4. The NAS Committee Approval of the LANL Interim Groundwater Monitoring Plan is a Mistake that Must be Corrected in the NAS Final Report.

The formal statement of task instructed the NAS committee to answer the following questions concerning the laboratory's interim groundwater monitoring plan:

> "The committee was asked to evaluate the interim groundwater monitoring plan developed by LANL. Specifically, two questions were posed in the committee's task statement: Does the plan follow good scientific practices; and is it adequate to provide for the early identification and response to potential environmental impacts from the laboratory? As noted previously, the short answer to the first question is a qualified yes, while the answer to the second question is no." p. 70.

The NAS committee's answer of a "qualified yes" to the first question is a mistake and is in direct contradiction with the "no" answer to the ability of the interim plan to provide for the early identification and response to potential environmental impacts from the laboratory. After all, the finding by the NAS committee that the interim plan fails to provide early detection of contamination requires a finding that the interim plan does not follow good scientific practices.

Furthermore, there is much discussion in the prepublication copy of the NAS report where the committee describes the interim plan as not following good scientific practices:

1). The overarching finding by the committee that possibly all of the LANL monitoring wells are not useful for monitoring contamination with the following statement as an example:

Many if not all of the wells drilled into the regional aquifer under the Hydrogeologic Workplan appear to be compromised in their ability to produce water samples that are representative of ambient groundwater for the purpose of monitoring. p. 79.

2). The overarching finding by the committee that LANL scientists have not properly applied geochemistry to identify well screens that produce reliable and representative water samples with the following statement as an example:

During this study the committee was presented a good deal of information indicating that most or all 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 knowledge that could help ensure future success. Evidence about the conditions prevalent around the screens in the compromised wells is indirect – relying on plausible but unproven[8] *chemical interactions,*

general literature data, analyses of surrogates, and apparent trends in sampling data that may not be statistically valid. p. 110.

[8] *Not directly observed and measured under LANL site conditions.*

3). The finding by the NAS committee that the "watershed approach" in the interim plan is not a good scientific practice as illustrated by the following statement:

However, there are areas where the Interim Plan does not appear to follow good scientific practice. The most important of these is the focus on a watershed approach, where the monitoring plan for each watershed within LANL is developed and laid out individually in the Interim Plan. This structure, which is specified in the Consent Order, works quite well for monitoring surface base flows and alluvial groundwater that are confined to the canyons. However, it does not work well for the intermediate aquifers and even less for the regional aquifer. p. 71.

4). The finding by the NAS committee that the interim plan is not up to date with the current knowledge of the hydrogeologic setting as illustrated by the following discussion:

The Hydrogeologic Workplan has been effective in improving characterization of the site's hydrogeology. However, the knowledge gained through the workplan does not appear to have been used effectively in the development of the interim plan. The workplan is mentioned only in the introduction of the interim plan, and rationale for the siting of new wells in the interim plan is not grounded in the scientific understanding of the site evident in the Synthesis Report and other publications such as the Vadose Zone Journal (VZJ, 2005).

Recommendations: *LANL should demonstrate better use of its current understanding of contaminant transport pathways in the design of its groundwater monitoring program. Tables in the monitoring plan that give the rationale for locating monitoring wells should at least provide a general linkage between the proposed locations and the site's hydrology, or a section discussing the relation between well locations and pathway conceptualizations should be added.* p. 77.

5). The NAS committee describes the importance of purging a sufficient volume of water from well screens to ensure collection of samples that are representative of the *in situ* groundwater, but then fails to bring attention to the fact that no-purge water samples are collected from 70% of the R-wells installed by the LANL Hydrogeologic Workplan. The importance of purging the well screens as a good scientific process is described in the prepublication copy:

Given that drilling and well construction inevitably causes disturbance of the subsurface formation, industry experience is that typically the native geochemical

and hydrological conditions tend to re-establish as groundwater flows around and through the well screen. To help ensure this re-equilibration, application of proper purging techniques in both well development and groundwater sampling is necessary for collection of representative groundwater samples, especially in the regional aquifer. The most trustworthy sampling technique includes purging three or more well volumes from the monitoring well before sample collection (ASTM D 4448, 1992). While this method requires containment and potential treatment of much more water that [sic] the minimum-purge techniques, it better ensures that samples from the developed wells represent the conditions in the nearby aquifer. p. 90.

