, or a reference to the enforceable document containing those requirements.

(d) * * *

(1) * * *

(iii) The owner or operator requests the Regional Administrator to apply alternative requirements to a regulated unit under §§ 265.90(f), 265.110(d), and/or 265.140(d).

* * * * *

5. A new § 265.121 is added to Subpart G to read as follows:

§ 265.121 Post-closure requirements for facilities that obtain enforceable documents in lieu of post-closure permits.

(a) Owners and operators who are subject to the requirement to obtain a post-closure permit under 40 CFR 270.1(c), but who obtain enforceable documents in lieu of post-closure permits, as provided under 40 CFR 270.1(c)(7), must comply with the following requirements:

(1) The requirements to submit information about the facility in 40 CFR 270.28;

(2) The requirements for facility-wide corrective action in § 264.101 of this chapter;

(3) The requirements of 40 CFR 264.91 through 264.100.

(b)(1) The Regional Administrator, in issuing enforceable documents under § 265.121 in lieu of permits, will assure a meaningful opportunity for public involvement which, at a minimum, includes public notice and opportunity for public comment:

(i) When the Agency becomes involved in a remediation at the facility as a regulatory or enforcement matter;

(ii) On the proposed preferred remedy and the assumptions upon which the remedy is based, in particular those related to land use and site characterization; and

(iii) At the time of a proposed decision that remedial action is complete at the facility. These requirements must be met before the Regional Administrator may consider that the facility has met the requirements of 40 CFR 270.1(c)(7), unless the facility qualifies for a modification to these public involvement procedures under paragraph (b)(2) or (3) of this section.

(2) If the Regional Administrator determines that even a short delay in the implementation of a remedy would adversely affect human health or the environment, the Regional Administrator may delay compliance with the requirements of paragraph (b)(1) of this section and implement the remedy immediately. However, the Regional Administrator must assure involvement of the public at the earliest opportunity, and, in all cases, upon making the decision that additional remedial action is not needed at the facility.

(3) The Regional Administrator may allow a remediation initiated prior to October 22, 1998 to substitute for corrective action required under a post-closure permit even if the public involvement requirements of paragraph (b)(1) of this section have not been met so long as the Regional Administrator assures that notice and comment on the decision that no further remediation is necessary to protect human health and the environment takes place at the earliest reasonable opportunity after October 22, 1998.

6. Section 265.140 is amended by adding a new paragraph (d) to read as follows:

§ 265.140 Applicability.

* * * * *

(d) The Regional Administrator may replace all or part of the requirements of this subpart applying to a regulated unit with alternative requirements for financial assurance set out in the permit or in an enforceable document (as defined in 40 CFR 270.1(c)(7)), where the Regional Administrator:

(1) Prescribes alternative requirements for the regulated unit under § 265.90(f) and/or 265.110(d), and

(2) Determines that it is not necessary to apply the requirements of this subpart because the alternative financial assurance requirements will protect human health and the environment.

PART 270—EPA ADMINISTERED PERMIT PROGRAMS: THE HAZARDOUS WASTE PERMIT PROGRAM

1. The authority citation for part 270 continues to read as follows:

Authority: 42 U.S.C. 6905, 6912, 6924, 6925, 6927, 6939, and 6974.

2. Section 270.1 is amended by revising paragraph (c) introductory text and adding a new paragraph (c)(7) to read as follows:

§ 270.1 Purpose and scope of these regulations.

* * * * *

(c) *Scope of the RCRA permit requirement.* RCRA requires a permit for the "treatment," "storage," and "disposal" of any "hazardous waste" as identified or listed in 40 CFR part 261. The terms "treatment," "storage," "disposal," and "hazardous waste" are defined in § 270.2. Owners and operators of hazardous waste management units must have permits during the active life (including the closure period) of the unit. Owners and operators of surface impoundments, landfills, land treatment units, and waste pile units that received waste after July 26, 1982, or that certified closure (according to § 265.115 of this chapter) after January 26, 1983, must have post-closure permits, unless they demonstrate closure by removal or decontamination as provided under § 270.1(c)(5) and (6), or obtain an enforceable document in lieu of a post-closure permit, as provided under paragraph (c)(7) of this section. If a post-closure permit is required, the permit must address applicable 40 CFR part 264 groundwater monitoring, unsaturated zone monitoring, corrective action, and post-closure care requirements of this chapter. The denial of a permit for the active life of a hazardous waste management facility or unit does not affect the requirement to obtain a post-closure permit under this section.

* * * * *

(7) *Enforceable documents for post-closure care.* At the discretion of the Regional Administrator, an owner or operator may obtain, in lieu of a post-closure permit, an enforceable document imposing the requirements of 40 CFR 265.121. "Enforceable document" means an order, a plan, or other document issued by EPA or by an authorized State under an authority that meets the requirements of 40 CFR 271.16(e) including, but not limited to, a corrective action order issued by EPA under section 3008(h), a CERCLA remedial action, or a closure or post-closure plan.

3. Section 270.14 is amended by adding a sentence to the end of paragraph (a) to read as follows:

§ 270.14 Contents of part B: General requirements.

(a) * * * For post-closure permits, only the information specified in § 270.28 is required in Part B of the permit application.

* * * * *

4. A new § 270.28 is added to Subpart B to read as follows:

§ 270.28 Part B information requirements for post-closure permits.

For post-closure permits, the owner or operator is required to submit only the information specified in §§ 270.14(b)(1), (4), (5), (6), (11), (13), (14), (16), (18) and (19), (c), and (d), unless the Regional Administrator determines that additional information from §§ 270.14, 270.16, 270.17, 270.18, 270.20, or 270.21 is necessary. The owner or operator is required to submit the same information when an alternative authority is used in lieu of a post-closure permit as provided in § 270.1(c)(7).

PART 271—REQUIREMENTS FOR AUTHORIZATION OF STATE HAZARDOUS WASTE PROGRAMS

1. The authority citation for part 271 continues to read as follows:

Authority: 42 U.S.C. 6905, 6912(a) and 6926.

2. Section 271.16 is amended by adding a new paragraph (e) to read as follows:

§ 271.16 Requirements for enforcement authority.

* * * * *

(e) Any State authority used to issue an enforceable document either in lieu of a post-closure permit as provided in 40 CFR 270.1(c)(7), or as a source of alternative requirements for regulated units, as provided under 40 CFR 264.90(f), 264.110(c), 264.140(d), 265.90(d), 265.110(d), and 265.140(d), shall have available the following remedies:

(1) Authority to sue in courts of competent jurisdiction to enjoin any threatened or continuing violation of the requirements of such documents, as well as authority to compel compliance with requirements for corrective action or other emergency response measures deemed necessary to protect human health and the environment; and

(2) Authority to access or sue to recover in court civil penalties, including fines, for violations of requirements in such documents.

[FR Doc. 98-28221 Filed 10-19-98; 10:16 am]

BILLING CODE 6560-50-P

Kieling, John, NMENV

From: Rhgilkeson@aol.com

Sent: Friday, September 04, 2009 4:48 PM

To: Kieling, John, NMENV

Cc: Rhgilkeson@aol.com; jarends@nuclearactive.org; dave@radfreenm.org; mccoydb01@msn.com

Subject: Commment By R.H. Gilkeson on the LANL Revised Draft Permit

Attachments: RHG COMMENT ON LANL REVISED DRAFT PERMIT.doc

Robert H. Gilkeson
Registered Geologist
P.O. Box 670
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505-412-1930
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September 4, 2009

By e-mail to: john.kieling@state.nm.us

John F. Kieling, Program Manager
Hazardous Waste Bureau
New Mexico Environment Department
2905 Rodeo Park Drive East, Building 1
Santa Fe, NM 87505-6303

Re: Comments to July 2009 Revised Draft Hazardous Waste Facility Permit
Facility: Los Alamos National Laboratory (LANL)
Facility Owner and C0-Operator: U.S. Department of Energy (DOE)
Facility Co-Operator: Los Alamos National Security, LLC (LANS)
EPA ID No: NM089910515

Dear Mr. Kieling:

Robert H. Gilkeson, Registered Geologist provides the following general and specific comments about the above referenced permit.

Mr. Gilkeson makes three requests:

1. NMED deny the LANL Draft Revised Permit in order to protect public health and the environment,
2. If NMED does not deny the Permit, then Mr. Gilkeson requests a public hearing, and
3. Prior to any public hearing, Mr. Gilkeson requests negotiations to resolve many issues raised in these comments, as well as by the other Interested Parties.

Mr. Gilkeson is a registered geologist, and a former lead consultant to the groundwater protection program at LANL. Mr. Gilkeson has written a number of reports and made presentations for the public, regulatory agencies as well as oversight boards about the problems with the drilling of the characterization wells at LANL with organic drilling fluids and bentonite clay muds which mask the detection of LANL contaminants. His work has been confirmed by the Department of Energy Inspector General[1], National Academy of Sciences[2] and the Environmental Protection Agency (EPA) Kerr Research Laboratory[3,4,5] in Ada, Oklahoma. He has described how the characterization wells do not comply with applicable regulations, including the New Mexico Hazardous Waste Act (HWA), the federal Resource Conservation and Recovery Act (RCRA), and the NMED LANL Consent Order that was enacted on March 1, 2005 and revised on June 18, 2008.

Mr. Gilkeson presented a report[6] to the March 14, 2007 meeting of the Northern New Mexico Citizens Advisory Board (CAB) that was successful in convincing LANL to stop the needless use of drilling methods that invaded the regional aquifer surrounding the well screens with organic drilling additives and/or bentonite clay drilling muds. LANL now uses the dual rotary underreamer casing advance drilling method recommended by Mr. Gilkeson at the March 14, 2007 meeting of the CAB. This drilling method only uses air and water for drilling into the regional aquifer.

Although LANL now uses the correct drilling method, a very serious problem remains with the large number of monitoring wells that were drilled with fluid-assisted methods that invaded the screened intervals with a large quantity of organic drilling additives and often bentonite clay drilling muds. The total number of screened intervals that were invaded with the organic and/or bentonite clay additives is approximately 100.
In addition, some screened intervals were plugged with additional quantities of bentonite clay because of mistakes in the construction of the wells. Some examples are wells R-13, R-16 screen #4, R-22 screen #3, and R-26.

The screens that are invaded with bentonite clay because of mistakes in well construction cannot be rehabilitated. In addition, all of the wells (approximately 14 wells many with multiple screens) that were drilled with the mud-rotary drilling method using bentonite clay drilling muds cannot be rehabilitated because the hydraulic energy of the drilling method for invading the bentonite clay muds deep into the sampling zone surrounding the well screen was more than an order of magnitude larger than the hydraulic energy for cleaning the bentonite clay from the screened interval.

The LANL *Workplan for R-Well Rehabilitation and Replacement* (LA-UR-06-3687 June 2006) recognized the requirement for the well development activities to remove all of the bentonite clay that was invaded into the aquifer formations along pathways for groundwater to travel into a monitoring well but as described above the complete removal of the bentonite clay is not possible. The pertinent excerpt from the LANL Workplan is pasted below:

> "If not completely removed by subsequent development, bentonite can serve as both a source of ions to groundwater as well as a sink for sorbing cations [i.e., trace metals and especially the strongly sorbing radionuclides including isotopes of cesium, americium and plutonium] and organic species." (page 3)

The NMED imposed for LANL to perform expensive rehabilitation efforts for several of the mud-rotary monitoring wells. The well rehabilitation was not successful. However, LANL uses the assessment scheme in the LANL *Well Screen Analysis Report –Revision 2* (WSAR-2) to claim that the rehabilitation was successful but the reports by the NAS[2] and the EPA Kerr Lab[5] describe the reasons the assessment scheme in the WSAR-2 is not credible. In addition, It is important to recognize the NMED approval letter for the LANL WSAR-2 presented a concern for the great uncertainty that the assessment scheme in the WSAR-2 could prove the impacted wells were reliable to detect the LANL strongly sorbing radionuclides including the isotopes of plutonium, americium, neptunium, cerium and cesium. The pertinent excerpt from the May 25, 2007 NMED approval letter for the WSAR-2 is pasted below:

> - "NMED notes that the conclusions obtained in the [WSAR-2) Report were derived mainly from analyses of extant data in the literature, possibly under conditions different from the Los Alamos National Laboratory's site (the site). The absence of critical site-specific data, such as adsorption properties, reaction

kinetics and microbial activities, implies that there would be uncertainties and limitations in using the methodology developed in the report to assess the quality of groundwater samples collected from monitoring wells installed at this site. NMED is especially concerned about the uncertainty with respect to monitoring certain potential contaminants of concern, such as the highly adsorptive radionuclides. NMED therefore suggests that the Permittees consider conducting proper laboratory and field studies to address the uncertainty regarding whether or not the monitoring wells installed as the monitoring network are capable of providing reliable data to monitor potential releases of the highly adsorptive radionuclides from operations of the Laboratory to groundwater."

The author is not aware that DOE and LANS has addressed the concerns of the NMED that the assessment scheme in the WSAR-2 cannot determine that the LANL monitoring wells (~100 screened intervals) impacted by drilling additives are reliable to detect the strongly sorbing LANL contaminants. The NAS and the EPA Kerr Lab also described the additional studies that were necessary to determine the impacted wells produced reliable and accurate data but the studies have not been performed.

A contradiction in the enforcement practice of the NMED is that NMED imposed the rehabilitation of several mud-rotary monitoring wells that are installed to detect releases from the LANL regulated units MDA G, H and L at Technical Area -54 and there is a concern for reliable detection of strongly sorbing radionuclides released from the buried wastes at MDA G and MDA H. However, NMED did not require LANS to perform the laboratory and field studies described above in the excerpt from the NMED approval letter for the LANL WSAR-2.

There is new information that indicates the WSAR-2 is not credible to determine that any of the impacted LANL monitoring wells produce reliable and representative water samples for even the RCRA hazardous constituent trace metals. The new information is the general presence of high concentrations of dissolved zinc in the new LANL monitoring wells that were installed with the dual rotary casing advance drilling method. This drilling method uses only air or water for drilling into the regional aquifer. The new wells generally produce groundwater with dissolved zinc concentrations above 10 ug/L, often above 20 ug/L and even above 50 ug/L in a few wells.

The common presence of dissolved zinc as a natural constituent in the groundwater produced from the new wells is important information that the low zinc levels measured in the water samples produced from wells invaded with the drilling fluids is evidence that the impacted wells still do not produce reliable and representative water samples. LANS and DOE should replace the impacted wells or perform a pilot study in a few of the impacted wells with the laboratory and field tests identified in the NMED approval letter and in the reports by the NAS and the EPA Kerr Lab.

The ongoing impacts from the incorrect fluid-assisted drilling methods is not the only problem with the large network of LANL monitoring wells. Many of the monitoring wells are not installed in the aquifer zones that are important to monitor. The author has coauthored two reports[7,8] with Concerned Citizens for Nuclear Safety that explain the mistakes in the drilling and installation of well R-22 and the reasons the well cannot be rehabilitated.

NMED allows LANL to use no-purge sampling methods. Another serious problem is that many of the monitoring wells are a multiple-screen design and water samples are collected with Westbay no-purge sampling systems. The NMED has not enforced the requirement in the Consent Order that wells are adequately purged before water samples are collected.

The well purging requirements in Section IX.B.2.i.i of the Consent Order which was enacted on March 1, 2005 and revised on June 18, 2008 are pasted below:

> **Section IX.B.2.i.i Well Purging**
> - All zones in each monitoring well shall be purged by removing groundwater prior to sampling and in order to ensure that formation water is being sampled. Purge volumes shall be determined by monitoring, at a minimum, groundwater pH, specific conductance, dissolved oxygen concentrations, turbidity, redox potential, and temperature during purging of volumes and at measurement intervals approved by the Department in writing. <u>The groundwater quality parameters shall be measured using a flow-through cell and instruments approved by the Department in writing</u> [emphasis added]. The volume of groundwater purged, the instruments used, and the readings obtained at each interval shall be recorded on the field monitoring log. Water samples may be obtained from the well after the measured parameters of the purge water have stabilized to within ten percent for three consecutive measurements. (p. 181)

The water samples that are collected from the multiple-screen LANL monitoring wells that are equipped with the Westbay^R no-purge sampling systems are an example of where the NMED has not enforced the purging requirement in the Consent Order. No volume of water is purged from the LANL monitoring wells that are sampled with the Westbay^R systems. The Westbay^R equipment collects water samples into stainless steel containers that are lowered to the individual screened zones in the multiple-screen monitoring wells. The water samples collected with the Westbay system do not comply with the purging requirements in Section IX.B.2.ii of the Consent Order. A flow-through cell could not be used to measure water quality parameters on water samples collected with the Westbay^R equipment. The Westbay^R equipment was used to collect water samples from fifty (50) of the eighty (80) screened intervals in the LANL monitoring wells that were evaluated in the LANL *Well Screen Analysis Report – Revision 2* (WSAR-3) LA-UR-07-2852, April 2007). The NMED approved the WSAR-2 on May 25, 2007 despite the fact that the majority of the wells in the WSAR-2 were sampled with no-purge methods that do not meet the well purging requirements in Section IX.B.2.i.i in the Consent Order.

The fact that no-purge methods were used to collect water samples from the majority of the LANL monitoring wells was an important reason for the NNMED to not approve of the LANL WSAR-2. The WSAR-2 is an example of an alternative requirement in the Draft LANL Permit and to the present time, the NMED continues to make a mistake to allow LANL to present water quality data as reliable and representative for water samples that are collected with no-purge methods using Westbay^R sampling equipment.

