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**Exhibits**
**In support of CCNS and EVEMG**
**comments regarding**
**the draft LANL SWEIS**

**Exhibit 1:** Gilkeson, Bob. "The Complex Geologic Setting Beneath LANL Requires the Use of Drilling Methods that Mask Detection of Most Radionuclide and Chemical Contaminants in Groundwater." Below.

**Exhibit 2:** Gilkeson, Bob. "Deficiencies in the Draft LANL SWEIS for the Water Quality Data Produced From the LANL Monitoring Wells."

**Exhibit 3:** Gilkeson, Bob. "Failure of Draft LANL SWEIS to Address the Environmental Impact From the Hexavalent Chromium Plume in the Regional Aquifer."
**Exhibit 4:** Gilkeson, Bob. "Failure of the Draft LANL SWEIS to Address Environmental Impact Because of Groundwater Contamination From the RCRA Regulated Disposal Sites at Technical Area 54."

**Exhibit 5:** George Rice, Remediation of MDAs.

**Exhibit 6: Multi Media Compact Discs**

**6.1** *Where do the Children Play?*

**6.2** CCNS and EVEMG Comment Images and source list

**Exhibit 7:** Email, Elizabeth Withers to Joni Arends, September 19, 2006

**Exhibit 8: Census Articles**

**8.1** Cotreras, Russell. "N.M. 40th in Nation in High School Grads." *Albuquerque Journal* July 3, 2004.

**8.2** Garcia, Patricia. "State's Social Health Poor, Study Says." *Albuquerque Journal* November 19, 2003.

**8.3** Burford, Katie. "More Live in Poverty, Group Says." *Albuquerque Journal* July 9, 2003.

**8.4** Armas, Genaro. "Thousands of Minority Kids Missed in Census." *Albuquerque Journal* December 7, 2002.

**8.5** Armas, Genaro. "N.M Tops U.S. For Poverty in 2001." *Albuquerque Journal* September 25, 2002.

**8.6** Dickinson, Joy. "N.M. Ranks 50th in Child Poverty Report." *Albuquerque Journal* May 24, 2002.

**8.7** Propp, Wren. "Los Alamos Leads State In Median Income Level." *Albuquerque Journal* January 15, 2002.

**8.8** Massey, Barry. "Report: N.M. Still Among Nation's Worst for Poverty," Associated Press, "Poverty Rate up for 4th Strait Year," *The New Mexican* August 8, 2005.

**8.9** Armas, Genaro. "White Counties Found Big Income Gains." *The New Mexican* June 28, 2002.

**8.10** Tollefson, Jeff. "Senator: Income Numbers Skew Aid Eligibility." *The New Mexican* March 15, 2002.

**Exhibit 9: Environmental Justice**

**9.1** Associated Press. "Lawsuit accused LANL of discrimination against women, Hispanics." *The New Mexican* August 8, 2006

**9.2** CCNS comments regarding the draft EIS for the National Enrichment Facility, January 7, 2005. Available at http://www.nuclearactive.org/docs/documents.html#LES

**9.3** Smith, Brice. "Soil Cleanup at Los Alamos National Laboratory." *Science For Democratic Action* April 2006. Available at www.IEER.org.

**9.4** State of New Mexico Environment Department Office of the Secretary. "Additional Fish Consumption Advisories Announced." January 2, 2006

**9.5** State of New Mexico Office of the Governor. "Executive Order 2005-056 Environmental Justice Executive Order." November 18, 2005. Available at http://www.nmenv.state.nm.us/Justice/index.html.

**Exhibit 10: Santa Fe City Council**

**10.1** Journal Staff Reports. "SF Against LANL Plutonium Work." *Albuquerque Journal* August 29, 2006.

**10.2** City of Santa Fe, New Mexico. "A Resolution Objecting to Proposed Expanded Nuclear Weapons Activities, Including Plutonium Pit Production [sic], at The Los Alamos National Laboratory and Directing the City Clerk to Inform Federal Authorities of the Objections."

**Exhibit 11: Receipts**

**11.1** CCNS and EVEMG draft LANL SWEIS Comments, 2006

**11.2** Letters Regarding the Draft LANL SWEIS, 2006

**11.3** Letters Opposing Construction and Operation of a Modern Pit Facility, 2003

**Exhibit 12: Mission**

**12.1** NM SEES. "New Security, New Mission, New Mexico."

**12.2** *Don't Let New Mexico Go to the Pits* Placard.

**12.3** Hill, Judyth. "Wage Peace."

**12.4** Political Cartoon, "One of the Lesser Known Elvis Movies."

**12.5** Glasgow. "Join the Fun?" *Albuquerque Journal* 1997.

**Exhibit 13: Maps**

**13.1** Map Showing Proximity of Los Alamos National Laboratory and Sandia National Laboratories.

**13.2** Areas of the Continental United States Crossed by More Than One Nuclear Cloud from Aboveground Detonations.

**Exhibit 14: International**

**14.1** Burroughs, John and Makhijani, Arjun. "Undermining Nuclear Security Agreements." Available at www.IEER.org.

**Exhibit 15: Cerro Grande Fire**

**15.1** Question Sheet: Cerro Grande Fire

**15.2** Russ, Abel. "Comments on the 2002 Risk Assessment Corporation analysis of risks from the 2000 Cerro Grande fire at Los Alamos National Laboratory." Available at http://www.nuclearactive.org/docs/documents.html#Cerro

**Exhibit 16: Water**

**16.1** Bearzi, James P. "Notice of Violation Los Alamos National Laboratory (LANL), EPA ID NM0890010515." Available at http://www.nmenv.state.nm.us/OOTS/ PR/PR%20LANL**NOV**Final%209-13-06.pdf.

**16.2** LANL WW Shared Values Statement. Available at http://www.nuclearactive.org/docs/Waterwatchindex.html

**Exhibit 17: Health**

**17. 1** Letter, EPA, Re: Public Comment Release- Public Health Assessment of LANL, July 27, 2005

**17.2** Bernd Franke, Catherine M. Richards, M.S., Steve Wing, Ph.D., David Richardson Ph.D., and Concerned Citizens for Nuclear Safety. "New Mexico's Right to Know: The Impacts of LANL Operations on Public Health and Environment."

**Attachment 1: Figures for Exhibits 1-4**

Exhibit 1.
The Complex Geologic Setting Beneath LANL
Requires the Use of Drilling Methods that
Mask Detection of Most Radionuclide and Chemical Contaminants in Groundwater.

1.0. Introduction. The Department of Energy (DOE) National Nuclear Security Administration (NNSA), the Los Alamos National Laboratory (LANL), and the New Mexico Environment Department (NMED) all concur that the complex geologic setting beneath the Laboratory facility requires the installation of monitoring wells with fluid-assisted drilling methods. The general agreement of the need to use the fluid-assisted drilling methods for the new network of monitoring wells installed at LANL over the past ten years by the LANL Hydrogeologic Workplan Project[1] (HWP) is described below in Section 2.0. The LANL HWP describes the new monitoring wells as "characterization wells."

The drilling fluids that were used for the construction of the LANL characterization wells have well known properties described below in Section 3.0 to mask the detection of the radionuclide contaminants that are generated by the manufacture of plutonium pits, a component of nuclear weapons. In fact, there are many recent LANL reports[2,3,4,5,6,] that acknowledge the inability of the new network of characterization wells to accurately detect many radionuclide contaminants including plutonium, neptunium, and americium. Therefore, instead of expanding the production of plutonium pits at LANL, under the National Environment Protection Act (NEPA), the Final LANL SWEIS is required to choose the *Reduced Operations Alternative* described in the Draft LANL SWEIS. In fact, the emerging presence of Plutonium-238, Plutonium-239, Plutonium-240, and Neptunium-237 contamination in the regional aquifer beneath LANL and in the drinking water supplied to citizens in Los Alamos County, Santa Fe, and the San Ildefonso Pueblo is a further requirement to choose the *Reduced Operations Alternative*. The presence of plutonium and neptunium contamination in the drinking water is shown by the data presented in the Draft LANL SWEIS and are described below in Section 4.0. of this Exhibit.

The new network of LANL characterization wells were drilled with organic and bentonite clay drilling fluids that have well-known properties that mask the detection of many LANL contaminants of concern in groundwater. In particular, the long-term effects of the drilling fluids prevent accurate knowledge of the contamination of groundwater by the strongly reactive radionuclide contaminants listed in Appendix F of the Draft LANL SWEIS including Americium-241, Cesium-137, Cobalt-60, Plutonium-238, Plutonium-239, Plutonium-240, and Radium-226. The other radionuclides listed in Appendix F that the drilling fluids may mask the presence of in groundwater include Neptunium-237, Strontium-90, Uranium-234, Uranium- 235, and Uranium-238.

In addition, the drilling fluids have strong properties to mask the detection of many of the chemical contaminants generated by LANL operations including solvents, semi-volatile organic compounds, high explosives, and trace metals including hexavalent chromium. A large poorly characterized plume of hexavalent chromium (the contaminant in the movie *"Erin Brockovich")* is in the regional aquifer beneath Mortandad and Sandia Canyons. The measured hexavalent chromium levels[7] in the plume are greater than 400 ug/L, a level 8 times higher than the NMED Drinking Water Standard.

The drilling fluids that were used for the LANL characterization wells are one of the factors responsible for the poor knowledge by DOE/NNSA and LANL for the dimensions of the plume of Hexavalent Chromium. The danger of the Hexavalent Chromium plume to the drinking water wells for Los Alamos County, for Santa Fe in the Buckman well field located near the Laboratory, and to the San Ildefonso Pueblo are described in Exhibit 3.

A recent LANL Report, the *"Well Screen Analysis Report"*[2] (WSAR) concludes that approximately 50% of the LANL characterization wells do <u>not</u> produce reliable and representative groundwater samples. Exhibit 2 is a comparison of the findings in the WSAR to Appendix F of the Draft LANL SWEIS to show that the majority of the LANL characterization wells cited in Appendix F were identified by the WSAR as wells that do <u>not</u> produce reliable and representative water samples because of the effects of drilling fluids on the chemistry of water produced from the wells. The reasons why the drilling fluids hide the presence of contaminants in the water samples produced from most of the LANL characterization wells are described below in Section 3.0.

In Section 3.0., many LANL reports, reports by regulators, and the technical literature document that the fluid-assisted drilling methods prevent the LANL characterization wells from accurately detecting the radionuclide contaminants that are generated by the production of plutonium pits at the Laboratory facility. In addition, the reports document that the LANL monitoring wells do not produce the representative groundwater samples that are required by the U.S. Environmental Protection Agency (EPA) Resource Conservation and Recovery Act (RCRA).[8] LANL is regulated under RCRA.

The ability to accurately monitor the groundwater contamination from all of the Laboratory operations is a fundamental requirement of the regulations of NEPA, RCRA, NMED, and DOE Orders. The demonstrated inability to monitor for the radionuclide and chemical contamination in the groundwater resource beneath LANL requires that the present production of plutonium pits at LANL be stopped.

The urgent need to stop the pit production is because the data in Appendix F of the Draft LANL SWEIS show the widespread presence of plutonium and neptunium contamination in the regional aquifer beneath LANL. Recent research[9] has established that the current EPA Drinking Water Standard of 15pCi/L for alpha emitting radionuclides such as plutonium and neptunium is based on decades old, obsolete science that is not protective of the danger of the alpha emitting radionuclides to public health. Accordingly, the State of Colorado[10] has enforced a Drinking Water Standard that plutonium levels shall not exceed 0.15 pCi/L. The data in Appendix F show that plutonium contamination is present in one of the LANL characterization wells at a level of 0.601 pCi/L and that the mean level of plutonium contamination in the new LANL characterization wells is at 0.125 pCi/L. Of course, because of the drilling additives, the water produced from the LANL characterization wells is not reliable for accurate knowledge of the levels of plutonium and the other alpha-emitting radioisotopes in the groundwater.

The alarming fact is that Appendix F of the Draft LANL SWEIS shows that the plutonium and neptunium contamination are present in the drinking water produced from the Los Alamos County Supply Wells and from the Santa Fe Supply Wells in the Buckman well field. The plutonium contamination in the Los Alamos wells is 4 times higher than the level in the Santa Fe wells as expected because of the closer location of the Los Alamos wells to LANL operations. Instead of expanding the production of plutonium pits at LANL, under NEPA the Final LANL SWEIS is required to choose the *Reduced Operations Alternative* described in the Draft LANL SWEIS.

In fact, the knowledge of the contamination of groundwater by Laboratory operations that has been gained over the past ten years requires a formal reconsideration of many projects that would go forward under the *Reduced Operations Alternative* because they were previously approved by completed NEPA analyses that were not aware of the extent of groundwater contamination by LANL operations.

Furthermore, the Draft LANL SWEIS documents the great uncertainty in the degree of contamination of the groundwater resources beneath the Laboratory and the great uncertainty for the physical properties of the regional aquifer beneath LANL that control flow paths and travel times of contaminants to existing drinking water supply wells:

- "Data concerning the spatial distribution of anthropogenic [LANL] contaminants in the regional aquifer has been inconclusive because of the exceptionally thick and complex vadose zone which makes it impossible to define the location and timing of contaminant entry to the regional aquifer" [page 658, Keating et al., 2005[15]].
- "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, Keating et al., 2005[15]].

The poor understanding of contaminant pathways and travel times are issues that also requires the Final LANL SWEIS to choose the *Reduced Operations Alternative*.

In Section 2.0 of this exhibit, we have included excerpts from the DOE IG Report, the EPA National Risk Management Research Laboratory Report, the technical literature, and even LANL reports as irrefutable evidence that the LANL characterization wells impacted by the organic and bentonite clay drilling fluids do not produce representative water samples for many LANL contaminants of concern and especially the strongly sorbing radionuclide contaminants that would be produced by *Expanded Operations Alternative* to quadruple the production of plutonium pits and construct and operate a Modern Pit Facility, capable of producing 450 plutonium pits per year.

The contamination in the regional aquifer that was discovered by the new network of characterization/monitoring wells installed for the LANL HWP include:
- Neptunium-237 – the data presented in Appendix F of the Draft LANL SWEIS show neptunium contamination to be present in the drinking water of Los Alamos County and Santa Fe (see section 4.0 below).
- Plutonium-239 and Plutonium-240 – the widespread plutonium contamination in the regional aquifer is shown by the data presented in Appendix F of the Draft LANL SWEIS (see section 4.0 below).
- Hexavalent chromium plume beneath Mortandad and Sandia Canyons in LANL characterization wells R-28, R-15, and R-11 (see Exhibit 3).
- Perchlorate contamination that has shut down the Los Alamos County Drinking Water Supply Well Otowi-1.
- High-explosives and solvent contamination detected in characterization well R-25.
- Radionuclide and chemical contaminants in the regional aquifer beneath Area G, the Laboratory's active facility for the disposal of low-level radioactive waste (see Exhibit 4).

## 2.0. Statements by DOE/NNSA and LANL of the need to use fluid-assisted drilling methods to install monitoring wells beneath the Laboratory and the surrounding region.

- Excerpts from LANL *"Well Screen Analysis Report"*[2] (WSAR):
  "Drilling and construction of monitoring wells within perched intermediate zones at depths greater than 100 ft or within the regional aquifer require the use of drilling fluids to ensure borehole stability and lubricity. Drilling fluids perform functions that include cleaning cuttings off of the bit and the bottom of the borehole, transporting cuttings to the surface, providing borehole stability, cooling the bit, and lubricating the drill string. Rotary drilling to these depths is not possible without the use of drilling fluids, without incurring substantial risk to the successful completion of the boreholes and installation of the wells." [page 2, WSAR]

"The earliest wells were drilled using air-rotary drilling methods with casing advance and the minimal use of fluids other than air. Because of significant problems associated with stuck casing, unstable boreholes, and lost circulation, small amounts of drilling fluids were used to improve lubricity, borehole stabilization, and cuttings circulation. Continuing drilling problems made total reliance on air-rotary drilling with casing advance impracticable for meeting drilling objectives. It became apparent that the depth of the wells and the difficult drilling environment, including substantial heterogeneity in physical rock properties, required that additional drilling techniques be employed in order to penetrate and respond to the complex hydrogeologic conditions that characterize the Pajarito Plateau." [page 8, WSAR]

"Organic fluids, primarily EZ-MUD® and QUIK-FOAM®, were used in all wells. In addition, sodium-bentonite drilling mud was used in twelve well-screen intervals. A variety of other materials were also added to many of the wells (Table B-2)." [page 8, WSAR]

- LANL Comments on EPA draft report "Impacts of Well Construction Practices" September 30, 2005

"Our attempts at drilling dry at LANL resulted in a failure rate of 65%. That is, in 65% of the well locations where this technique was employed, the drill pipe became stuck, requiring the abandonment of the borehole and the construction of a new hole at significant cost/time."