6). The NAS committee finds sparse monitoring in the southern region of the Laboratory where a very large inventory of plutonium is buried at MDA AB as follows:

In looking at the regional monitoring network, the committee found that the southern portion of LANL is one area of the regional aquifer that is currently very sparsely monitored. p. 72.

Comment by the authors: We brought to the attention of the NAS committee that the "sparse monitoring" at MDA AB is only with the old LANL test wells installed in the early 1960's that have never produced reliable water samples for detection of contaminants of concern for MDA AB. We are disappointed that the committee has not brought attention to the need to plug and abandon the old LANL test wells and install the required network of reliable monitoring wells at MDA AB. The fact that the interim plan continues to collect water samples from the old test wells and then publish the spurious data from these wells as reliable for knowledge that the groundwater is not contaminated is another example that the interim plan does not follow good scientific practices.

7). The committee finds sparse monitoring on the San Ildefonso Pueblo as illustrated by discussion:

Another area that appears to be undersampled is the Pueblo de San Ildefonso to the east of LANL, which is generally downgradient from the site. Plans to install monitoring wells on Pueblo lands under the Memorandum of Understanding described in Section 3 of LANL (2006a) are a step in the right direction. Additional monitoring to ensure early detection of contaminant plumes beneath these Pueblo lands will likely be required. p. 73.

Comment by the authors: The Pueblo lands that are sparsely monitored are between many sources of LANL contaminants and the Rio Grande and on to the Buckman well field located immediately east of the Rio Grande. The Buckman well field is an important water resource to the City of Santa Fe. The highest known contamination in the hexavalent chromium plume is immediately north of the Pueblo lands and the presence of this contamination across the Pueblo lands is not monitored. The large legacy waste disposal sites MDA G and MDA L are located immediately south of the

Pueblos lands but groundwater contamination from these sites is not monitored (see the next topic).

8). The committee identifies the need to monitor the groundwater beneath the legacy waste disposal sites (MDAs) located atop mesas but the interim plan does not meet this need for <u>any</u> of the MDAs as illustrated by the discussion from the prepublication copy:

> LANL considers that 9 of its 25 MDAs have a significant potential to contaminate groundwater. Of the nine MDAs considered significant, the inventory for two is "unknown" (see Table 3.2). For MDA G, the tritium inventory according to Table 3.2 is about 3.6 million Ci, which is far larger than the tritium discharged from any of the liquid outfalls. A large amount of Pu-239, about 2300 Ci or 39 kg, is reported to be in MDA AB.
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> The presence of large amounts of radioactive materials in unlined pits in the MDAs is an issue. Although the mesa tops are generally considered to be dry, this is not true year-round. Standing water has been observed in unlined pits in several locations, including MDA AB (CCNS, 2007; Levitt et al., 2005). This contact of precipitation and runoff with stored waste materials implies that a fraction of the contaminants are subject to leaching and subsequent migration. The extent of this leaching is not known. CCNS, 2007.
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> *Overall, LANL estimates 40-60 percent of the SWMUs have been sampled; however, information about the total mass of contaminants for the SWMUs has not yet been compiled (D. Katzman, personal communication, August 2006). Although LANL is still in the process of characterizing most solid waste disposal areas, the committee was not shown data to substantiate the claim that waste has not migrated from the SWMUs.* p. 34.