Some examples of LANL multiple-screen monitoring wells that are approved by the NMED for use as monitoring wells and that are still sampled with Westbay^R no-purge sampling methods that do not meet the well purging requirements in Section IX.B.2.i.i of the Consent Order include the following 12 wells with 36 screened intervals: 1). Well CdV-R-15-3 (3 screens), 2). Well CdV-R-37-2 (3 screens), 3). well R-5 (3 screens), 4). Well R-7 (1 screen), 5). Well R-8 (2 screens), 6). Well R-9i (2 screens), 7). Well R-16 (3 screens), 8). Well R-19 (6 screens, 9). Well R-20 (3 screens), 10). Well R-25 (5 screens), 11. Well R-26 (I screen), and 12. Well R-31 (4 screens).

The NMED described the importance of purging water from the LANL monitoring wells in the **Notice of Disapproval Well Screen Analysis Report Los Alamos National Laboratory EPA ID #NM) 0890010515 HWB-LANL-05-22** that was issued to LANL on September 18, 2005. The pertinent excerpt from the NMED Notice of Disapproval (NOD) is pasted below:

> The sampling method, specifically whether purging is conducted before collection of samples, may play a crucial role in determining the quality of water samples. This is especially critical if residual drilling fluids and bentonite are present around screened intervals in the affected wells (emphasis added). According to *Ground-Water Sampling Guidelines for Superfund and RCRA Project Managers* (EPA 542-S-02-001, 2002), monitoring well must be purged so that water samples representative of formation water can be obtained. . . . Purging is a safeguard against collecting a sample biased by stagnant water. Purging is also an efficient way to reduce the contact time of formation water with a screen and any surrounding areas impacted by drilling fluids or other anthropogenic influences on water quality, which helps to minimize the potential influences of such factors on water sample quality. (p. 2).

In addition, the NMED provided directions to LANL on April 9, 2007 to modify the LANL *Well Screen Analysis Report* in the document DIRECTION TO MODIFY WELL SCREEN ANALYSIS REPORT, REVISION 1 EPA ID #NM0O890010515 HWB-LANL-05-022. The NMED made statements in this document that also show the NMED understood the need to enforce the requirements in the Consent Order in Section IX.B.2.i.i Well Purging. The pertinent excerpt is pasted below:

> However, certain surface changes due to precipitation of newly-created minerals may also change the reactivity of the minerals in the aquifer adjacent to impacted screens. For example, the availability of organics constrained in drilling fluids likely stimulate, sequential microbial metabolism, including iron reduction and sulfate reduction. As a result, it is likely that iron sulfides are produced as precipitates, thereby enhancing reactivity of the aquifer solids adjacent to impacted screens [emphasis added]. (p.4)

The above discussion from the NMED April 9, 2007 directions document is a description of the new reactive chemistry with properties to prevent the detection of many LANL contaminants that is created in a zone surrounding the impacted well screens. The excerpt from the NMED document describes the need for NMED to enforce the well purging requirements in Section IX.B.2.i.i in the Consent Order but the NMED has failed to do this.

The National Academy of Sciences 2007 Final Report on the LANL Groundwater Protection Practices described the need for purging the LANL monitoring wells as follows:

(a)pplication of proper purging techniques in both well development and groundwater sampling is necessary for collection of representative groundwater samples, especially in the regional aquifer. The most trustworthy sampling technique includes purging three or more well volumes from the monitoring well before sample collection (ASTM, 1992) (p. 56).

Purging Requirements in the LANL Revised Draft Permit. The Well Purging requirements in the March 1, 2005 Consent Order are also the **identical requirements** in **Section 11.10.2.8.ii – Well Purging** in the Draft LANL Part B Permit that was issued on July 6, 2009 for public comment.

- Why hasn't the NMED enforced the purging requirement in **Section IX.B.2.i.i Well Purging** in the LANL Consent Order?

– The record shows that NMED has not enforced the purging requirement in the Consent Order although the record shows in great detail that the NMED understands the importance for purging the wells. Given the pattern and practice of NMED to not require LANL to do the required purging in the Consent Order, what is the assurance that the NMED will enforce the identical purging requirements in the Draft LANL Part B (i.e., Permit **Section 11.10.2.8.ii – Well Purging)?**

The NMED does not enforce the Groundwater Sample Collection requirements in the Consent Order. The NMED does not enforce Consent Order **Section IX.B.2.i.ii Groundwater Sample Collection.** Section IX.B.2.i.ii is pasted below:

- Groundwater samples shall be obtained from each well after a sufficient amount of water has been removed from the well casing to ensure that the sample is representative of formation water.

However, the fact that the NMED continues to allow LANL to collect no-purge water samples from many multiple-screen wells equipped with Westbay sampling systems is one example of the failure of NMED to enforce Consent Order Section IX B. 2. i.ii. In addition, a review of water quality data for the constituent dissolved zinc is proof that a sufficient amount of water is not removed from many of the single-screen LANL monitoring wells to ensure that the collected samples are representative of formation water.

The single-screen monitoring wells are equipped with submersible pumps that provide for purging large amounts of groundwater before water samples are collected for the analytical suite. Nevertheless, the very low concentrations of dissolved zinc in the groundwater samples produced from many of the single-screen wells are evidence that the wells do not produce reliable and representative water samples because of on-going impacts from the new mineralogy formed in a zone surrounding the well screen by the organic and bentonite clay drilling muds. Some examples of single-screen monitoring wells where the very low concentrations of dissolved zinc are evidence of an on-going impact from the organic or bentonite clay drilling additives are wells R-1, R-2, R-4, R-6, R-9, R-10a, R-13, R-15, R-16r, R-18, R-21, R-23, R-27, R-28, and R-34. This is a serious problem that requires resolution by either replacing these wells in most cases because of the contaminants that the wells are required to provide reliable detection.

The NMED has not required LANL to comply with use of chemicals to destroy organic polymer drilling additives. The pertinent section in **Consent Order Section X.B.3 Water Rotary and Mud Rotary** is pasted below:

> - [o]rganic polymer drilling muds have been observed to facilitate bacterial growth, which reduces the reliability of sampling results. If polymer emulsions are to be used in the drilling program at the Facility, polymer dispersion agents shall be used at the completion of the drilling program to remove the polymers from the boreholes. For example, if EZ Mud® is used as a drilling additive, a dispersant (e.g., BARAFOS® or five percent sodium hypochlorite) shall be used to disperse and chemically breakdown the polymer prior to developing and sampling the well.

However, the organic polymer EZ-Mud® and other polymer drilling additives were allowed to invade the screened intervals in approximately 100 of the LANL monitoring wells. This practice continued in over 10 monitoring well installed after the enforcement date of the Consent Order on March 15, 2005. However, the NMED never required LANL at any time to use chemicals to disperse and breakdown the polymers. Instead, the polymers were allowed to facilitate bacterial growth which reduced the reliability of the sampling results for many of the LANL contaminants. Some examples of LANL monitoring wells installed after the Consent Order was enacted where organic polymer drilling additives invaded the screened zones and chemicals were not used to destroy the organic polymers include wells R-16r, R-17, R-27 and R-34.

The NMED has not enforced the method reporting limits that are required in the Consent Order. Section IX.C.3.c Method Reporting Limits is pasted below:

> IX.C.3.c Method Reporting Limits
> Method reporting limits for sample analyses for each medium shall be established at the lowest level practicable for the method and analyte concentrations and shall not exceed soil, groundwater, surface water, or vapor emissions background levels, cleanup standards, and screening levels. The preferred method detection limits are a maximum of 20 percent of the background, screening, or cleanup levels. Detection limits that exceed established soil, groundwater, surface water, or air emissions cleanup standards, screening levels, or background levels and are reported as "not detected" shall be considered data quality exceptions and an explanation for the exceedance and its acceptability for use shall be provided.

The analytical results for groundwater samples collected from new LANL monitoring well R-38 illustrate the failure of NMED to enforce the above listed Section IX.C.e.c in the Consent Order. RCRA Contaminants are detected in well R-38 but the nature and extent of contamination is not accurately known because of the poor resolution of the method reporting limits.

LANL monitoring well R-38 is located in the north fork of Canada del Buey to monitor contamination from MDA L. The location of well R-38 is displayed on Figure 1. Well R-38 is located approximately 1500 feet northeast of MDA L. Well R-38 was installed at the direction of the New Mexico Environment Department. The RACER database presents analytical data from two sampling dates for well R-38 which are February 6, 2009 and May 1, 2009. On both sampling dates, the three RCRA hazardous constituents Benzene, Toluene and Bis(2-ethylhexyl)phthalate were detected in the water produced from well R-38. The Benzene contamination measured in the water sample collected on February 6. 2009 was at a level greater than the EPA Drinking Water Standard (DWS) of 5 ug/L. Table 1 presents the water quality data for well R-38.

Table 1 shows that the RCRA constituents pentachlorophenol and benzo(a)pyrene were not detected in the water samples produced from well R-38T. However, it is important to note that Table 1 shows that the method reporting limits for the analytical methods that were used for the two constituents are <u>far above</u> the EPA DWS of 0.2 ug/L for Benzo(a)pyrene and 1 ug/L for pentachlorophenol.

Table 1. Water Quality for Three Sampling Events in Well R-38

	02-06-09	05-01-09 11:40 AM	05-01-09 12:32 PM
-	**UNF**	**UNF / DUP**	**UNF / DUP**
- Benzene (ug/L) #71-43-2	**6.34**	**1.8 / 1.4**	**1.81 / 1.6**
- Toluene (ug/L) #108-88-3	**1.46**	**1.7 / 1.5**	**1.9 / 1.8**
- Ethylbenzene (ug/L)	**< 1**	**< 1 / < 1**	**< 1 / < 1**
- Bis(2-ethylhexyl)phthalate (ug/L)	**6.14**	**7.09 / NL**	**35.6 / 3.3**
- Benzo(a)pyrene (ug/L) #50-32-8	**< 1.15 U**	**< 1.05 U / NL**	**< 11 U / < 1.11 U**
- Pentachlorophenol (ug/L) (6.2 ug/L @ R-22) # 87-86-5	**< 11.5 U**	**< 10.5 U / NL**	**< 22 U / < 11.1 U**
- Methyl ethyl ketone (ug/L)	**< 5 UJ**	**< 5 U / NL**	**< 5 U / NL**
- Benzoic acid (ug/L) (3 - 12.5 ug/L @ R-22)	**< 23 UJ**	**< 21.1 UJ / NL**	**< 54 U / < 22.2 UJ**
- Diethylthalate (ug/L) (1.3 ug/L @ R-22)	**< 11.5 U**	**< 10.5 U / NL**	**< 11.1 U / < 11 U**
- Butyl benzyl pthalate (ug/L) (9.8 ug/L @ R-22)	**< 11.5 U**	**< 10.5 U / NL**	**< 11.1 U / < 11 U**

The EPA Drinking Water Standard for Benzene is 5 ug/L
The EPA Drinking Water Standard for Pentachlorophenol is 1 ug/L
The EPA Drinking Water Standard for Benzo(a)pyrene is 0.2 ug/L
The EPA Drinking Water Standard for Toluene is 1000 ug/L

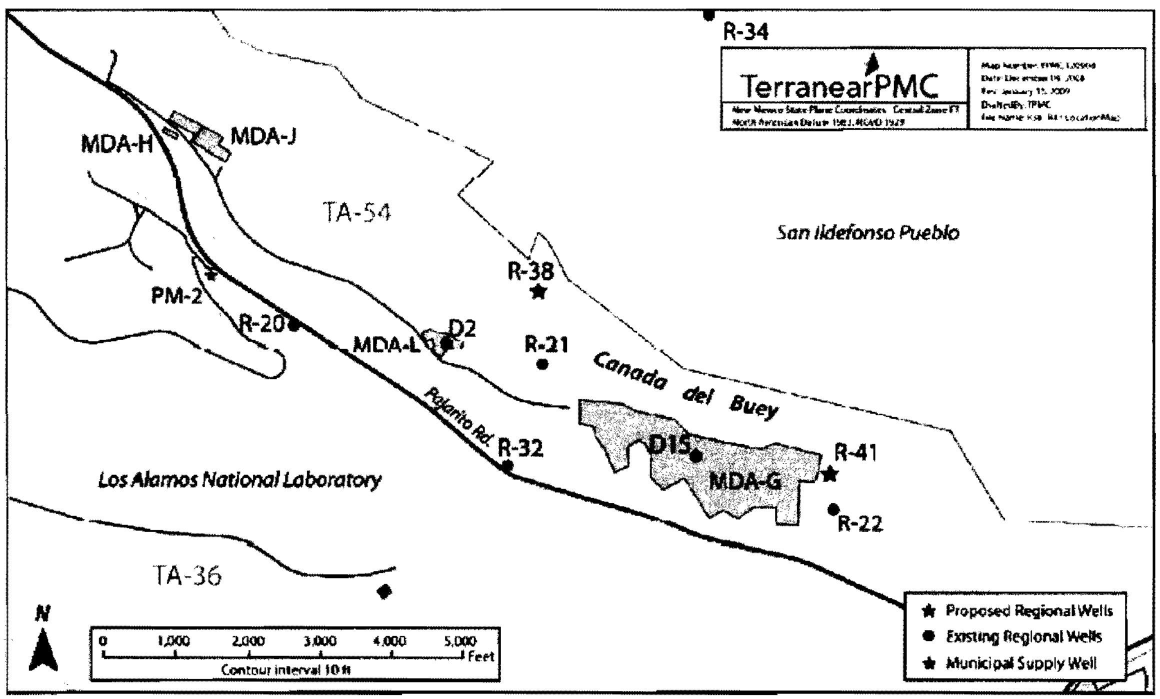
The VOCs and SVOCs detected in water samples produced from well R-22 were described in LANL Report – (LA-UR-04-6777, September 2004) as follows:

> "Thirty-one volatile and semi-volatile organic compounds have also been detected in water from well R-22. Only two of these, pentachlorophenol (1 detection, 6.2 ppb, MCL = 1 ppb) and benzo(a)pyrene (2 detections, 0.24 ppb, MCL = 0.2 ppb) were present at concentrations above the MCL. Monitoring for organic compounds at well R-22 will continue" [MCL means Maximum Contaminant Level allowed in the EPA Drinking Water Standards].

The analytical results for well R-22 show that in many cases analytical methods with lower limits of detection were used for analyses of water samples from well R-22 than were used for the analysis of water samples from well R-38. It is essential to use analytical methods that provide the best detection possible for the analysis of water samples produced from well R-38.

In addition, the contaminants detected in well R-38 and earlier in well R-22 are "statistically significant evidence of contamination" under 40 CFR §264.97. Accordingly, LANL is required to implement the RCRA Compliance Monitoring Program of 40 CFR §264.99 for the three regulated units MDA G, MDA H and MDA L. LANL has not installed the networks of monitoring wells at the three regulated units that are required by the Compliance Monitoring Program. There is an immediate need to correct this deficiency.

Figure 1. Location of monitoring well R-38 approximately 1500 feet northeast of LANL waste disposal site MDA L



The issues presented in the August 15, 2007 NMED Notice of Disapproval (NOD) for the monitoring well network at TA-16 were not resolved in the revised version of the LANL *TA-16 Well Evaluation Report – Revision 1* (LA-UR-07-6433, September 2007). The NMED has made a mistake to approve the LANL report.

The NOD issued by the NMED Hazardous Waste Bureau (HWB) correctly identified that the network of monitoring wells at TA-16 did not provide early detection of contamination. The pertinent excerpt from the NOD is pasted below:

> *NMED continues to question the suitability of the current groundwater monitoring network surrounding Technical Area (TA) 16 to address the needs for monitoring potential contaminant releases from Consolidated Unit 16-021(c)-99.* ***A well-designed groundwater monitoring network should be capable of intercepting the centerline of a plume, (i.e., the zone likely to contain the highest concentration of contaminants), as early as possible once contaminants reach the regional aquifer.*** *[emphasis added]. The numerical modeling efforts described in the Evaluation assumed contaminant breakthrough from two areas: below Cañon de Valle and Martin Spring Canyon.*

The revised LANL report which was approved by NMED **still** does not have the required network of monitoring wells for early detection of groundwater contamination. The failure of LANL to install the required network of monitoring wells at TA-16 is proven because the LANL TA-16 revised report assumes that there are large plumes of high explosives contamination in the regional aquifer below Cañon de Valle and Martin Spring Canyon. The plumes are displayed on Figure 1. The LANL report assumes each of the two plumes has a width of ¾ miles and is migrating to the east toward the Los Alamos County drinking water wells. The LANL report describes the two plumes as follows:

> Groundwater modeling results indicate that a contaminant plume impinging on the regional aquifer beneath Cañon de Valle (the most likely pathway for HE contamination in the deep perched and regional aquifer) has an east-northeast trend with a width of approximately 0.75 mi. A contaminant plume impinging on the regional aquifer in a more southerly portion of TA-16 (Martin Spring Canyon) has a similar width but travels in an east-southeasterly direction. The modeling suggests that the spacing of both the near-field (R-18, CdV-R-15-3, CdV-R-37-2) and far-field (R-17, R-19, R-27) downgradient wells is probably adequate to detect migration of contaminants off-site from TA-16. Wells R-18 and R-17 are located along the calculated east-northeast plume flow direction, so they are potentially important monitoring wells. Very low levels (<1 part per million) of RDX have been detected at R-18. [**NOTE:** This statement is disingenuous because the measured concentrations of RDX measured in well R-18 are close to the U.S. EPA drinking water screening level of 0.61 parts per billion.]
>
> Statistical analyses of the ability of the monitoring network, as well as subsets of that network, to detect contaminants migrating downgradient in the regional aquifer were performed. The analyses indicate that a network consisting of both the near- and far-field wells has a greater than 95% chance of detecting TA-16 contaminants before they impinge on a production well. Analyses of a subnetwork consisting only of the near field wells [CdV-16-3(i), R-18, CdV-R-

15-3, CdV-R-37-2] suggest that such a network has less than a 95% chance of detecting TA-16 contaminants long before (>20 yr) they impinge on a production well. The time frame of detection for these wells is approximately 10 yr, which is approximately 20 yr before the predicted impingement of any plume on the production wells.