- Excerpt from LANL *"Workplan for R-well Rehabilitation and Replacement"* [3] (WRRR):

"For the wells to reach the regional aquifer in some wells (e.g., in the Santa Fe Group), fluids and additives were used during drilling and well installation to enable the advancement of the drill casing or drill bit and to prevent the collapse of open-borehole intervals during the collection of borehole geophysical data. The hydrogeologic complexity and varying degrees of competence of the stratigraphic units beneath the Laboratory also dictated the use of fluids for penetration. Bentonite drilling muds were used at nine screens in four of the wells that are shown in this workplan as requiring rehabilitation or replacement. Organic fluids, such as EZ-MUD and QUIKFOAM, were used in all of the wells. 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 and organic species. Similarly, residual organic drilling fluids left in situ provide nutrients for microorganisms, a situation that leads to reducing conditions that can dissolve naturally occurring metal oxides and hydroxides, including those of iron and manganese, thereby releasing any coprecipitated or sorbed metals. At the same time, organic fluids reduce anions such as nitrate to nitrogen gas and sulfate to sulfide. Reducing conditions also may enhance the degradation rate of some organic species in the vicinity of the screen. The combined effects of these chemical reactions create conditions leading to unrepresentative groundwater quality and the inability to determine the presence or absence of contaminants in the groundwater with confidence." [page 3, WRRR]

- <u>LANL Description of the failure of the Air Rotary Casing Advance Drilling Method to Install Monitoring Wells in Meetings with the Public.</u> An example of the description of the failure of the casing advance drilling method to install monitoring wells beneath LANL that was common in LANL meetings with the public is the following excerpt on page 14 of the minutes of the October 29-31, 2002 Quarterly Public Meeting of the LANL Hydrogeologic Characterization Program:

"Drilling Techniques Issue:

- Casing advance is a slow, expensive and risky drilling technique.
- Wells such as R-25 and R-8 are examples of how costly casing advance can be.

Drilling Techniques Issue Resolution:

- Maintaining borehole stability with fluids (stiff foam and bentonite mud) has been added as a drilling option.
- Drilling the boreholes goes much faster using fluids."

- <u>Meeting Notes of the July 13, 2004 Annual Meeting of LANL Groundwater Protection Program. Excerpt of discussion on page 3:</u>
- Question from meeting attendant: "Is the plan to drill the boreholes dry?"
- Reply by Tom Whitacre (DOE/NNSA): "The plan is to drill dry. The problem with drilling dry is that it creates dust and we have to add water to control the dust. Also, when we get into the basalt we have to add foam to fill in the cracks in order to get returns."
- Question from meeting attendant: "What are the DQOs for chemistry data?"
- Reply by Mr. Whitacre: Don't believe you can drill completely dry to these depths. Casing advance still needs fluid for lubricity and there is lots of stuck casing from using casing advance."
- Question from meeting attendant: "is it a question of time – if you drilled slower could you drill dry"?
- Reply by Mr.Whitacre: "No, if you try to drill completely dry, you will get stuck. First we try adding water and if that doesn't work, then we add foam."
- Question from meeting attendant: "What is in the foam?"
- Reply by Mr. Whitacre: "Primarily isopropyl alcohol." [The isopropyl alcohol in the drilling foam is a fuel for well known microbial chemical processes that cause the LANL characterization wells to mask the presence of radionuclide contaminants is the water produced from the wells.]

3.0. Properties of the Drilling Fluids that Hide the Presence of Many Contaminants From LANL Operations in the Water Samples Produced From the LANL Characterization Wells.

All of the LANL characterization wells were drilled with methods that invaded the screened intervals with drilling additives that caused the development of a new mineralogy on the strata that surround the well screens. Robert H. Gilkeson, a Registered Geologist, wrote a report[11] in 2004 to bring attention to the many problems that prevent the characterization wells from producing representative water samples. As a result of Mr. Gilkeson's report, reports were written by the DOE Office of the Inspector General[12] and by the Environmental Protection Agency[13] (EPA) that agreed with Mr. Gilkeson's position that the drilling additives would hide the presence of contamination in the water samples produced from the wells, and also would lower the permeability of the impacted strata that surround the well screens. Besides unreliable water quality data, the wells also are not reliable for knowledge of the in situ permeability of the aquifer strata. Knowledge of the permeability of the strata is important to calculate the speed of travel of contaminated groundwater to the drinking water wells and to the Rio Grande.

Excerpts from the DOE IG Report and the EPA Reports are included in the summary below of articles in the technical literature with reasons for not installing monitoring wells in strata that are invaded with organic drilling additives or bentonite clay drilling muds.

**Article A-1:** The Office of the Inspector General of the Department of Energy wrote a report[12] about the bentonite clay drilling mud and organic drilling additives that were allowed to invade the screened intervals in monitoring wells installed at the Los Alamos National Laboratory – Report DOE/IG-0703, September 2005. Excerpt from the report:

- "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."

**Article A-2**: The EPA National Risk Management Research Laboratory published a report[13] in February, 2006 about the adverse impact of drilling additives on the quality of data from the monitoring wells installed at the Los Alamos National Laboratory. Excerpts from the EPA Report:

> "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."

> "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 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. The time frame for this continuing impact to the representativeness of groundwater samples may be years to decades."

> "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."

> "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 groundwater 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 unlikely that the new mineral phases formed during biodegradation of the organic materials would be fully removed during redevelopment."

**Article A-3:** The text book Aqueous *Environmental Chemistry* by Langmuir (1997) describes the preferential adsorption of the LANL radionuclide contaminants listed in Appendix F of the Draft LANL SWEIS by the bentonite clay drilling muds that were allowed to invaded the screened intervals in the LANL characterization wells as follows:

> "Adsorption (onto bentonite clay) of a dissolved ionic species is always part of an (ion) exchange reaction that involves a competing ionic species. The desorbing species creates the vacant site to be occupied by the adsorbing one. As the trace metal (or radioactive contaminant) level drops relative to that of a competing major ion, adsorption of the trace species is increasingly favored relative to competing major species."

**Article A-4:** The text book *Aquatic Chemistry* by Stumm and Morgan (1996) describes the preferential adsorption of trace contaminants by bentonite clay as follows:

"The sorption of alkaline and earth-alkaline cations (e.g., strontium-90) on expandable three-layer clays [e.g., bentonite clays] can usually be interpreted as stoichiometric exchange of interlayer ions (ion exchange). To understand binding of trace heavy metals [e.g., also the trace radioactive contaminants such as plutonium and americium] on clays, one needs to consider – in addition to ion exchange – the surface complex formation on end–standing functional OH groups. Three layer silicates (e.g., bentonite clays) contain on the crystal edges (broken bonds) end-standing OH groups which can interact with [remove from groundwater] metal ions [and most of the radionuclide contaminants listed in Appendix F of the Draft LANL SWEIS]."

**Article A-5:** The Los Alamos National Laboratory (LANL) established a team of experts known as the External Advisory Group (EAG) to review activities to install a network of monitoring wells beneath the Laboratory facility. The EAG Semi-Annual Report (EAG, Dec. 23, 1999) lists 17 disadvantages for installing monitoring wells in boreholes that were drilled with the mud-rotary method. The EAG report contains the following summary statements concerning use of the mud rotary drilling method:

"The use of mud-rotary drilling techniques is largely inappropriate for the goal of the LANL Hydrogeologic Workplan. Drilling with mud carries the risk of adsorbing contaminants onto the bentonite that permeates into the pore space around the well screen and is not removed by well development. Should this occur, it could result in reduced concentrations or non-detects on contaminants that are actually present in the vicinity of the well."

"The artificial entrainment of bentonite clay drilling muds in the pore space around a monitoring well is clearly not desirable. This is because these materials can remove from solution the very constituents that need to be monitored by the well. This is a significant concern for LANL since radionuclides are known to be adsorbed by these clays. That the drilling mud, i.e., bentonite, penetrates into the aquifer strata is not disputed. It is reasonable to assume that fairly extensive intrusion of the bentonite into the aquifer strata can be expected."

"It is argued that well development, via high-flow pumping, using surge blocks, etc. is sufficient to remove blockage and create adequate flow through the well screen when a well has been drilled with mud. This is generally true. However, sufficient water flow is not the only consideration here. It is extremely unlikely that such well development techniques can remove the extruded bentonite sufficiently to assure that residual clay materials are not present in the pore space around the wells and serving as an adsorptive barrier to contaminant detection and quantification."

"Unfortunately, if no contamination is detected then there is simply no way (without drilling another well by a different technique) to determine whether the contaminant is truly absent at this point or whether it is being adsorbed by residual drilling fluids. The EAG would therefore caution LANL about using mud drilling techniques for the installation of the deep regional monitoring wells. If bentonite clay drilling mud is to be used, it should be used sparingly (e.g., as a lubricant only) and it would be best to avoid it altogether when drilling zones where the well screens will be located." [Emphasis Added].

Organic drilling fluids were allowed to invade the screened intervals in all of the LANL characterization wells. The effects of the organic fluids to reduce the permeability of the aquifer strata that surround the screened intervals and the properties of the iron precipitates formed by microbially mediated chemical processes that result from the organic drilling fluids are well known in the technical literature as shown by the articles below.

**Article A-6:** *Handbook of Ground Water Development* by Roscoe Moss (1990).
**-** From page 211 of the Handbook:

"Because iron and sulfur bacteria are ubiquitous, - care should be taken in drilling and casing and screen installation so as not to introduce gross organic contamination into the aquifer."

**-** From page 371 of the Handbook:

"Excessive growth of filamentous iron bacteria results in gelatinous slimes that may seriously reduce water yield from wells. This problem is more likely to occur in a well that is inactive or intermittently operated."

**Article A.7:** *"Aqueous Environmental Geochemistry"*, by Donald Langmuir, 1997 by Prentice-Hall, Inc., Upper Saddle River, New Jersey.
**-** From page 436:

"Crystallization of hydrous ferric oxide (HFO) takes years in waters low in iron, but may occur in a few hours or days, in the presence of several mg/kg (mg/L) of dissolved iron."

**-** From page 462:

"They (iron precipitates) are especially a problem in fouling of iron pipes in water supply systems and well screens. They can cause a loss of up to 90 % in the productivity of a well."

- From Page 538:

"Among common minerals, the strongest sorbents for most actinide cations (e.g., cations of uranium, plutonium, americium) are the ferric oxyhydroxides and especially hydrous ferric oxide."

**Article A.8:** Excerpt from the LANL "*Hydrogeologic Synthesis Report*"[16] –

**-** "Adsorption occurs when dissolved species interact with surfaces of aquifer material coated with hydrous ferric oxide, manganese dioxide, clay minerals or other adsorbents. Hydrous ferric oxide has a specific surface area of 600 $m^2/gm$ --

Many metals and radionuclides including barium, chromium, nickel, uranium, strontium-90, americium-241, plutonium-238, and plutonium-239,-240 typically adsorb onto hydrous ferric oxide coated particles between pH values 5 and 8." [page 3-10, *Hydrogeologic Synthesis Report* ]

The LANL water quality data[7] for the LANL characterization wells are evidence that the organic drilling fluids have caused the formation of coatings of ferric oxyhydroxides and hydrous ferric oxides on the strata that surround the well screens.

**Article A-9:** The article by Gibb, J.P., and K.V.B. Jennings. 1987, "How Drilling Fluids and Grouting Materials Affect the integrity of Ground Water Samples from Monitoring Wells. *Ground Water monitoring Review* 7(1): 33. describes how drilling fluids and grouting materials affect the integrity of groundwater samples from monitoring wells. The article has the following discussion concerning the drilling of boreholes for monitoring wells with the fluid-assisted rotary drilling method using organic drilling fluids and/or bentonite clay muds:

- "Rotary drilling methods using bentonite or organic based drilling fluids present serious problems in the construction of monitoring wells. Wells constructed with these drilling methods are seldom capable of providing accurate hydrologic or chemical data for a wide variety of inorganic and organic constituents. - - The amount of drilling fluids lost into formations or deposits (aquifer strata) is directly proportional to their hydraulic conductivity."
- "In geologic environments where drilling fluids are a necessity, inorganic clay muds are preferred over those containing organic materials. The introduction of substrates for microbial activity can seriously impact the integrity of water samples."
- "In addition to the migration of drilling fluids into the subsurface materials, monitoring wells normally are constructed in the borehole while it is still filled with the drilling fluid. The casing, screen, and gravel pack materials are placed directly into the drilling fluid. The gravel pack materials often become suspended in the drilling fluid making it extremely difficult to determine where the gravel pack materials terminate and the overlying well seal begins. It is almost impossible to document the "as built condition" of monitoring wells constructed using rotary drilling methods and drilling fluids."
- "Breaking down the mud cake and removal of all drilling fluids introduced during the drilling and construction process is extremely difficult. Groundwater velocities required to remove drilling fluids, and the colloidal size particles associated with them from the aquifer materials usually cannot be created during development of small diameter monitoring wells."
- "The potential consequences of using drilling fluids (fluids and muds) should be obvious. The use of drilling fluids and muds should be curtailed whenever possible. Migration of bentonite or even "clean water" into the aquifer materials

disturbs the subsurface environment and creates chemical and biological conditions that have the potential for altering water quality in the immediate vicinity of the well and the area
impregnated. Due to the limited area of influence experienced during the development of monitoring wells, drilling fluids seldom are removed to the extent that they will not cause "well trauma". ["well trauma" means the monitoring well provides groundwater samples with a chemistry that is not representative of the aquifer. Water samples over time from the majority of the LANL characterization wells exhibit "well trauma".]
**-** "Experience has shown that drilling muds not effectively removed from the well bore opposite the screen and gravel pack will interfere with the chemical and biological quality of samples from those wells."

*The above excerpts from the DOE IG Report, the EPA Report, the technical literature, and even LANL reports are irrefutable evidence that the LANL characterization wells impacted by the organic and bentonite clay drilling fluids do <u>not</u> produce representative water samples for many LANL contaminants of concern and especially the strongly sorbing radionuclide contaminants that would be produced by expanded operations to manufacture plutonium pits.*

4.0. <u>The Emerging Presence of Plutonium and Neptunium Contamination in the Groundwater Resources of Los Alamos County and Santa Fe.</u>

The data in Appendix F of the Draft LANL SWEIS bring attention to the emerging presence of Neptunium-237 and Plutonium-239 and Plutonium-240 in the regional aquifer because of the nuclear weapons research over the past sixty years at the Los Alamos National Laboratory. Plutonium and neptunium do not occur naturally in the groundwater. The presence of the contaminants is due to nuclear weapons research at LANL. Colorado[10] has set the maximum allowable level of Pu-239 and Pu-240 in drinking water at 0.15 pCi/L for the following reasons:

> "**Basis for Commission Decision** Since the previous basic standard was set, several changes have occurred: 1) a new methodology for assessing carcinogens has become the standard practice, 2) new data have resulted in periodic updates to the slope factors used in this methodology, and 3) a more refined Commission policy on appropriate levels of protection for carcinogens has been developed. This latter risk-based policy also parallels a national trend towards risk-based approach to environmental cleanup standards."
> "The 15 pCi/L dose-based approach was calculated using a "reference-man" and considered exposure during his working life. It was an approach designed to address questions related to occupational exposure. It did not consider sex, age and organ-specific factors over a lifetime. In contrast, the new slope factor methodology, used in EPA's 1989 Risk Assessment Guidance for Superfund Sites, is more complete, more

> applicable to a general population and has become the standard practice for calculating risk."
>
> "The Commission adopted a basic standard of 0.15 pCi/L for plutonium and americium, calculated using a 1 x $10^{-6}$ risk level, based on residential use. This risk level is consistent with the Commission's policy for human health protection."

A recent article[9] by noted nuclear physicist Arjun Makhijani describes the new medical knowledge of the health impacts of the alpha-emitting radionuclides that are generated by nuclear weapons research activities at LANL that require changing the EPA Drinking Water Standard to 0.15 pCi/L:

> "EPA should set a combined maximum contaminant level for alpha-emitting, long-lived transuranic radionuclides of 0.15 picocuries per liter. If only one of the radionuclides in question were present, then the limit for that radionuclide would be 0.15 picocuries per liter. The radionuclides included are: neptunium-237, plutonium-238, plutonium-239, plutonium-240, plutonium-242, americium-241, and americium-243. These changes should be made as part of the EPA's review of radionuclide standards in drinking water that is scheduled for 2006."

Section 3.0 describes the effects of the drilling additives to prevent the LANL characterization wells from producing water samples that are reliable for the detection of the alpha-emitting radionuclides generated by LANL nuclear weapons research and by the manufacture of plutonium pits at the Laboratory facility. Another important reason that DOE/NNSA and LANL do not have the required knowledge of the presence of the plutonium and neptunium radionuclides in the regional aquifer is that the necessary research on the role of colloids and nanoparticles to facilitate transport of the radionuclides has not been performed as shown by the Draft LANL SWEIS:

> "The role of colloids in transport of contaminants at LANL is largely unknown and uninvestigated." [page E-27 of the Draft LANL SWEIS]

The failure of DOE/NNSA and LANL to have the required knowledge of the role of nanoparticles and colloids for contaminating the groundwater resources beneath and away from the Laboratory facility with the transuranic radionuclides is another reason that the Final LANL SWEIS is required, under NEPA, to select the *Reduced Operations Alternative.*

4.1. Plutonium-238 and Plutonium-239 contamination in the regional aquifer is proven by the data presented in Appendix F of the Draft SWEIS. The Draft LANL SWEIS presents the level of Plutonium-238 and Plutonium-239 measured in groundwater in Appendix F. The figure below is from Appendix F.

