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Albuquerque Operations Office
Los Alamos Area Office
Los Alamos, New Mexico 87544

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Mr. Carl Will, Permits Project Leader
Permits Management Program
Hazardous Waste Bureau
New Mexico Environment Department
2044-A Galisteo Street
P. O. Box 26110
Santa Fe, NM 87502

Dear Mr. Will:

Subject: Los Alamos National Laboratory (LANL) Response to the Request for Supplemental Information (RSI) for the October 1998, General Part B Permit Application, Revision 1.0, EPA I.D. NM0890010515

The purpose of this letter is to provide the Department of Energy's (DOE) response to the RSI issued by the Hazardous Waste Bureau (HWB) of the New Mexico Environment Department (NMED) on July 7, 2000. The RSI asked for additional information supplementing a Resource Conservation and Recovery Act (RCRA) Part B permit application submitted to support the renewal of the LANL Hazardous Waste Facility Permit issued on November 8, 1989. The original document contained LANL facility wide hazardous waste management plans and information and is titled "*Los Alamos National Laboratory, General Part B Permit Application,*" Revision 1.0, October 1998.

The RSI and this response were discussed in meetings of the joint Permit Working Group this summer. The draft version of this document was delivered to HWB on September 14, 2000. The submittal of this final version was discussed with you on October 5, 2000, and no comments were received at that time.

This submittal consists of a response to the four comments contained in Attachment A of the RSI. It also includes a revised permit application appendix, "Facility Description," as discussed in the comment responses. This potential replacement section is presented in "clean" format versions for substitution in the permit application and in "bold/strikeout" format for informative purposes. A certification statement is also provided for this document as a revision of the original permit application. An electronic copy of the revised section has also been included.

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If you should have any questions or concerns regarding this submittal, please feel free to contact Joseph Vozella, DOE/Los Alamos Area Office, at 665-5027 or Gian Bacigalupa, LANL/University of California, at 667-1579.

Sincerely,

David A. Gurulé, P.E.
Area Manager

LAAME:6JV-042

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LA-UR-00-4951
October 2000

Response to Request for Supplemental Information for the October 1998 General Part B Permit Application, Revision 1.0 Los Alamos National Laboratory (LANL) EPA I.D. NM0890010515

Prepared by:

Los Alamos National Laboratory
Hazardous and Solid Waste Group (ESH-19)
Los Alamos, New Mexico 87545

Response to Request for Supplemental Information for the October 1998 General Part B Permit Application, Revision 1.0, Los Alamos National Laboratory (LANL) EPA I.D. NM0890010515

LA-UR-00-4951
October 2000

Prepared by:
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ATTACHMENT A
Request for Supplemental Information for the Technical Review of the May 12, 1999, General Part B Permit Application, Revision 1.0 Los Alamos National Laboratory (LANL) EPA I.D. NM0890010515

Introduction

The following information is the LANL response to the Request for Supplemental Information (RSI) issued by the Hazardous Materials Bureau (HMB) of the New Mexico Environment Department (NMED) on July 7, 2000. The RSI asked for additional information for a Resource Conservation and Recovery Act (RCRA) Part B permit application submitted in accordance with the New Mexico Administrative Code, Title 20, Chapter 4, Part 1 (20 NMAC 4.1), Subpart IX, to support the renewal of the LANL Hazardous Waste Facility Permit originally issued on November 8, 1989. The application contained LANL facility-wide hazardous waste management plans and information and is titled "*Los Alamos National Laboratory General Part B Permit Application,*" Revision 1.0, October, 1998 (General Part B).

This document consists of responses to the four information comments or requests contained in Attachment A of the RSI. It includes a revised permit application appendix, as referenced in the comment responses. NMED's original comments are included in this document as italicized text.

Specific Responses to RSI Comments:

1. *Section 2.2.5 of the General Part B Permit Application version 0.0, 1996 is not present in version 1.0. This section should be included in the current permit application.*

Response:

A general discussion of groundwater is now incorporated into a revised Appendix A, included as Attachment 1 of this document.