All of the monitoring wells except well R-25 are located too far away from the contaminant release zones. The time frame for detection of contamination at the TA-16 monitoring wells of 10 years is unacceptable. The strategy in the revised LANL report to allow great contamination of the regional aquifer over a distance of several miles is unacceptable by the New Mexico Water Quality Act. The network of monitoring wells is displayed on Figure 2. The revised plan installs only one new monitoring well in the regional aquifer. The new well is well R-4X on Figure 2. The proposed well R-4X is located one mile down gradient from the contaminant release zone in Cañon de Valle. The location of well R-4X is a mistake given the need to install monitoring wells close to the two release zones.

It is necessary for the NMED HWB to order LANL to install monitoring wells close to the contamination release zones at TA-16. Figure 2 shows that LANL multiple-screen monitoring well R-25 is the well that is located the closest to the Cañon de Valle release zone.

However, the *TA-16 Well Evaluation Report* presents information which shows that well R-25 has never produced reliable and representative groundwater samples because 1). the many mistakes in installing well R-25 allowed cross-contamination from the thick perched zone into the regional aquifer, 2). the screened zones in well R-25 are all very poorly productive of groundwater either because the screens are installed in impermeable rock or the screens are plugged by the drilling additives, and 3). the Westbay no-purge sampling system produces stagnant water samples that do not represent the *in situ* groundwater in the regional aquifer.

The highest RDX contamination in the regional aquifer below TA-16 are concentrations greater than 25 ug/L (see Figure 3.3-1 in LANL report LA-UR-06-5510, August 2006). The highest concentration were measured in water samples produced from well R-25. The RDX contamination measured in the regional aquifer at well R-25 is much higher than the U.S. EPA drinking water screening limit of 0.61 ug/L. The actual nature and extent of the RDX contamination in the regional aquifer at the location of well R-25 is not known because of the poor reliability of the water samples produced from well R-25. It is necessary for the NMED to order LANL to install new single-screen monitoring wells in the regional aquifer to replace well R-25.

All of the existing monitoring wells were drilled with improper methods. LANL invaded the screened zones in all of the existing monitoring wells in the *TA-16 Well Evaluation Report* with organic polymer drilling fluids. The NMED Hazardous Waste Bureau (HWB) did not enforce the requirement in the Consent Order for LANL to use chemicals to destroy the organic drilling additives. LANL now has the capability to use drilling methods that do not invade the monitoring well sampling zones with any drilling additives other than air of water. It is necessary for the NMED HWB to order LANL to install a new network of monitoring wells at TA-16 with the proper casing advance drilling methods.

Most of the existing monitoring wells are a multiple-screen design that produce stagnant unreliable water samples. The multiple-screen monitoring wells with Westbay no-purge sampling systems include the following:

- Well R-25 – seven screens that do not produce usable water quality data
- Well R-26 – one functional screen in a perched zone and one plugged screen in the regional aquifer that does not produce water samples
- Well CdV-R-15-3 – three screens that do not produce usable water quality data
- Well CdV-R-37-2 – three screens that do not produce usable water quality data
- Well R-19 – six screens that do not produce usable water quality data

At other locations across LANL, NMED has ordered LANL to rehabilitee at least five of the multiple-screen monitoring wells with replacement of the Westbay no-purge sampling systems with active pumping systems. The Westbay sampling system is not installed in any new monitoring wells at LANL because the "no-purge" sampling system does not produce reliable and representative water samples. The NMED has made a mistake not to require LANL to replace all of the multiple- screen wells used to monitor TA-16.

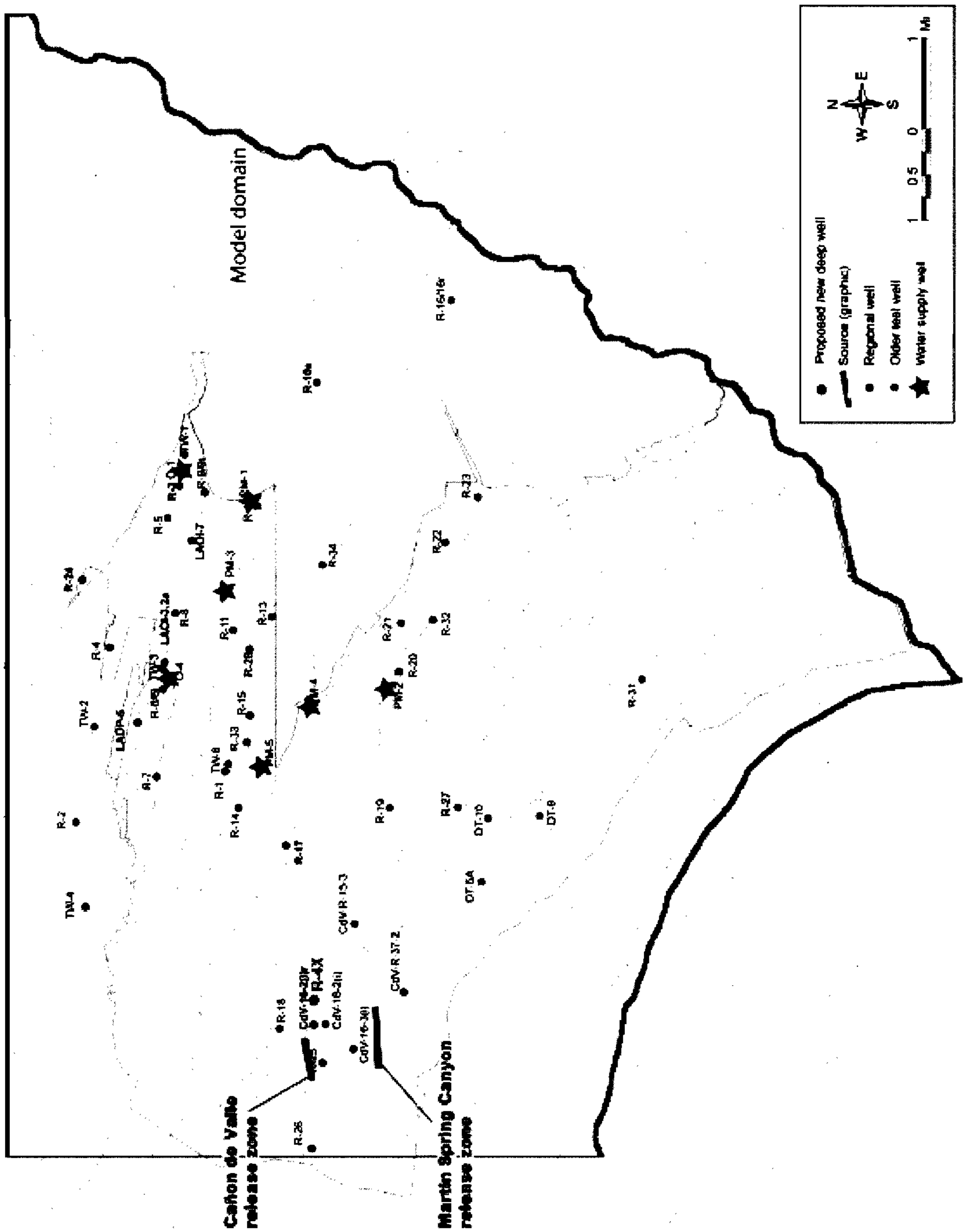
The LANL *Well Screen Analysis Report – Revision 2 (WSAR-2) (LA-UR-07-2852 May 2007)* is not credible for the assessment that the LANL monitoring wells at TA-16 produce reliable and representative water samples. The NMED HWB has made a mistake to approve of the LANL WSAR-2 for assessment that the LANL monitoring wells have cleaned up from the impacts of the organic and bentonite clay drilling additives. The 2007 report by the National Academy of Sciences (NAS) and many reports by the EPA Kerr Research Laboratory conclude that the assessment scheme in the LANL WSAR reports is not credible and is not based on a good scientific practice. All of the existing monitoring wells at TA-16 are impacted by the improper drilling practices that invaded the wells with organic drilling additives. The use of the LANL WSAR-2 to assess that the wells produce reliable and representative water samples is unacceptable.

Single-screen Well R-18 is installed too deep into the regional aquifer. The high explosive contaminant RDX is routinely measured in water samples produced from monitoring well R-18. The highest RDX concentration measured in water samples collected in 2009 was 0.58 ug/L which is near the U.S. EPA drinking water screening limit of 0.61 ug/L. The nature and extent of RDX groundwater contamination in the regional aquifer at the location of well R-18 is not known because the well screen is installed 70 feet below the water table and below a clayey confining bed. The RDX contamination in the groundwater at the water table may be much higher than the levels measured in well R-18. There is a need to install a new monitoring well at the location of well R-18 to investigate the nature and extent of the RDX contamination.

An additional problem is that well R-18 is installed at a distance of one mile from the Cañon de Valle release zone. This distance is too great. The RDX contamination at well R-18 requires the NMED HWB to order LANL to install additional monitoring wells between well R-18 and the Cañon de Valle release zone to investigate the nature and extent of groundwater contamination.

<u>There are no monitoring wells at TA-16 that provide usable background water quality data</u>. Monitoring well R-26 with two screened intervals was installed to provide background water quality data for TA-16 but the well has never produced usable water quality data on either the perched zone of saturation or the regional aquifer because of the many mistakes on drilling, installation and sampling of this well. The drilling methods invaded the sampling zones with organic drilling additives and bentonite clay muds. The screen installed in the regional aquifer has never produced water samples because the screen is plugged with bentonite clay. The screen installed in the perched zone does not produce reliable and representative water samples because of 1). the new mineralogy formed in the screened zone by the organic drilling additives and 2) the Westbay no-purge sampling system collects stagnant water samples from the zone impacted by the organic drilling additives. The NMED must order LANL to replace well R-26 with two new single-screen monitoring wells.

Figure 2. The large plumes of high-explosives contaminated groundwater assumed to be present in the regional aquifer below Canon de Valle and Martin Spring Canyon in TA-16 at Los Alamos National Laboratory. The two plumes are shown in red on the western side of the map.



Source: Figure E-2.0-1 in LANL TA-16 Well Evaluation Report, Revision 1

References:

1. "Characterization Wells at Los Alamos National Laboratory," DOE/IG-0703, September 2005.
2. "Plans and Practices for Groundwater Protection at the Los Alamos National Laboratory," Final Report, National Research Council of the National Academies.
3. "Los Alamos National Laboratory, Los Alamos, New Mexico (01RC06-001) Impacts of Well Construction Practices," February 10, 2006. Memo from the EPA Kerr Research Laboratory, Ada, Oklahoma.
4. "Los Alamos National Laboratory, Los Alamos, New Mexico (05RC06-001) Review of LANL Well Screen Analysis Report (LA-UR-05-8615)," February 16, 2006. Memo from the EPA Kerr Research Laboratory, Ada, Oklahoma.
5. "Los Alamos National Laboratory (LANL), Los Alamos, NM (09RC06-001) Well Screen Analysis Report (WSAR), Rev. 2 (LA-UR-07-2852) Groundwater Background Investigation Report (GBIR), Rev. 3 (LA-UR-07-2853)." March 30, 2009. Memo from the EPA Kerr Research Laboratory, Ada, Oklahoma.

6. Comment on the Proposed Drilling Plan for LANL Characterization Wells R-35a and R-35b as Sentry Monitoring Wells for Los Alamos County Drinking Water Well PM-3 by Robert H. Gilkeson, Registered Geologist - A report presented to the March 14, 2007 Meeting of the Northern New Mexico Citizen's Advisory Board.

7. Gilkeson, R. H. and Joni Arends. February, 2009. The Los Alamos National Laboratory *Fieldwork Plan for R-22 Well Rehabilitation and Conversion* is Unacceptable and Must be Denied by the New Mexico Environment Department.

8. Comment on May 6, 2009 by Concerned Citizens for Nuclear Safety and Robert H. Gilkeson, Registered Geologist, on the Los Alamos National Laboratory *Fieldwork Plan for R-Well Redevelopment, Phase I (April 2009, LANL Report EP2009-0171)*

Kieling, John, NMENV

From: Rhgilkeson@aol.com

Sent: Friday, September 04, 2009 4:59 PM

To: Kieling, John, NMENV

Cc: Rhgilkeson@aol.com; jarends@nuclearactive.org

Subject: Reports for the Public Comment Record for the LANL Revised Draft Permit

Attachments: CAB RHG Comment on the Drilling Plan for LANL Wells R35.doc; CCNS - Gilkeson comment on proposed rehab of well R-22.pdf; COMMENT ON LANL WELL R-22 REHABILITATION PLAN PDF.pdf

September 4, 2009

Dear Mr. Kieling

This e-mail brings to the attention of the New Mexico Environment Department (NMED) the attached reports for adding to the Public Comment Record for the Revised Draft LANL Permit and to the NMED LANL Administrative Record.

Please provide an answer to this request to confirm that the NMED has added the attached reports to the Public Comment Record for the Revised Draft LANL Permit and to the LANL Administrative Record..

Sincerely

Robert H. Gilkeson, Registered Geologist
P.O.Box 670
Los Alamos, NM 87544
505-412-1930
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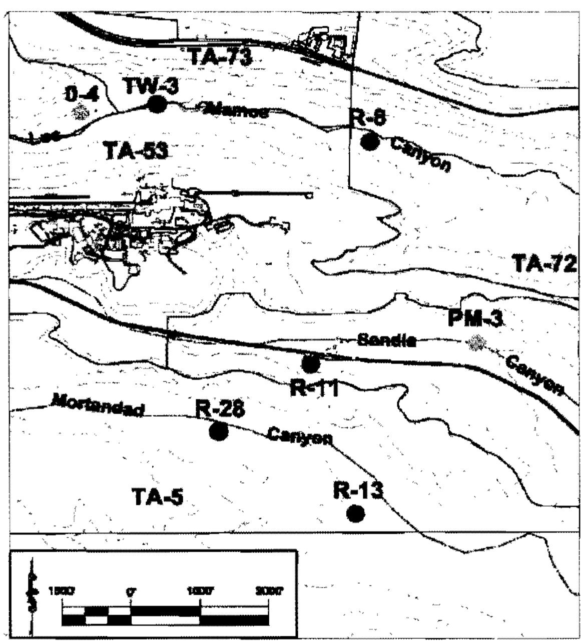
Comment on the Proposed Drilling Plan for LANL Characterization Wells R-35a and R-35b as Sentry Monitoring Wells for Los Alamos County Drinking Water Well PM-3 by Robert H. Gilkeson, Registered Geologist
- A report presented to the March 14, 2007 Meeting of the Northern New Mexico Citizen's Advisory Board.

Introduction. A plume of hexavalent chromium is present in the regional aquifer beneath the Los Alamos National Laboratory (LANL). Hexavalent chromium is the groundwater contamination in the movie ***Erin Brockovich.*** The dimensions of the plume are poorly understood at the present time. The highest hexavalent chromium contamination is measured in well R-28 at a level often above 400 ug/L (400 parts per billion). The Environmental Protection Agency (EPA) maximum contaminant level (MCL) for chromium is 100 ug/L. There is a concern that the chromium plume may contaminate the water produced from Los Alamos County drinking water well PM-3. The location of wells PM-3 and R-28 are displayed on Figure 1.

The principal source for the chromium plume is effluent waste waters that were released to Sandia Canyon from the LANL power plant. Sandia Canyon is displayed on Figure 1. The power plant is located far to the west of the stretch of the canyon shown on the figure. However, the region of recharge of the chromium contamination to the regional aquifer is in the reach below Sandia Canyon that is southwest to due south of Los Alamos County drinking water well Otowi-4 (shown as O-4 on Figure 1).

A major mistake in the LANL study of the chromium contamination is that a well to the regional aquifer was not installed at a location along Sandia Canyon where the recharge of the chromium contamination and other contamination including molybdenum and zinc to the regional aquifer occurred. Drinking water well O-4 is in danger of contamination by the recharge of waste water effluents along the floor of Sandia Canyon.

Figure 1. Map Showing the Locations of LANL Characterization Wells R-8, R-11, R-13, R-28, and the Los Alamos County Drinking Water Wells O-4 and PM-3.



-- Boundary of LANL with the property of the San Ildefonso Pueblo

As shown on Figure 1, the property of the San Ildefonso Pueblo is ¼-mile to the south of well R-28. LANL well R-13 does not establish the lateral dimensions of the hexavalent chromium plume because the top of the well screen is 125 feet below the water table, and below confining beds of clayey sediments. It is very probable that the chromium plume is present in the highly permeable aquifer strata that are present at a shallow depth below the water table at the location of well R-13.

It is very probable that the chromium plume is contaminating the regional groundwater resource that is the property of the San Ildefonso Pueblo. It is also possible that the level of hexavalent chromium contamination is greater on the Pueblo property than is measured at well R-28. There is an immediate need to install a reliable monitoring well on the property of the San Ildefonso Pueblo at a location south of well R-28.

LANL presentation to the March 14, 2006 meeting of the CAB on *"the path forward for drilling reliable monitoring wells at LANL."* The LANL presentation includes two reports submitted to the CAB:

Broxton, David, 2006. *"A Brief History of Drilling for the Hydrogeologic Workplan at LANL,"* – a Powerpoint presentation to the May 15, 2006 meeting of the National Academy of Sciences study committee on LANL groundwater protection practices. The meeting convened in Santa Fe, New Mexico.