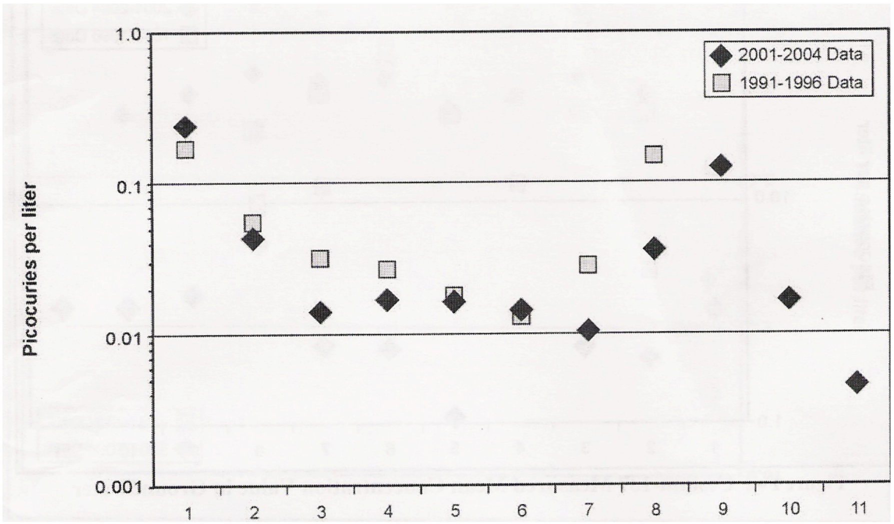


**Figure F– 4 Plutonium-239 and Plutonium-240 Measured Mean Concentration Value in Groundwater [From Draft LANL SWEIS page F-4]**

On Figure F– 4, the highest mean value for Pu-239 and Pu-240 are at location 1 and are in the groundwater samples from the monitoring wells installed in the alluvial sediments along the floors of the canyons that received plutonium laden waste waters from over 60 years of nuclear weapons research. The tables in Appendix F show that the maximum level of dissolved Pu-239 and Pu-240 in the shallow groundwater along the canyon bottoms is 1.78 pCi/L for a location in Mortandad Canyon. On Figure F-4 locations 9, 10, and 11 display the mean values for Pu-239 and Pu-240 in the groundwater samples from the LANL characterization wells installed in the regional aquifer, the Los Alamos County supply wells, and the City of Santa Fe wells in the Buckman well field as follows:

| | Concentration of Plutonium-239 and Plutonium-240 | |
|---|---|---|
| | mean value (pCi/L) | maximum value (pCi/L) |
| LANL Wells in Alluvial Sediments | 0.478 | 1.78 (Mortandad Canyon) |
| LANL Characterization Wells | 0.125 | 0.601 (Mortandad Canyon) |
| Los Alamos County Supply Wells | 0.0167 | 0.0308 |
| Santa Fe Buckman Well Field | 0.00455 | 0.00910 |

Note on the above table that the highest mean values and maximum values of Pu-239 and Pu-240 are in the LANL characterization wells, followed by lower levels in the Los Alamos County supply wells, and even lower levels in the Buckman well field. This is the expected trend for contamination of the groundwater with plutonium from the Laboratory operations as the characterization wells are the closest to the source of the contamination and the wells in the Buckman well field are the most distant.
The actual concentration of plutonium contamination in the regional aquifer at the location of the LANL characterization wells is not known because of the impact of the drilling additives and other factors to reduce the level of plutonium in the <u>unreliable and nonrepresentative water samples</u> produced from the characterization wells.

Nevertheless, the mean value of <u>0.125 pCi/L</u> with a maximum value of <u>0,601 pCi/L</u> measured in the regional aquifer in the water produced from a LANL characterization well at a location below Mortandad Canyon (<u>note that Appendix F in the Draft LANL SWEIS shows the highest plutonium contamination at 1.78 pCi/L is in the shallow groundwater in the alluvial sediments in Mortandad Canyon</u>) are alarming because of recent reports[9,10] that recognize the need to set the drinking water standard for the combined concentration of Plutonium-239 and Plutonium-240 at <u>0.15 pCi/L</u>.

In addition, the Draft LANL SWEIS acknowledges that the plutonium contamination in settings such as Mortandad Canyon may travel through the vadose zone to contaminate the regional aquifer:

> "Finally, local recharge does occur along canyons that cross the LANL property – this recharge has important water quality implication in locations where contaminant effluent discharges have been released" [page 668, Keating et al., 2005].

4.2. <u>Neptunium-237 contamination in the drinking water of Los Alamos County and Santa Fe is proven by the data presented in Appendix F of the Draft LANL SWEIS</u>

Neptunium-237 is an alpha-emitting radionuclide that does not occur naturally. The contaminant was produced by the nuclear weapons research at LANL. The emerging presence of Neptunium-237 in the regional aquifer beneath LANL is alarming because the radionuclide is much more mobile in groundwater[14] than the plutonium isotopes and is also much more of a danger to public health.[9] Of course, the actual concentration of Neptunium-237 contamination in the regional aquifer at the location of the LANL characterization wells is not known because of the impact of the drilling additives and other factors to reduce the level of the radionuclide contaminant in the <u>unreliable and nonrepresentative water samples</u>[2] produced from the monitoring wells.

The table below displays the data in Appendix F in the Draft LANL SWEIS for the mean and maximum values for Neptunium-237 in the groundwater samples from the LANL characterization wells installed in the regional aquifer, the LANL Old Test Wells installed in the regional aquifer, the Los Alamos County supply wells, and the City of Santa Fe wells in the Buckman well field as follows:

| | Concentration of Neptunium-237 | |
|---|---|---|
| | mean value (pCi/L) | maximum value (pCi/L) |
| LANL Characterization Wells | 5.4 | 30.1 (Sandia Canyon) |
| LANL Old Test Wells | 14.9 | 21.2 (Motandad Canyon) |
| Los Alamos County Supply Wells | 10.6 | 15.6 |
| Santa Fe Buckman Well Field | 10.3 | 10.8 |

The above table shows that the mean value of Neptunium-237 measured in the LANL characterization wells and old test wells is at the EPA maximum contaminant level (MCL) of 15 pCi/L that is allowed for drinking water. The maximum level measured in the set of LANL characterization wells in Appendix F of the Draft LANL SWEIS is double the EPA MCL.

More alarming is the high level of Neptunium-237 in the drinking water produced from the supply wells for Los Alamos County and Santa Fe. Note that the maximum level measured in a Los Alamos County supply well exceeds the EPA MCL of 15 pCi/L and the recent research[9] and action by the Colorado Water Commission[10] establish the need for the New Mexico Environment Department to change the New Mexico Drinking Water Standard to 0.15 pCi/L. The mean value in the drinking water produced from the supply wells for Los Alamos County and for Santa Fe from the supply wells in the Buckman well field are above 10 pCi/L and far above the necessary drinking water standard of 0.15 pCi/L to protect public health.

4.3. Neptunium-237 and Strontium-90 Contamination in Groundwater From the *"Other Springs."*

Table F-14 in the Draft LANL SWEIS lists a very high concentration of Strontium-90 in groundwater that discharges from unidentified "other springs". The mean and maximum levels of Strontium-90 in Table F-14 are 45.6 and 115 pCi/L, respectively, compared to the EPA MCL for Strontium-90 in drinking water of 8 pCi/L. It is unconscionable that the Draft LANL SWEIS does not inform the reviewers of the number and the locations of the "other springs" that produce the very high levels of Strontium-90.

In addition, Table F-14 in the Draft LANL SWEIS lists a mean value of 12.7 pCi/L for Neptunium-237 in groundwater samples collected from the "other springs". Unfortunately, the table does not list the maximum value for Neptunium-237 in the groundwater samples collected from the "other springs".

4.4. Immediate Need for Accurate Knowledge of the LANL Contamination That is Present in Drinking Water and in groundwater discharging from the "other springs"

A major deficiency in the Draft LANL SWEIS is the failure to bring attention to the widespread contamination of the groundwater resources in Los Alamos and Santa Fe Counties that has already occurred because of the 60 year history of nuclear weapons research and production at the Los Alamos National Laboratory. Indeed, the data in the Draft LANL SWEIS show the presence of Plutonium-239, Plutonium-240, Neptunium-237, and Strontium-90 in the water resources at levels that the Federal Law and experts recognize as a danger to public health. The above listed contaminants are not natural in the environment. Instead, they are unique to nuclear weapons research and manufacture of plutonium pits.

There is an immediate need to sample all of the water supply wells of Los Alamos County and Santa Fe (in the Buckman well field) for a complete suite of LANL produced radionuclide and hazardous wastes on a quarterly schedule to validate the measured values of Neptunium-237, Plutonium-239, and Plutonium-240 that are listed in Appendix F of the Draft LANL SWEIS and to identify the impacted supply wells. In Appendix F of the Draft LANL SWEIS, the presence of Neptunium-237 contamination in the Santa Fe drinking water was based on only the analysis of 3 water samples from the Santa Fe Supply Wells in the Buckman well field. There is an immediate need to collect water samples from all of the wells for analysis of LANL contaminants, and to identify the necessary Corrective Action.

In Appendix F of the Draft LANL SWEIS, the presence of Neptunium-237 contamination in the Los Alamos County drinking water was based on the analysis of 13 water samples from the Los Alamos County Supply Wells. The Neptunium-237 contamination was detected in 4 of the water samples. However, the impacted wells are not identified in the Draft LANL SWEIS. There is an immediate need to collect water samples from all of the Los Alamos County Supply Wells for analysis of LANL contaminants and to address the needed Corrective Action.

The high levels of Strontium-90 and Neptunium-237 reported for the "other springs" requires the immediate collection of water samples for a complete suite of the radionuclide and hazardous waste analytes on a quarterly schedule. If the comprehensive study validates the high levels of Strontium-90 and possibly other LANL contaminants including Neptunium-237, then a Corrective Action is required to clean up the contaminated water.

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**Exhibit 2.**
Deficiencies in the Draft LANL SWEIS for the
Water Quality Data Produced From the LANL Monitoring Wells

1.0. Introduction. During the past ten years, approximately 40 characterization wells were installed in the regional aquifer and in the perched zones of saturation beneath the Los Alamos National Laboratory (LANL). Exhibit 1 documents that the new monitoring wells were drilled with methods that cause the majority of the wells to produce water samples that are not reliable for detection of many of the radionuclide and hazardous contaminants that are generated by the present LANL nuclear weapons research operations. The purpose of this Exhibit is to show that DOE/NNSA and LANL have not installed the required network of monitoring wells at LANL to meet the monitoring requirements for expanded operations to manufacture plutonium pits, a major component of nuclear weapons.

This exhibit will show that the groundwater data presented in the Draft LANL SWEIS are from LANL monitoring wells that do not produce reliable and representative water samples for the detection of contaminants produced by operations to manufacture plutonium pits. LANL is regulated under the Resource Conservation and Recovery Act (RCRA). However, LANL does not have the groundwater monitoring program that is required under RCRA. The noncompliance with RCRA demonstrates noncompliance with the National Environment Protection Act (NEPA), and requires the Final LANL SWEIS to select the *Reduced Operations Alternative* that is described in the Draft LANL SWEIS.

The Draft LANL SWEIS gives the appearance of presenting the knowledge gained from the large number of new characterization wells. More than 30 of the wells are displayed on Figure E-1 in Appendix E of the Draft SWEIS and in Figure 1-1 of the attachment to this Exhibit. However, the references for Appendix F – *"Environmental Sample Data"* in the Draft LANL SWEIS reveal that the data in Appendix F are from only a small number of the new wells in the regional aquifer and in the perched zones of saturation. The references to Appendix F of the Draft LANL SWEIS show that the water quality data in Appendix F are from only the four LANL *Surveillance Reports* that present analytical data on water samples collected from only a small number of the new characterization wells during the years of 2001 to 2004. For the regional aquifer, the discrete wells that were sampled are as follows:

Year 2001 – no characterization wells were sampled
Year 2002 – Wells R-5, R-7, R-9, R-12, R-13, R-15, R-19, R-22, R-25
Year 2003 – Wells R-5, R-7, R-9, R-12, R-13, R-15, R-19, R-22, R-25
Year 2004 – Wells R-7, R-9, R-12, R-13, R-15, R-19, R-22, R-25 (Wells POI-4
and LOIS(a)-1.1 in perched zones of saturation)

The nine R-series wells in the above list represent only approximately 25% of the total number of characterization wells installed in the regional aquifer beneath LANL.

However, a recent LANL Report, the "*Well Screen Analysis Report*" (WSAR) identified that the majority of the wells in the above list do <u>not</u> produce reliable and representative water samples. Furthermore, because of a limited scope, the WSAR did not identify that practically all of the LANL monitoring wells in the Draft LANL SWEIS do not produce reliable and representative water samples and are not in compliance with RCRA.

2.0. <u>Nonrepresentative water quality from the LANL characterization wells</u>. All of the LANL characterization wells were drilled with fluid-assisted drilling methods using drilling fluids with well known properties to mask the detection of many LANL contaminants in the water produced from the wells. The effects of the drilling fluids to hide groundwater contamination are described in Exhibit 1. Because of concerns raised in reports by Registered Geologist Robert H. Gilkeson[1], the DOE Office of the Inspector General[2,], and by the Environmental Protection Agency[3], the DOE/NNSA required LANL to prepare a report that identified the well screens that did not produce representative water samples because of the drilling additives and because of other factors. This report, the LANL *Well Screen Analysis Report*[4] (WSAR) identified that approximately 50% of the well screens do not produce representative water samples because of the drilling additives.

An important deficiency is that the Draft LANL SWEIS does not acknowledge the LANL reports, the DOE report, and the EPA reports that describe the problems with the new network of characterization wells to detect radionuclide contaminants produced from the current LANL nuclear weapons research operations, and produced from expanded operations to manufacture plutonium pits.

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The findings in the LANL WSAR were from an automated statistical analysis of only the most recent water sample collected from each screened interval. Figure 1-2 (from the
WSAR) presents the results of the statistical study of the water quality data for a single sampling event of 64 discrete screened intervals. Figure 1-2 presents grades for each discrete screen from Poor to Very Good. RCRA does not recognize the scheme used in the WSAR to assign grades to the water quality data. Furthermore, the WSAR made the arbitrary decision that screens with grades of Good and Very Good produced representative water samples and screens with grades of Fair and Poor did not. A LANL report[6] summarizes the grading scheme in the WSAR as follows:

*"The WSAR results indicated that for 64 screens analyzed, 16 of the wells had [31] screens that were in Fair or Poor condition and could not be relied upon to provide representative data or to detect contaminants in groundwater."*

The limited statistical analysis in the WSAR did <u>not</u> identify all of the wells that could not be relied upon to provide representative data or to detect contaminants in groundwater. Two EPA reports[3,5] describe the problems with the LANL characterization wells and the deficiencies in the WSAR. A review of readily available data in the large set of LANL well completion reports shows that when all factors are considered, the total number of screened intervals in the LANL characterization wells that do not produce representative groundwater samples under RCRA is possibly greater than 90%.

The existing monitoring well network at LANL does not meet the regulatory requirements of NEPA, RCRA, the NMED LANL Consent Order, and DOE Orders 435.1 and 450.1. Therefore, under NEPA. the Final LANL SWEIS must institute the *"Reduced Operations Alternative."*

2.1. <u>Water quality data in the LANL Draft SWEIS for water samples collected from LANL characterization wells installed in the regional aquifer.</u>

The table below describes the capability of each screened interval in Appendix F of the Draft LANL SWEIS Report to produce reliable water samples.

Table. 1. Regional Aquifer Characterization Wells in Appendix F of the SWEIS

| Well/ Screen no. | WSAR Grade | Screen Length[6,A] | Comment |
|---|---|---|---|
| R-5, #3 | Very Good | 60 ft | [B]Westbay, [c]screen crosses water table |
| R-7 #3 | Poor | 67 ft | Wetbay, screen crosses water table |
| R-9 | Very Good | 60 ft | screen crosses water table |
| R-12 #3 | Poor | 63 ft | Westbay, screen crosses water table |
| R-13 | Good | 60 ft | screen too deep below water table |
| R-15 | Very Good | 60 ft | well is spreading contamination |
| R-19 #3 | Fair | 90 ft | Westbay, screen crosses water table |
| R-19 #4 | Good | 65 ft | Westbay, screen too deep |
| R-19 #5 | Poor | 50 ft | Westbay, screen too deep |
| R-19 #6 | Poor | 105 ft | Westbay, screen too deep |
| R-19 #7 | Fair | 20 ft | Westbay, screen too deep |

| | | | |
|---|---|---|---|
| R-22 #1 | Poor | 60 ft | critical location at Area G, new well needed |
| R-22 #2 | Very Good | 70 ft | strata with very low permeability do not meet RCRA requirements, Westbay |
| R-22 #3 | Good | 40 ft | strata contaminated with bentonite clay grout |
| R-22 #4 | Poor | 20 ft | Westbay, screen too deep |
| R-22 #5 | Poor | 40 ft | Westbay, screen too deep |
| R-25 #4 | Very Good | 11 ft | cross-contamination, Westbay |
| R-25 #5 | Fair | 17 ft | cross-contamination, Westbay |
| R-25 #6 | Very Good | 17 ft | cross-contamination, Westbay |
| R-25 #7 | Very Good | 18 ft | cross-contamination, Westbay |
| R-25 #8 | Good | 19 ft | cross-contamination, Westbay |

[A] EPA and NMED recommend a maximum screen length of 10 feet. See Section 6.0. [B] Westbay, Stagnant water samples are collected with a Westbay[R] No-Purge water sampling system. See the discussion of the Westbay sampling of well R-5 #3 on the next page. [C] Screens installed across water table create a pathway for atmospheric pressure changes to "pump" oxygen into the groundwater and therefore, to change groundwater chemistry.