2. *Appendix A, Section A.5, Page A-7. "Any units subject to permitting requirements that have associated groundwater monitoring requirements are included in the "Hydrogeologic Workplan," approved by the NMED on March 25, 1998." The Hydrogeologic Workplan is a facility-wide plan to define hydrogeologic characteristics. It is not a regulated unit monitoring well network plan. All required groundwater detection, and assessment monitoring, will follow 20.4.1 NMAC, 40 CFR 264 Subpart F and 270.14(c). LANL should include provisions for these requirements in the permit application.*

Response:

The Hydrogeologic Workplan was specifically prepared as a result of a written request from the NMED dated August 17, 1995, that stated the Laboratory should prepare a plan to address the requirements of RCRA and the Hazardous and Solid Waste Amendments of 1984 (HSWA) as detailed in regulations and the Laboratory's permit. As set forth in the approved workplan, the objectives of the described activities are to provide sufficient information to, in part, "establish detection monitoring programs pursuant to 40 CFR 264.91-100 for regulated units or to demonstrate that groundwater monitoring requirements could be waived, or to provide appropriate groundwater monitoring as part of corrective actions pursuant to 40 CFR 264.101 for Solid Waste Management Units that have been determined to have had a release that is a threat to human health or the environment..." ("Hydrogeologic Workplan," Los Alamos National Laboratory, May 22, 1998, page ES-1).

As such, the workplan is intended to characterize the hydrogeology of the facility and provide potential monitoring capabilities, should they be deemed necessary and appropriate. Efforts have been taken to design and construct the program wells in a manner consistent with RCRA performance standards, with the participation of NMED representatives to the Groundwater Integration Team. In addition, the workplan activities enable the Laboratory to obtain the hydrogeologic characterization that will be used to form the basis for any monitoring program potentially implemented for regulated units or to support a groundwater monitoring waiver demonstration under 20 NMAC 4.1, Subpart F. Therefore, the reference to the workplan was included in the General Part B in order to partially meet the 20 NMAC 4.1, 270.14(c), information requirements. It may be determined at a subsequent date that further provisions for groundwater monitoring of regulated units are needed.

The Appendix A, Section A.5 language can be modified to make this relationship more clear. LANL suggests the following replacement for the section text:

"Regulated units (surface impoundments, waste piles, land treatment units, and landfills, as provided by 20 NMAC 4.1, Subpart V, 264.90(a)(2) [6-14-00]), will meet the requirements specified in 20 NMAC 4.1, Subpart V, 260.90-101 [6-14-00], as appropriate. The LANL "Hydrogeologic Workplan" will be used to characterize the hydrogeologic regime at the facility as a preliminary basis for potential monitoring or demonstration of a groundwater monitoring waiver. The groundwater wells constructed in the workplan program may be used for monitoring regulated units if deemed necessary and appropriate. Relevant groundwater monitoring provisions for regulated units will be addressed in TA-specific permit applications, permit modification requests, and permit renewal documents. Appropriate groundwater monitoring provisions for LANL's solid waste management units will be addressed through the HSWA portion of the permit."

3. *Appendix F, Closure Plan. Closure Plans should be TA specific. Only a place-holder reference to TA-specific closure plans should be included in this appendix.*

Response:

As stated in LANL's June 29, 2000, response to the RSI issued by the NMED HMB on March 29, 2000, LANL proposed that the existing Appendix F, "Closure Plan," of the General Part B be deleted. The proposal was in response to Permit Working Group (PWG) discussions held with the HMB on May 5, 2000. The concern had become that the original permit strategy may result in TA- or unit-specific closure plans that cannot be used as discrete documents and that may require permit-wide modifications as closure activities progress. The information originally contained in the General Part B closure plan can be moved to the closure plans in TA-specific permit applications, making them comprehensive documents.

A new placeholder Appendix F, "Closure Plan," for insertion into the General Part B was provided in Attachment 6 of LANL's "Response to Request for Supplemental Information for the October 1998 General Part B Permit Application, Revision 1.0, Los Alamos National Laboratory (LANL), EPA I.D. NM0890010515," submitted to the NMED on June 29, 2000.

4. *Supplement 5. Determination of 100-Year Floodplain Elevations at Los Alamos National Laboratory. See Attachment B – DOE Oversight Bureau's June 26, 1998 comments regarding Determination of 100-Year Floodplain Elevations at LANL. Pursuant to 20.4.1 NMAC, 40 CFR 264.18(b), LANL should included a current 100-Year Floodplain determination that addresses all of the issues delineated in Attachment B.*

Response:

LANL is currently working on a response to the NMED DOE Oversight Bureau's letter commenting on the 100-year floodplain report. LANL anticipates submitting this response to the Oversight Bureau in September 2000. The response will address the issues discussed in the NMED letter and conform to discussions held during the PWG meeting on July 27, 2000. New information being developed as a result of the Cerro Grande Fire will be discussed in the response.

