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September 17, 1997

Mat Johansen, DOE AIP POC
U.S. Department of Energy
Los Alamos Area Office, MS A316
Los Alamos, New Mexico 87544

HSLA LANL 6/17/97

Subject: Hydrogeologic Workplan, Los Alamos National Laboratory, December 6, 1996

Dear Mr. Johansen:

The DOE Oversight Bureau (DOE OB) has reviewed the subject document. The attached comments are provided for the purpose of communicating the results of the review. They are not provided or intended for the purpose of representing the regulatory position of the New Mexico Environment Department.

This workplan describes activities proposed by Los Alamos National Laboratory (Laboratory) to characterize the hydrogeologic setting beneath the Laboratory, and to enhance the Laboratory's groundwater monitoring system. Because of the significance of this document to further investigations of the hydrogeologic setting, and to the implementation of the ground-water monitoring system, the majority of the attached comments are intended to promote the accurate description of the hydrogeologic environment. Some general conclusions from the review are included below:

- The Hydrogeologic Workplan addresses many of the concerns which were transmitted in the AIP Program's "Initial Assessment of the Ground Water Monitoring Program at Los Alamos National Laboratory, New Mexico" (Stone, W.J., Davis, T.D., and Katzman, D., 1993). Specifically, it proposes an updated monitoring system and installation of deep-aquifer monitoring wells.

- Deficiencies in the workplan include (1) inaccuracies relating to the description of the hydrogeologic systems, (2) insufficient plans to describe the relationship of Laboratory contaminant sources to surface and shallow ground-water contamination, and (3) incomplete characterization of intermediate depth ground-water occurrences.

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We appreciate the extent to which the Laboratory and the DOE provided us the opportunity to participate in the development of this workplan. However, our involvement in the preparation of current workplan was somewhat less than our previous involvement in the development of the ground-water protection management program plan (GWPMPP) during 1994 and 1995. Also, this review was limited because current hydrogeologic and hydrochemical data, particularly ESH-18 water-level measurements and ER Project ground-water sampling results, were not available to us.

We look forward to reviewing subsequent workplans and reports. If there are any questions about this review, please contact Michael Dale, DOE Oversight Bureau ground-water issues manager, at (505) 672-0449.

Sincerely,

Stephen Yanicak

Steve Yanicak, LANL POC
Department of Energy Oversight Bureau

cc w/o attachment:
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New Mexico Environment Department
DOE Oversight Bureau Review of Los Alamos
National Laboratory's Hydrologic Work plan,
Los Alamos National Laboratory, December 6, 1996

Specific Comments:

1. § 2.1.3.1, paragraph 3, Page 2-12, General Hydrology

"Only four of the canyons contain perennial (flowing continuously) reaches inside Laboratory....."

The DOE OB recognizes seven onsite perennial reaches: (1) a short reach in Chaquehui Canyon near the Rio Grande, (2) Ancho Canyon from Ancho Spring to the Rio Grande, (3) a short reach in Twomile Canyon, (4) a short reach in Threemile Canyon, (5) Cañon de Valle at the northern boundary of Tech Area (TA)-16 (near MDA-P), (6) 2-3 mi reach in Pajarito Canyon from the Starmer Gulch confluence to approximately the Twomile Canyon confluence, and (7) Sandia Canyon from TA-3 to approximately LANL's Environmental Surveillance (ES) surface-water station SCS-3. Streamflow in Chaquehui, Ancho, Twomile, Threemile Canyons is supplied by Spring 9A, Ancho Spring, Anderson Spring and TA-18 Spring respectively. Perennial flow in Cañon de Valle and Pajarito Canyons has been periodically measured by DOE OB since January, 1995, and discharge rates range from 0.023 to 0.178 cfs in Cañon de Valle and 0.049 to 0.446 cfs in Pajarito Canyon. Base flow in Cañon de Valle and Pajarito Canyon is assumed to be supplied by perennial springs which discharge from Unit 3 and/or Unit 4 of the Bandelier Tuff. Perennial flow in Sandia Canyon is supplied by NPDES outfalls located at TA-3; periodic field observations made by the DOE OB show that flow normally extends for approximately three miles east of the TA-3 area.

The sentence should more accurately reflect the actual surface-water conditions at the laboratory (e.g., "Only seven canyons contain perennial reaches within the Laboratory.....").