For the 21 screened intervals in the 9 characterization wells represented in Appendix F of the Draft LANL SWEIS to monitor water quality in the regional aquifer, the WSAR assigns only 11 of the screens as producing representative water samples. However, when all of the factors are considered, <u>none</u> of the 21 screens produce representative water samples. The reasons the 11 screened intervals graded as Good or Very Good do not produce representative water samples are described below;

<u>Well R-5 #3. Very Good.</u> The well does not produce representative water quality samples for the following reasons. The long well screen may cause dilution of contamination. In addition, the screen straddles the water table and therefore, allows "atmospheric pumping" to change the chemistry of the water produced from the well by the introduction of oxygen. Water samples are collected with the Westbay[R] no-purge sampling system that does not purge any volume of water from the screened interval before water samples are collected for the analytical suite. The no-purge sampling methodology collects "stagnant water" that was in contact for a long period of time with the new mineralogy created by the drilling additives that have properties to mask detection of contaminants, and altered chemistry because the water samples are affected by the "atmospheric pumping".

Well R-9. Very Good. Early water chemistry data[7] show residual effects of drilling additives. Dilution by long screen and top of well screen is above water table. Water samples are affected by the new mineralogy and by "atmospheric pumping"/

Well R-13. Good. Water chemistry[7] is affected by the new mineralogy formed by organic drilling additives. Top of 60-ft long screen is 125 feet below water table. Important permeable strata near water table are not monitored.[8] See Exhibit 3.

Well R-15. Very Good. 60-ft long screen is installed across the water table and also has breached a confining bed and is spreading contamination to greater depth in the regional aquifer.[1,9] The pump installed at the bottom of the long screen ensures dilution of contamination at the water table. There is an immediate need to rehabilitate or replace well R-15. Contaminants[7] detected in the well include hexavalent chromium, perchlorate, tritium, and nitrate. Other contaminants such as 1,4-dioxane may be present but are not detected because of the dilution or because of the affects of "atmospheric pumping".

Well R-19 #4. Good. Representativeness of water samples cannot be certain because of the no-purge water sampling methodology, the dilution because of the 65-ft long screened interval, and the screen is located over 200 feet below the water table.[6]

Well R-22 #2. Very Good. The very low permeability of the screened interval of 0.04 ft/day[10] does not meet the requirements of the RCRA Statute[14] to collect water samples from the strata with high permeability. Strata with high permeability[11] are present both above and below the low permeability strata that are monitored by screen #2.

Well R-22 #3. Good. A LANL report[11] documents that screen #3 is contaminated by bentonite clay grout materials that were misplaced during well construction. In addition, the screened interval has a relatively low permeability of 0.2 ft/day[10] compared with strata above the screen that may have a permeability greater than 50 ft/day.

Well R-25 #4, #6, #7. Very Good, #8. Good. Mistakes in the construction of well R-25 allowed cross-contamination of the water in the regional aquifer with solvent and high-explosives contaminated water from a perched zone of saturation above the regional aquifer for a period of time of greater than one year.[12] Because of the long period of cross-contamination, the no-purge water samples collected from the well with the Westbay[R] sampling equipment cannot ensure that representative water samples are collected.

2.2. Water quality data in the Draft LANL SWEIS for water samples collected from LANL characterization wells installed in the perched zones of saturation

Tables F-11, F-15, and F-16 in Appendix F of the Draft LANL SWEIS present a statistical analysis of analytical data for water samples collected from wells installed in perched zones of saturation. The tables do not identify the discrete wells that are sampled. The tables do not identify the total number of wells that are sampled. The source of the analytical data for the tables in the Draft LANL SWEIS are the LANL Surveillance Reports and the data represent water samples collected over the years of 2001 through 2004.

The LANL *Surveillance Reports* for water samples collected over the four year period of 2001 to 2004 include analytical data from only eight LANL characterization wells with screens installed in the perched zones of saturation. Six of the eight wells are multiple-screen designs with water samples collected by the Westbay[R] no-purge sampling system. There are a total of 13 screened intervals in the multiple-screen wells. However, the LANL *Well Screen Analysis Report* (WSAR) identified that 5 of the 13 screens were dry and did not produce water samples. Furthermore, a later LANL report[6] identified that an additional screened interval did not produce water samples for a total of 6 "dry screens." The available information indicates that most of the "dry screens" are the result of the plugging action of the drilling additives that were used to drill the boreholes for the wells. Table 2 identifies the discrete wells and the Grades in the WSAR.

Table 2. Perched Zone Characterization Wells in Appendix F of the SWEIS

| Well/ Screen no. | WSAR Grade | Comment |
|---|---|---|
| R-5 #1 | dry –not graded | |
| R-5 #2 | Very Good | - - - - - - - - A LANL report[6] identified the screened interval as incapable of producing water samples |
| R-7 #1 | dry – not graded | |
| R-7 #2 | dry – not graded | |
| R-9i #1 | Fair | |
| R-9i #2 | Fair | |
| R-12 #1 | Poor | |
| R-12 #2 | dry – not graded | |

Table 2 (cont.)
Perched Zone Characterization Wells in Appendix F of the SWEIS

| Well/ Screen no. | WSAR Grade | Comment |
|---|---|---|
| R-19 #1 | dry – not graded | |

| | |
|---|---|
| R-19 #2 | Fair |
| R-19 #3 | Fair |
| R-25 #1 | Fair |
| R-25 #2 | Fair |

Well LOI(a)-1.1 – This single-screen well was not graded in the WSAR. However, a review of the LANL water quality data website[7] reveals that the analytical results for dissolved iron, manganese, nickel, and zinc were at anomalously high levels in the first water samples collected from the well, and trended to lower values in the more recent samples. The trend in the dissolved concentrations of the metals is evidence of chemical processes that form a new mineralogy on the strata surrounding the well screen with properties to remove contaminants from the water samples collected from the well i.e., the well does not produce representative water samples.

Well POI-4. This single screen well was not graded in the WSAR. However, a review of the LANL water quality data[7] is an indication that the well may produce reliable and representative water quality data. A study of all available information on drilling, well construction, and sampling methodology should be done to make a finding that the well produces reliable and representative water quality data.

The available information show that only one of the perched zone wells included in Appendix F of the Draft LANL SWEIS may produce representative water samples. It is essential for the Final LANL SWEIS to accurately present the inability of the LANL monitoring wells to produce scientifically sound and technically defensible data under RCRA for the detection of contamination in the perched zones of saturation beneath LANL. Accurate knowledge of contaminants in the perched zones is essential information for the early detection of contaminants that are traveling down through the vadose zone to the regional aquifer.

3.0. Nonrepresentative water quality from the old LANL Test Wells. Appendix F of the Draft LANL SWEIS places an unacceptable reliance on water quality data from the old LANL test wells for the radionuclide contaminants Americium-241, Cesium-137, Cobalt-60, Neptunium-237, Plutonium-238, Plutonium-239 and -240, Potassium-40, Radium-226, Sodium-22, Strontium-90, Tritium, Uranium-234, Uranium, 235 and-236, and Uranium-238. In fact, none of the old LANL test wells produce water samples that are representative under DOE Orders, the NMED Consent Order, or RCRA for any of the contaminants of concern in the groundwater beneath LANL.

The well construction features[13] that prevent the old test wells from producing representative water samples were general knowledge in the monitoring well industry for more than the past twenty years. They include
1). the dilution of contaminants by the long well screens,
2). the installation of the long well screens across the water table to allow the change in

water chemistry that results from invasion of oxygen from "atmospheric pumping",
3). the use of common iron well screens and casing that hide the presence of radionuclide and hazardous contaminants, and
4). the use of the mud-rotary drilling methods that hide the presence of contaminants.

The environmental sampling data in Appendix F of the Draft LANL SWEIS include the spurious analytical data from the old LANL test wells TW-1, TW-2, TW-3, TW-4, TW-8, DT-5A, DT-9, and DT-10. The old test wells should have been plugged and abandoned twenty five years ago. The presentation of the spurious water quality data from the old test wells in the LANL *Surveillance Reports* from first publication up to the present time are a misrepresentation of having factual knowledge that the groundwater was not contaminated by LANL wastes.

The routine long-term collection of spurious water samples from the old test wells for LANL contaminants is one of many examples of the failure over decades of time of DOE/NNSA, LANL, and NMED to follow good scientific practices. The Final LANL SWEIS should stop the disingenuous presentation of the spurious contaminant data from the old test wells.

3.1. The dilution of contamination by the long screens in the old test wells
- Test Well TW-8. Well TW-8 is an example of the long length of the well screens in the old test wells. The well was drilled in 1960 with carbon steel casing installed in an unsealed borehole over the depth interval of 64 to 1065 feet below the land surface.[13] The well screen was formed by cutting slots in the bottom 112 feet of the carbon steel well casing. The long length of the slotted casing ensures dilution of contamination at the water table; an important concern at the location of the well is the detection of contaminants including hexavalent chromium at the water table. Instead of providing reliable analytical data on the presence of contamination, the long screen in test well TW-8 is a pathway for spreading contamination at the water table to a greater depth in the regional aquifer. Indeed, there is data to show that the unsealed borehole for well TW-8 is allowing contaminated water in a perched zone of saturation to contaminate the regional aquifer. There is an immediate need to plug and abandon old test well TW-8. and all of the other old test wells.

The concern of EPA[14] for long well screens is described below:

"To avoid dilution, the Agency prefers that well screens be kept to the minimum length appropriate for intercepting a contaminant plume, especially in a high-yielding aquifer. The screen length should generally not exceed 10 feet."

The NMED Consent Order[15] for LANL requires the monitoring wells to meet the above RCRA guidance for screen length. In addition, the NMED Consent Order requires the monitoring wells to meet the requirements of the NMED Hazardous Waste Bureau

Position Paper *"Use of Low-Flow and Other Non-Traditional Sampling Techniques for RCRA Compliant Groundwater Monitoring,"* October 30,2001. Below is an excerpt from the NMED Position Paper:

"The screened interval of the monitoring well should be short. Optimal screen length should be less than 10 feet (USEPA, March 1998). Low-flow purging and sampling may be approved for use in wells with screen lengths greater than 10 feet, provided pump intake placement is demonstrated to be appropriate. Wells with screened intervals connecting intervals of different head and/or hydraulic conductivity may act as conduits for vertical flow within the screened interval" [From page 6 of NMED Position Paper].

3.2. <u>The spurious water quality data from the old test wells because of the common steel casing and screens.</u>
An example of the poor quality of groundwater samples collected from the old test wells is the discussion in the minutes of the Jan, 28, 2004 LANL Groundwater Protection Committee Public Meeting:

Comment of meeting attendant: "Water samples from TW-3 had the appearance of iced tea. Believe TW-3 should be plugged and abandoned."

Reply by LANL: "The color of the water was due to corrosion of the metal casing."

Old test well TW-3 was replaced by LANL characterization well R-6 according to the following statement in the well R-6 completion Report:

*"R-6 will serve as a replacement well for the <u>obsolete</u> monitoring well TW-3 and as an upgradient monitoring point for municipal water supply well Otowi-4"* [Emphasis Added]. [LANL well R-6 Completion Report, Kleinfelder Project No. 37151].

*Why does the Draft LANL SWEIS present analytical data from an old test well that a LANL report describes as an obsolete monitoring well?*

The properties of the corrosion products to prevent water samples from being representative of hexavalent chromium, other trace metals, and most radionuclide contaminants are well understood in the technical literature. From page 6-30 in *"RCRA GROUNDWATER MONITORING: DRAFT TECHNICAL GUIDANCE" – The EPA RCRA Manual for Monitoring Wells,* EPA, November 1992:[14]

"The presence of corrosion products represents a high potential for the alteration of ground-water sample chemical quality. The surfaces where corrosion occurs also present potential sites for a variety of chemical reactions and adsorption. These surface interactions can cause significant changes in dissolved metal or organic compounds in ground-water samples (Marsh and Lloyd, 1980)."

"According to Barcelona et al. (1983), even purging the well prior to sampling may not be sufficient to minimize this source of sample bias because the effects of the disturbance of surface coatings or accumulated corrosion products in the bottom of the well are difficult, if not impossible, to predict. On the basis of these observations, the use of carbon steel, low-carbon steel, and galvanized steel in monitoring well construction is not recommended in most natural geochemical environments."

- The features described above in the construction of well TW-8 and the presence of corrosion products in the water samples may mask the detection of hexavalent chromium and other contamination in the regional aquifer. The features of well TW-8 and TW-3 are common to all of the old LANL test wells. The wells have no value for knowledge of the presence of contaminants. Instead, the wells are a danger as pathways for contamination to reach the regional aquifer.

4.0. Summary. The mandate for DOE/NNSA to demonstrate Environmental Stewardship requires that all of the old test wells are plugged and abandoned and the reports that presented findings based on the spurious contaminant data produced over the decades be retracted. An example of an important report in the Draft LANL SWEIS that DOE/NNSA is required to take action for retraction is the ATSDR (Agency for Toxic Substances Disease Registry) *"Draft Public Health Assessment of the Los Alamos National Laboratory,"* released for public comment in June, 2005. Note that the Draft LANL SWEIS presented the Draft ATSDR report as a published report and a basis for a "clean bill of health" for LANL operations. It was disingenuous of the Draft LANL SWEIS to present the Draft ATSDR report. Because of the large number of concerns for the poor quality of the ATSDR Draft report by the public and by EPA, the final report was never released. A reason for DOE/NNSA to demand retraction of the ATSDR Draft Report is that similar to the Draft LANL SWEIS, the ATSDR review of public health from LANL operations was from the spurious data produced by the old LANL test wells.

In fact, DOE/NNSA and LANL have not installed a reliable network of monitoring wells that are capable of producing the data required for the ATSDR to perform a public health assessment. This is another reason that requires, under NEPA, for the Final LANL SWEIS to make a finding that LANL is unsuited for expanded operations to manufacture plutonium pits and for the Final LANL SWEIS to institute the "Reduced Operations Alternative."

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Exhibit 3
Failure of Draft LANL SWEIS to Address the Environmental Impact
From the Hexavalent Chromium Plume in the Regional Aquifer

1.0. Introduction. The Final LANL SWEIS must reconcile the misrepresentation in the Draft LANL SWEIS that LANL operations will not cause significant contamination to the regional aquifer. From page 4-63 in the Draft LANL SWEIS:

*"As a result, little contamination reaches the regional aquifer from the shallow perched groundwater bodies and water quality impacts on the regional aquifer, though present, are low."*

The record shows that the above statement is not true and that LANL operations have caused a large impact on water quality in the regional aquifer. Exhibit 1 describes the emerging presence of plutonium and neptunium in the drinking water supply wells for Los Alamos County and Santa Fe. One of the Los Alamos County supply wells has been shut down because of perchlorate contamination from LANL operations.

In addition, LANL was aware in January of 2004 of the hexavalent chromium contamination in the regional aquifer at the location of characterization well R-28 that exceeds the Federal and State drinking water standards. The hexavalent chromium contamination[1] in well R-28 has increased over time and was greater than 400 ug/L for water samples collected in 2006. This is more than 4 times greater than the Federal Drinking Water Standard and 8 times greater than the State Water Quality Standard.

The Final LANL SWEIS must address
1). the uncertainty in the knowledge of the dimensions of the hexavalent chromium plume in the regional aquifer,
2). the uncertainty in the speed of travel of the plume, and
3). the uncertainty in the danger of the hexavalent chromium plume
a). to the drinking water wells of Los Alamos County,
b). to the drinking water wells in the Buckman well field, an important water resource
for the City of Santa Fe,
c). to the Rio Grande, and
d). to the groundwater resources of the San Ildefonso Pueblo.

Figure 1-1 shows the locations of well R-28, the Los Alamos County drinking water wells (wells PM-3 and O-4 are most threatened by the chromium plume), the Buckman well field, and the property of the San Ildefonso Pueblo.

2.0. The poor understanding of the dimensions of the chromium plume and the speed of groundwater travel. The Final LANL SWEIS must address the impact that the poor knowledge of the dimensions of the hexavalent chromium plume has on LANL operations at the present time and in the future. Presently, the proximity of the plume to the Los Alamos County drinking water wells, to the groundwater resources of the San Ildefonso Pueblo, and to the Buckman well field are not known. There is a concern for a great rise in the levels of chromium that are reported in the most recent Santa Fe Water Department Annual Report for water quality in the Buckman well field. Presently, the cause for the increase in chromium in not understood by Concerned Citizens for Nuclear Safety (CCNS). We are seeking a meeting with the Santa Fe Water Department.

Because of the close proximity of well R-28 to the property of the San Ildefonso Pueblo, it is very probable that the hexavalent chromium contamination from LANL operations has already contaminated the groundwater resources of the Pueblo. Indeed, the chromium contamination in the groundwater resources of the San Ildefonso Pueblo may be at higher levels than at well R-28.

The mistakes that were made in the installation of LANL characterization wells R-13 and R-34 confound knowledge of the dimensions of the chromium plume. The locations of the LANL property boundary with the San Ildefonso Pueblo, well R-28, and the downgradient wells R-13 and R-34 are shown on Figure 1-1.