LANL, 2006. *"Drilling Workplan for Regional Aquifer Wells R-35a and R-35b,"* LANL report LA-UR-06-3964, June 2006.

Comment on the Broxton Report. The Broxton report presents the position that the casing advance drilling method resulted in abandonment of drill casings in 8 of the boreholes for a total abandonment of 2,632 feet of casing. In the Broxton report, abandoned casing is listed in wells R-7, R-8, R-9, R-12, R-16, R-19, R-25, and R-31.

In many reports and at many meetings, the staff of LANL, the Department of Energy (DOE), and the New Mexico Environment Department (NMED) have claimed that the casing advance drilling method is too risky and too costly, and therefore, it is necessary to drill the LANL monitoring wells with methods that invade the screened intervals with drilling fluids that have well known properties to mask the detection of many LANL contaminants, and especially the radionuclide contaminants produced by the manufacture and research on nuclear weapons.

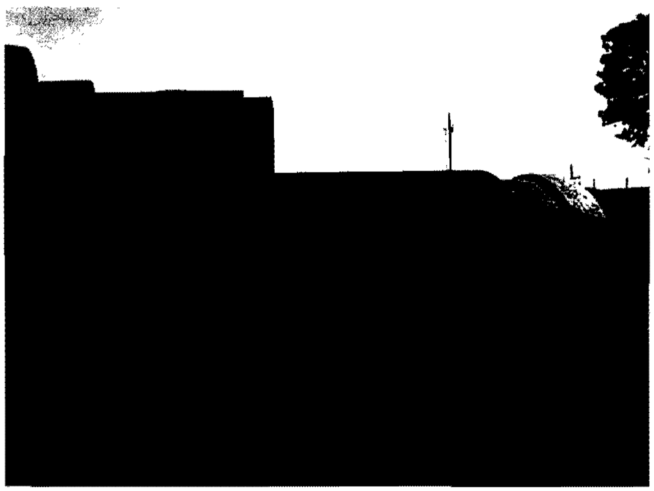
A Powerpoint^{R} presentation by LANL scientist Ardyth Simmons also makes the incorrect claim that the casing advance drilling method is too costly and too risky. The Simmons presentation materials were a handout at the January 17, 2007 EMSR meeting of the CAB. I provided the CAB with a report to document that the casing advance drilling method was not responsible for the abandoned drill casing in any of the wells – Comment by Robert H. Gilkeson on the LANL Groundwater Data Adequacy Project as presented by Ardyth Simmons on January 10, 2007 (LA-UR-06-2146, LA-UR-06-3516, and LA-UR-06-4825).

An important example of the wrong claim that casing was abandoned because of seizure by the borehole wall is the 953 feet of casing abandoned in well R-9. The drill casing was not seized to the borehole wall. Instead, retracting the drill casing was pulling the well out of the ground. The casing advance drilling method is not responsible for the mistakes made in constructing the well that caused the well to become "locked" to the drill casing.

Furthermore, a review of the LANL Well R-31 Completion Report does not show that any drill casing was abandoned in this well as claimed in the Broxton and Simmons reports.

A major factor that is responsible for the seizure of drill casing in the boreholes is the larger diameter of the threaded collars that attach together each 10-ft or 20-ft section of drill casing. The collars are displayed on Figure 2. The collars had a markedly larger diameter than the outside wall of the casing. The collars greatly increased the danger of the drill casing becoming seized in the boreholes, especially when too great a distance was drilled with one diameter of casing, and when adequate time was not spent with backreaming drilling to keep the borehole wall stable.

Figure 2. The Large Threaded Connectors on the LANL Retractable Drill Casing Increased the Potential for the Casing to Become Seized in Boreholes.



The action of the larger diameter of the drill collars as catch points is illustrated by using the thumb and first finger on one hand to grasp before the knuckles of the fingers on the other hand. The larger size of the knuckles form catch points. The large collars were not necessary. Threaded collars with the same dimension as the drill casing are available and had adequate strength for the drilling activities.

At wells R-9 and R-12, smooth outside wall drill casings were used with the dry air-rotary drilling method for drilling from land surface to a depth into the regional aquifer with the use of no organic drilling fluids, organic foam, or bentonite clay drilling muds. Also, at LANL, boreholes for characterization of the vadose zone were drilled with the dry air rotary casing advance method to depths of 700 feet with a single string of smooth walled drill casing. The drill casing was retracted during construction of multiple-port wells for sampling soil gas.

The large collars slowed down the drilling speed and are one of the factors responsible for the abandonment of the drill casing in wells R-7, R-8, R-16, R-19, and R-25. The large collars greatly decreased the safe drilling depth for each discrete string of telescoped casing. It also was necessary to spend more time with back-reaming drilling procedures to help stabilize the boreholes from collapsing and seizing the retractable drill casing. As a general rule, the larger size of the collars also required the use of organic drilling fluids or bentonite clay drilling muds to prevent strata in the borehole wall from seizing the casing. The drill casing was seized in the boreholes of wells R-19 and R-25 because of the attempt to drill the catch-point loaded drill casing without any drilling fluids other than air.

The LANL scientists knew that the geologic strata beneath the Pajarito Plateau were unstable but did not take caution for the proper application of the casing advance drilling method with flush-threaded casing. Flush-threaded casings were only used for drilling the boreholes of the very first wells R-9 and R-12. All of the other wells with the exception of the recently installed well R-16r were drilled with the catch-point loaded drill casings. *Well R16r was drilled in September, 2005 with three telescoped strings of smooth-walled drill casing* [emphasis added]. Also, now the LANL scientists specify flush-threaded smooth outside wall drill casing for the casing advance drilling of the boreholes for the two new wells R-35a and R-35b.

In LANL reports and at meetings, the casing advance drilling method is described as responsible for the high costs of wells R-8, R-9, R-12, R-16, and R-25. In all cases, there are other factors that are responsible for the high cost of the wells. The responsible factors are described in a case history report that I have provided to the CAB – *"Case History Study of LANL Characterization Wells Installed in Boreholes Drilled With the Air Rotary Casing Advance Drilling Method"* by Robert H. Gilkeson, M.S., Registered Geologist, February 20, 2007.

For many of the LANL characterization wells, the high cost was because of the fluid-assisted open hole drilling methods that could not provide a stable borehole for installation of the characterization well. Often, the casing advance drilling method was used as a last resort to install a well in a borehole that open drilling methods could not prevent from collapse. Two examples are wells R-8 and R-16. The abandonment of drill casing in the two boreholes was because of drilling too great a distance in unstable strata with one diameter of drill casing that was loaded with "catch points" because of the large size of the threaded collars.

Two analogies come to mind for the misplaced blame that is placed on the casing advance drilling method –

- Hammers should be banned because they often hit and bruise fingers.
- Cars should be banned because they cause accidents.

Comment on the LANL Drilling Plan for Characterization Wells R-35a and R-35b.
The two wells will be located approximately 500 feet to the west of the Los Alamos County drinking water well PM-3 to investigate the lateral and vertical extent of the chromium plume. In addition, the two wells will serve as long-term sentry monitoring wells to identify the travel of a large suite of LANL contaminants to the drinking water well. The wells will serve in the capacity of sentry wells for the next 50 to 100 years. The potential groundwater contaminants include many chemicals, the strongly sorbing actinide radionuclides plutonium, neptunium, and americium, and the moderately sorbing radionuclide contaminant strontium-90. There is an essential need to install the wells in a pristine environment clean of any organic or bentonite clay drilling additives. This is

because of the need to have accurate knowledge of the presence of ultra-tiny amounts of the radionuclide contaminants in the groundwater samples produced from the wells.

The EPA drinking water standard (DWS) for strontium-90 is 8 picocuies per liter of water (8 pCi/L.). The tiny mass of strontium-90 that provides an activity level of 8 pCi/L is 60 parts per quintillion. Changes by three orders of magnitude each are marked in the sequence parts per million, parts per billion, parts per trillion, parts per quadrillion, and then parts per quintillion. One part per quintillion is one trillionth of a part per million. A visual representation is that 14 parts per quintillion would be the equivalent of about 14 drops of pollutant in 1 million standard 10,000 gallon railroad tank cars.

Because of the new research on health, there is a concern to lower the current EPA DWS for the combined level of the actinide contaminants by two orders of magnitude from 15 pCi/L to 0.15 pCi/L. Accordingly, in a letter dated November 2, 2005 Governor Richardson recommended for EPA to consider lowering the drinking water standard for the actinides. Below is an excerpt from the Governor Richardson letter to EPA:

> Specifically, my staff have reviewed portions of the report prepared by the Institute for Energy and Environmental Research (IEER), *Bad to the Bone: Analysis of the Federal Maximum Contaminant Levels for Plutonium-239 and Other Alpha-Emitting Transuranic Radionuclides in Drinking Water*. This report concludes that an MCL for alpha-emitting, long-lived transuranic radionuclides should be 100 times smaller than the largest amount that would be allowed under the current rules for gross alpha contamination. According to the IEER report, a tightening of the standard for these man-made radionuclides is warranted in light of scientific research since 1976. I understand that the EPA has published some of the latest relevant scientific research as part of its regulatory guidance documents. However, this research has not yet been used to set an MCL for plutonium-239 and other alpha-emitting, long-lived transuranic radionuclides.
>
> As you know, New Mexico is host to Los Alamos National Laboratory, where a great deal of exciting work of national and global importance is carried out, but where there is, as a result, a considerable amount of radioactive waste, some of which contains significant amounts of plutonium. I know that no public water systems are today contaminated anywhere near the tighter level that is proposed. However, a protective standard in line with the latest science published by the EPA is necessary to ensure continued protection of our water resources for future generations.

The IEER web-site for the report mentioned in the Richardson letter and for reports on the mobility of the radionuclides is www.ieer.org/ . The actinide radionuclides are also a danger to public health when present at ultra-trace levels in drinking water.

Well PM-3 is displayed on Figure 1. The plan is to install well R-35b in aquifer strata with high permeability at a shallow depth near the regional water table. Well R-35a will be installed at a depth of approximately 300 ft below the water table in aquifer strata with high permeability that produce water to the upper part of the screened interval in drinking water well PM-3.

Invading the screened intervals with drilling additives is unacceptable. The R-35 drilling plan invades the screened intervals in the two wells with organic drilling foams, organic fluids, and possibly also with bentonite clay drilling mud. All of the listed drilling additives have strong properties to mask the detection of many LANL contaminants of concern.

The sorption power of bentonite clay to remove heavy metals and many of the LANL radionuclide contaminants and especially the actinides is well known in the technical literature.

The organic drilling additives cause well understood microbial mediated chemical processes that form a new mineralogy of iron and manganese coatings on the strata that surround the screened intervals in the monitoring wells. The new coatings have very strong sorption properties for trace metals and the actinide radionuclide contaminants.

LANL well development methods do not sufficiently remove the drilling fluids and foams from the screened intervals. Even the "new and improved" aggressive LANL well development methods in the single-screen wells have not sufficiently removed the bentonite clay drilling muds or the organic fluids and organic foams from the screened intervals to prevent the formation of the new mineralogy. The LANL scientists claim that developing the screened interval until the produced water has a turbidity of not greater than 5 NTU and a dissolved organic content of not greater than 2 mg/L *i.e.,* 2 parts per million (ppm). In fact, there is no scientific basis for this claim and a study of water chemistry data shows that the performance of well development to meet these requirements does not sufficiently remove the drilling fluids.

The failure of the well development methods to remove the drilling fluids are illustrated by the information in the well completion reports for the pumping tests that were performed in three of the single-screen wells. The pumping tests were performed after the completion of the well development activities.

Incomplete development of mud-rotary well R-4. LANL characterization well MW-4 was drilled with the mud-rotary method that allowed great invasion of the aquifer strata with a bentonite clay drilling mud. The Well R-4 Completion Report (Kleinfelder Project No. 37151) lists 10,075 pounds of bentonite clay, 250 gallons of polymer cellulose, 45 gallons of organic foam, and 10 gallons of organic fluid. At the termination of well development, the water produced from well R-4 had a turbidity of 3.1 NTU and a TOC of 1.34 ppm. From page D-8 of the Well R-4 Completion Report (Kleinfelder Project No. 37151) –

> "Once the pumping rate was stabilized to a little over 13 gpm, the water levels remarkably rose throughout the remainder of the test. The discharge rate declined steadily from 13.7 gpm to 13.1 gpm during the test. However, the magnitude of water level rise exceeded what would be predicted based on the discharge rate reduction alone. Therefore, the conclusion was that the well efficiency had increased during the test, i.e., the well continued to develop, simply by pumping" [emphasis added].

The performance of the pumping test in well R-4 is evidence that the well development activities were not sufficient to remove the bentonite clay drilling mud and organic drilling fluids from the screened interval.

Incomplete development did not remove organic foam in well R-16r. Well R-16r was drilled with a fluid-assisted air-rotary casing advance drilling method that allowed the organic drilling fluids QUIK-FOAM[R] and EZ-MUD[R] to invade the screened interval of the single-screen well. At the termination of well development, the water produced from well R-16r had a turbidity of 4.28 NTU and a TOC of 0.99 ppm. A pumping test to measure aquifer properties was performed in well R-16r after the well development activities were completed.

Below is an excerpt from the pumping test report included as an appendix in the LANL Well R-16r Completion Report (Kleinfelder Project No. 49436, February 2006) –

> "Test data were affected profoundly by air trapped or dissolved in the formation. During testing, the air was able to come out of solution and/or expand and contract in response to pumping and recovery. The air affected performance by clogging formation pores and entering the well and pump, resulting in very unusual data sets" [emphasis added].

The above excerpt from the pumping test reveals that the well development was unsuccessful in removing the drilling foam and the drilling air trapped within the foam . The drilling foam plugged the aquifer strata resulting in an unreasonably low and spurious permeability value measured by a pumping test. In addition, the new mineralogy formed by the organic drilling foam causes the well to produce unreliable water quality data for knowledge of the presence of the LANL contaminants. There is a need for additional development of well R-16r and performance of a new pumping test in well R-16r. After the redevelopment efforts, an extensive and expensive field test of the ability of the well to accurately detect LANL groundwater contamination is necessary. It may be necessary to replace well R-16r.

Incomplete development did not remove organic foam in well R-34. Well R-34 is located along the predicted flow path of the chromium plume to the southwest of Figure 1 on the property of the San Ildefonso Pueblo. The open borehole for the single-screen well (23-ft long screen) was drilled with fluid-assisted air rotary drilling methods that invaded the strata surrounding the borehole with organic drilling foam that contained drill air. At the termination of well development, the water produced from well R-34 had a turbidity of 3.70 NTU and a TOC of 1.99 ppm. The pumping test in well R-34 did not provide reliable information on the permeability of the aquifer strata because of the out-gassing of the drill air and foam.

From the LANL well R-34 pumping test report:

- "The presence of air in the formation water interfered with pump operation, resulting in either erratic discharge rate fluctuations or no flow at all."
- "Furthermore, the presence of the gas phase would be expected to significantly reduce the formation hydraulic conductivity."

The LANL report documented the problems that prevent the pumping test from providing reliable measurement of the aquifer permeability. Nevertheless, the LANL *Synthesis Report* published the obviously spurious permeability value of 3.5 ft/day.

The low permeability value in the *Synthesis Report* is also contradicted by the description of the coarse strata at the screened interval in Well R-34 and by the results of the Schlumberger borehole geophysics. Table 2-5 in the *Synthesis Report* describes the aquifer strata at well R-34 as "fairly coarse gravels with some cobble beds". Table 2-5 has a similar description of the aquifer strata at the nearby wells R-11 and R-28 where pumping tests measured permeability values of 116 and 149 ft/day, respectively.

In addition, the Schlumberger geophysics logs are similar for wells R-11, R-28, and R-34. The geophysics data show the presence of a 64-ft thick section of aquifer strata immediately below the water table at the location of well R-34 that warrant a permeability of greater than 125 ft/day. The thick section of permeable strata may be contaminated with hexavalent chromium that is not monitored by the deep depth of the well screen. A conservative estimate is that the regional aquifer at the location of well R-34 has an ability to produce water from a single well at a rate of greater than 1,100 gallons per minute or 1.5 million gallons per day. The valuable water resource may be contaminated with chromium.

It is important to note that the Schlumberger Geophysics logs identify that the screened interval in well R-34 was not installed in the aquifer strata with highest permeability. In fact, the Schlumberger logs identify clay sediments to be present across the top 6 ft and in a thin zone in the middle of the screened interval. Greater than 30 % of the screened interval is surrounded by clay strata with low permeability.

Open-hole drilling methods are unacceptable. The drilling history at LANL for the geologic setting of the R-35 wells has established that the open-hole drilling methods are too risky and too costly. The proposed plan for open-hole drilling of the two wells is unacceptable because of the danger of borehole collapse, the loss of the open-hole drilling equipment, and the need to drill a new borehole. Of course, a very important reason open-hole drilling methods are unacceptable is the invasion of the screened intervals with drilling fluids that mask the detection of contamination.

LANL characterization well R-8. Well R-8 is one example of the failure of the attempt to drill an open borehole with the same open-hole methods proposed for the two R-35 wells. The location of Well R-8 north of drinking water well PM-3 is displayed on Figure 1.

The failure of the open-hole drilling methods at well R-8 is described in the well R-8 completion report.