In addition, we suggest that the recent development of perennial surface water in upper Water Canyon may be a recharge source for underlying aquifers. On February 21, 1997, DOE OB inspected the spring that supplied the Water Canyon Gallery (Big Spring), which is located in a northern tributary to Water Canyon west of SR501. A break in the water-line approximately 400 ft downstream from Big Spring was discovered, and discharge from the pipe was estimated at 120 gpm. Flow was continuous downstream for approximately 300 ft. The DOE OB inspected the site again on March 23, 1997, and noted that flow had now extended in Water Canyon to at least SR 501. On April 21, 1997, continuous flow was observed in Water Canyon 0.25 mi west of its confluence with Cañon de Valle confluence to approximately one mile west of SR4, and probably extended across the western portion of the Laboratory at SR501 and to Big Spring. It is assumed that some portion of this flow was supported by snowmelt runoff in the upper reaches of Water Canyon. On July 30,

1997, Big Spring water flowed approximately 1000' before infiltrating into the alluvium; therefore, it is assumed that this water is being transmitted via abundant underflow and/or seepage beneath the canyon alluvium. Hence, due to the water-line break mentioned above, an additional ground-water recharge source has recently developed, and the hydrologic system(s) downgradient from this area may change dramatically.

2. § 2.1.3.1, paragraph 4, Page 2-12, General Hydrology

The DOE OB has made numerous surveillance trips to lower Water and Chaquehui Canyons since 1993, and has never observed perennial and/or intermittent flow to the Rio Grande. Spring 5AA is characterized by damp alluvium and supports no baseflow in Water Canyon. Flow from Spring 9A discharges from the south-facing slope of Chaquehui Canyon and supports flow in Chaquehui Canyon for approximately 300 ft before infiltrating into the canyon alluvium.

Water from Homestead Spring supplies baseflow in Pajarito Canyon, merges with perennial flow in Starmer Gulch (PA-8.9), and subsequently flows downstream to some unknown point between PA-8.9 and TA-18. On July 22, 1994, the DOE OB traversed down canyon from PA-8.9 to the confluence with Twomile Canyon, and observed continuous flow for the entire reach. During the spring of 1996, which was an extremely dry period, flow was measured at 0.049 cfs (22.3 gpm) at PA-8.9. Since February 1995, periodic non-storm-water flow measurements were made at PA 8.9. Flow rates ranged from 0.049 to 0.446 cfs (22.3 to 202 gpm); hence, perennial flow exists within this canyon reach for several miles.

Stream flow in Starmer Gulch and Pajarito Canyon just above their confluence has been measured and estimated by DOE OB staff on several occasions. The entire surface discharge of groundwater from Homestead Spring is approximately 0.02 cfs (7 gpm). Surface water flow from Homestead Spring continues to the confluence of Pajarito Canyon and Starmer Gulch. The perennial flow from Starmer Gulch (0.05 cfs or 22.65 gpm) at the confluence is approximately 3 times the amount of that in Pajarito Canyon. Also, perennial streamflow in Arroyo De Ladelfe (LA-UR-93-1230), a tributary to Pajarito Canyon, located about 300 meters east of the confluence of Pajarito and Starmer, is approximately 0.03 cfs (15 gpm).

The perennial flow from Starmer Gulch and Arroyo De Ladelfe should be included in the description of perennial reaches in Pajarito Canyon.

3. § 2.1.3.2, paragraph 1, Page 2-14, Ground Water

The DOE OB recognizes one additional mode of ground-water occurrence: perched in the Tshirege Member of the Bandelier Tuff. Ground water has been observed discharging from the upper units of the Tshirege in the western and central portions of the Laboratory from perennial and ephemeral springs and seeps.

The DOE OB observed continuous flow from several of these springs, such as Burning Ground Spring, from 1994 through the present. Flow decreased in response to drought conditions during late 1995 and early 1996; however, during the spring of 1997 flow from these springs, such as Homestead Spring, increased dramatically following the snowmelt runoff period. Additionally, these occurrences were probably utilized by pre-laboratory inhabitants (homesteaders, Native Americans, etc.). This theory is supported by the presence of pre-laboratory structures such as water collection systems (cisterns) or homestead sites located near perennial reaches which are supplied by this ground-water.

This mode of ground water, including a description, should be included in the text.

4. § 3.1, paragraph 1, Page 3-1, Central Database

"All ER analytical results are stored in the database."