The chromium plume at well R-28 is in aquifer strata with very high permeability[2] in the upper part of the regional aquifer. The borehole data from wells R-28,[2] R-13,[3] and R-34[4] indicate that the high permeability strata at well R-28 are continuous across the landscape from well R-28 to well R-34. The high permeability strata are a fast pathway for the horizontal travel of the chromium plume. Presently, there is poor understanding of the speed of groundwater travel in the regional aquifer of the chromium plume because the necessary studies have not been performed as shown by the following excerpts from a LANL report by Keating et al:[5]

> *"Travel times through the regional aquifer are poorly understood because of the lack of tracer tests and in situ measurements of effective porosity."*
> *"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"* [page 668, Keating et al., 2005].

It is of critical importance for the Final LANL SWEIS to acknowledge the poor understanding by LANL and DOE/NNSA for the danger of the chromium plume to the water resources. Figure 1-1 shows the large region between the chromium plume at well R-28 and the Buckman well field where there are no monitoring wells.

The perspective in LANL reports is that the chromium plume at well R-28 is of limited size because contamination is not detected in wells R-13 and R-34. However, the screens in wells R-13[3] and R-34[4] are located deep below the water table of the regional aquifer and below a layer of clay strata that have very low permeability. The layer of clay strata are a hydraulic barrier between the chromium plume and the aquifer strata where the two screens are installed.

The hydrostratigraphy for wells R-28 and R-13 are displayed on Figure 1-3. The water quality data from well R-13 are not reliable for the presence of the chromium plume at the location of well R-13 because of the layer of clay strata located above the screen. It is very probable that the chromium plume is present in the aquifer strata above the clay barrier but the contamination goes unnoticed in the water samples collected from well R-13.

Figure 1-4 displays the Schlumberger borehole geophysics for wells R-28 and R-34. Well R-34 is located downgradient of well R-28 in the direction of groundwater flow at a location on the San Ildefonso Pueblo. As with well R-13, the screen in well R-34 is located deep below the water table and below a layer of clay strata that form a hydraulic barrier between the groundwater above and below the clay layer. The water quality data from well R-34 are not reliable for knowledge of the presence of the chromium plume in the highly permeable aquifer strata above the layer of clay.

There is a pressing need for the installation of additional monitoring wells to investigate the dimensions of the hexavalent chromium plume in the strata with high permeability to
the south of well R-28 on the property of the San Ildefonso Pueblo, at the location of well R-34, and between well R-34 and the Buckman well field to address the uncertainty about the presence of the chromium plume, and to address the uncertainty about travel times through the regional aquifer for the chromium plume to reach the drinking water wells.

The report by Keating et al. identified that the Buckman well field is producing water from beneath the Pajarito Plateau to the west of the Rio Grande:

*"Simulations suggest that flow beneath the Rio Grande (west to east) has been induced by production at the Buckman well Field. Our calculations show that this flux may have increased from zero (pre1980) to approximately 45 kg $s^{-1}$ at present, or about 20% of the total annual production at Buckman"* [page 658, Keating et al., 2005].

Furthermore, Keating et al. identify the need to install monitoring wells at appropriate locations between LANL operations and the Buckman well field for multi-well pumping tests and tracer tests to acquire the necessary knowledge concerning contaminant transport issues:

*"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"* [ page 668, Keating et al., 2005].

3.0. Misrepresentation in LANL Reports of the high permeability of the aquifer strata beneath the San Ildefonso Pueblo

A serious mistake in the LANL *Synthesis Report*[6] is the statement that "no high permeability zones occur east of well R-13". Well R-13 is located immediately north of the San Ildefonso Pueblo in Mortandad Canyon. Figure 1-5 is a map from the LANL *Synthesis Report* that portrays the regional aquifer to the west and south of well R-13 beneath the Pueblo property to have a permeability lower than 3.4 meters per day. Quite the opposite is true.

In fact, over a large part of the San Ildefonso Pueblo property, the regional aquifer has a permeability much greater than 3.4 meters per day. The available information from the LANL Hydrogeologic Workplan Project is that thick intervals of aquifer strata with a permeability greater than 20 meters per day occur over much and probably all of the Pueblo property to the west of the Rio Grande across the landscape to the south of well R-13. At the locations of wells R-34, R-22, and possibly well R-21, there are thick intervals of aquifer strata with a permeability greater than 40 meters per day. The LANL *Synthesis Report* is hiding the very large and very valuable groundwater resource on the San Ildefonso Pueblo.

3.1. The High Permeability of the Regional Aquifer at Well R-34. Figure 1-1 shows the location of characterization well R-34 in Cedro Canyon on the San Ildefonso Pueblo. The LANL *Synthesis Report* makes the mistake to describe the regional aquifer at well R-34 as having a low permeability of 1.07 meters per day. The spurious low permeability was measured by a pumping test that was affected by residual foam drilling fluids, and because of the mistakes that were made in the construction of the well. As described below, the available information show the regional aquifer at well R-34 to have a permeability greater than 40 meters per day.

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.[4] The pumping test in well R-34 did not provide reliable information on the permeability of the aquifer strata because of the outgassing of the drill air and foam. From the LANL well R-34 pumping test report:[4]

- "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 prevented the pumping test from providing reliable measurement of the aquifer permeability. Nevertheless, the LANL

*Synthesis Report*[6] published the obviously <u>spurious</u> low permeability value of 1.07 m/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*[6] 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 wells R-11 and R-28 where pumping tests measured permeability values of 35.51[7] and 45.52 m/day,[3] respectively.

In addition, the Schlumberger geophysics logs are similar for wells R-11,[7] R-28,[2] and R-34.[4] Figure 1-4 is a comparison of the permeability of the aquifer strata at wells R-28 and R-34 from the Schlumberger borehole geophysics that were performed in the boreholes for the two wells. 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 40 m/day.

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. The clay strata had an important effect to lower the permeability measured by the pumping test in well R-34.

The drilling record and geophysics record for the well R-34 borehole document that the regional aquifer in the western region of the San Ildefonso Pueblo has a total thickness of aquifer strata with high permeability of greater than 250-ft thick and probably greater than 500-ft thick from interpretation of regional information.

The Final LANL SWEIS must identify and reconcile the wrong information that is presented in the LANL reports. The high permeability of the aquifer strata beneath the San Ildefonso Pueblo greatly increase the danger of LANL waste to contaminate the valuable groundwater resource of the Pueblo and for the contamination to reach the Rio Grande and the Buckman well field.

4.0. <u>The poor reliability of LANL characterization well R-16 to identify the danger of LANL operations to the Buckman well field.</u>

The danger of the hexavalent chromium plume to contaminate the groundwater at the Buckman well field is increased because of the mistakes that were made in the construction of well R-16, the LANL sentry well for LANL groundwater contamination traveling to the Buckman well field. Figure 1-7 displays the as-built construction of the multiple-screen well R-16. Screen #1 is blocked off by the retractable drill casing that was abandoned in the borehole. Screen #4 is surrounded by bentonite clay slough sediments[8] that were not removed from the borehole before installing the backfill materials. The bentonite clay have well known properties to mask the detection of contaminants in the water produced from the well. The borehole for the well was drilled with the mud-rotary drilling method that caused the screened intervals to be invaded with bentonite clay drilling mud and organic drilling additives. The LANL *Well Screen Analysis Report*[9] identified that screen #2 and #4 in well R-16 do not produce reliable and representative groundwater samples (see Figure 1-2).

An additional mistake with the construction of well R-16 is that the Schlumberger borehole geophysics reveal that screen #4 was installed in a layer of strata with very low permeability and that layers of strata with markedly higher permeability are located above and below the strata that surround screen #4. The Schlumberger geophysics is displayed on Figure 1-8. Well R-16 is one of the monitoring wells for monitoring the release of contaminants from the RCRA regulated waste disposal sites at TA-54. The RCRA regulations require installation of well screens in the strata with highest permeability and the collection of representative groundwater samples. Well R-16 is not in compliance with RCRA 40 CFR §§ 264.90-100 (referred to as RCRA §264 Subpart F).
Well R-16 is not a reliable sentry well for contamination traveling to the Buckman well field. There is a pressing need to replace well R-16 and to install additional monitoring wells for the detection of LANL waste upgradient of the San Ildefonso Pueblo, the Buckman well field and the supply well of Los Alamos County.

NEPA required recognition of the deficiencies of the existing LANL monitoring well network and a finding in the Final LANL SWEIS to institute the *"Reduced Operations Alternative"* that was described as one of the alternatives in the Draft LANL SWEIS.

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**Exhibit 4.**

Failure of the Draft LANL SWEIS to Address Environmental Impact Because of Groundwater Contamination From the RCRA Regulated Disposal Sites at Technical Area 54.

1.0 Introduction. The RCRA regulated units at Technical Area 54 (TA-54) of the Los Alamos National Laboratory (LANL) are MDA G, MDA H, and MDA L The regulated units are on Figure 1-6. The Final LANL SWEIS must address the environmental impact of the legacy wastes disposed of at the three MDAs to contaminate the regional aquifer. The Draft LANL SWEIS did not acknowledge the groundwater contamination[1] beneath MDA G that was detected at statistically significant levels in water samples collected from LANL characterization well R-22 (Table 1). The Final LANL SWEIS must acknowledge the uncertainty of the groundwater contamination in the regional aquifer because of the failure of DOE/NNSA, LANL, and the New Mexico Environment Department (NMED) to install the network of monitoring wells at the three MDAs that are required for compliance with RCRA 40 CFR §§ 264.90-100 (referred to as RCRA § 264 Subpart F). The groundwater monitoring program at the three regulated units is not in compliance with RCRA, and for that reason, the Final LANL SWEIS cannot present a finding that LANL meets requirements for expanded manufacturing of plutonium pits. Instead, the Final LANL SWEIS must institute the *"Reduced Operations Alternative"* that was described in the Draft LANL SWEIS.

MDA G is the legacy mixed wastes that are disposed of at Area G, the active LANL landfill for the disposal of low-level radioactive waste. Area G has a size of 65 acres. MDA L is the legacy hazardous wastes disposed of at a 2.6 acre facility that is now permitted for surface storage of hazardous waste. MDA H is a small inactive legacy waste disposal site where disposal of mixed waste was into a set of disposal shafts.

The six LANL characterization wells that are intended to meet the RCRA requirements for monitoring the three MDAs are the characterization wells R-16, R-20, R-21, R-22, R-23, and R-32. The six wells are displayed on Figure 1-6. None of the six wells meet the RCRA § 264 Subpart F requirements for monitoring the regulated units. Exhibit 1 describes the the properties of the drilling additives to mask the detection of LANL contaminants in the water samples produced from the 6 wells.

In addition, A fundamental deficiency is that RCRA 40 CFR § 264.95 requires for monitoring wells to be located at the immediate boundary of the regulated units to monitor the groundwater flowing from beneath the regulated units. Figure 1-6 shows that there are no monitoring wells located close to the downgradient boundaries of the three MDAs The closest well to the downgradient boundary of a discrete regulated unit is well R-22 located approximately 500 feet east from the downgradient boundary of MDA G.

The Draft LANL SWEIS identified the need to install a set of monitoring wells at appropriate locations at the three MDAs to investigate the presence of groundwater contamination at the present time and in the future. From page I-230 of the Draft LANL SWEIS:

> *Uncertainty about the long-term infiltration rates at MDAs leads to uncertainty about the long-term performance of the MDAs. The result is uncertainty about possible future human risk from groundwater contamination assuming nothing is done to reduce long-term infiltration into the MDAs.*

The draft LANL SWEIS is correct about the uncertainty for groundwater contamination due to long-term infiltration into the MDAs. However, more important for MDA L and MDA G is the uncertainty of groundwater contamination that has already occurred because of the waste disposal operations over a thirty year period from the late 1950s until the late 1980s.

2.0. <u>The nature of waste buried at MDA G.</u> MDA G occupies 65 acres and has been an active landfill since 1957. There are plans to expand MDA G by an additional 30 acres. At this time, the waste disposed of at MDA G are described as low-level radioactive waste. The term "low-level" does not mean the waste have low radioactivity. In fact, the "low-level waste" disposed of at MDA G may have a very high level of radioactivity. In addition, a LANL report[2] documents that "high level" transuranic (TRU) radioactive waste was routinely disposed of in pits at MDA G from 1957 through 1970, with disposal of small amounts of TRU waste continuing through 1979. Furthermore, LANL reports[2] document that prior to 1986, most of the Laboratory's "<u>mixed low-level waste</u>" was disposed of at MDA G. The mixed waste contains both radioactive waste and hazardous waste (toxic chemical waste). The large plumes of solvent chemicals[2] that are present in the unsaturated strata beneath MDA G are evidence of the large amount of hazardous waste that were disposed of in the unlined pits at MDA G. The radioactive and chemical contamination in the regional aquifer beneath MDA G that were detected in water samples produced from well R-22[1] are listed below in Table 1.

3.0. <u>The nature of waste buried at MDA L.</u> MDA L occupies 2.6 acres and was an active disposal site for hazardous chemical waste since the late 1950's until 1985. An unlined pit (Pit A) located along the northern side of MDA L received all waste until 1975. Chemical waste were disposed of in Pit A from the late 1950's through December, 1978. A large quantity of <u>liquid</u> toxic chemical waste were disposed of in Pit A.[2] In addition, two surface impoundments at MDA L were used for the disposal of a large quantity of liquid waste from the late 1970's through 1986.[2]

Thirty four unlined disposal shafts were drilled at MDA L between 1975 and 1985. They range in diameter from 3 to 8 feet and are each approximately 60-feet deep. Much of the waste disposed of in the shafts are toxic liquids (solvents) contained in 55-gallon steel drums.[2] Liquids were disposed of in drums or other containers without adding absorbents.[2] Smaller containers were frequently simply dropped into the shafts.[2] Noncontainerized waste were also disposed of in these shafts.

A large vapor plume of solvent contamination is present in the subsurface beneath MDA L. The existence of the plume has been known for over 25 years.[2] The primary solvents in the plume include the toxic contaminants 1,1,1-trichloroethane (TCA), trichloroethylene (TCE), and perchloroethylene (PCE).[2] It is not known if the solvent contamination or other chemical contamination released from MDA L have contaminated the regional aquifer beneath MDA L or if contaminants released from MDA L have contaminated the groundwater beneath the San Ildefonso Pueblo because no reliable monitoring wells have been installed at appropriate locations immediately at MDA L and between MDA L and the Pueblo (see Figure 1-6). The only well between MDA L and the San Ildefonso Pueblo is well R-21. This well does not meet requirements of RCRA §264 Subpart F because of the great distance away from MDA L, the nonrepresentative water chemistry because of the effects of the drilling additives,[8.9] and the great depth of the well screen below the water table of the regional aquifer.[8]

The detection of chemical contamination in the regional aquifer beneath MDA G[1,7] is evidence that it is very likely that the liquid wastes released from MDA L have contaminated the regional aquifer. The disposal of a very large but unknown quantity of liquid chemical waste at MDA L over a time period of greater than 25 years presents a great danger to contamination of the groundwater resources. It is a violation of RCRA § 264 Subpart F that DOE/NNSA and NMED have not required the installation of a network of monitoring wells in the immediate vicinity of MDA L (and MDA G) for monitoring contamination in the regional aquifer.

3.0. <u>Mistakes in the Construction of LANL Characterization Well R-22.</u>
Well R-22 is located atop Mesita del Buey east of MDA G along the direction of groundwater travel from beneath MDA G to the property of the San Ildefonso Pueblo, the Rio Grande, and the Buckman well field, an important groundwater resource to Santa Fe. Figure 1-6 shows the location of MDA G, well R-22, and the southern property line of the Pueblo. The location of the Rio Grande and the Buckman well field are on Figure 1-1. Well R-22 is a multiple-screen well with 5 separate screened intervals at different depths in the regional aquifer. The mistakes in the construction of well R-22 that prevent the well from being in compliance with RCRA § 264 Subpart F for the detection of groundwater contamination from Area G are described below.

3.1. <u>The strata surrounding the screens in well R-22 are invaded with organic drilling additives that were not removed by the well development activities.</u> The LANL water quality data show that the drilling additives have caused a large change to the chemistry[1,9] of the water produced from screen #1. Indeed, a LANL report[3] predicts that screen #1 will not produce representative water samples for the next <u>ten years</u>.

Screen #1 is located in strata with high permeability at the water table of the regional aquifer. Screen #1 is the most important screen in well R-22 for the detection of the release of contamination from Area G to the regional aquifer. The LANL *"Well Screen Analysis Report"*[4] identifies that screen #1 in well R-22 does not produce representative water samples. The scheme in the LANL Workplan for R-well Rehabilitation and Replacement[5] is to seal off screen #1 and use screen #2 as the uppermost screen for monitoring groundwater contamination beneath MDA G. This scheme is unacceptable because of the very low permeability of 0.04 ft/day[6] that was measured for the strata that surround screen #2. RCRA § 264 Subpart F requires that well screens are installed in the aquifer strata with high permeability that are located near the water table and strata with high permeability are above screen #2 at the location of screen #1.

There is an immediate need to install a cluster of new monitoring wells immediately east of the boundary of MDA G that are installed in the aquifer strata with high permeability at a shallow depth below the water table of the regional aquifer, and in the deeper intervals of aquifer strata with high permeability that are located in the depth interval between screen #2 and screen #3 (see Figure 1-9).