> "After surface casing was set, BH1 was drilled from 30 ft to 390 ft bgs using a 14.50-in. under-reaming down-hole hammer (UR-DTH) bit while advancing 13.375-in. drill casing. The 13.375-in. casing was landed in the Puye Formation at 390 ft. [Open borehole] drilling resumed with borehole advancement to a depth of 1022 ft bgs. The drillers decided to switch to casing-advance methods when they encountered flowing sands. Dynatec began to trip out the drill string to make the conversion to casing-advance with 11.75-in. drill casing. While pulling the assembly out of the borehole, the drillers experienced very tight borehole conditions in the interval between 680 to 750 ft bgs and could not work the drill-bit assembly beyond this interval. From October 26 to 30, 2001, Dynatec worked to free the drill assembly while continuing to repair the drill rig. On October 31, 2001,

Dynatec retrieved all the drill pipe; however, the drillers had twisted off the drill-bit assembly and left the stabilizer, the air-exchange sub, and the bit in the borehole."

A period of two months was spent in the unsuccessful attempt to recover the seized drilling equipment in the open borehole. The first borehole was plugged and abandoned.

LANL characterization well R-4. A second example of the failure of open borehole methods and loss of drilling equipment is the first borehole that was drilled for well R-4 with the same drilling methods proposed for open borehole drilling at the two R-35 wells. Well R-4 is located northwest of the two R-35 wells. Below are excerpts from the LANL Well R-4 Completion Report:

> "The following day the borehole was advanced to 270 ft bgs where the bit and DTH assembly became stuck due to the accumulation of approximately 47 ft of slough above the drill bit. WDC elected to trip in 2-in tremie pipe to 214 ft bgs, about 6 ft above the top of the slough and airlift the slough from above the drill bit to the surface. This strategy was successful and, once freed, the drill string was tripped out of the borehole."
>
> "On August 30, 2003, WDC switched to a 12¼-in tricone drill bit and resumed drilling at 270 ft bgs using air-rotary drilling technique assisted with drilling fluids consisting of QUIK-FOAM®, EZ-MUD®, and potable water [for drilling an open borehole to a total depth of 845 ft bgs."
>
> "WDC experienced difficulty tripping out the drill stem from 845 ft bgs and had to back-drill up to make progress. The drill stem could not be pulled past 710 ft bgs and operations ceased for the day. The following day, WDC tagged the top of slough and determined there was approximately 235 ft of slough above the drill bit preventing the drill stem from being tripped out."
>
> "On the morning of September 6, 2003, after working until midnight trying to free the drill stem without success, the tremie pipe was tripped out of the borehole and it was discovered that the lower 120 ft of tremie pipe had sheared off. WDC attempted to view the lost tremie pipe with the down-hole video camera on September 6, 2003. On September 7, 2003, efforts to fish-out the lost tremie pipe sections resulted in the loss of an additional 60 ft of pipe. Subsequent efforts to pull the drill string were unsuccessful. On September 8, 2003, WDC, in agreement with the DOE and NMED project representatives, decided to break off the drill stem and plug and abandon the borehole."

High-Risk of Open Hole Drilling Acknowledged in LANL R-35 Drilling Plan. In fact, the LANL R-35 drilling plan acknowledges the high risk for the open hole drilling. From pages 1 and 2 of the plan –

> "As the open borehole is advanced, caving of poorly consolidated geologic units such as the Totavi Lentil and Santa Fe Group deposits may result in unstable borehole conditions that could lead to loss of drilling equipment and possibly the borehole itself. If unstable conditions are detected, smooth-walled casing will be used to advance the borehole past the unstable zones. The use of a casing-advance system in conjunction with open-hole air rotary drilling may be sufficient to reach the target depth of the borehole. However, mud-rotary drilling may be

used to complete the R-35a borehole in the event that insurmountable borehole stability problems are encountered while drilling with air-rotary and casing-advance systems."

Mud-rotary drilling is unacceptable. LANL/DOE have made a serious mistake in the use of the mud-rotary drilling method for the installation of many of the LANL characterization wells. The drilling mud used with the mud-rotary method is a mixture of water with bentonite clay and organic additives including PAC-L^R, a natural cellulosic polymer, and EZ-Mud^R, a liquid polymer emulsion containing partially hydrolyzed polyacrylamide/poly-acrylate (PHPA) copolymer.

The LANL scientists acknowledge the detrimental effect of the EZ-Mud that cause monitoring wells to produce unreliable water quality data. From page 2 of the R-35 drilling plan –

> "Because of the potential impact on groundwater quality, its use [EZ-Mud^R] is limited to drilling situations where it can improve borehole stability or it is needed to control lubricity and fluid viscosity when drilling with bentonite or foam."

Nevertheless, a review of the LANL reports shows that EZ-Mud was allowed to invade the screened intervals in practically all of the LANL characterization wells.

The mud-rotary drilling method fills the borehole with a column of drilling mud. Because of the great depth to the water table at the well R-35 location, the column of mud has a hydraulic force of greater than 350 pounds per square for invading the aquifer strata with the drilling mud. The powerful mud pump on the drill rig further increases the invasion force of the drilling mud. Recovery of most of the drilling mud by the well development activities is not possible because the invasion force is orders of magnitude greater than the limited extraction energy of the well development procedures.

The well R-35 drilling plan includes the use of the chemicals sodium acid pyrophosphate (SAPP) or AQUA-CLEAR PFD for well development with an incorrect claim that the chemicals remove the bentonite clay drilling mud. It is well understood in the monitoring well industry that the main effect of the chemical agents is to disaggregate the bentonite clay mudcake that has formed in the screened interval, and disperse the bentonite clay outward in the aquifer strata to a distance beyond recovery by the well development methods.

The combination of bentonite clay and organic additives establish a new mineralogy in the screened intervals with strong properties for masking the detection of many LANL contaminants, and especially, heavy metals, and the strongly sorbing actinide radionuclides.

Casing advance drilling method. Because of the high potential for failure in the attempt of drilling an open borehole, the required drilling method for the two R-35 wells is air-rotary casing advance with possibly four telescoped strings of drill casing. It is very important for each string of the drill casings to have smooth outer walls with flush-threaded connectors. The appropriate dimensions for the smooth outside wall of the three strings of casing are 13.75 inches, 11.75 inches, 9.625 inches, and 6.625 inches.

An important advantage of the air-rotary casing advance drilling method is that the drill casing prevents invasion of drilling fluids into the screened intervals.

Required dual rotary drill rig. The casing advance drilling must be performed with a dual rotary drill rig that meets the design specifications of the Foremost^R Model DR-24 HD. The Foremost^R Dual Rotary drill rigs feature two rotary drives; the lower rotary drive in the drill table is used to advance and retract the drill casing, and the upper rotary drive in the drill mast operates the downhole drilling equipment. The dual rotary drilling method is essential for efficiently drilling with casing advance. The slow performance of the casing advance drilling at LANL wells R-9 and R-12 was because the drilling was with an underpowered drill rig that only had rotation in the drill mast and that would only operate with drill casing sections not longer than 10 feet. The Foremost^R Model DR-24 HD will drill with casing lengths of 20 feet.

Fluid-assisted drilling with casing advance. The casing advance drilling shall start at a shallow depth inside surface casing of 15-inch diameter that is cemented to an appropriate depth of approximately 30 to 50 feet. Water-based drilling fluids may be used to assist the casing advance drilling of the first borehole to a depth near or a shallow depth below the regional zone of saturation. This drilling scheme assumes that deliberate careful characterization of the presence of perched zones of saturation is not to be done. In the event that a thick, productive perched zone is discovered, the telescoped drill casings shall be used to seal off the zone.

Air-rotary drilling with casing advance in the regional aquifer. The only drilling method that is acceptable for drilling to the estimated depth of 300 feet into the regional aquifer is air-rotary casing advance. A careful log of drill cuttings, water production, and drill rig performance shall be kept during drilling.

Real-time analysis of water quality during drilling. Water samples shall be collected on an interval of every 5 to 10 feet of drilling and at changes in properties of the strata for "real-time" analysis at the field site for hexavalent chromium levels. EPA approved Hach^R kits provide accurate resolution of total and hexavalent chromium. The field measurements shall also include other appropriate analytes. Water samples shall also be submitted to a laboratory on a selected schedule for verification of the field measurements and for other analytes. The "real-time" profiling of water quality is of critical importance and is only possible if the only drilling fluid is air.

Concerns of the EPA and the DOE/IG for the LANL practice of allowing drilling fluids to invade the screened intervals of monitoring wells. There are many recent LANL reports and independent reports by the Department of Energy Inspector General (DOE IG) and the Environmental Protection Agency (EPA) that prove the new network of LANL characterization wells and the old LANL test wells do not produce reliable data for the contamination of the regional aquifer with radionuclides and chemicals from LANL wastes.

DOE/LANL allowed organic drilling additives (both organic fluids and foams) to invade the screened intervals in all of the new characterization wells installed during the past ten years under the Hydrogeologic Workplan. In addition, many of the new wells were drilled with the mud-rotary method which invaded the screened intervals with bentonite clay drilling muds that also contained organic additives. The organic and bentonite clay drilling additives have well-known properties to mask the detection of most LANL chemical and radionuclide contaminants. The organic additives created a new mineralogy of iron precipitates, a slime which coats the strata that surround the screened interval masking the detection of contamination.

The failure of DOE/LANL to install a reliable network of monitoring wells is summarized in the notes recorded by a LANL scientist of a telephone conference call with the scientists from the EPA National Risk Management Research Laboratory in Ada, Oklahoma:

> "EPA also thought that iron minerals would not return to predrilling conditions in the foreseeable future."
>
> "EPA further expressed the opinion that it would be difficult to determine when and whether the impacted screens would return to predrilling conditions. EPA expressed the opinion that LANL would never be able to get representative samples from the impacted wells, but could only make choices and tradeoffs based on specific contaminants at various locations."

At the request of the CAB, the EPA scientists wrote a report about the LANL well installation practices that allowed drilling fluids to invade the screened intervals of the characterization wells. Below are excerpts from the EPA report:

> "Predictions of the time frames for the impacted intervals to return to natural conditions are uncertain. It is also likely that the inability to fully remove the additives which were used during drilling has reduced the hydraulic conductivity of many of the impacted screened zones."
>
> "Due to the difficulty in assessing the damage that may be caused by the presence of residual drilling additives in the screened zone of a well, it is recommended that the need for continued use of additives within the screened interval of monitoring wells be reassessed."
>
> "Strive to drill boreholes using no bentonite or organic additives within screened intervals. Additives may be used in intervals above the target monitoring zone if telescoping casing constructions are used and the hole is adequately cleaned before drilling the final footage within the interval to be screened. Targeting of monitoring intervals prior to drilling should be possible at locations where data from the existing characterization wells are available."

The DOE IG wrote a report that described the failure of DOE/LANL to meet the requirements of the Resource Conservation and Recovery Act (RCRA) to install monitoring wells that produce reliable and representative water samples for the detection of LANL contaminants. From IG Report DOE/IG-0703, September 2005:

> "However, LANL did not adhere to specific constraints established in the RCRA guidance when using muds and other drilling fluids, and, as a result, LANL could not assure that certain residual drilling fluids were fully removed; and muds and other drilling fluids that remained in certain wells after construction created a chemical environment that could mask the presence of radionuclide contamination and compromise the reliability of groundwater contamination data."

The DOE IG Report also described the requirement for DOE/LANL to implement a surveillance groundwater monitoring program by December 31, 2005 under DOE Order 450.1. DOE/LANL are not in compliance with the DOE Order. Again, from the DOE IG Report:

> The current requirements for a groundwater surveillance monitoring program are found in DOE O 450.1, "Environmental Protection Program," which LANL has until December 31, 2005, to implement. As LANL works to meet this deadline, we believe that the Laboratory should, as the Hydrogeologic Workplan wells are converted to monitoring wells, ensure that monitoring data are reliable. We also believe that particular attention should be given to well development and purging methods, the quality of radionuclide data, and any qualifications on that data."

DOE/LANL are not in compliance with the DOE Order as demonstrated by the conclusion presented in the LANL *Well Screen Analysis Report* (WSAR) published in November 2005 that only approximately 50% of the new LANL characterization wells produce reliable and representative water samples. The WSAR was only a study of the effects of the drilling additives on the water quality data and did not address the many other factors that prevent the wells from meeting the requirements of monitoring wells.

On September 18, 2006 , the New Mexico Environment Department (NMED) issued a Notice of Disapproval to LANL for the WSAR because of its failure to perform a thorough study. When all factors are considered, the number of LANL characterization wells that fail to produce representative and reliable water quality data is possibly greater than 90%. In the past few days, LANL has submitted the first revision of the WSAR to the NMED as required by the Notice of Disapproval. I will provide comments about the revised WSAR to a future meeting of the CAB.

A rigorous sampling program for the Los Alamos County and Santa Fe drinking water wells is necessary because of the:
1). failure of DOE/LANL to install the required surveillance network of monitoring wells as required by RCRA and DOE Order 450.1, and
2). the groundwater contamination that is found in the 2006 draft LANL SWEIS and in the 1999 final LANL SWEIS.

The rigorous sampling program requires collection of water samples on a quarterly schedule with analysis for a large suite of naturally occurring chemical and radionuclide constituents, chemical contaminants and radionuclide contaminants with the appropriate analytical methods for the highest possible precision in the measurements.
Data from a reliable network of monitoring wells is the frontline of information about the sources of contamination from the LANL waste and impacts to the drinking water wells. After 10 years and approximately $150 million, LANL does not have the required network of wells for that knowledge. The continued obfuscation of data and failure to implement appropriate drilling methods does not help the process, nor protect drinking water supplies.

The unreliable new network of characterization wells does not provide accurate information about the characteristics of the groundwater beneath LANL which is required by DOE Order 450.1, RCRA, New Mexico Water Quality Control Commission regulations, as well as the NMED/LANL Consent Order.

Send Questions or Comments to

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May 6, 2009

Comment by Concerned Citizens for Nuclear Safety and Robert H. Gilkeson, Registered Geologist, on the Los Alamos National Laboratory *Fieldwork Plan for R-Well Redevelopment, Phase I (April 2009, LANL Report EP2009-0171)*

1.0 Summary. The subject Los Alamos National Laboratory (LANL) *Fieldwork Plan for R-Well Redevelopment, Phase I (April 2009, LANL Report EP2009-0171)* is a modification of a fieldwork plan submitted to the New Mexico Environment Department (NMED) on January 30, 2009. Figure 1 is a display of the as-built construction of multiple-screen well R-22. The January fieldwork plan proposed to plug and abandon screens #1, #4, and #5 and convert well R-22 from a five-screen well to a two-screen well that would produce water samples only from screens #2 and #3.

However, CCNS and Gilkeson provided written comment to NMED on the LANL January plan that explained the many factors that prevent the rehabilitation of well R-22 as a Resource Conservation and Recovery Act (RCRA) – compliant monitoring well. Although CCNS and Gilkeson described the factors that prevent the rehabilitation of well R-22 for use as a RCRA-compliant monitoring well, the April fieldwork plan shows that LANL still intends to use well R-22 for that purpose. The pertinent excerpt from the April plan is pasted below:

- "The original fieldwork plan was modified from one that would convert R-22 to a dual-screen well to a plan using a phased and graded approach. The reason for making changes is the need for greater understanding of hydrologic flow conditions in the vicinity of Technical Area 54, particularly with respect to hydraulic interconnectivity of wells within the regional aquifer as well as the adequacy of screens in R-22 for Resource Conservation and Recovery Act (RCRA) monitoring [emphasis added]. Based on discussions with NMED, a phasing of activities at R-22 has now been planned" (page 1).

The proposed phasing of activities at well R-22 will still not identify a credible method for rehabilitation of any of the five screens in well R-22. CCNS and Gilkeson are disappointed at the continuing pursuit to use well R-22 as a monitoring well for the hazardous and radioactive contaminants released from the very large inventory of hazardous, mixed and radioactive wastes buried in unlined trenches and shafts at MDA G.

Well R-22 cannot be rehabilitated because of the many mistakes in the drilling, construction and original well development. An overarching factor is the misplacement of the well screens. Moving the well screens to the necessary zones that are important to monitor for groundwater contamination from MDA G is not possible.

CCNS and Gilkeson request the rehabilitation of well R-22 be delayed until the new DOE expert panel can present findings about 1). the best use for well R-22, 2). the feasibility to rehabilitate any of the five screens, and 3). the field activities that are necessary to prove that the rehabilitation was successful.

2.0 Poorly Conceived Objectives in the LANL April Fieldwork Plan. The five objectives in the April plan are pasted below in italics with annotation of why the five objectives are not warranted.

Objectives for Phase I work are the following:

1.0 confirm the status of the tritium that has been observed at screen 5 for concentration and likely source, i.e., having been brought down from screen 1 during original drilling or as a contaminant in the aquifer

Knowledge of the source for the tritium contamination measured in screen 5 is not necessary at this time because of the very low level of the measured tritium levels compared to the Environmental Protection Agency (EPA) Drinking Water Standard (DWS) of 20,000 picocuries per liter (pCi/L). The levels measured in screen 5 have declined over a eight year period by approximately 50 % from 18.5 pCi/L in a sample collected on December 7, 2001 to 7.4 pCi/L for a sample collected on September 16, 2008. The maximum level of 18.5 pCi/L that was measured in screen 5 is less than one-thousandths of the EPA DWS of 20,000 pCi/L. In addition, the marked decline in the measured tritium levels over the eight year period is one line of evidence that the tritium contamination in screen 5 was caused by cross-contamination in the open borehole and also in the open well before the Westbay sampling system was installed to prevent flow between the five screens.