It appears that some Environmental Restoration-derived data have not been submitted to FIMAD. In addition, a sufficient amount of analytical data has not been released by the Field Units from the QA/QC section of FIMAD in a usable format. The DOE OB views this as a very serious problem that will ultimately affect both the time- and cost-effectiveness of the LANL ER Project. A process of data availability should be defined for the retrieval of the ground-water data collected by the Field Units.

5. § 3.1.1, paragraph 2 (Bullet 5), Page 3-2, Compile Existing Data in a Central Database and Assess the Validity

"Spring location inventory entered into FIMAD by NMED DOE..."

The DOE OB would like to schedule a meeting with LANL hydrologists to establish concurrence as to which springs are ephemeral or perennial, as well as their location, nomenclature, etc.

6. § 3.1.1, paragraph 2 (Bullet 6), Page 3-2, Compile Existing Data in a Central Database and Assess the Validity

"Watershed maps based on current digital elevation model entered into FIMAD"

Unfortunately, computer-generated watershed maps are subject to problems with delineation accuracy. These inaccuracies will follow through in surface-water studies. It is suggested that any improper delineation be corrected before maps are used in modeling.

7. § 3.1.2, Consolidate Newly-Collected Data in Central Database

We concur with LANL's idea of developing a Central Database; however, we do recommend that LANL include all non-ER or ESH data, as well as all historical environmental/geological data. A central database, including recent and historical data, should be developed as soon as possible.

The target date for completion of the centralized database should be included.

8. § 3.1.2 (Table 3-1A and 3-1B), Pages 3-3 and 3-4

There is no information displayed on Table 3-1 concerning the collecting and/or analyzing of fracture data. It is suggested that this be added.

9. § 3.2.1 (Table 3-2, Key Steps, Item 6), Page 3-6

Maintenance of existing gaging stations should be included due to the fact that some of LANL's stream-monitoring sites have experienced head cutting or backfilling, and flow can no longer be correctly or accurately measured. In addition, some of LANL's primary-measuring devices (e.g, 120° V-notch weir) are not designed to accurately measure peak-flow rates. For example, peak flows at gaging station E030 exceed the upper-head restrictions for that particular weir. LANL should assess the adequacy of all their primary-measuring devices.

10. § 3.2.1 (Item 2), Page 3-7, Overview

The target date for completion of the background studies should be included?

11. § 3.2.1 (Items 8 and 9), Page 3-8

It is unknown if regional-aquifer vertical gradients exist; which may cause mixing (dilution) of deep and shallow (water-table conditions) ground water. In addition, flow across hydrostratigraphic units may also occur if well screens extend across units. Precautions (e.g., short-screen lengths, multiple-screened intervals) to prevent such mixing should be included in the document.

12. § 3.3.1, paragraph 3, Page 3-9, Overview of Modeling

"Hydrologic modeling within the Hydrologic Work plan will be applied at two levels: The first addresses....."

This may only be a problem of wording, but it would seem more reasonable to first develop a site-wide model and then zoom in on/adjust it for aggregates.

13. § 3.3.4, paragraph 1, Page 3-10, Site-wide Saturated Zone Model

"Rather than creating a unified vadose zone-saturated zone model, a saturated....."

We agree that a complex model is not warranted at this time or with the data now available. LANL's proposed approach is reasonable.

14. § 3.3.4, paragraph 2, fifth bullet, Page 3-10, Site-wide Saturated Zone Model

The list of issues to be addressed by the modeling includes ground-water chemistry. As a preliminary step to both flow and transport modeling, we recommend a water-quality study to identify the hydrochemical facies on the Pajarito Plateau. This may be coupled with a study of background water quality, which is also needed for ER/Risk Analysis tasks.

15. § 3.3.4, paragraph 4, Page 3-10, Site-wide Saturated Zone Model

Although the recent effort by Frenzel (1995) is a useful starting place for flow modeling, it does not seem necessary to match it. Rather, the different objectives of that model (supply) should be taken into account in any use of it to design the site-wide model.

16. § 3.3.5, paragraph 2, Page 3-11, Information Support

"If there is good agreement, it will then be possible to incorporate reasonable assumptions into the groundwater modeling effort."

If there is not good agreement, then steps to achieve an agreement should be included in the document.

17. § 4.0 HYDROLOGIC CHARACTERIZATION

The following general comments concerning Chapter 4.0 are subdivided into different sections which the DOE OB deems important:

A. WELL PLACEMENT

Alluvium Wells

Although the Hydrologic Work plan proposes 51 alluvium wells, the appropriate number and location of such wells, and rationale, will only be determined once the ER canyon's investigation group evaluates and assesses all available data/information. For example, the ER group is in the process of developing a characterization Work plan for Mortandad Canyon. Their detailed compilation, evaluation and assessment of all available data have improved or refined the overall conceptual model for that particular canyon system. Their well-placement and characterization decisions will be more technically valid.