Some of the hazardous and radionuclide contaminants that were detected in screen #1 of well R-22 are listed in Table 1. The nature of contamination in the strata at the top of the regional aquifer beneath Area G are not accurately known because of the properties of the organic drilling additives to mask the detection of contamination. A LANL Report[7] acknowledges the large number of chemical contaminants that were detected in the groundwater samples from well R-22 during the first year of collecting samples.

> "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 EPA Drinking Water Standard]

Table 1. Contaminants[1] detected in water samples collected from Well R-22.

***tritium (109 picocuries per liter (pCi/L) for a sample collected at the water table),**
***technetium-99 (4.3 and 4.9 pCi/L),**
***pentachlorophenol (6.2 micrograms per liter (ug/L)),**
***chloroform (0.94 ug/L),**
***phenol (19 and 32 ug/L),**
***4-methylphenol (44 to 210 ug/L),**
***2-butanone (6.9 to 8.9 ug/L),**
***diethylphthalate (1.3 ug/L),**
**benzoic acid (3 to 12.5 ug/L),**

**butyl benzyl phthalate (9.8 ug/L),**
**toluene (0.2 to 0.76 ug/L),**
**methylene chloride (0.62 and 2.2 ug/L),**
**bis(2-ethylhexyl)phthalate (1.0 and 3.9 ug/L),**
**several substituted benzene compounds including**
**isopropylbenzene (0.16 to 0.54 ug/L), and**
**1,4-dichlorobenzene (0.16 to 0.23 ug/L).**

- Mobile Contaminants. Tritium, Technetium-99, and the six chemical contaminants with asterisks in the above list are highly mobile in groundwater. The six chemical contaminants are commonly found in groundwater beneath toxic waste landfills studied by the Superfund activities of EPA.

- Pentachlorophenol. Pentachlorophenol was detected in a groundwater sample from well R-22 at a concentration more than six times greater than the maximum contaminant level (MCL) allowed by the Federal Drinking Water Standard. In addition, EPA has assigned a maximum contaminant level goal (MCLG) of zero for this chemical contaminant because of the serious health issues. The health issues include 1). damage to the central nervous system, 2). reproductive effects, 3). damage to liver and kidneys, and 4). cancer.

- Radioactive Tritium and Technetium-99. A tritium level of 109 pCi/L was measured

in a water sample collected from the water table of the regional aquifer during the drilling of the borehole for well R-22. The fluid-assisted drilling methods diluted the actual level of tritium in the groundwater. The anomalously high levels of tritium and the presence of technetium-99 are direct evidence that contamination from MDA G has reached the regional aquifer. Other radionuclide contaminants may have traveled from MDA G to the regional aquifer, but are not noticed because of the mistakes in the installation of well R-22 and the other characterization wells that surround MDA G.

The plan by DOE to continue monitoring for chemical and rationalize contaminants in the water produced from well R-22 is irresponsible because LANL reports acknowledge that it may be as long as ten years before the well produces reliable water samples. In fact, it is very probable that screen #1 in well R-22 will never produce reliable and representative water samples because of the new mineralogy of iron coatings on the strata that surround the well screen.

3.2. The Westbay$^R$ Sampling System Collects Stagnant Water From Well R-22.
The poor quality of the water samples collected from well R-22 are compounded because no attempt is made to purge the stagnant water from the well before samples are collected for the analytical suite. Water is not pumped from the screened intervals in well R-22. Instead a small Westbay$^R$ sampler collects stagnant water samples that were

in contact for a long period of time with the new chemistry introduced by the organic drilling additives.

3.3. The screened intervals in well R-22 are not installed in the aquifer strata with high permeability. An additional problem with well R-22 is that except for screen #1 the screened intervals are not installed in the aquifer strata with high permeability. The strata with high permeability are the strata where the highest levels of contamination are expected and are the strata for fast horizontal travel of contamination away from MDA G. From the text book *Applied Hydrogeology* by Fetter (1994):

> **"Heterogeneities in the aquifer can cause the pattern of the solute movement to vary from what one might expect in homogeneous beds. Because flowing groundwater always follows the most permeable pathways, those pathways will also have the most contaminant."**

The regional aquifer strata beneath MDA G and the San Ildefonso Pueblo have high heterogeneity. The regional aquifer is a "layer cake" of strata with very high and very low permeability. Figure 1-9 shows the "layer-cake" strata and the location of well screens in Well R-22. Figure 1-9 is a comparison of the permeability of the aquifer strata from the Schlumberger borehole geophysics to the location of the screened intervals in well R-22.

The figure shows that screens were not installed in two thick intervals of basalt strata that have high permeability, possibly greater than 125 feet per day. Instead, screen #2 is installed in basalt strata that the borehole geophysics show to have very low permeability. The low permeability was confirmed by aquifer tests[6] that measured a permeability of 0.04 feet per day for the basalt strata that surround screen #2. .

It is both puzzling and troubling that
1). screened intervals in well R-22 were not installed in the strata with high permeability that were identified by the drilling activities and the borehole geophysics (Figure 1-9), and
2). the LANL Reports[6.10] misrepresent the regional aquifer strata beneath Area G and the San Ildefonso Pueblo as having low permeability – see Figure 1-5.

The presence of strata with high permeability were proven by both the borehole geophysics[7] and the drilling record[11] for well R-22. There was knowledge of the strata with high permeability before well R-22 was constructed and before the LANL Reports were written. DOE must reconcile the failure to monitor the "fast pathways" for the travel of contaminants in groundwater laterally away from Area G and the misrepresentation of the danger of Area G and Area L to the groundwater of the San Ildefonso Pueblo, the Rio Grande, and the Buckman well field, an important water resource to Santa Fe.

The report by Keating et al[12] brings attention to the great uncertainty in the direction and speed of travel of groundwater in the basalt strata beneath MDA G and MDA L as follows:

> *"As shown in Table 3, a significant proportion of uncertainty in fluxes downgradient of LANL results from uncertainty in the permeability of the basalts. 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, Keating et al., 2005].
>
> *"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, 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"* [page 668, Keating et al., 2005].
>
> "These uncertainties can be reduced meaningfully with more data collection, including multiwell pumping and tracer tests" [ Keating et al., 2005].

The uncertainty in the Keating et al report for the impact of Area G on the water resources is an issue that must be resolved by the installation of the needed network of monitoring wells immediately at MDA G, MDA L, and MDA H as required to meet the requirements of RCRA § 264 Subpart F. There is a need to characterize the flow of groundwater away from TA-54 to the San Ildefonso Pueblo, the Rio Grande, and the Buckman well field. This characterization requires the installation of monitoring wells at appropriate locations for multi-well pumping tests and tracer tests as this need was identified in the report by Keating et al.

The demonstrated failure of DOE/NNSA, LANL, and NMED to comply with RCRA § 264 Subpart F and DOE Orders to have accurate knowledge of the impact of the Laboratory's RCRA regulated mixed waste and chemical waste disposal facilities on the groundwater resources leaves no recourse for the Final LANL SWEIS but to institute the ***"Reduced Operations Alternative"*** for the future operations at the Los Alamos National Laboratory

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11. LANL, 2001. Well R-22 Completion Report. LANL Report LA-13893-MS, 2001.

12. Keating, Elizabeth, B.A. Robinson, and V.V. Vesselinov, 2005, "Development and Application of Numerical Models to Estimate Fluxes through the Regional Aquifer

beneath the Pajarito Plateau," Vadose Zone Journal, Volume 4, August, 2005.

**Exhibit 5**

Comments on the Remediation of MDAs in the Draft Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National laboratory

**George Rice, September 18, 2006**

## Remediation of MDAs

The *Draft Site-Wide Environmental Impact Statement* (SWEIS) considers three alternatives: 1) No Action, 2) Reduced Operations, and 3) Expanded Operations.[1] However, DOE is proposing to remediate major Material Disposal Areas (MDAs) only under the Expanded Operations alternative.[2] This does not make sense. The potential for contamination at the MDAs is not a function of the alternative that is chosen.

The following is from the draft SWEIS:

> *Uncertainty about the long-term infiltration rates at MDAs leads to uncertainty about the long-term performance of the MDAs. The result is uncertainty about possible future human risk from groundwater contamination, assuming nothing is done to reduce long-term infiltration into the MDAs.*[3]

The MDAs should be remediated under all of the alternatives.

Under any alternative, DOE should determine whether any contaminant excursions[4] have occurred at any MDAs or other facilities where wastes have been stored or disposed. If any excursions have occurred, DOE should determine the extent and nature of the excursion, and develop a remediation plan.

All waste disposal facilities should include a monitoring system capable of detecting excursions before contaminants reach the environment. Such a system might consist of dual low permeability liners with instruments for detecting excursions installed between the liners.

## Lateral flow into wastes

Any proposed remediation plan should consider the possibility of lateral movement of water into the wastes. Lateral flow may occur episodically in response to rainfall or snowmelt. Rogers (1977) reported lateral flows into waste disposal pits at MDA G. The water flowed into the pits through fractures and along the soil-bedrock interface.[5]

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[1] DOE, 2006a, pages S-5 and S-39.
[2] DOE, 2006a, page S-39. Under the Expanded Operations alternative, the MDAs may be capped (wastes left in place), or excavated (wastes removed and disposed in another facility) (DOE, 2006a, page 3-61).
[3] DOE, 2006a, page I-230.
[4] Excursion: migration of contaminants across the boundary of a disposal facility.
[5] Rogers, 1977, pages G-36, G-70, and G-71.

All proposed remedial options should include features to prevent the lateral flow of water into the wastes. Those features could consist of impermeable barriers or capillary breaks.

**Tritium in White Rock Canyon**

The SWEIS states:

> "*However, groundwater from springs in White Rock Canyon has no tritium and probably ranges in age somewhere between 3,000 to 10,000 years (LANL 2005a).*"[6]

This is incorrect. A number of springs in White Rock Canyon discharge water that contains tritium (e.g., CCNS Spring (2B); springs 4, 4A, 4B, and 4C; and Doe Spring).[7] The presence of tritium at these springs shows that at least a portion of the water is recent. That is, the water was recharged since LANL was established in 1943.

**Definition of background groundwater quality**

DOE claims that the discharges from a number of springs in White Rock Canyon represent background groundwater quality for the Pajarito Plateau[8]. However, one of them, La Mesita Spring, is east of the Rio Grande[9] and flows from a point 20 m above the river.[10] Therefore, groundwater discharging from this spring may originate in the mountains to the east of the Rio Grande. If this is the case, samples from La Mesita Spring do not represent background for the Pajarito Plateau.

Unless DOE can show that the discharge from La Mesita Spring originates on the Pajarito Plateau, samples from spring should not be used to define background quality for the Pajarito Plateau.

**Contaminants in Regional Aquifer**

The SWEIS states:

> "*As a result, little contamination reaches the regional aquifer from the shallow perched groundwater bodies and water quality impacts on the regional aquifer, though present, are low.*"[11]

This is incorrect. Chromium concentrations as high as 404 μg/L have been detected in regional aquifer well R-28. This is more than four times higher than the Federal drinking water standard and eight times higher than the State drinking water standard.[12]

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[6] DOE, 2006a, page E-33.
[7] CCNS, 2004, table 8-1.
[8] DOE, 2006a, figure E-9.
[9] Purtyman, 1995, figure XXII-B.
[10] LANL, 2005a, page E-2.
[11] DOE, 2006a, page 4-63.
[12] DOE, 2006a, page 4-65.

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Exhibit 6.1

Where Do the Children Play?
CCNS and EVEMG draft LANL SWEIS Comment Mix
Song Selection Made By Kalliroi Matsakis and Leah McLeroy

The following is a track list for the enclosed music mix compact disk (Mix CD). This Mix CD is intended to compliment our comments, by providing emotional undertone, which our specific, and even general, comments cannot convey. It is also intended for your enjoyment while reviewing the public comments regarding the draft LANL SWEIS.

As stated above, CCNS and EVEMG request a response, in kind, to this Mix CD. The remarks following the title and artist for each track are intended to aid you in preparing such a response. If you have any questions or would like to schedule a meeting to discuss our request further, please contact Kalliroi Matsakis, Media Network Coordinator, Concerned Citizens for Nuclear Safety, by phone at 986-1973, or email at kmatsakis@nuclearactive.org.

**Track 1:** *Where Do the Children Play*, Cat Stevens
An evolving family of nuclear weapons, which has come a long way from Fat Man and Little Boy, and is changing day to day, is all well and good, but we ask you "Where do the children play?"

One answer is on baseball fields next to Area G, the legacy and low-level nuclear waste dump. Another is in *Acid Canyon,* which is as safe as an extended backyard so long as they don't eat the dirt (please see Exhibit 9.3 and/or http://www.ieer.org/reports/lanl/cleanup.pdf ).

**Track 2:** *The Battle Is Over, But the War Goes On*, Sonny Terry and Brownie MaGhee
"Its only through love, this ol' world can stay alive"

**Track 3:** *River,* Joni Mitchell
We wish we had a river which was not contaminated with elevated levels of PCBs, to the extent that you cannot eat the channel catfish caught in White Rock Canyon. Please see Exhibit 6.2.11.

**Track 4:** *Imagine,* John Lennon
Imagine the first verse went a little something like this:

> Imagine incorporating our comments
> It's easy if you try
> No DU Burned
> Openly in our sky

Imagine all the people
Breathing clean air

Imagine there's no new nukes
It isn't hard to do
Nothing to kill or die for
No more waste TRU
Imagine all the people
Living life in peace

You may say that we are dreamers
But we are not the only ones
We hope someday that you will join us
And the world will live as one

**Track 5:** *I Wanna Be An Engineer,* Pete Seeger
Please see above comments regarding employment discrimination at LANL. Solidarity Forever.

**Track 6:** *Talking about a Revolution* Tracy Chapman
Los Alamos County is the richest county in the country and surrounded by some of the most impoverished counties in the nation. Please See Exhibit 8 and 9.1

**Track 7:** *A Hard Rain is Gonna Fall*, Bob Dylan
Data presented in the draft LANL SWEIS shows that there are very high levels of plutonium in storm water run off, as well as in the regional aquifer as reported in Appendix F of the draft LANL SWEIS. Please see comments from the Institute for Energy and Environmental Research for more details.

**Track 8:** *Eve of Destruction*, Barry Mc Guire
When you are singing along to this track please pay close attention to the line that says "I can't twist the truth, it knows no regulation" and please consider using this line instead "I will twist the truth, because I forgot the regulations" or maybe "I always the twist the truth, because I don't care about the regulations" or on a more uplifting note "I won't twist the truth anymore, because I respect and love the regulations".

Please see CCNS and EVEMG water comments and Exhibits 1-4 for further discussion of DOE/NNSA's use of regulations in the draft LANL SWEIS.

**Track 9:** *Ball of Confusion (That's What the World is Today),* The Temptations
"Oh, great googalooga, can't you hear me talking to ya?"

**Track 10:** *War*, Edwin Star

‘Nuff said.

**Track 11:** *Wade in the Water* Big Mama Thorton
All people that live downstream and downwind from LANL require and have a right to clean water for drinking, sacred ceremony, growing food, raising animals, recreating, and overall wellbeing. Please see the Los Alamos National Laboratory Water Watch Shared Values Statement, Exhibit 16.2**.**

**Track 12:** *Bad to the Bone*, George Thoroughgood
This is a shout out to the Institute for Energy and Environmental Research, and their report, ‘Bad To the Bone: Plutonium and Drinking Water Standards.” DOE/LANL must check out the report and the proposal to lower the standard for plutonium and other actinides in drinking water by 100 times based on new understanding of plutonium in the human body. These findings must be incorporated into the reanalysis for a new draft LANL SWEIS. Please see:
http://www.ieer.org/reports/badtothebone/fullrpt.pdf

**Track 13:** *Man in Black*, Johnny Cash
And why do our comments have a somber tone? Well there’s a reason for the things we’ve put down. . .

**Track 14:** *Lies,* Violent Femmes
The draft LANL SWEIS relies on conclusions made in the **draft** Agency for Toxic Substances and Disease Registry (ATSDR) Public Health Assessment for its statement that there is no health impact from existing and proposed operations. The draft report was released for public comment last summer. In comments about the draft assessment, the Environmental Protection Agency (EPA) stated, “**Blanket statements** are made regarding the conservatism of this public health assessment **without supporting documentation**. In general, a risk assessment is revised to reflect more appropriate site-specific exposures or exposure point concentrations to rather than rely upon defaults and **declare** that the risk assessment is conservative.” (Emphasis added) p.1 Exhibit 17.1. Further, this ATSDR public health assessment was shelved without response to comments due to lack of funding as stated in an ATSDR letter dated December 8, 2006. The ATSDR report has not been finalized, yet DOE/NNSA relied upon its conclusions in the draft LANL SWEIS.

**Track 15:** *Trash*, New York Dolls
Let us clarify the lyrics, “TRASH, go pick it up, don’t take your life away.” CCNS and EVEMG state that the MDA removal option is the only way to protect surface water, ground water and existing and future drinking water supplies.

**Track 16:** ‘Godzilla’, Blue Oyster Cult
Godzilla was a Japanese pop culture response to the United States dropping atomic bombs on two Japanese cities, Hiroshima and Nagasaki. The bombings occurred only

three days apart, on August 6th and 9th, 1945. These bombings killed over 70,000 people instantly and many, many more over time. Please see the photos of Hibakusha and Hiroshima Shadows in Exhibit 6.2.