A more important issue is the large number of RCRA hazardous contaminants that were measured in water samples produced from screen 5. Unfortunately, there is no mention of this contamination in either the LANL January or April fieldwork plan. Table 1 is an example of the seventeen RCRA contaminants measured in screen 5 in a water sample collected on January 10, 2001. In addition, the LANL report – (LA-UR-04-6777, September 2004) recognized the on-going contamination detected in the water samples produced from well R-22 as follows:

- "Thirty-one volatile and semi-volatile organic compounds have also been detected in water from well R-22. Only two of these, pentachlorophenol (1 detection, 6.2 ppb, MCL = 1 ppb) and benzo(a)pyrene (2 detections, 0.24 ppb, MCL = 0.2 ppb) were present at concentrations above the MCL. Monitoring for organic compounds at well R-22 will continue" [MCL means Maximum Contaminant Level allowed in the EPA Drinking Water Standards].

Under RCRA, the tritium and hazardous waste contamination detected in the water samples collected from well R-22 is ***"statistically significant evidence of contamination."*** Accordingly, DOE is required to comply with the requirement in RCRA 40 CFR §264 Subpart F and install the required number of new monitoring wells to provide accurate knowledge of the nature and extent of the groundwater contamination at the location of well R-22. Here it is important to understand that the five objectives in the LANL April fieldwork plan do not replace the need for the installation of new wells at the location of well R-22.

2. confirm screen 1 for its potential as a viable monitoring screen

- The proposed sampling activities are of no value to determine the potential of screen 1 as a RCRA-compliant monitoring screen. The properties of the new mineralogy established by the organic drilling additives that invaded screen 1 to mask the detection of many hazardous and radionuclide contaminants of concern in the water samples produced from screen 1 is well described in many LANL reports. The EPA Kerr Research Laboratory described the need to perform "push-pull tests" to determine the ability of the screens impacted by organic additives to produce reliable and representative water samples, but the LANL April fieldwork plan does not perform any "push-pull tests."
- At a minimum, the "push-pull tests" are essential to confirm screen 1 in well R-22 for its potential as a viable monitoring screen. If NMED decides to approve the badly flawed LANL plan, then NMED should require the "push-pull tests" in screen #1 and also in screen #2 and #3.

3. determine specific capacity of screens 1 through 5 to enable more definitive calculations predicting the potential for cross-communication between screens

- This activity is evidence of the poor knowledge that LANL has of the actual cross-contamination that will occur if the Westbay packer system is removed from well R-22. The scheme to remove the Westbay packer system and allow cross-flow between the screens was based on <u>assumptions</u> that the cross-flow would be relatively small.

4. minimize the time for an open well bore during the testing process

- Although the April fieldwork plan describes the importance to "*minimize the time for an open well bore during the testing process,*" this is not accomplished. In fact, minimizing the time for cross-flow cannot be accomplished because the cross-flow of water in the open well bore begins when the Westbay packers are deflated and deflation of the packers is necessary before the process to remove the Westbay system begins. The period of time 1). to remove the Westbay system, 2). to measure the composite water level in the well after removal of the Westbay system, and 3). to install the new packer system to stop the downward flow of water in the open well and out through screen 5 is too long to be described as a minimal cross-flow of groundwater.

- In addition, the installation of the packer above screen 5 does not stop the continued flow of water from the water table of the regional aquifer down the open well and out through screen #3 and #4. No measures are taken to prevent the great disturbance of the *in situ* water levels and chemistry of groundwater at the water table of the regional aquifer because of the long period of time that well R-22 will be open.

- Indeed, the statement in activity 4 to minimize the time for an open well bore during the testing process is not accomplished by the described activities. However, Chief Bearzi of the NMED Hazardous Waste Bureau described the importance to minimize the cross-flow of groundwater in the open well. The pertinent excerpt in the Chief Bearzi email sent to CCNS on April 14, 2009 is pasted below:

> "No matter what they do (or don't do) to R-22, they will be required to minimize any flow of water from screen 1 to 5 (e.g., if the Westbay system is removed), probably by using packers. Any approach that would purposely allow prolonged water flow from 1 to 5 – even in an effort to obtain relevant or interesting data -- will not be approved."

The activities proposed in the LANL April fieldwork plan require the removal of the Westbay system, and the proposed activities will allow prolonged water flow from screen 1 to 5. In addition, no measures are taken to prevent prolonged drainage down the open well after a packer is placed above screen 5. The large amount of groundwater that will be allowed to flow down the open well is one of many reasons for NMED to deny approval of the LANL April fieldwork plan.

5. perform appropriate sampling to obtain critical decision data for implementation in Phase II

- In fact, the LANL April fieldwork plan does not perform appropriate sampling to obtain critical decision data for implementation in Phase II. Phase II would be rehabilitation of selected screens in well R-22 as a RCRA-compliant monitoring well and this is not possible because the screens are misplaced.
- Screen #1 is installed across the water table of the regional aquifer and is the only screen installed across a zone that meets requirements for a monitoring well. However, the April fieldwork plan does not perform the "push-pull tests" that are essential to determine that the rehabilitation of screen 1 was successful and that screen 1 produces reliable and representative water samples for detection of the large inventory of RCRA hazardous constituents and DOE radionuclides in the wastes buried in open trenches and shafts in MDA G.

- Screen #2 is installed within basalt strata that have a very low permeability. RCRA requires the installation of monitoring wells in permeable zones in the regional aquifer.

- Screen #3 is installed too deep below the water table and below two zones of high permeability that RCRA requires to be monitored but well R-22 does not monitor. One or both of the highly permeable zones above screen #3 may be the source for the RCRA contaminants measured in well R-22. Rehabilitation of well R-22 cannot provide information on the nature and extent of contamination in the permeable zones that are not monitored by well R-22. Three additional problems that prevent screen #3 from being used as a RCRA-compliant monitoring well are 1). the screen is installed in sediments with low permeability, 2). the mistake in the well construction that invaded the screened interval with bentonite clay grout and 3). the very long length of the filter pack sediments and "flowing formation sand" that surround screen #3 (see Figure 1).

- Screens #4 and #5 are installed too deep below the water table to be useful as RCRA-compliant monitoring wells for detection of contamination from MDA G. In addition, screen #4 is installed within a basalt formation with low permeability where contamination is not expected to be present.

The position of CCNS and Robert H. Gilkeson is that the only use for well R-22 is the measurement of water levels and the five screens in the well should be used for this purpose. The only sampling activity that is warranted in well R-22 is the continued collection of water samples from screen #5 for tritium.

If LANL and NMED believe that well R-22 can be rehabilitated as a RCRA-compliant monitoring well, then the rehabilitation should not be attempted without concurrence by the new DOE expert panel that will meet on LANL groundwater protection practices this summer.

Please contact CCNS and Robert H. Gilkeson with questions or comment.

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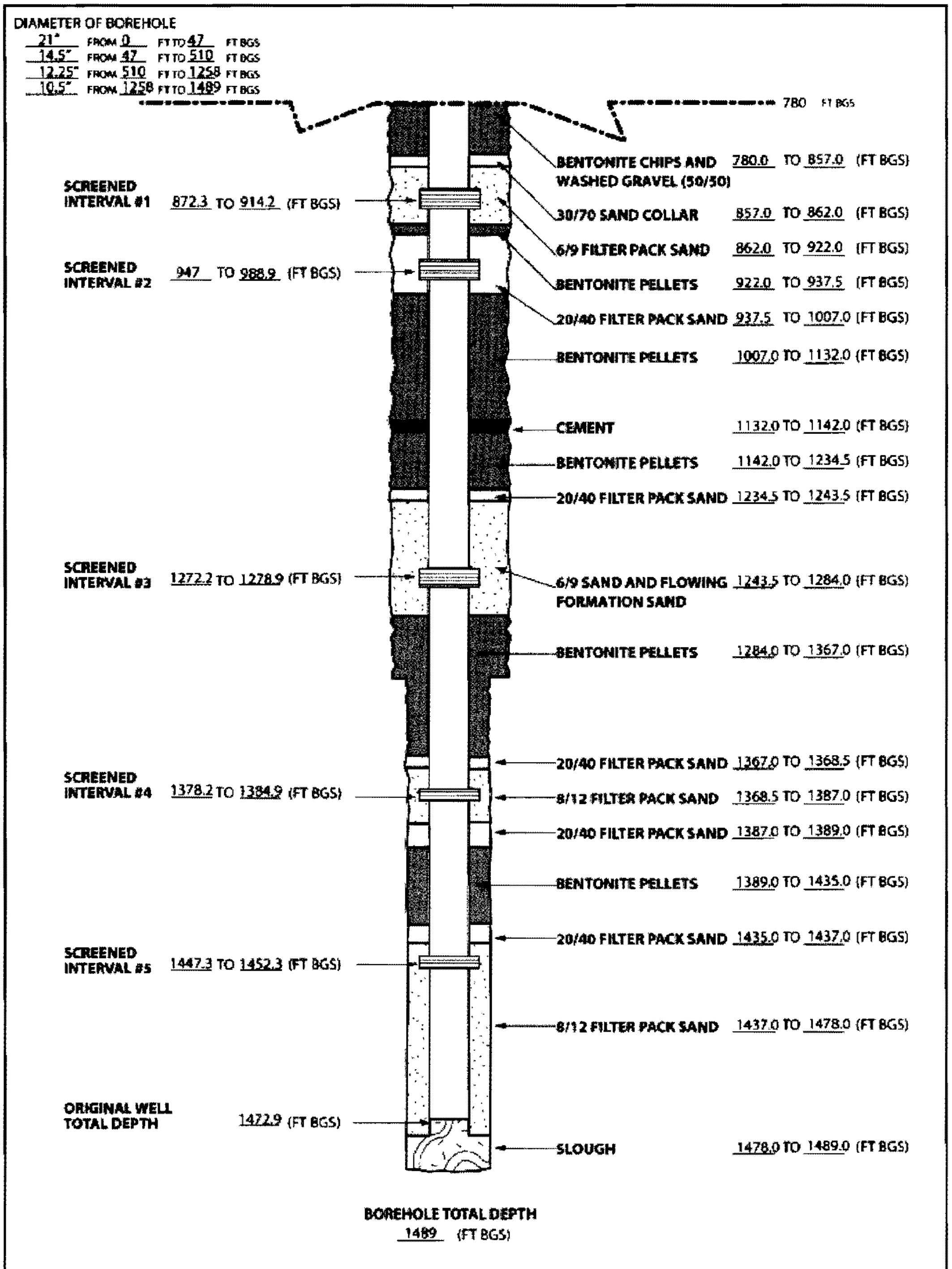
Figure 1. As-built design of LANL well R-22



TerranearPMC		Rehabilitation and Conversion Regional Well R-22 Pajarito Canyon Los Alamos National Laboratory Los Alamos, New Mexico	X.X NOT TO SCALE
Drafted By: TPMC Project Number: 83000	Date: March 19, 2009 Filename: Figure X-X		

Table 1. Data summary for detected organic chemicals in the groundwater sample collected on January 10, 2001 from screen #5 in LANL characterization well R-22.
Source: Table A-40 *in* LANL Well R-22 Geochemistry Report

Analyte	Screen	Depth (ft)[a]	Collection Date	Field Preparation	Number of Analyses	Number of Detects	Detected Value (µg/L)	Non-detected Value (µg/L)	Drinking Water MCL[b] (µg/L)
Acenaphthene	5	1448	12/10/01	NF[e]	1	1	0.42	—[f]	—
Acenaphthylene	5	1448	12/10/01	NF	1	1	0.4	—	—
Anthracene	5	1448	12/10/01	NF	1	1	0.36	—	—
Benzo(a)pyrene	5	1448	12/10/01	NF	1	1	0.24	—	0.2
Benzo(b)fluoranthene	5	1448	12/10/01	NF	1	1	0.41	—	—
Benzo(k)fluoranthene	5	1448	12/10/01	NF	1	1	0.38	—	—
Bis(2-ethylhexyl)phthalate	5	1448	12/10/01	NF	1	1	1	—	6
Chloronaphthalene[2-]	5	1448	12/10/01	NF	1	1	0.46	—	—
DDT[4,4'-]	5	1448	12/10/01	NF	1	1	0.024	—	—
Diethylphthalate	5	1448	12/10/01	NF	1	1	1.3	—	—
Fluoranthene	5	1448	12/10/01	NF	1	1	0.38	—	—
Fluorene	5	1448	12/10/01	NF	1	1	0.42	—	—
Methylnaphthalene[2-]	5	1448	12/10/01	NF	1	1	0.42	—	—
Pentachlorophenol	5	1448	12/10/01	NF	1	1	6.2	—	1
Phenanthrene	5	1448	12/10/01	NF	1	1	0.4	—	—
Pyrene	5	1448	12/10/01	NF	1	1	0.49	—	—
Toluene	5	1448	12/10/01	NF	1	1	0.76	—	1000
Total Organic Carbon	5	1448	12/10/01	NF	1	1	4880	—	—

[a] The static water level for the regional aquifer at R-22 was 883 ft when the well was drilled.

[b] MCL = Maximum contaminant level. US Environmental Protection Agency (EPA) MCLs are from *National Primary Drinking Water Regulations*, 40 CFR *Secondary Drinking Water Regulations*, 40 CFR Part 143. State of New Mexico MCLs are from *Drinking Water Regulations*, 20 NMAC 7.1.

[c] NMED = New Mexico Environment Department.

[d] State of New Mexico groundwater standards are from *New Mexico Water Quality Control Commission Regulations, Ground and Surface Water Protect*

[e] NF = Nonfiltered.

[f] — = Not available or not applicable.

The Los Alamos National Laboratory *Fieldwork Plan for R-22 Well Rehabilitation and Conversion* is Unacceptable and Must be Denied by the New Mexico Environment Department

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Executive Summary. The Los Alamos National Laboratory *Fieldwork Plan for R-22 Well Rehabilitation and Conversion* is unacceptable and should be denied by the New Mexico Environment Department. The R-22 Plan fails to recognize the many reasons that it is not possible to convert well R-22 into a monitoring well for the detection of groundwater contamination from the hazardous and mixed wastes buried in MDA G. RCRA §264.99 requires a comprehensive investigation of the nature and extent of groundwater contamination in the regional aquifer below MDA/Area G and at the location of well R-22. At this time, the only use of well R-22 is the measurement of water levels. Both the National Academy of Sciences and the LANL scientists understand the lack of knowledge that exists for the hydraulic properties of groundwater travel in the regional aquifer, but the necessary and very important aquifer pumping tests and tracer tests to reduce the uncertainty are not being performed. It is very important to leave the Westbay^R sampling system installed in well R-22 because removal of the system will allow the contaminated groundwater at the water table to drain down the open well and this drainage and cross-flow of groundwater in the open well must be prevented.

1. Background. On January 30, 2009, the Los Alamos National Laboratory (LANL) submitted the *Fieldwork Plan for R-22 Well Rehabilitation and Conversion* (R-22 Plan) to the New Mexico Environment Department (NMED) Hazardous Waste Bureau (HWB). The NMED needs to deny the R-22 Plan for reasons presented in this report. Mr. James Bearzi, Chief of the HWB, provided the R-22 Plan to the author for review and comment. Previously, on January 28, 2009, the author presented a report to Chief Bearzi that explained the many reasons well R-22 was not usable as a monitoring well. The R-22 Plan does not change the conclusions in the author's original report and that report is included as an attachment with this review and comment.

The purpose of the R-22 Plan is to convert the LANL characterization well R-22 into a monitoring well for the detection of groundwater contamination from the large waste disposal site known as MDA G / Area G at TA-54.

However, the R-22 Plan fails to recognize the many reasons that it is not possible to convert well R-22 into a monitoring well for the detection of groundwater contamination from the hazardous and mixed wastes buried in MDA G. Figure 1 shows the location of well R-22 approximately 500 feet east of the eastern boundary of MDA G/ Area G. MDA G / Area G is the largest waste disposal site at LANL and occupies 63 acres. Burial of radioactive and mixed wastes in unlined trenches and shafts began in 1957 at MDA G and burial of low-level radioactive continues to the present time at Area G.

MDA G is regulated under the Resource Conservation and Recovery Act (RCRA) as a "Regulated Unit" because hazardous wastes were buried at MDA G after July 26, 1982. RCRA requires that MDA G must have a network of groundwater monitoring wells that are in compliance with RCRA 40 CFR §§264.90 through 264.100 (a set of regulations known as RCRA 264 Subpart F). Presently, the required network of monitoring wells does not exist. This report describes the many reasons that the R-22 Plan will not be successful in the rehabilitation and conversion of well R-22 into a monitoring well that meets the requirements of RCRA 264 Subpart F. In addition, well R-22 cannot be rehabilitated to provide the water quality data that are necessary for the NMED LANL Consent Order to identify the final remedy for MDA G that will protect human health and the environment.

Figure 2 shows the as-built design of well R-22 with five well screens. Screen #1 is installed across the water table and screen #5 is installed at a depth of 560 feet below the water table. When the R-22 borehole was drilled in September of 2000, the top of the regional aquifer was at a depth of 883 feet below ground surface. The R-22 Plan will plug and abandon screens #4 and #5 and seal off screen #1. Jetting procedures will be used to redevelop screens #2 and #3. Then a pumping system will be installed in the well to produce water samples from screens #2 and #3. However, there are many factors that will prevent the rehabilitation of screens #2 and #3 from being successful. Those factors are described in the author's January 28, 2009 report and are summarized below. Well R-22 must be replaced because it does not meet the requirements of RCRA as a monitoring well but it is an important well for measurement of water levels.