Shallow Perched Wells (Tshirege Member)

We recommend that LANL characterize and monitor shallow perched ground water which exists within the upper Tshirege Member, especially in areas of known releases, such as the high-explosive corridor at TA-16.

Intermediate Wells

We strongly recommend that LANL characterize and monitor intermediate perched ground water (e.g., that in the Guaje Pumice Bed), especially in areas of known contaminant releases such as Mortandad, Los Alamos and Acid Canyon and high-explosive corridor at TA-16. Where these zones exist, they need to be characterized (e.g., flow direction) prior to drilling additional deep-aquifer wells in these areas.

It should be noted that saturated basalt or basalt cinder deposits were encountered during the drilling of a 300 ft-ER borehole at TA-

33; therefore, we recommend that LANL evaluate this ground-water occurrence.

Deep Wells

The DOE OB concurs with some of LANL's deep aquifer well-placement locations, and realizes that both the placement and order of succession for a number of the wells will change due to the drilling of higher priority wells. However, the DOE OB has several recommendations:

- Re-locate R-5 closer to TW-1 (Los Alamos Canyon).
  Rationale: gain additional information concerning the ground-water mound present in the TW-1 area,

- Re-locate R-25 (Cañon de Valle) approximately 2000 ft southeast of MDA P on the mesa top rather than in the bottom of the canyon.
  Rationale: logistical problems associated with drilling in the canyon bottom north of MDA P and the assumed southeast flow direction of deep ground water and its relationship to contaminant sources and/or releases in the explosive corridor region of the laboratory,

- Re-locate R-32 (Ancho Canyon) approximately 1000-2000 ft to the northwest or up-canyon.
  Rationale: logistical problems associated with drilling within the canyon bottom,

- In terms of prioritization, we recommend that wells used to characterize all ground-water occurrences in Pueblo, Los Alamos and Mortandad Canyons be installed first.
  Rationale: Will permit the location of major contaminant sources which may have the greatest potential for contaminant transport or migration (e.g., Mortandad Canyon).

- Rework existing deep-aquifer test wells and other penetrations such as: 1) evaluate the possibilities of re-entering and completing older boreholes such as SHB-3 or DT-5, 2) where appropriate, remove well casings in older test wells (e.g., TW-8), and complete with standard methods, 3) modifying existing wells, such as DT-5A, in order to isolate the upper-saturated portion and obtain useful water-table and hydrochemical data, and 4) make geophysical logs of older existing wells (e.g., TW-3) in order to obtain stratigraphic and/or hydrologic data.

B. SCREEN LENGTH

Due to the fact that it is unknown wether vertical gradients exists within the regional aquifer, long screened intervals may not be suitable for water-quality monitoring and/or aquifer testing. Wells should be constructed in view of their intended uses.

Due to the amount of deep-aquifer drawdown observed in certain areas of the Laboratory, the DOE OB recommends that the upper 40-50 ft of saturation be screened (upper most screened across the water table) and separated at approximately 20-25 ft below the water table with one 5 ft blank with a corresponding seal in the annulus. This would facilitate sampling discrete intervals when packers are set inside the casing at the blank. In order to define such parameters as recharge, flow velocity, vertical, thermal, and chemical gradient, we recommend that individual hydrostratigraphic units be screened at appropriate wells.

C. CASING AND ANNULAR SEAL MATERIALS, DECONTAMINATION PROCEDURES, WELL DEVELOPMENT, PURGING AND WATER-QUALITY SAMPLING METHODS, ETC.

In terms of well construction, well development, purging, sampling, etc., the DOE OB recommends that LANL refer to EPA's publications: "RCRA GROUND-WATER MONITORING: DRAFT TECHNICAL GUIDANCE, 1992" and "Handbook of Suggested Practices for the Design and Installation of Ground-Water Monitoring Wells, 1991".