Please recall that August 9th was also the date of the second Public Comment Hearing for the draft LANL SWEIS, held in Española, NM. Ms. Withers described this scheduling choice as "ironic." We would say 'telling,' but perhaps we should quote Blue Oyster Cult and say, "history shows again and again, how nature points out the folly of man."

**Track 17:** *Human Behavior,* Bjork
There is no way to determine the future land use because there is definitely, definitely, definitely no logic to human behavior. Therefore all cleanup must be done to a level which would allow a future pregnant subsistence farmer and her children and grandchildren to live there for their entire lives.

**Track 18:** *Atomic*, Blondie
Despite how sexy this song may be, nuclear weapons are not hot, well, not figuratively at any rate.

**Track 19:** *Party Like Its 1999*, Prince
Although the millennium didn't bring the apocalypse, relying so heavily on the analysis in the 1999 LANL SWEIS just might. Especially when it is applied as a substitute for a true No Action Alternative in the draft LANL 2006 SWEIS.

**Track 20:** *Respect*, Aretha Franklin
The draft LANL SWEIS is misleading, incomplete, inadequate and technically indefensible. DOE/NNSA must withdraw it and issue a new . . . you read our comments, we don't need to repeat ourselves yet again. All we are asking for is a little R-E-S-P-E-C-T.

**Exhibit 7.1**
**CCNS and EVEMG Comment Images**

1. Guernica by Picasso:
http://upload.wikimedia.org/wikipedia/en/7/74/PicassoGuernica.jpg

2. Hiroshima Human Shadow 1: http://netcoop.airpost.net/HiroshimaHumanShadow374x512.jpg

3. Hiroshima Human Shadow 2:
http://barista.media2.org/wp-content/hiroshima%20shadow.jpg

4. Hiroshima Human Shadow 3:
http://history.independence.co.jp/ww2/raid/h02.jpg

5. Hiroshima Human Shadow 2:
http://www.24hourmuseum.org.uk/content/images/2003_0126.JPG

6. Hiroshima Survivor 1:
http://www.aldeaeducativa.com/IMAGES/hiroshima02.jpg

7. Hiroshima Survivor 2:
http://mdn.mainichi-msn.co.jp/photospecials/graph/050806hiroshima/52.jpg

8. Hiroshima Survivor 3:
http://www.damninteresting.net/content/hibakusha_burns_2.jpg

9. Los Hoyos:
Luis Sanchez Saturno/The Santa Fe, New Mexican

10. Peace:
http://www.raventalk.com/Images/peace-sign.jpg

11. Rio Grande:
http://www.teamten.com/Postings/EastwardDay9/Rio%20Grande.jpg

12. Russian Children with CCNS YoYo 1 and 2: Taken by Scott Kovac in a small village outside of Tomck, August 2006

13. Seeds of Change:
http://www.trivalleycares.org/images/seedsofchangeposter.jpg

**Exhibit 7**
**Email from Elizabeth Withers to Joni Arends**

From: "Withers, Elizabeth" <ewithers@doeal.gov>
Date: Wed, 20 Sep 2006 08:18:09 -0600
To: Joni Arends <jarends@nuclearactive.org>
Subject: RE: Submitting dLANL SWEIS comments

Hello, Joni: Please note the answers to your questions below. Thanks,
E.

-----Original Message-----
From: Joni Arends [mailto:jarends@nuclearactive.org]
Sent: Tuesday, September 19, 2006 7:10 PM
To: Withers, Elizabeth
Cc: Pleau, Bernard; Chavez-Wilcynski, Jan
Subject: Submitting dLANL SWEIS comments
Importance: High

Elizabeth,
CCNS called your office several times today with pressing questions. We did not receive a response from you. Hopefully, you will find the time to answer our email questions before the comment period ends:

1. With regard to submitting comments tomorrow, if we email them to you before midnight, will they be noted as being submitted in time?
***Yes, they will be considered to have been received in a timely fashion.

2. Unfortunately, there are two different addresses in the draft LANL SWEIS for the NNSA office. On the inside cover the address is 528 35th Street, but on the first page, your address is listed as 538 35th Street. Which is the correct address? ***The correct address is 528 35th Street.
Does the USPS deliver mail to your office even if it has the incorrect address? *** Usually, it does. That's the benefit of being located in a small town I guess.
If not, will you notify the USPS of the error and ask them to deliver all mail addressed to you at either address? Please send a copy of that correspondence to me. Thank you.

3. CCNS understands that you have had email correspondence with the Northern NM Citizens' Advisory Board about an extension of time to

submit comments.  CCNS requests the same treatment.  Please inform me about the extension of time as soon as possible (ASAP).  ***** There is no extension of the comment period beyond September 20th.  I (and other folks at DOE) always allow about a week after the end of a NEPA document comment period for any mail that may have been dropped into a mailbox at midnight on the last day of the comment period to have a reasonable chance to have been received.  In this instance, seven days after the 20th falls in the middle of the week so I made the decision that my team of folks would get together in a room without a phone, shut the door, and start the process of the final EIS preparation on Monday, October 2nd.  Therefore, all comments that I receive by September 30th will be considered in the preparation of the Final SWEIS.  Any comments received after that point will receive consideration to the extent practicable.
I'm telling this to everyone who asks for a "few additional days" to comment, including the Northern New Mexico Citizens Advisory Board. The key point here is that I must RECEIVE the comments by September 30th - so if folks want to gamble and drop their comments into a USPS mailbox after September 20th, the letter may not reach me for a week or more and may not be considered in the preparation of the Final SWEIS. If you are going to wait beyond September 20th to send in comments I highly recommend that you e-mail them, or, second best, fax them in to me, and if you wait beyond the end of September to send in comments by any method then the odds increase daily that your comments will not receive consideration.

Joni

--

Joni Arends, Executive Director
Concerned Citizens for Nuclear Safety
107 Cienega Street
Santa Fe, New Mexico 87501
Tel (505) 986-1973
Fax (505) 986-0997
www.nuclearactive.org

***Attachment 1***
Figures for Exhibits 1-4
CCNS and EVEMG Comments
Regarding the draft LANL SWEIS

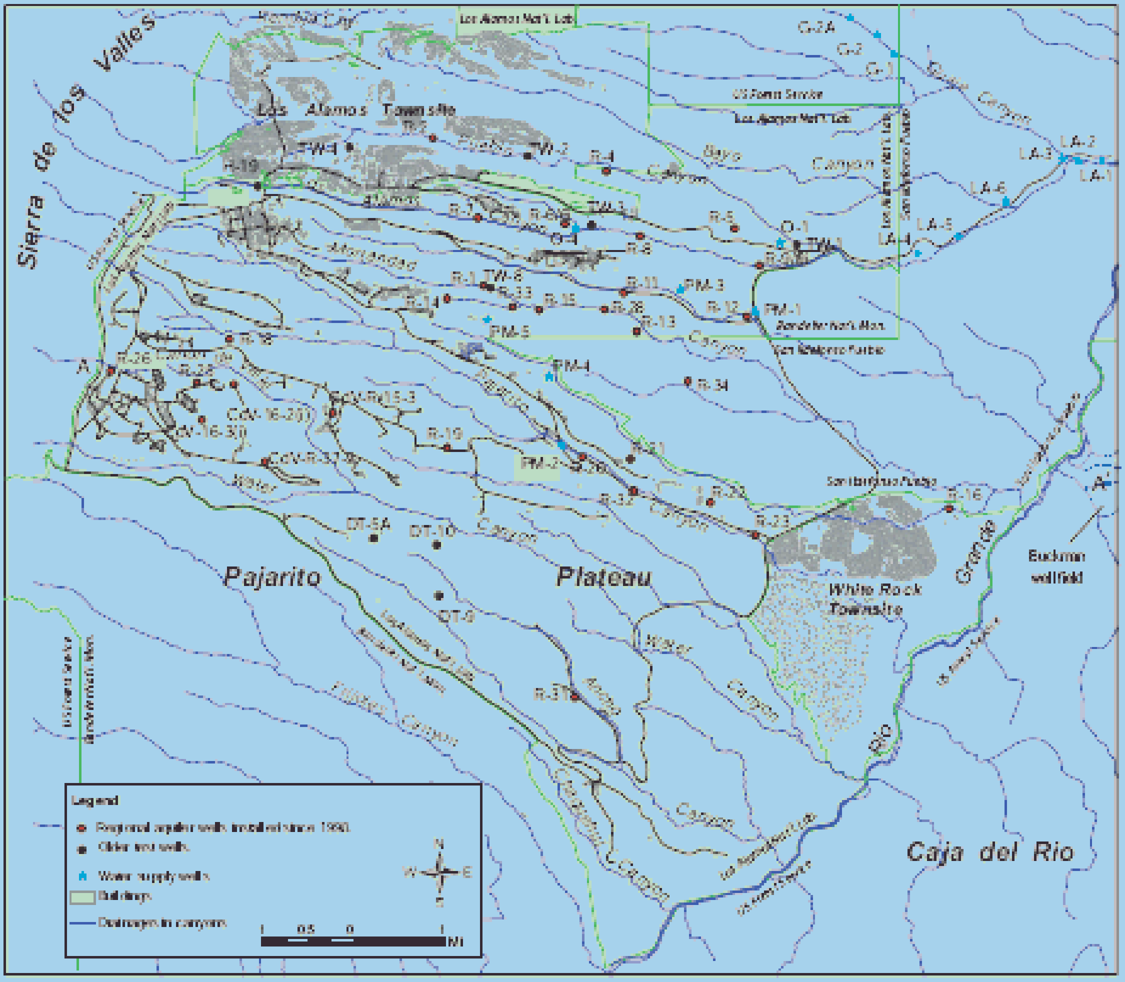



Figure 1-1.    Map showing location of wells constructed under the Hydrogeologic Workplan

From: LANL Workplan for R-Well Rehabilitation and Replacement, LA-UR-06-3687, June 2006.

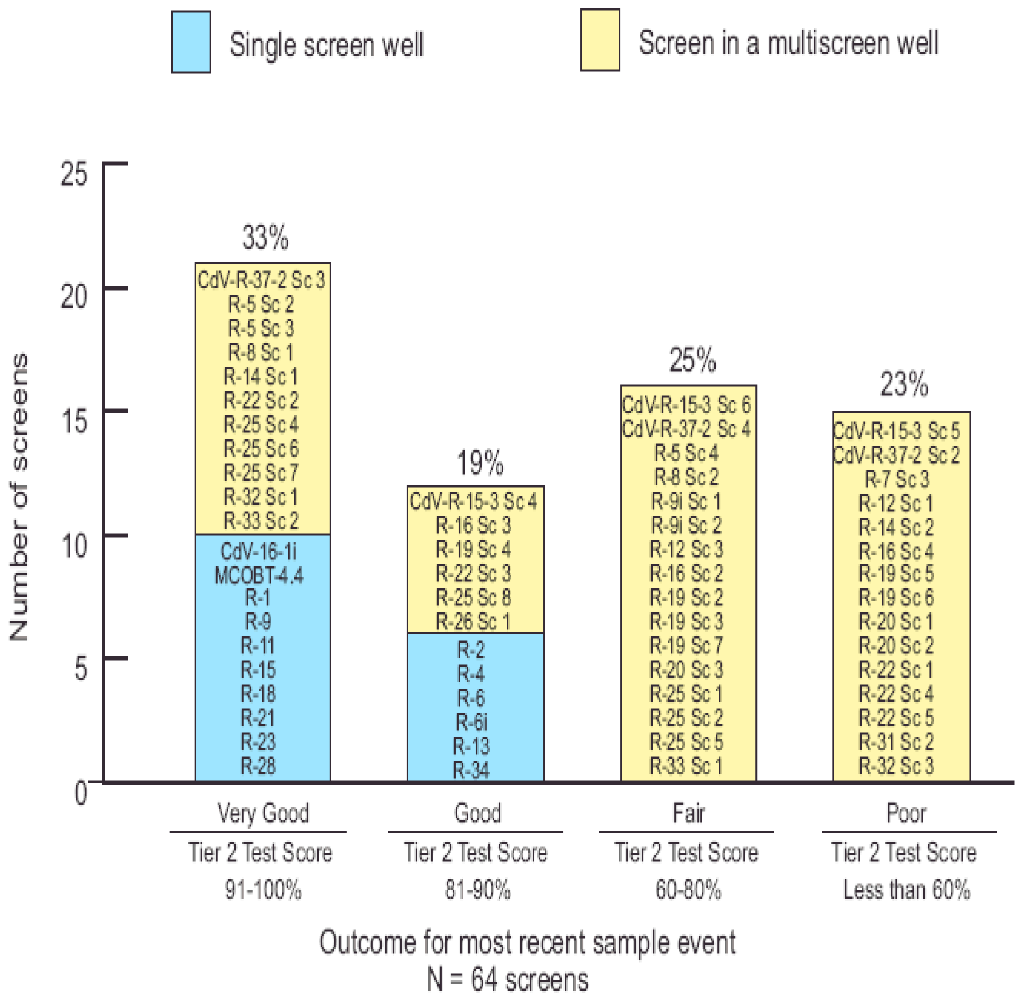



**Figure 1-2.** **Overall condition of screens for producing reliable and representative water-quality samples as of November 2005**

From: LANL *Well Screen Analysis Report:* LA-UR-05-8615, November 2005

## Figure 1-3.

## Hydrostratigraphy at LANL Wells R-28 and R-13

**LANL Well R-13 is Downgradient of Chromium Plume at Well R-28**

**Well R-28** **Well R-13**

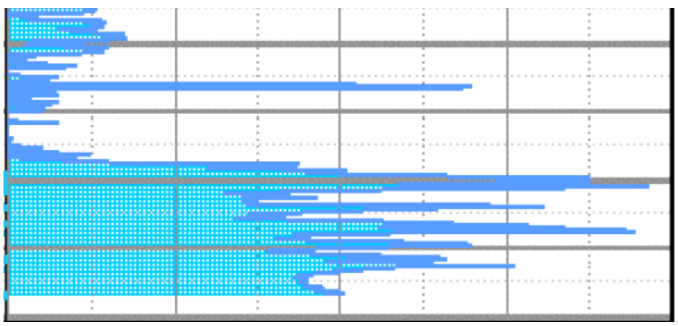
Water Table<br>
Elevation ~5840<br>
(feet above - ~5837<br>
sea level) All strata at -<br>
well R-28 Permeable strata probably have<br>
have high high chromium contamination<br>
permeability but are not monitored<br>
Screen 5794 -<br>
Elevation X 400 ppb -<br>
X hexavalent chromium -<br>
5770 -<br>
-<br>
Layer of clay strata form aquitard between<br>
shallow and deep groundwater<br>
-<br>
-<br>
-<br>
-<br>
5715<br>
X<br>
X<br>
*EPA recommends monitoring well *60-foot screen<br>
screen length of not greater causes dilution<br>
than 10 feet of contamination<br>
X<br>
5654<br>
-<br>
-<br>
-<br>
-<br>
Borehole drilled deep into aquifer with no<br>
reliable data on groundwater contamination<br>
1065 feet = Total Depth 5540 ft (elevation)