Personnel in LANL's Water Quality and Hydrology Group (ESH-18) are continuing to revise floodplain maps for LANL, and expect to have them available within a year. While there is technical disagreement on the floodplain report between the Oversight Bureau and LANL, both parties agree the treatment, storage, and disposal activities at LANL would not be affected by a 100-year flood. With the exception of TA-39-57, no waste management units are identified in the list, "LANL Buildings Potentially Within Floodplain," included as Appendix G in the above-referenced comments. As the floodplain location standard in 20 NMAC 4.1, Subpart V, 264.18(b)(1) is not an issue, there can be no permit concern regarding this standard. Although the information that will be used to develop the floodplain maps will be available within a year, a newly-published and peer-reviewed floodplain report will take more time to prepare.

APPENDIX A

FACILITY DESCRIPTION

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MAP NO.	TITLE
A-1	Los Alamos National Laboratory Sanitary Sewer and Storm Drain Systems

LIST OF ABBREVIATIONS/ACRONYMS

AASHTO	American Association of State Highway & Transportation Officials
amsl	above mean sea level
cm/s	**centimeters per second**
cm/yr	**centimeters per year**
D&D	decontamination and decommissioning
DOE	U.S. Department of Energy
HE	high explosives
LANL	Los Alamos National Laboratory
20 NMAC 4.1	New Mexico Administrative Code, Title 20, Chapter 4, Part 1
pCi/L	**picocuries per liter**
R&D	research and development
RCRA	Resource Conservation and Recovery Act
TA	technical area

APPENDIX A
FACILITY DESCRIPTION

The information provided in this appendix is submitted in accordance with the applicable requirements of the New Mexico Administrative Code, Title 20, Chapter 4, Part 1 (20 NMAC 4.1), revised ~~January 1, 1997 [1-1-97].~~ **June 14, 2000 [6-14-00].** The following subject areas are addressed in this appendix or are referenced to technical area (TA)-specific permit applications, permit modification requests, or permit renewal documents:

- A general description of the Los Alamos National Laboratory (LANL) facility (20 NMAC 4.1, Subpart IX, 270.14(b)(1) ~~[1-1-97]~~ **[6-14-00]**);
- Traffic patterns, volume, and control (20 NMAC 4.1, Subpart IX, 270.14(b)(10) ~~[1-1-97]~~) **[6-14-00]**;
- Facility location information for compliance with the seismic standard and floodplain requirements (20 NMAC 4.1, Subpart IX, 270.14(b)(11), 270.14(b)(19)(ii), and 20 NMAC 4.1, Subpart V, 264.18(a) and (b) ~~[1-1-97]~~ **[6-14-00]**);
- Topographic map requirements (20 NMAC 4.1, Subpart IX, 270.14(b)(19) ~~[1-1-97]~~ **[6-14-00]**).

A.1 GENERAL DESCRIPTION [20 NMAC 4,1, Subpart IX, 270.14(b)(1)]

LANL is located in Los Alamos County, an incorporated county, in north-central New Mexico, approximately 60 miles north-northeast of Albuquerque and 25 miles northwest of Santa Fe. The regional location of LANL is shown on Figure A-1. LANL is divided into TAs, as shown on Figure A-2. LANL, which occupies an area of 43 square miles, and the associated residential and commercial areas of Los Alamos County, which occupy an area of 109 square miles, are situated on the Pajarito Plateau. The plateau consists of a series of finger-like mesas separated by deep east-west trending canyons. Ephemeral, interrupted, or intermittent streams lie at the bottoms of all the canyons. The mesa tops range in elevation from approximately 7,800 feet above mean sea level (amsl) at the flank of the Jemez Mountains, located to the west of Los Alamos, to about 6,200 feet amsl at their eastern extent, where they terminate above the Rio Grande.