D. ADDITIONAL GROUND-WATER MONITORING

The DOE OB strongly recommends that LANL monitor the following springs for flow and water-quality parameters: Starmer's (x=473384.98, y=1767653.56), Homestead (x=473926.77, y=1768582.67), Burning Ground (x=473877.07,y=1764474.28), (x=473614.58, y=1764567.59), Martin (x=474492.29, y=1761862.85), Bulldog (x=474765.23, y=1767092.58), TA-18 (x=493879.97, y=1760608.01), Los Alamos (x=517253.8, y=1770858.6) and Big (spring source for Water Canyon Gallery) (x=464276.46, y=1761851.24). These springs supply some recharge to perched ground water within canyon alluvium and possibly deeper zones. Additionally, perennial reaches in Pajarito Canyon and Cañon de Valle downstream from these springs should be gaged in order define water-balance relationships or parameters (infiltration, seepage, etc.). Monitoring and characterizing these springs, and associated surface waters, would improve the validity of this project and possible others (e.g., Watershed Management Program Plan).

18. § 4.1.1.1, Page 4-16, Borehole Advancement and Well Installation Specifications

"c) No coring in the alluvium, but approximately....."

When appropriate, the DOE OB recommends that upper sections of the alluvium be cored and analyzed for target analytes such as ^{239}Pu. These data will aid in the characterization of contaminated and/or non-contaminated sedimentary units within the canyon bottom (e.g., vertical extent of contamination).

19. § 4.2.2.5, paragraph 1, Page 4-34, Recharge

In order to achieve some of the referenced goals, LANL should characterize and monitor intermediate aquifers beneath the plateau.

20. § 4.3.1.2, paragraph 1, Page 4-37, Surface Water

"Surface water in Pueblo Canyon occurs as ephemeral runoff from precipitation and as perennial flow supported by effluent discharge from...."

No perennial flow exists in Pueblo Canyon. Periodically, flow downstream from the treatment plant dries up. Field observations show that flow at Basalt Spring decreases dramatically within one to two days after flow ceases within Pueblo Canyon; hence, the hydrochemistry of Basalt Spring probably varies as well. Unlike Basalt Spring, flow at Los Alamos Spring appears to be independent of surface-water discharges in Pueblo and Los Alamos Canyons, and hydrochemical data do not tend to vary as do those of Basalt Spring.

21. § 4.3.1.2 paragraph 2, Page 4-41, Intermediate Perched Zone and Regional Aquifer Groundwater Investigations

"Well I-1 is located above the confluence with Los Alamos Canyon...."

The sentence should read "Well POI-4 is located..."

The DOE OB recommends that LANL install one intermediate well just west of the Los Alamos County Sewage Treatment Plant (LACSTP), in order to characterize and monitor intermediate ground water up gradient of the LACSTP. Mixing of possible LACSTP water with up gradient ground water may be occurring.

22. § 4.3.1.3, paragraph 1, Page 4-42, Surface Water

It should be noted that on June 8, 1996, DOE OB staff members observed no surface water entering Los Alamos Reservoir. Based on our observations at the mouth of the reservoir during this dry period, we would or could assume that the no-flow period lasted for more than two or three days, perhaps as much as several weeks.

23. § 4.3.1.3, Page 4-45, Alluvial Groundwater

We recommend that a summary of LANL's ER ground-water characterization/monitoring efforts be added to this section (e.g., the installation of monitoring well LAO-0.3).

24. § 4.3.1.4, paragraph 1, Page 4-48, Surface Water

"Surface water occurs in Sandia Canyon as ephemeral runoff from precipitation and as effluent discharge...."

We have observed and always assumed that continuous flow occurs from the Laboratory sanitary treatment plant and/or the TA-3 power plant. It appears that flow infiltrates rapidly into the alluvium at a point corresponding to the Cerro Toledo outcrop (approximately 0.75 mi west of TA-72; hence, ground-water seepage from the alluvium into the Cerro Toledo may be occurring at this point.

25. § 4.3.1.4, paragraph 2, Page 4-48, Alluvial Groundwater

"Two alluvial wells were installed in 1990 as part of the HSWA permit..."

Multiple-field observations recorded by the DOE OB in Sandia Canyon show that surface-water flow normally extends for several miles; from TA-3 (NPDES-discharge points) to about 0.75 mi west of TA-72. We also suggest that ground water probably extends to this point as well.

26. § 4.3.2.3, paragraph 1, Page 4-54, Alluvial Groundwater

"There is no occurrence of alluvial groundwater in Canada del Buey, based on six dry...."

This statement contradicts the next sentence: "Two holes, CDBO-6 and CDBO-7, encountered water perched in the alluvium approximately one mile upstream of MDA L."