- **Screen #2 in well R-22.** The top of the 42-foot long screen is located 64 feet below the water table and in a basalt formation with a very low permeability of 0.04 feet per day (0.04 ft/day). The R-22 Plan makes the mistake to assume that screen #2 samples groundwater at the water table but the seven foot lower water level measured in screen #2 compared to screen #1 is evidence that there is little hydraulic communication between screen #2 and the water table. The available information shows that screen #2 is installed in a section of the basalt that only produces small quantities of groundwater. It is a requirement of RCRA 264 Subpart F and the NMED Consent Order to install monitoring wells in productive aquifers that are along the expected pathways for contaminated groundwater to travel from waste disposal sites. Screen #2 is installed in a confining bed that is not a pathway for groundwater contamination from MDA G.

Because of the very low permeability at screen #2, **Darcy's law** calculates a lateral speed of groundwater travel in the basalt of only 13 feet per year for a time of 40 years for groundwater to travel from the eastern boundary of MDA G to screen #2 in well R-22 and travel times of 150 and 270 years for groundwater below the central and western parts of MDA G, respectively. The conservative values used in the calculation with Darcy's law are a saturated hydraulic conductivity of 0.04 ft/day, an effective porosity of 2% and a hydraulic gradient of 0.1887. The hydraulic gradient was calculated from the LANL contour map for the water table below MDA G. The long travel times for groundwater below MDA G to reach screen #2 in well R-22 show that the R-22 Plan to rehabilitate screen #2 is unacceptable and should be denied by the NMED.

- **Screen #3.** There are many factors that prevent screen #3 in well R-22 from being usable as a monitoring well to detect groundwater contamination from MDA G.

- The top of the 7-foot long well screen in located 390 feet below the water table and below thick layers of highly permeable aquifer strata that are not monitored by either screen #2 or #3.

- The available information show that the thick layers of aquifer strata above screen #3 have a high permeability in the range of 50 ft/day to possibly greater than 100 ft/day.

- For comparison, the permeability measured at screen #3 was a low value of 0.21 ft/day. The well R-22 lithologic log describes the unconsolidated sediments surrounding screen #3 as "very fine silty sand to pebble gravel" - a description of poorly sorted sediments that have low permeability and are not productive aquifers.

- For the measured permeability of 0.21 ft/day, **Darcy's law** calculates a lateral speed of groundwater travel of only 6 feet per year for a time of 80 years for groundwater to travel from the eastern boundary of MDA G to screen #3 in well R-22 and travel times of 330 and 580 years for groundwater below the central and western parts of MDA G, respectively. The conservative values used in the calculation with Darcy's law are a saturated hydraulic conductivity of 0.21 ft/day, an effective porosity of 25% and a hydraulic gradient of 0.1887. The long travel times for groundwater below MDA G to reach screen #3 in well R-22 show that the R-22 Plan to rehabilitate screen #3 is unacceptable and should be denied by the NMED.

- The drilling method invaded the #3 screened interval with organic drilling additives that have created a new reactive mineralogy with well known strong properties to prevent accurate detection and measurement of many LANL contaminants of concern for MDA G. The R-22 Plan does not recognize the LANL reports that describe the new mineralogy screen #3 that was created by the organic drilling additives.

- The R-22 Plan does not describe the mistake during the construction of well R-22 that invaded the filter pack sediments surrounding screen #3 with the bentonite clay grout materials that were used to seal the well annulus. The bentonite clay has well known strong properties to prevent the detection and accurate measurement of many contaminants from MDA G.

- The R-22 Plan does not recognize the LANL reports that show the well development performed in November of 2000 was not successful in removing the organic drilling additives or the bentonite clay grout from screen #3. The pipe-based design of the well screen is one factor that prevented the well development from being successful. The restrictive design of the pipe-based screen is displayed and described in Figure 3.

- The R-22 Plan does not recognize that the restrictive design of the pipe-based well screen will also prevent the redevelopment activities in the R-22 Plan from being successful in cleaning the new reactive mineralogy and the grout contamination from screen #3.

2. Overview of the groundwater contamination detected at LANL characterization well R-22 and the requirement of RCRA and the NMED Consent Order for a minimum of two new monitoring wells close to well R-22. At the location of well R-22, the groundwater in the regional aquifer is contaminated with hazardous and radionuclide waste that was released from the unlined trenches and pits at MDA G. The nature and extent of the groundwater contamination in the regional aquifer is not known because of the many

mistakes in 1). the drilling, 2). the well construction, 3). the misplaced locations of well screens, and 4). the no-purge methods that were used for collecting water samples from the five screened intervals in well R-22.

A water sample collected when the borehole drilled into the water table of the regional aquifer was contaminated with tritium @109 pCi/L and chloride @ 21 mg/L. The measured concentrations are much higher than the background values for tritium and chloride. The type and amount of contamination at the water table is not known because the water sample was diluted by the water-based organic drilling fluids. Screen #1 was installed across the water table but this screen never produced reliable and representative water samples of the original *in situ* formation water because of

- 1). the careless drilling methods in the R-22 borehole that allowed the original *in situ* groundwater at the water table to drain down the open borehole,
- 2). the new reactive mineralogy from the organic drilling fluids, and
- 3). the Westbay[R] no-purge sampling system that collected stagnant water samples from the zone with the new mineralogy.

The drilling operations did not seal off the contaminated aquifer zones near the top of the regional aquifer. Instead, the contaminated groundwater was allowed to drain down the open borehole. A large number of hazardous waste contaminants and also tritium were detected for many years in the water samples produced from the screens in well R-22 including screen #5, the deepest screen in the well. The tritium contamination is still detected in water samples from screen #5. See Table 1 on the next page.

Table 1. Tritium contamination* in groundwater samples collected from screen # 5 in LANL characterization well R-22.

- Sample Date	Tritium pCi/L	- Sample Date	Tritium pCi/L	- Sample Date	Tritium pCi/L
- 1. 06-26-2000	14	- 6. 07-05-2005	11.1	- 11. 09-07-2007	7
- 2. 12-07-2001	17	- 7. 08-21-2006	8.7	- 12. 12-18-2007	7
- 3. 03-07-2002	15	- 8. 12-06-2006	7.8	- 13. 03-05-2008	3
- 4. 07-10-2002	13	- 9. 03-22-2007	8.1	- 14. 06-23-2008	6
- 5. 11-21-2003	12.5	- 10. 07-10-2007	7	- 15. 09-16-2008	7

*** The background concentration for tritium in groundwater in the regional aquifer is 0.32 pCi/L. Source: LANL report LA-UR-07-2853 (May 2007)**

Table 2. Contaminants in groundwater samples collected from well R-22.

– Contaminants listed in the February 2002 LANL Well R-22 Completion Report LA- 13893-MS (February 2002)
– tritium - 109 picocuries per liter (pCi/L) at the water table of the regional aquifer
– chloride - 21 mg/L at the water table of the regional aquifer

– Contaminants listed in the September 2002 LANL Well R-22 Geochemistry Report LA-13986-MS (September 2002)
– tritium - many detections
– technetium-99 (4.3 and 4.9 pCi/L)

– *pentachlorophenol (6.2 parts per billion (ppb))
– *chloroform (0.94 ppb)
– *phenol (19 and 32 ppb)
– *4-methylphenol (44 to 210 ppb)
– *2-butanone (6.9 to 8.9 ppb)
– *diethylphthalate (1.3 ppb)
– benzo(a)pyrene (0.24 ppb)
– benzoic acid (3 to 12.5 ppb)
– butyl benzyl phthalate (9.8 ppb)
– toluene (0.2 to 0.76 ppb)
– methylene chloride (0.62 and 2.2 ppb)
– bis(2-ethylhexyl)phthalate (1.0 and 3.9 ppb)
– Several substituted benzene compounds including
– isopropylbenzene (0.16 to 0.54 ppb), and
– 1,4-dichlorobenzene (0.16 to 0.23 ppb).

A LANL report – (LA-UR-04-6777, September 2004) recognized the on-going contamination detected in the water samples produced from well R-22 as follows:

- "Thirty-one volatile and semi-volatile organic compounds have also been detected in water from well R-22. Only two of these, pentachlorophenol (1 detection, 6.2 ppb, MCL = 1 ppb) and benzo(a)pyrene (2 detections, 0.24 ppb, MCL = 0.2 ppb) were present at concentrations above the MCL. Monitoring for organic compounds at well R-22 will continue" [MCL means Maximum Contaminant Level allowed in the EPA Drinking Water Standards].

- Tritium and technetium-99 are radionuclide contaminants that are highly mobile. Large amounts of both contaminants are buried in unlined pits and shafts at MDA G and Area G. The detection of the two contaminants in water samples collected from well R-22 are evidence of groundwater contamination from MDA G and Area G.

- *The six hazardous waste contaminants with asterisks in the above list are highly mobile in groundwater and all are commonly found in groundwater beneath hazardous waste dumps. There are large amounts of these contaminants in the mixed wastes buried in MDA G. The measurement of these contaminants in the water samples produced from well R-22 is evidence of groundwater contamination below MDA G. The nature and extent of the contamination is not known but must be investigated.

The tritium and hazardous waste contamination detected in screen #5 is probably because the contaminated groundwater at the water table and/or in another permeable layer of aquifer strata within the upper 200 feet of the regional aquifer was allowed to drain down the open borehole. Table 2 lists the hazardous and radionuclide contamination measured in the water samples collected from well R-22.

Table 3 at the end of this report lists the hazardous contaminants detected in screen #5 for water samples collected on January 10, 2001.

It is a serious mistake that the LANL R-22 Plan makes no mention of the many RCRA hazardous waste contaminants that were repeatedly detected in water samples collected for many years from well R-22. The LANL R-22 Plan only mentions the tritium contamination detected in screen #5.

However, the repeated detection of tritium contamination in the water samples produced from well R-22 is recognized by RCRA §264.98(f) as **"statistically significant evidence of contamination."** RCRA §264.98(f) required that LANL or DOE must determine whether there is statistically significant evidence of contamination for <u>any chemical parameter</u> and tritium is a chemical parameter.

Table 1 shows that the tritium contamination consistently measured in water samples collected from screen #5 were always more than one order of magnitude greater than the LANL background value for tritium in the regional aquifer. RCRA §264 Subpart F required LANL and DOE to formally notify the New Mexico Environment Department (NMED) of the tritium contamination within seven days of the determination that the tritium contamination represented statistically significant evidence of contamination. In addition, LANL and DOE were required to implement the RCRA Compliance Monitoring Program for MDA G that is described in 40 CFR §264.99.

RCRA §264.99 requires a comprehensive investigation of the nature and extent of groundwater contamination in the regional aquifer at the location of well R-22. At this time, the only use of well R-22 for this comprehensive investigation is the measurement of water levels. It is very important to leave the Westbay^{R} sampling system installed in well R-22 because removal of the system will allow the groundwater at the water table to drain down the open well and this drainage and cross-flow of groundwater in the open well must be prevented.

The combination of the water-based drilling fluids and the cross-contamination that was allowed during drilling the R-22 borehole prevented the collection of water samples during drilling to identify the permeable layers of aquifer strata that are the pathways for the travel of groundwater contamination from MDA G to well R-22. Accordingly, there is an immediate need to install a minimum of two new single-screen monitoring wells close to well R-22 at appropriate locations between the well and MDA G. One well is necessary in the permeable aquifer strata that are present to a depth of approximately 25 feet below the water table. The second well is necessary in the thick layers of permeable aquifer strata that are present in the depth interval of approximately 150 to 250 feet below the water table.

Screen #1 in well R-22 is installed in the approximately 15-foot thick interval of permeable aquifer strata that are present immediately below the water table. This permeable zone is the **RCRA uppermost aquifer** and must be monitored by a reliable single-screen monitoring well. The R-22 Plan correctly recognized that screen #1 cannot be rehabilitated because of the new mineralogy formed in this screened interval by the organic drilling fluids. The R-22 Plan made a mistake to assume that screen #2 could replace screen #1.

Well R-22 does not have a screen installed in the thick zone of highly permeable aquifer strata in the depth interval of 150 to 250 feet below the water table. The R-22 Plan made a mistake to not identify the requirement of RCRA §264.99 for the installation of a monitoring well in this zone which is also recognized by RCRA as the uppermost aquifer.

3. The NMED ordered a detailed evaluation of the LANL characterization wells but short-circuited this evaluation for well R-22. The NMED Hazardous Waste Bureau (HWB) issued a letter on April 5, 2007 that ordered LANL to do a detailed evaluation of each screened interval in the LANL characterization wells to assess their potential value as a monitoring well. The pertinent excerpt from pages 2-3 of the NMED letter is pasted below and annotated with an evaluation of well R-22 with particular attention to the technically indefensible R-22 Plan in brackets.

- "The evaluations must assess each well's construction and location, paying particular attention to a well's, or group of wells', ability to yield samples capable of detecting contaminants of concern released from waste management units." *[It is not possible to rehabilitate screens #2 and #3 in well R-22 to produce water samples capable of detecting contaminants of concern from MDA G.]*

- "To the extent possible, wells should double as compliance monitoring points; the evaluation should consider this." *[The R-22 Plan will not make well R-22 usable as a compliance monitoring well.]*

- "Factors to consider in the evaluations, and for groundwater monitoring network design, include, but are not limited to:

- 1. well construction (e.g., excessive screen lengths, excessive filter pack length, damaged casing or screen); *[Screen #2 has an excessive length of 42 feet and an excessive length of filter pack sediments of 70 feet. Screen #3 has a short length of 7 feet surrounded by an excessively long length of filter pack sediments of 40 feet.]*

- 2. seal integrity between water bearing intervals, including influences from annular seal material; *[The filter pack sediments at screen #3 are contaminated with the bentonite clay grout annular seal material because of a mistake in constructing well R-22. The R-22 Plan does not mention the bentonite clay contamination.]*

- 3. spatial distribution of wells relative to groundwater flow, including any pumping influences; *[The groundwater flow in the fast pathway aquifer strata below and away from MDA G are poorly understood. Screens #2 and #3 in well R-22 are not installed in the fast pathway aquifer strata where contaminated groundwater from MDA G is expected to be present.]*

- 4. well locations and distribution relative to potential contaminant sources, including influences on groundwater flow direction and groundwater velocity from municipal supply wells; *[Well R-22 is too distant from MDA G and does not meet the point of compliance requirement of RCRA 24 Subpart F.]*

- 5. location of screened interval relative to hydrostratigraphic units monitored and the hydrologic properties of those units; *[Screen #2 is installed in a basalt formation with very low permeability. Aquifer strata with high permeability that are important to monitor are located above screen #2 but are not monitored by screen #2. Screen #3 is located 390 feet below the water table in poorly sorted unconsolidated sediments that have a low permeability. Screen #3 is located below three thick intervals of aquifer strata with high permeability that are important to monitor but are not monitored by well R-22.]*

- 6. influences on groundwater flow by geologic structures such as faults, folds, and fracture zones; *[An important factor missing from this list is the **important control of confining beds (e.g., layers of geologic formations with low permeability)** on the lateral and vertical travel of contaminated groundwater. The large difference between confining beds and the fast pathway aquifer strata have not been considered in the design of the monitoring well network for MDA G].*

- 7. influences from chemical, mineralogical, and physical impacts resulting from the use of drilling fluids and inadequate well development. The Permittees should incorporate the results from the Well Screen Analysis Report, as appropriate; *[The NMED HWB **still fails to understand** that the statistical scheme in the LANL Well Screen Analysis Report is not credible to determine that the impacted wells produce reliable and representative water samples.]*

- 8. remedies under consideration for the area (e.g., pump and treat, natural attenuation). *[An important remedy that is missing from this section is **wastes left in place in unlined trenches and shafts below a dirt cover.** This remedy requires comprehensive characterization of the hydrogeologic setting in the regional aquifer below MDA G and a large network of monitoring wells to assure long-term performance of the dirt cover. The comprehensive characterization and the required monitoring wells do not exist.]*

- "The Department expects the evaluation for each area (e.g., TA-54) to include recommendations regarding the design of the groundwater monitoring networks for the area, and where appropriate, the relevant watershed(s). The recommendations must: 1) identify any gaps in well coverage of groundwater zones (both laterally and vertically), 2) propose locations for additional monitoring wells, 3) identify the target hydrostratigraphic units, 4) identify wells and well screens that may pose a pathway for contaminant migration, 5) identify wells that are unsuitable or irreparable, 6) include plans to isolate or plug and abandon wells, well screens, or both, 7) recommend reduced functions (e.g., use for water level measurements only) for some well screens in some wells, and 9) identify any available wells suitable for monitoring releases from permitted or interim status waste management units." ***[LANL and DOE have not provided the evaluation of TA-54 that is required by NMED on April 5, 2007 in the above paragraph!]***

4. The NMED ordered the rehabilitation of characterization well R-22 without a detailed evaluation. The NMED letter of April 5, 2007 did not require the detailed evaluation of well R-22. Instead, the NMED letter short-circuited the evaluation by placing an imposition for the rehabilitation of characterization well R-22 without a careful evaluation of the feasibility for the rehabilitation.

The NMED letter of April 5, 2007 ordered LANL and DOE to "rehabilitate" well R-22 by abandoning screens #4 and #5, sealing off screen #1 and equipping the well with pumping systems to produce groundwater only from screens #2 and #3.

However, for well R-22, the conclusion from the comprehensive evaluation ordered by the NMED for the LANL characterization wells is that

- 1). <u>none</u> of the screened intervals in well R-22 can be rehabilitated to yield samples capable of detecting contaminants of concern from MDA G, and

- 2). the only use for well R-22 is measurement of water levels. In fact, Section 5 of this report describes the essential need to maintain the five screened intervals in well R-22 for measurement of water levels.