<u>Comment by the authors:</u> Although LANL <u>acknowledges</u> that 9 of the 25 MDAs have a significant potential to contaminate groundwater, to the present time LANL has not installed monitoring wells at appropriate locations immediately near any of the MDAs as required by sound scientific practices. The only exception is well R-22 located 500 feet downgradient of MDA G, and this well detected a large suite of radionuclide and chemical contaminants during the first several years of sampling.

- Contaminants listed in the LANL Well R-22 Geochemistry Report:
  - * pentachlorophenol (6.2 parts per billion (ppb))
  - * chloroform (0.94 ppb)
  - * phenol (19 and 32 ppb)
  - * 4-methylphenol (44 to 210 ppb)
  - * 2-butanone (6.9 to 8.9 ppb)
  - * diethylphthalate (1.3 ppb)

benzo(a)pyrene (0.24 ppb)
benzoic acid (3 to 12.5 ppb)
butyl benzyl phthalate (9.8 ppb)
toluene (0.2 to 0.76 ppb)
methylene chloride (0.62 and 2.2 ppb)
bis(2-ethylhexyl)phthalate (1.0 and 3.9 ppb)

Several substituted benzene compounds including
isopropylbenzene (0.16 to 0.54 ppb), and
1,4-dichlorobenzene (0.16 to 0.23 ppb).

* The six contaminants with asterisks in the above list are highly mobile in groundwater and are all commonly found in groundwater beneath toxic waste landfills. In addition to the large number of chemical contaminants, the highly mobile radioactive contaminants technetium-99 and tritium were detected in the first water samples from Well R-22.

> A LANL report – LA-UR-04-6777, September 2004 recognizes the contamination detected in the water samples produced from well R-22 as follows:
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> 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.

Comment by the authors: The decline and disappearance of the contamination in the water samples produced from well R-22 is because of the many mistakes in the drilling, installation and sampling of the well. The danger of the large quantity of legacy wastes buried in MDA G to contaminate the groundwater below the Pueblo de San Ildefonso, the Rio Grande and the Buckman well field is not known because of the failure of LANL to follow goof scientific practices to:

a). install the required network of monitoring wells, and
b). perform the necessary field studies to determine the speed of groundwater travel in the fast pathways.

9). The interim plan does not monitor groundwater contamination due to travel of contaminants as vapors and the NAS committee identifies a special concern for vapor phase transport of contamination below the legacy waste disposal sites atop dry mesas. From the prepublication copy:

The importance of vapor transport in deep vadose profiles varies and strongly depends on soil texture and water content. Because the water contents in the dry mesas are low, vapor transport may be significant. LANL's conceptualization of contaminant transport from dry mesas is not as well developed as that for wet canyons. Given the large inventory of wastes disposed of on the mesas, assumptions that underpin the view that contaminants will be relatively immobile need more field and laboratory confirmation. Vapor transport deserves greater study. p. 61.

Comment by the authors: Large vapor plumes of solvent contaminants including PCE, TCE, and TCA are known to be present below MDAs C, G, and L with the largest plumes present below MDA L. Monitoring wells have not been installed at any of the MDAs to investigate if downward transport of contaminants as vapors has caused contamination of the regional aquifer. The failure to install the required wells is another example that the interim plan does not follow good scientific practices.

Table 3.2 in the NAS report does not include MDA L as a legacy waste disposal site with a high potential to contaminate groundwater. This is a mistake that must be corrected because the disposal history at MDA L is clear evidence of the high potential for contamination of the regional aquifer to have occurred due to transport of contaminants as vapors. The property of the San Ildefonso Pueblo is very near MDA L and very susceptible to groundwater contamination from the waste disposal practices at MDA L. It is important to revise Table 3.2 to include MDA L and include MDA L on Color Plate 4.

The ten topics listed here as discussion in the NAS prepublication report are proof that the NAS committee has made a mistake to answer the question "Does the interim groundwater monitoring plan follow good scientific practices?" with a "qualified yes." The correct answer is no. It is imperative for the NAS Final Report to correct this mistake in the prepublication copy.