

7. **The NAS Prepublication Copy Misrepresents the LANL Knowledge of Background Groundwater Chemistry.**

RCRA requires accurate knowledge of the background water chemistry upgradient of each solid waste management unit (SWMU) on a RCRA facility such as the Los Alamos National Laboratory. The required knowledge of background chemistry for remediation decisions does not exist. It is a mistake for the NAS committee to describe the knowledge that LANL scientists have of the background groundwater chemistry as “detailed” and “comprehensive.” Indeed, the praise that the NAS committee has for the poor knowledge acquired of background water chemistry is another example of bias in the prepublication copy. For example,

LANL’s Groundwater Background Investigation Report (2006b) provides a detailed description of background concentrations of chemical constituents. The report defines background as “natural groundwater occurring at springs or penetrated by wells that have not been contaminated by the Laboratory or other municipal or industrial sources and that are representative of groundwater discharging from their respective host rocks or aquifer material.

The background report contains detailed information about the chemical analysis (inorganic, organic, stable isotope, radionuclide) of 208 groundwater samples from 12 springs and wells considered background.” p. 36.

The LANL Groundwater Background Investigation Report (LANL, 2006b) provides comprehensive data on naturally occurring contamination in the site’s groundwater.” p. 53.

A sample population of 12 springs and wells is too small a number of sampling locations in consideration of the 43-square mile size of the laboratory and the need to monitor for groundwater contamination over even a much larger region. The LANL background water quality report is neither detailed information nor comprehensive data. The LANL scientists use the sparse population of data to fabricate the background values that are used to assess that well screens impacted by drilling fluids have “cleaned up” and are producing reliable and representative water samples. However, a report by EPA (Ford, R., S.D. Acree, and R.R. Ross. 2006) that is included in the references to the prepublication copy point out the poor quality of the LANL background groundwater quality data set for this purpose:

The proposed criteria [that the well screens have “cleaned up”] are based on analysis of water chemistry. It should be noted that while analysis of changes in aqueous chemistry at a given well screen presents one potential tool for characterizing well recovery, there is a high degree of uncertainty associated with this avenue of analysis. Specifically, aqueous chemistry data cannot be used to infer the distribution of contaminant mass (between water and solids) within the impacted zone adjacent to a well screen without knowledge of the initial concentration of the contaminant entering the impacted zone (*i.e.*, background constituent concentrations). In addition, comparison of measured concentrations of

indicator parameters (or contaminants of concern) to background ground-water concentrations are useful only when the chosen background condition is representative of the un-impacted aquifer adjacent to the well screen being sampled. Reliance on an uncertain background condition to assess apparent well recovery limits the reliability of this approach.

In this regard, the data used to characterize background conditions (LANL, 2005a) appear to be too sparse, derived from sources representing mixtures of water that are significantly different from the samples obtained from the hydrogeologic characterization wells, and representative of significantly different flow paths within the aquifer. It is recommended either that additional background data be obtained from monitoring wells screened solely within the specific units of interest and installed without the use of additives within the screened interval or that much less dependence be placed on the use of currently available background data in this evaluation. p. 8, Ford, R., S.D. Acree, and R.R. Ross. 2006.

An evaluation of “background” ground-water chemistry is provided in LANL (2005a). In this study, sources for background data determined to reflect conditions in the regional aquifer were limited to a few springs and long-screened water production wells located at significant distances from many of the characterization wells. These types of sources generally produce water that is a mixture of contributions from different lithologic units and different areas. This type of study may provide useful information concerning “background” constituent concentrations for the purpose of siting a water supply well. However, it does not appear to be appropriate for detailed comparisons with water samples obtained from monitoring wells that provide samples from discrete zones and likely represent much smaller volumes of the aquifer and different flow paths within the aquifer. Although the information in LANL (2005a) provides insight into the possible range of “background” conditions, data from monitoring wells located upgradient of waste management units/disposal areas would be needed to allow more reliable comparisons with wells located downgradient of these units. Therefore, the current “background” data should not be used as the sole indicator of whether samples are representative of aquifer conditions.” p. 14, Ford, R., S.D. Acree, and R.R. Ross. 2006.

In August 2003, at a time that was six years into the “evolution” of the LANL/DOE ability to install characterization/monitoring wells, the characterization well R-26 was installed specifically to characterize the background chemistry of groundwater in the regional aquifer. LANL well R-26 completion report; Kleinfelder Project No. 37151. The well was drilled with mud-rotary methods that allowed water in a perched zone of saturation to flow down the open borehole to cross-contaminate the groundwater in the regional aquifer.

The mud-rotary drilling method did not recognize the water table of the regional aquifer with the result that the R-26 borehole was needlessly drilled to a depth of greater than 500 feet below the water table. The screen was installed in inappropriate strata that were so extensively invaded with the bentonite clay drilling mud that the well does not produce a sufficient amount of water for sampling.