5. The only use for well R-22 is measurement of water levels. The only value for well R-22 is the measurement of water levels during pumping tests to gain knowledge of the hydraulic properties of the regional aquifer and the R-22 Plan to permanently plug and abandon screens #4 and #5 and isolate screen #1 will greatly lower the value of well R-22 for that important purpose.

The National Academy of Sciences (NAS) 2007 report - *Plans and Practices for Groundwater Protection at the Los Alamos National Laboratory: Final Report* - described the need for more pumping tests to determine the hydraulic properties of the regional aquifer. The pertinent excerpts from the NAS report are pasted below:

- "The data from the [two LANL] aquifer tests suggested two competing conceptual models. First, the regional aquifer may be a leaky confined aquifer with leaky units located above a highly conductive layer that is about 260 meters (850 feet) thick. A second possible conceptualization is that the regional aquifer *appears* to behave like a leaky confined system because it contains interbedded layers of alternating high and low hydraulic conductivities that are sandwiched together into a high-yielding zone. (page 41)

- "LANL's present conceptualizations of the regional aquifer lead to very different pictures of how contaminants in the aquifer might behave. If there is low connectivity between layers within the aquifer, the contaminants might remain near the top of the regional aquifer and most likely discharge in the springs near the Rio Grande. On the other hand, higher connectivity could result in the contaminants spreading vertically and more likely entering the deep screened intervals of regional water supply wells." (page 47)

- "**Recommendation:** LANL should continue efforts begun under the Hydrogeologic Workplan to characterize the regional aquifer. <u>More large-scale pumping tests and improved analyses of the drawdown data</u> [from the pumping tests] are needed to establish a scientifically defensible conceptual model of the aquifer, i.e., leaky-confined, unconfined, or layered." (page 47).

- "Even though planned three-dimensional model simulations to further examine aquifer heterogeneity should provide a better interpretation of the aquifer test data, additional hydrogeologic characterization of the regional aquifer is warranted [i.e., additional long-term aquifer pumping tests at important locations including the area below and away from TA-54]. Geochemical information could also be used to corroborate the aquifer test data. Effective design of a groundwater monitoring system will require an accurate and complete conceptual model of the regional aquifer." (page 41)

A 2005 paper in *Vadose Zone Journal* by LANL scientists specifically identified the need for aquifer pumping tests to reduce the large uncertainty for the hydraulic properties of the regional aquifer at well R-22. The pertinent excerpts from the paper by Keating et al. *in Vadose Zone Journal* (Volume 4, August, 2005) are pasted below:

- "Travel times through the regional aquifer are poorly understood because of the lack of tracer tests and *in situ* measurements of effective porosity." (page 658)

- "(a) significant proportion of uncertainty in fluxes downgradient of LANL results from uncertainty in the permeability of the basalts. **[Note by the author.** The San Ildefonso

Pueblo, the Rio Grande and the Buckman well field - an important drinking water supply for Santa Fe are downgradient of LANL.**]** Basalt units are very important for potential contaminant transport because of their expected low effective porosity. Therefore, we can expect at least a factor of 3 uncertainty in the associated travel times resulting in uncertainty in the flow equation." (page 666) **[Note by the author.** The two basalt units in the regional aquifer at well R-22 have a thickness of 290 feet at the top of the regional aquifer and 70 feet at depth beginning at 450 feet below the water table. Knowledge of the hydraulic properties of both basalt units are very important to protect groundwater resources from contamination by the LANL wastes buried at MDA G.**]**

- "The current understanding of hydrostratigraphy, as implemented in the numerical models, is sufficient to explain general trends in heads (spatial and temporal) but is lacking in a few key areas such as in the vicinity of R-9, R-12, **R-22** [emphasis added], and R-16. Detailed transport calculations in the vicinity of these wells would benefit from a refinement of the hydrostratigraphic framework model" [page 667 to 668, Keating et al., 2005]

- "The implication of this work for contaminant transport issues is that because of parameter uncertainty, predicted fluxes and velocities are quite uncertain. Uncertainties in permeability and porosity values lead to additional model uncertainty. **These uncertainties can be reduced meaningfully with more data collection, including multiwell pumping and tracer tests."** [emphasis added] [page 668, Keating et al., 2005]

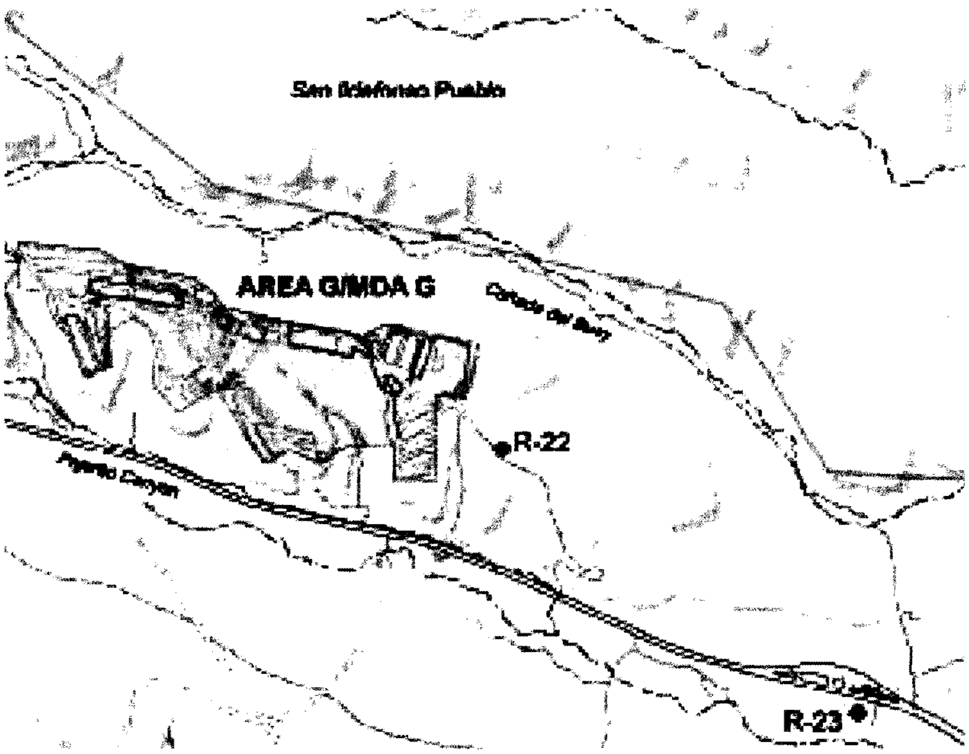
- Both the NAS and the LANL scientists understand the lack of knowledge that exists for the hydraulic properties of groundwater travel in the regional aquifer but the necessary and very important aquifer pumping tests and tracer tests to reduce the uncertainty are not being performed.

Table 3. Data summary for detected organic chemicals in the groundwater sample collected on January 10, 2001 from screen #5 in LANL characterization well R-22.
Source: Table A-40 *in* LANL Well R-22 Geochemistry Report

Analyte	Screen	Depth (ft)[a]	Collection Date	Field Preparation	Number of Analyses	Number of Detects	Detected Value (µg/L)	Non-detected Value (µg/L)	Drinking Water MCL[b] (µg/L)	Frequency of Detects > Drinking Water MCL	NMED[c] Groundwater Standard[d] (µg/L)	Frequency of Detects > NMED Groundwater Standard
Acenaphthene	5	1448	12/10/01	NF[e]	1	1	0.42	—[f]	—	—	—	—
Acenaphthylene	5	1448	12/10/01	NF	1	1	0.4	—	—	—	—	—
Anthracene	5	1448	12/10/01	NF	1	1	0.38	—	—	—	—	—
Benzo(a)pyrene	5	1448	12/10/01	NF	1	1	0.24	—	0.2	1/1	0.7	0/1
Benzo(b)fluoranthene	5	1448	12/10/01	NF	1	1	0.41	—	—	—	—	—
Benzo(k)fluoranthene	5	1448	12/10/01	NF	1	1	0.38	—	—	—	—	—
Bis(2-ethylhexyl)phthalate	5	1448	12/10/01	NF	1	1	1	—	6	0/1	—	—
Chloronaphthalene[2-]	5	1448	12/10/01	NF	1	1	0.46	—	—	—	—	—
DDT[4,4'-]	5	1448	12/10/01	NF	1	1	0.024	—	—	—	—	—
Diethylphthalate	5	1448	12/10/01	NF	1	1	1.3	—	—	—	—	—
Fluoranthene	5	1448	12/10/01	NF	1	1	0.38	—	—	—	—	—
Fluorene	5	1448	12/10/01	NF	1	1	0.42	—	—	—	—	—
Methylnaphthalene[2-]	5	1448	12/10/01	NF	1	1	0.42	—	—	—	—	—
Pentachlorophenol	5	1448	12/10/01	NF	1	1	6.2	—	1	1/1	—	—
Phenanthrene	5	1448	12/10/01	NF	1	1	0.4	—	—	—	—	—
Pyrene	5	1448	12/10/01	NF	1	1	0.49	—	—	—	—	—
Toluene	5	1448	12/10/01	NF	1	1	0.76	—	1000	0/1	750	0/1
Total Organic Carbon	5	1448	12/10/01	NF	1	1	4880	—	—	—	—	—

[a] The static water level for the regional aquifer at R-22 was 863 ft when the well was drilled.
[b] MCL = Maximum contaminant level. US Environmental Protection Agency (EPA) MCLs are from *National Primary Drinking Water Regulations*, 40 CFR Part 141. US EPA secondary MCLs are from *National Secondary Drinking Water Regulations*, 40 CFR Part 143. State of New Mexico MCLs are from *Drinking Water Regulations*, 20 NMAC 7.1.
[c] NMED = New Mexico Environment Department.
[d] State of New Mexico groundwater standards are from *New Mexico Water Quality Control Commission Regulations, Ground and Surface Water Protection*, 20 NMAC 6.2.
[e] NF = Nonfiltered.
[f] — = Not available or not applicable.

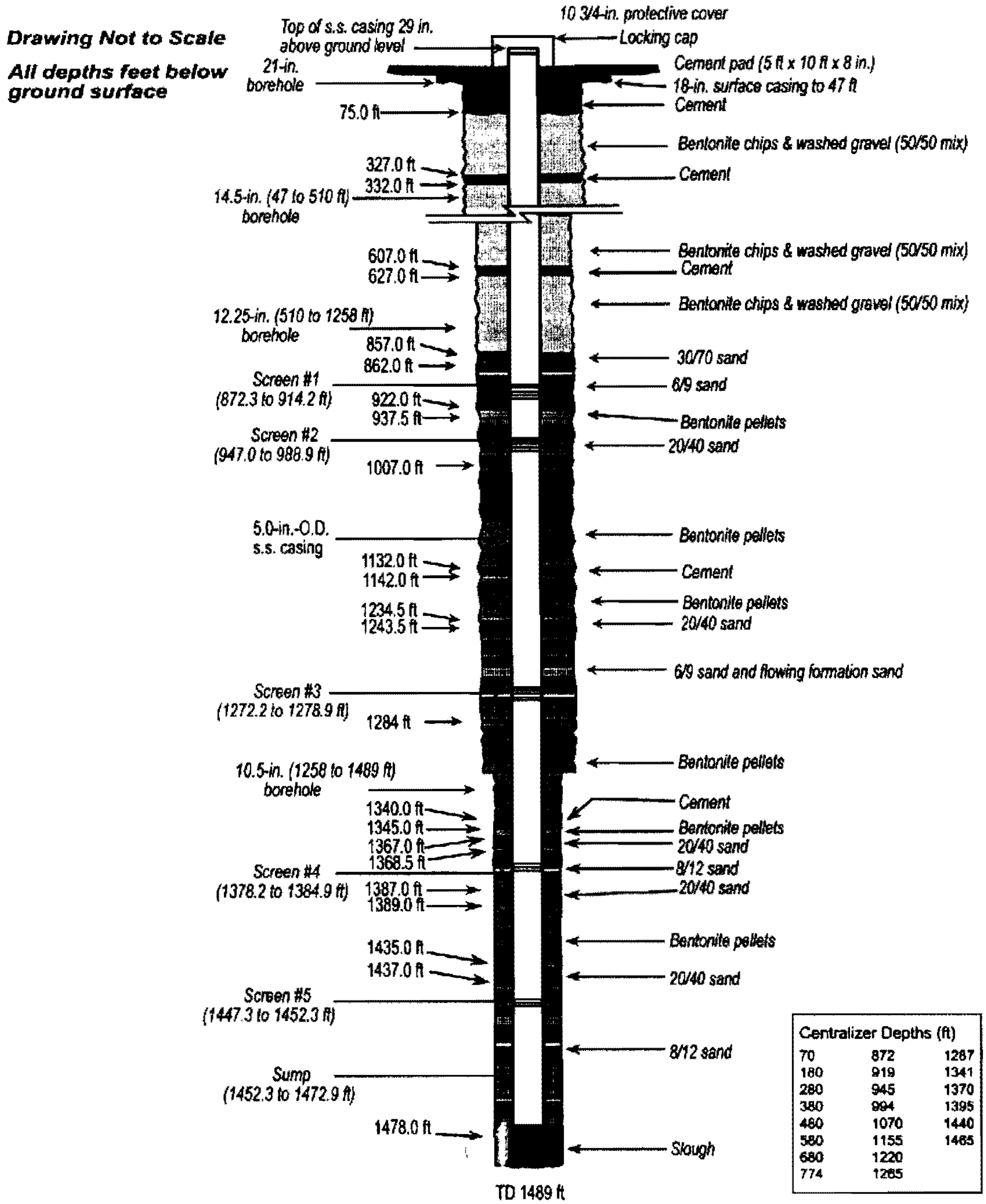
Figure 1. The locations of LANL characterization wells R-22 and R-23 east of the LANL 63-acre landfill and waste dump Area G/MDA G.



scale 0 - - - - - - - - 1000 feet

- **The orange line north of MDA G marks the boundary of LANL with the San Ildefonso Pueblo.**
- **Wells R-22 and R-23 are installed in the regional aquifer to monitor groundwater contamination from MDA G. The distances from the eastern boundary of MDA G to wells R-22 and R-23 are 500 feet and 3,300 feet, respectively.**
- **The direction of groundwater flow at the water table below MDA G is from west to east toward the Rio Grande. The travel time for contaminated groundwater in the permeable aquifer strata below MDA G below MDA G to reach wells R-22 and R-23 is not known because of insufficient characterization of the geology below and away from MDA G.**
- **The many mistakes in the location, drilling, well construction, misplaced well screens and improper sampling methods prevent the wells R-22 and R-23 from producing reliable and representative water samples for the detection of groundwater contamination from MDA G.**

Figure 2. The as-built construction of LANL characterization well R-22.

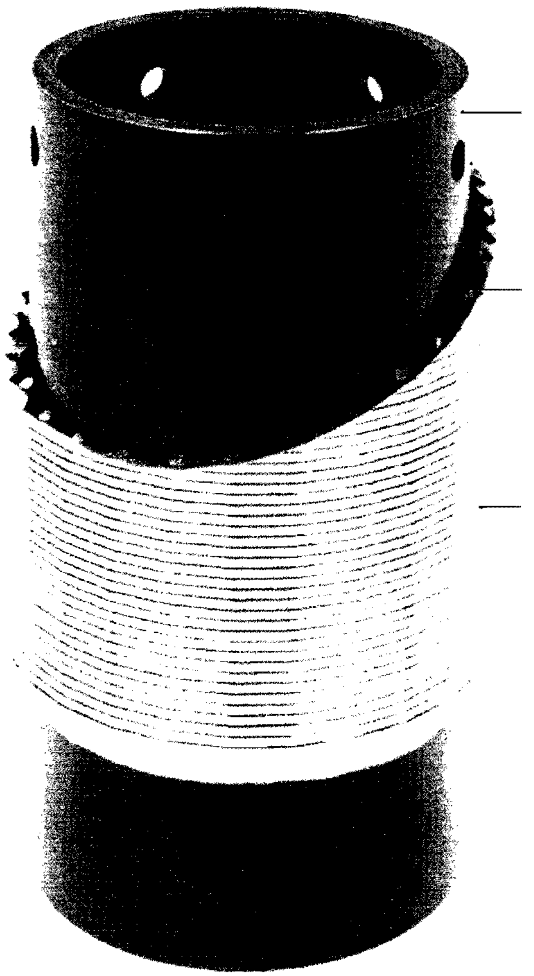


Centralizer Depths (ft)		
70	872	1287
180	919	1341
280	945	1370
380	994	1395
480	1070	1440
580	1155	1465
680	1220	
774	1265	

Note: 1. The screen interval lists the footage of the pipe perforations, not the top and bottom of screen joints.
2. Pipe-based screen: 4.5-in. I.D., 5.563-in. O.D. 304 stainless steel with s.s. wire wrap: 0.010-in. slot.

Source for Figure 2: LANL Characterization Well R-22 Completion Report, (LA-13893-MS, February 2002).

Figure 3. Schematic of the pipe-based wire-wrap stainless steel well screen installed in many of the LANL characterization well R-22.



- The pipe-based screens in LANL characterization well R-22 are constructed with 84 holes drilled through the base pipe per linear foot of screen. The drill holes have a diameter of 0.375 inches.

- The surface area of the holes drilled through the base pipe is only 5% of the surface area of the well screen.

- The restrictive design of the pipe-based screens prevented the original well development activities from removing the organic drilling additives from the five screened intervals in well R-22.

- The restrictive design of the pipe-based screens will prevent the rehabilitation activities in the R-22 PLAN from removing the new mineralogy created by the organic drilling additives and the bentonite clay grout contamination from screen #3 in well R-22.