In addition, approximate water-table elevations at CDBO-6 and CDBO-7 are 6782 and 6734 ft respectively. LANL needs to determine if

the surrounding monitoring wells or penetrations (dry) were drilled deep enough to encounter this perched zone.

27. § 4.3.2.3, paragraph 1, Page 4-54, Alluvial Groundwater

"Two holes, CDBO-6 and CDBO-7, encountered water perched in the alluvium approximately one mile upstream of MDA L."

After careful review of the well logs, we suggest that the ground water at CDBO-6 and CDBO-7 lies within the Bandelier Tuff, not the alluvium.

28. § 4.3.2.3, paragraph 1, Page 4-55, Intermediate Perched Zone and Regional Aquifer

"No intermediate perched zones are known to occur in this area."

We understand that intermediate perched ground water was encountered during the drilling of SHB-4 at 125-145' and PM-2 at 334'. These wells are located approximately 1000-1500' south of MDA L.

29. Page 4-55, Surface Water

"About 1 mile east of the Laboratory's western boundary, Homestead Spring supports a perennial....."

See DOE OB's comment # 2.

30. § 4.3.2.4, paragraph 2, Page 4-55, Surface Water

"Many of these springs issue from hillslopes in the Tshirege Member..."

The DOE OB was unable to obtain the Purtymun and Kennedy (1971) reference. We would like to review the referenced materials before submitting our comments or recommendations concerning this issue.

31. § 4.3.2.4, Page 4-55 and 4.-57, Alluvial Groundwater

We suggest that a summary of LANL's ER ground-water characterization/monitoring efforts be added to this section (e.g., monitoring well BG-1 at TA-18).

32. § 4.3.3.2, paragraph 2, Page 4-60, Surface Water

"Surface water chemistry results show contaminant levels at detection or background levels over this period (LANL 1992f)."

The DOE OB would like to point out that above-background levels were detected in surface waters at two LANL ES annual sampling locations during 1995: Ancho Canyon near Bandelier (^{90}Sr at 50.9 pCi/L, gross alpha at 23 pCi/L, gross beta at 73 pCi/L, and total uranium at 9.47 ug/L), and Water Canyon at Beta (NO_3-N at 9.61 mg/L).

33. § 4.3.4.2, paragraph 2, Page 4-63, Surface Water

"Storm water collected at the gaging station in one of the 1995..."

This statement appears to contradict LANL's statement made on page 4-60, Surface Water, second paragraph: "Surface water chemistry results show contaminant levels at detection or background levels over this period (LANL 1992f)." We recommend that LANL clarify this statement.

34. § 4.3.4.2, Page 4-66, Intermediate Perched Zones and the Regional Aquifer

We would like to point out that LANL (ER Project) encountered wet or saturated basalt during the drilling of a 300' borehole at TA-33; as noted in ER's Core Document dated April 1997.

35. § 4.3.4.3, paragraph 1, Page 4-67, Surface Water

"Perennial flow occurs from these two springs to the Rio Grande."

It should be noted that Spring 9A flows from the south facing slope of Chaquehui Canyon to the stream channel and then infiltrates into the alluvium several hundred feet downstream. Thus, perennial flow to the Rio Grande does not exist.

In addition, Spring 9 does not flow into Chaquehui Canyon. It flows directly to the Rio Grande from the western slope of White Rock Canyon.

36. § 4.3.5.2, paragraph 1, Page 4-70, Surface Water

"One perennial reach, between outfall TA-16-260 and a location east of MDA P, has flowed continuously since the initial ER Project investigations began in 1992."

This sentence contradicts LANL's statement made in Chapter 2, page 2-12, second paragraph which states: "Only four of the canyons contain perennial (flowing continuously) reaches inside the Laboratory boundaries....". See DOE OB's comment 1.

37. § 4.3.5.2, paragraph 2, Page 4-70, Surface Water

"Chlorine, sodium, and manganese are above the regional background for spring waters."

The DOE OB would like to know exactly where the regional background spring-water values came from. Are these results associated with discharges known to emanate from the Guaje Pumice Bed, Cerro Toledo interval, etc. or what? The source of the water used to developed regional background values should be included in the document.

If there are any questions about this review, please contact Steve Yanicak at 505-672-0448 or Michael Dale, the DOE OB LANL ground water issues manager at 505-672-0449.

Document reviewed by: Michael Dale, Bill Stone, Alice Mayer, Chris Hanlon-Meyer, and Steve Yanicak.

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