LANL's central mission is the reduction of global nuclear danger supported by research that also contributes to conventional defense, civilian, and industrial needs. This includes programs in nuclear safeguards and stockpile stewardship; nuclear, medium energy, and space physics; hydrodynamics; conventional explosives; chemistry; metallurgy; radiochemistry; space nuclear systems; controlled thermonuclear fusion; laser research; environmental technology; geothermal, solar, and fossil energy research; biomedicine, health, and biotechnology; and industrial partnerships. LANL is owned by

the U.S. Department of Energy (DOE) and is operated jointly by DOE and the University of California. The facility mailing address is P.O. Box 1663, Los Alamos, New Mexico, 87545.

LANL is an existing treatment, storage, and disposal facility. Hazardous waste is generated at LANL primarily from research and development (R&D) activities, general facility operations, and decontamination and decommissioning (D&D) projects. Mixed low-level waste is generated mainly from R&D activities, processing and recovery operations, general facility operations, D&D projects, and environmental restoration activities. Mixed transuranic waste is generated primarily from R&D activities, processing and recovery operations, and D&D projects. High explosives (HE)-contaminated waste is generated mainly from R&D activities, environmental restoration activities, water treatment processes, and building maintenance and modification activities. Brief descriptions of specific hazardous and mixed waste management units at LANL are presented in Attachment A of TA-specific permit applications, permit modification requests, or permit renewal documents. Waste generated from R&D activities, processing and recovery operations, and environmental restoration activities may be received from off-site facilities, as described in Supplement 6 of this General Part B Permit Application.

A.2 TRAFFIC PATTERNS [20 NMAC 4.1, Subpart IX, 270.14(b)(10)]

The traffic pattern information presented below is general in nature. More detailed information is addressed in TA-specific permit applications, permit modification requests, or permit renewal documents.

A.2.1 General

The rugged topography of alternating mesas and canyons present at LANL limits traffic circulation to only a few major arterial roads. Approximately 85 miles of paved roads are present within LANL (Pan Am World Services Inc., 1986). The major roads are shown on Figure A-3. There are approximately 19 miles of highway, 22 miles of TA access roads, and 44 miles of roads in LANL's TAs.

The main access route to LANL is State Road 502; the majority of traffic to LANL approaches from the east on State Road 502 and East Jemez Road. Alternate access routes are available from the south on State Roads 4 and 501 (West Jemez Road).

The pattern of east-west trending canyons at LANL prohibits north-south automobile travel in nearly all portions of LANL, with the exception of Diamond Drive and part of West Jemez Road.

Los Alamos Canyon is spanned at Diamond Drive by an 820-foot-long steel-arch bridge that was completed in 1951 and improved in 1993. This bridge provides the main access between LANL facilities located on either side of Los Alamos Canyon.

Approximately 10,000 people are currently employed at LANL (including full-time, part-time, and casual LANL personnel and subcontractors). Roughly 4,000 people commute to LANL daily from communities outside Los Alamos County.

A.2.2 Waste Collection Areas

Hazardous and mixed waste is generated at TAs throughout LANL. Small quantities of waste are generally accumulated in containers at less-than-90-day storage areas or satellite accumulation areas and then packed in containers, such as drums, boxes, or crates, for transport to storage or treatment areas, as necessary. Bulk liquid waste is contained primarily in drums or tanks. Because hazardous and mixed waste may be generated throughout LANL, waste transport may occur on nearly all roads within LANL. Off-site wastes may be received at LANL on a limited basis. Waste collection areas for these off-site wastes will be discussed in TA-specific permit applications, permit modification requests, or permit renewal documents.

A.2.3 Routes of Travel

Information addressing unit-specific travel routes is presented in Attachment A of TA-specific permit applications, permit modification requests, or permit renewal documents.

A.2.4 Traffic Volumes

According to a 1997 traffic study, the peak traffic periods are between 7:30 and 8:30 a.m., 12:15 and 1:15 p.m., and 4:30 and 5:30 p.m. (Los Alamos County, 1997). The 1997 traffic study was limited to the intersection of Diamond Drive and Trinity Drive, just north of the TA-3 area. Consequently, the data presented in the study should reflect the existing traffic conditions in the TA-3 area at LANL. TA-3 will typically have higher vehicular volumes than the rest of LANL; thus, this study provides a conservative estimate of facilitywide traffic volumes. Maps and data from the cited study depicting vehicular traffic-count movements at the intersection of Diamond and Trinity Drives are included in Supplement 4 of this document. Based on the 1997 traffic study, the Diamond Drive and Trinity Drive intersection had a volume of 3,152 vehicles from 7:30 to 8:30 in the morning, and 2,815 vehicles from 4:30 to 5:30 in the afternoon.