Figure 1-4.
Schlumberger Permeability Logs for Wells R-28 and R-34

- Schlumberger Permeability Log For Well R-28

0.001 100,000 gal/day/ft

-- 800 feet



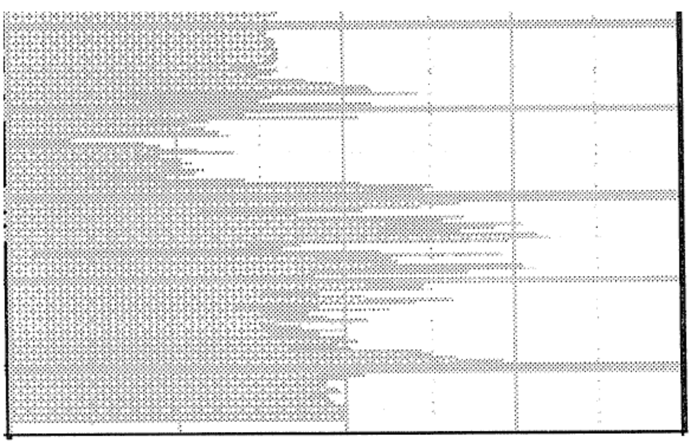
---- Water Table at 883 Feet

---- Well R- 28 Screen
- 934 to 958 feet

Pumping Test Permeability
of Well R-28 Screen
= 45.4 meters/day

- Schlumberger Permeability Log for Well R-34

0.001 100,000 gal/day/ft



---- 750 feet

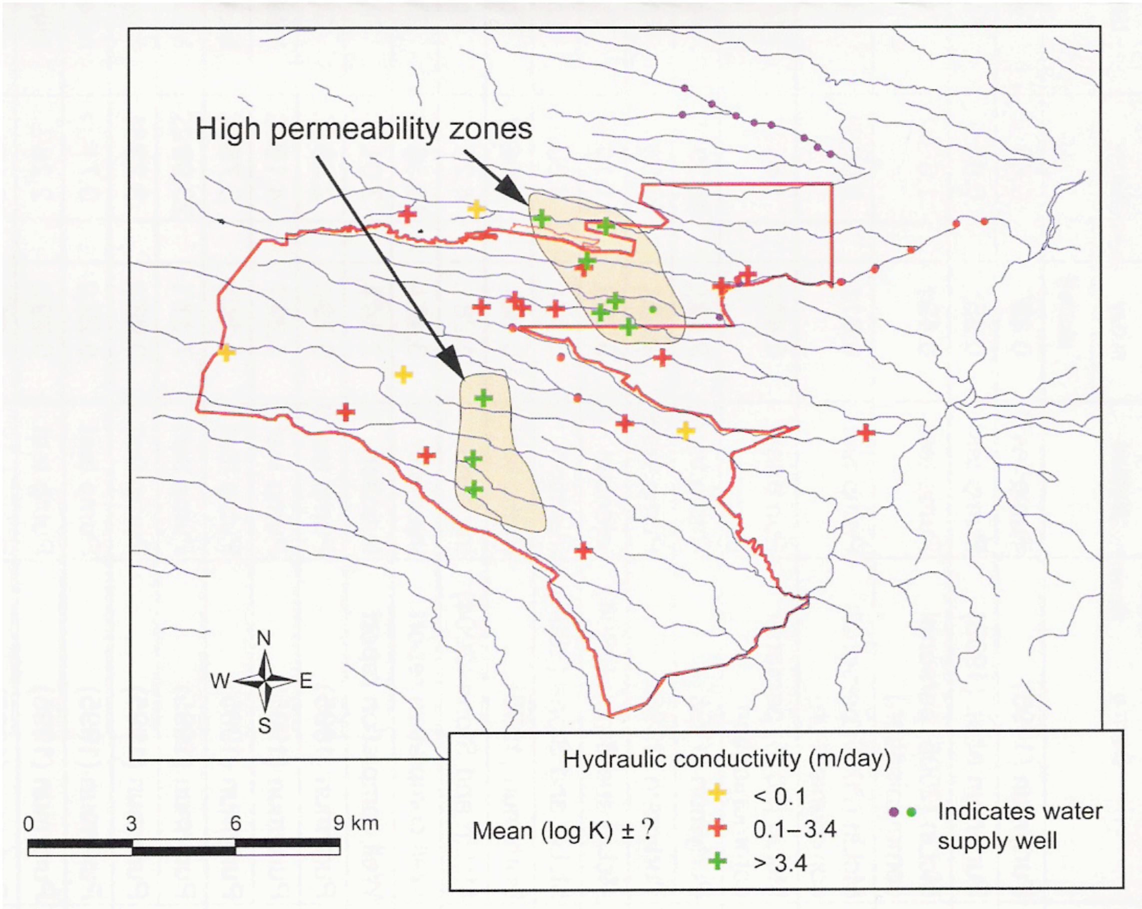
---- Water Table at 794 feet
75 feet of Strata with high
permeability - 794 to 868 feet

----- Well R-34 Screen
- 884 to 907 feet

Well R-34 screen installed 90 feet below water table and below 22-ft thick confining bed of clay strata. Strata with high permeabilty immediately below water table are not monitored.

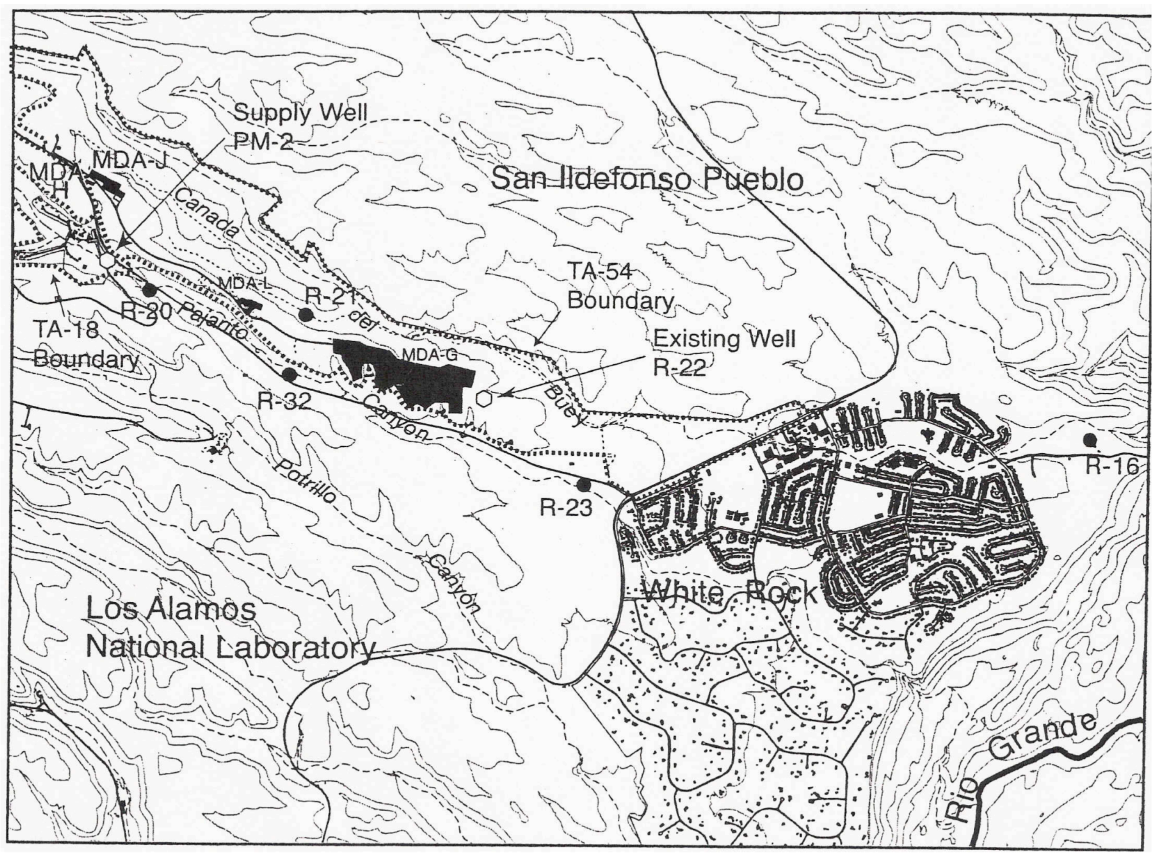
- Schlumberger Logs show clay strata with very low permeability in depth interval of 868 to 890 feet. The clay strata are across the upper 6 feet of the well screen.

- **Because of mistakes, Well R-34 Pumping Test measured a SPURIOUS low permeability of 1.1 meters/day. The regional aquifer at well R-34 may have a permeabilty greater than 40 meters per day.**




The above figure is figure 2-26 from the LANL *Synthesis Report* (LANL Report LA-14263-MS, December 2005)

**Figure 1-5. The misrepresentation in the LANL *Synthesis Report* that the regional aquifer beneath the San Ildefonso Pueblo does not have high permeability. In fact, the LANL data show that the regional aquifer across the property of the Pueblo has very high permeability – possibly greater than 40 meters per day for much of the Pueblo. The regional aquifer of the San Ildefonso Pueblo is a valuable groundwater resource that must be protected from LANL waste. The high permeability of the regional aquifer increases the danger of widespread contamination of the groundwater of the San Ildefonso Pueblo from LANL waste.**

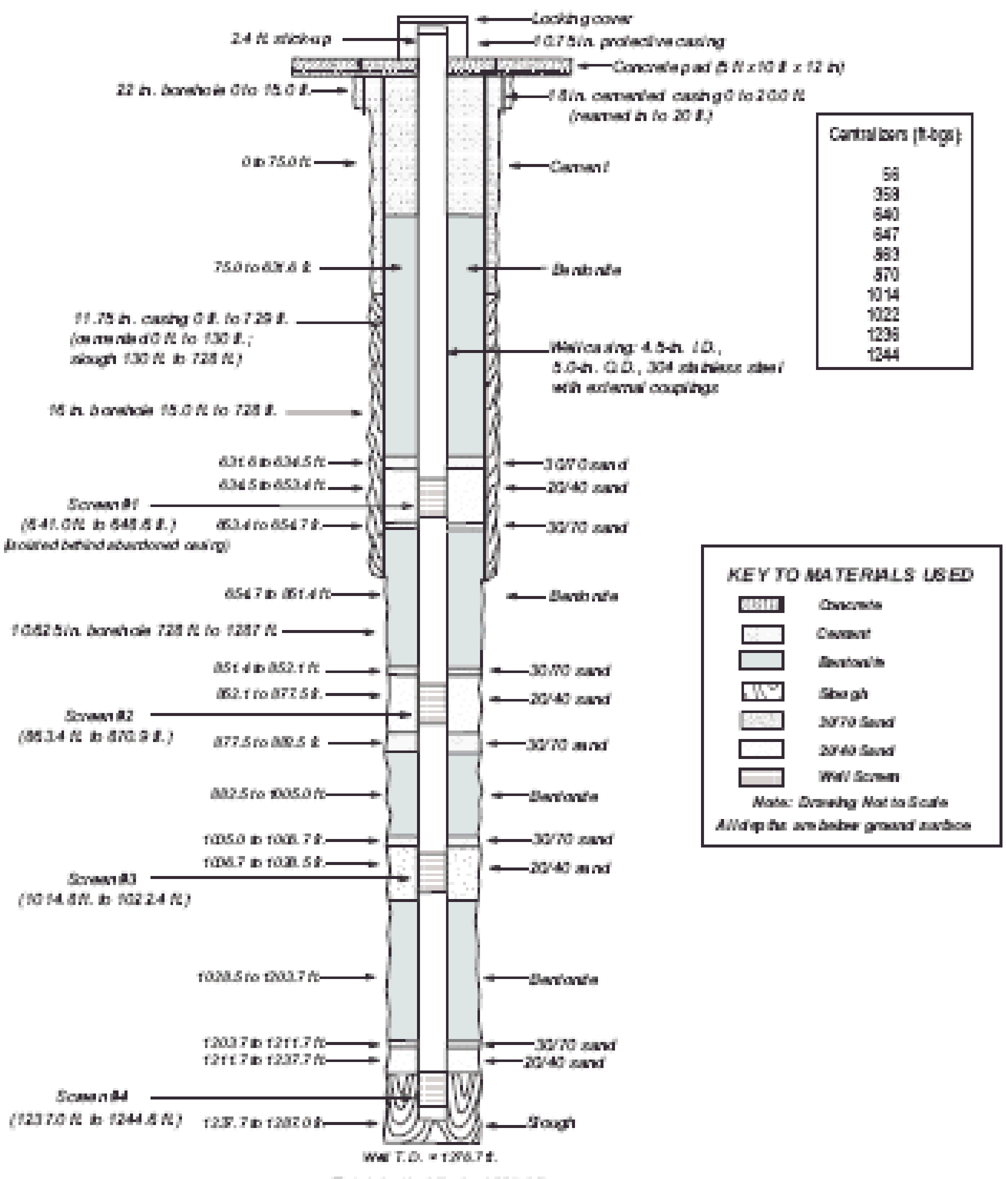



Scale 0 1 2 miles

**Figure 1-6.** The LANL characterization wells R-16, R-20, R-21, R-22, R-23, and R-32 that surround the three RCRA regulated units MDA G (Area G), MDA L, and MDA H. None of the six wells meet the requirements of RCRA for monitoring groundwater contamination.

**Figure 1-7.**

As-built construction of LANL characterization well R-16, a sentry well for LANL contaminants traveling to the Rio Grande and to the Buckman well field.
Screen #1 is blocked off by retractable drill casing that was abandoned in the borehole.
Screen #4 does not produce representative groundwater samples because the screen is surrounded by bentonite clay slough sediments that were not cleaned from the borehole



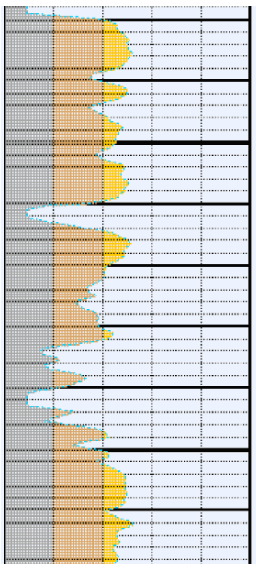

Source: LANL Well R-16 Completion Report, LA-UR-03-1841

**Figure 1-8.**

**Well R-16 Schlumberger Geophysics of Screen #4. Pemeability increases**

from left to right on the figure.

Strata with markedly higher permeability are at a depth of 1180 to 1188 feet and at a depth of 1252 to 1262 feet below ground surface (bgs).



1180 ft bgs

1200 ft

--------Screen #4, 1237-1245 ft – Installed across silty and clayey strata with low permeability, K = 0.5 m/day – LANL *Synthesis Report*

- Also, Screen #4 is surrounded by Bentonite Clay Slough that was not cleaned out of the borehole

- Well R-16 was drilled with the Conventional Mud Rotary Method.

- All of the screened intervals are invaded with large quantities of Bentonite Clay Drilling Mud and Organic Additives. None of the Screened Intervals in LANL Well R-16 meet the requirements of RCRA Subpart F.

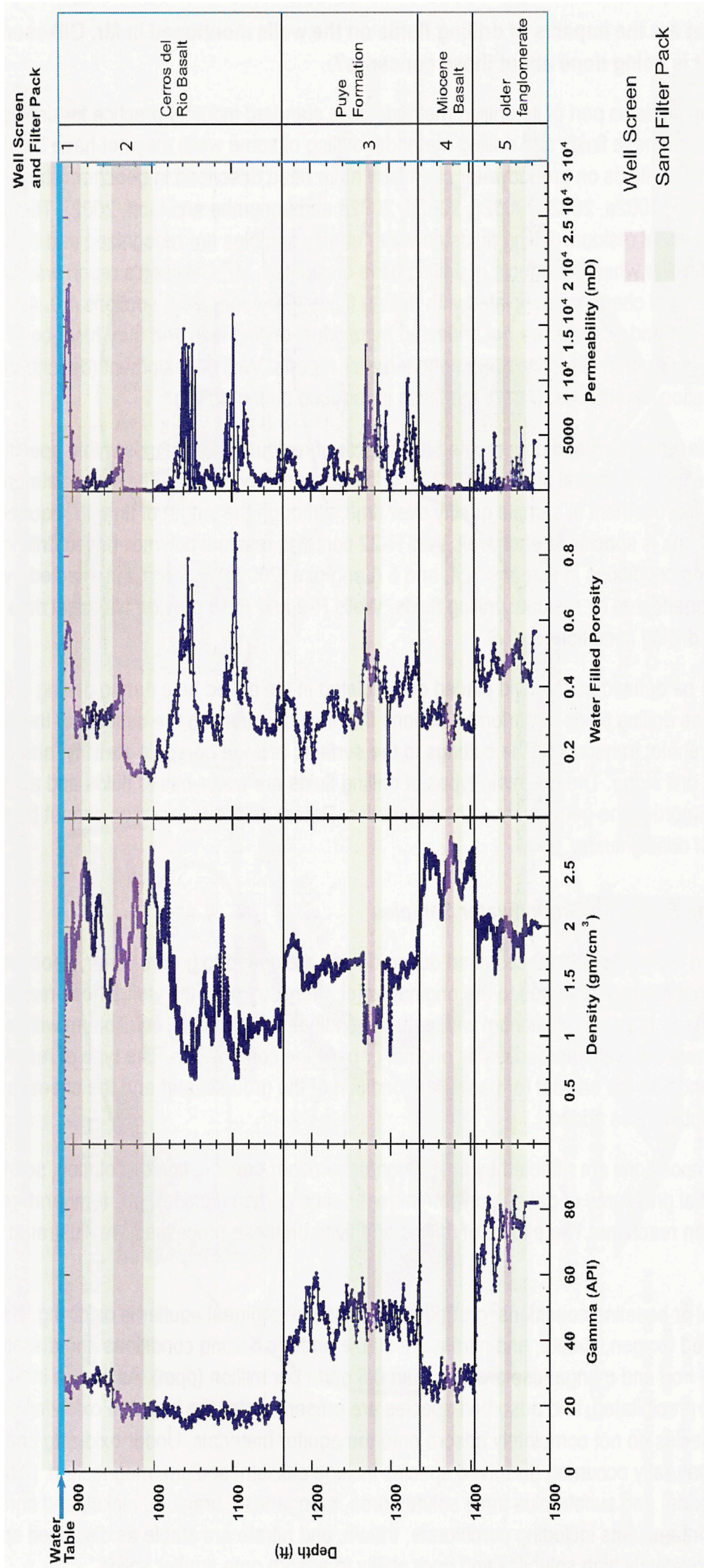
- All of the drill cuttings produced from the mud rotary borehole are mixtures of cuttings from different depths as the cuttings travel out of the borehole along the borehole wall. Furthermore, all of the drill cuttings were contaminated with the bentonite clay drilling mud.

- The contaminated and mixed drill cuttings are not useful for identifying the strata with highest permeability that are appropriate for monitoring

- The borehole geophysics were the best information for locating the well screens in well R-16 but the Sclumberger report shows that the well screens are not installed in the aquifer strata that are important for long-term monitoring.

- There is a need to install a new monitoring well near the location of well R-16 to monitor the aquifer strata that may form a pathway for contami-nation from LANL to travel beneath the Rio Grande to the Buckman Well Field, and important water supply for Santa Fe.

**Figure 1-9. Schlumberger Geophysics for Well R-22. From LA-UR-04-6777.**



Well Screen and Filter Pack
1
2
3
4
5
Cerros del Rio Basalt
Puye Formation
Miocene Basalt
older fanglomerate
Water Table
Depth (ft)
Gamma (API)
Density (gm/cm³)
Water Filled Porosity
Permeability (mD)
Well Screen
Sand Filter Pack