The Schlumberger^R geophysics performed in the R-26 borehole identified a thick interval of aquifer strata with high permeability at a depth within 150 feet below the water table. These are the strata that are important for characterization of background chemistry but LANL/DOE failed to install well R-26 for this purpose.

The failure of LANL/DOE to install a usable monitoring well for background water chemistry in the regional aquifer at a cost of greater than \$1 million is an example of the bias shown by the NAS committee to the “evolution” of the capability of LANL/DOE to install characterization/monitoring wells. Furthermore, well R-26 is one of many examples of the failure of the open-hole drilling methods, and the need to install drill casing as a “last resort” to save the borehole from collapse. Drill casing was installed to a depth of 1000 feet in the R-26 borehole to allow continued drilling with the mud-rotary method.

RCRA requires installation of background water quality monitoring wells at appropriate locations immediately upgradient of each SWMU. The NMED/LANL Consent Order fails to enforce this requirement under RCRA for the groundwater protection program at LANL. For comparison and as an example of inconsistent regulation of DOE sites in New Mexico, NMED requires Sandia National Laboratories (SNL) Albuquerque facility to install background wells immediately upgradient of the SWMUs. A recent example is the NMED letter of March 23, 2007 to SNL that required SNL/DOE to replace the background monitoring well for the Sandia Mixed Waste Landfill, an old legacy waste dumpsite, because the existing background monitoring well has gone dry.

A contradiction within the prepublication copy is the praise for the characterization of background water quality on pages 36 and 53 compared to the finding by the NAS committee on page 95 that the LANL scientists have poor knowledge of the background concentration for cesium-137 and chromium in the groundwater:

While the Background Investigation Report shows good statistical data compilation focused on well-documented QA/QC approaches, gaps remain. The report is not clear on how the QAPP procedures were actually followed and implemented, and in fact it does not reference the QAPP. The report also contains discrepancies in terms of documenting the actual analytical methods used and the respective MDL and PQL for the analyses. One example is for Cs-137. The background investigation report (Table 4.2-4a) gives a Cs-137 concentration of 1.1 pCi/L without specifying the MDL or PQL. Notably, 1.1 pCi/L is below the PQL for Cs-137 that LANL cites elsewhere—8 pCi/L in the Integrated Groundwater Monitoring Plan (Table C-4).

In another important example, the mean Cr concentration in a filtered sample representative of the background in the regional aquifer is given as 4.083 μ g/L with a standard deviation of 5.948 μ g/L (Table 4.2-4a). The same report (Table 4.1-2) cites the MDL as being either 2 or 10 μ g/L depending on the particular analytical method used.

Thus the actual mean Cr background concentration is not established. All that can be inferred is that the true background level is somewhere in the 1-10 $\mu\text{g/L}$ range.

On this basis, it appears that the majority of the Cr concentrations cited in Figure 3-3 of the Interim Measures Work Plan for Chromium Contamination in Groundwater (LANL, 2006d) are *background levels* and that only the Cr concentrations cited for wells R-28 and R-11 can be attributed to the LANL operations. Yet without this clarification, one can infer that all the levels cited in that figure are significant (i.e., greater than background).”

A further contradiction in the prepublication copy is the following discussion of the background for chromium on page 46 without mention of the critical discussion on page 95 that the LANL scientists have poor knowledge of the background concentration for chromium:

Extent of Contamination in Regional Groundwater

Chromium has been detected in the regional groundwater at concentrations above the background value of 6.62 $\mu\text{g/L}$ in three wells including R-28, R-11, and R-15.

Another example of where the NAS committee describes the poor knowledge that the LANL scientists have for the background geochemistry is for the purpose of assessing that well screens impacted by the drilling fluids produce reliable and representative water samples. This concern is described on many pages in the prepublication copy, such as the following:

During this study the committee was presented with information indicating that many wells into the regional aquifer at LANL (R-wells) are flawed for the purpose of monitoring. The committee did not disagree, but rather found a lack of basic scientific understanding of the subsurface geochemistry that could help ensure future success. Evidence about the conditions prevalent around the sampling points (screens) in the compromised wells is indirect—relying on plausible but unproven chemical interactions around the screens, general literature data, analyses of surrogates, and apparent trends in sampling data that may not be statistically valid. p. 6.

Similarly, note that the excerpt above from page 8 of the EPA report shows the concern of the EPA scientists for the poor knowledge of the background groundwater quality that the LANL scientists use to assess that the impacted well screens have “cleaned up.”

The record shows that LANL/DOE have not produced the knowledge of background groundwater water quality that is necessary under RCRA for knowledge of the:

- 1). nature and extent of the hexavalent chromium plume,
- 2). “clean up” of well screens impacted by drilling fluids, and
- 3). nature and extent of contamination from legacy waste disposal sites.

It is important for the NAS committee to accurately present in the NAS Final Report the poor knowledge by LANL/DOE of the background groundwater chemistry and the

need to improve the characterization of the background groundwater chemistry in the perched zones of saturation and especially in the regional aquifer.