Maps and data from a traffic count conducted at the same intersection in April 1998 are also included in Supplement 4 (Los Alamos County, 1998). The peak traffic periods for the 1998 study are between 7:15 and 8:15 a.m., 12:30 and 1:30 p.m., and 5:00 and 6:00 p.m. The traffic volume from 7:15 to 8:15 in the morning was 2,428 vehicles. From 5:00 to 6:00 in the afternoon, the volume was 2,648 vehicles. The count is biased low because Los Alamos High School was on spring break during this traffic study.

Additional traffic volume information is provided in Attachment A of TA-specific permit applications, permit modification requests, or permit renewal documents.

A.2.5 Traffic Control Signals

Sitewide traffic flow at LANL is controlled by traffic lights, stop signs, and yield signs. Traffic lights are in place at all major intersections. Traffic signs are used at "T" intersections throughout LANL. Access to high security TAs is controlled by security guards or special access gates. Only personnel having appropriate security clearance and identification or escorted visitors are allowed access to the high security TAs. Vehicles and personnel entering these TAs are subject to periodic search by security personnel.

Unit-specific information addressing traffic control signals is presented in Attachment A of TA-specific permit applications, permit modification requests, or permit renewal documents.

A.2.6 Road Load-Bearing Capacity

Roads at LANL carrying the greatest traffic volumes include Diamond Drive, Pajarito Road, and East and West Jemez Roads. These roads are typically constructed with an 8-inch-thick base overlain with a 5-inch-thick asphaltic concrete surface. They were designed and built in conformance with American Association of State Highway & Transportation Officials (AASHTO) specification HS-20. This specification is intended to accommodate truck loading capacities of 32,000 pounds per axle. Roads within TAs are generally two-lane roads with asphaltic concrete surfaces. These roads are typically constructed with a 6-inch-thick base overlain with a 3-inch-thick asphaltic concrete surface. These roads were also designed and constructed to meet AASHTO specification HS-20.

A.3 LOCATION INFORMATION

A.3.1 Seismic Standard [20 NMAC 4.1, Subpart IX, 270.14(b)(11)(i and ii) and 20 NMAC 4.1, Subpart V, 264.18(a)]

LANL is located in Los Alamos, New Mexico; therefore, pursuant to 20 NMAC 4.1, Subpart IX, 270.14(b)(11)(i) and 20 NMAC 4.1, Subpart V, Appendix VI ~~[1-1-97]~~ **[6-14-00]**, the seismic standard of 20 NMAC 4.1, Subpart V, 264.18(a) ~~[1-1-97]~~ **[6-14-00]**, is applicable. Unit-specific information addressing the seismic standard requirements of 20 NMAC 4.1, Subpart IX, 270.14(b)(11)(ii), and 20 NMAC 4.1, Subpart V, 264.18(a) ~~[1-1-97]~~ **[6-14-00]**, is presented in Attachment A of TA-specific permit applications, permit modification requests, or permit renewal documents.

A.3.2 Floodplain Standard [20 NMAC 4.1, Subpart IX, 270.14(b)(11)(iii through v) and 270.14(b)(19)(ii); 20 NMAC 4.1, Subpart V, 264.18(b)]

As required in "Module VIII: Special Conditions Pursuant to the 1984 Hazardous and Solid Waste Amendments to RCRA for Los Alamos National Laboratory, EPA I.D. NM0890010515" (EPA, 1994), LANL has mapped all 100-year floodplain boundaries within the LANL complex. A report was published documenting the floodplain mapping procedures (McLin, 1992). This report is included as Supplement 5 of this document. A LANL-wide 100-year floodplain map is provided on page 36 of that report. The floodplain-boundary map resides on LANL's Facility for Information Management, Analysis, and Display system, a geographical information system. **These maps are being revised as a result of the Cerro Grande Fire, and new maps and supporting calculations will be submitted, as they become available.**

In accordance with 20 NMAC 4.1, Subpart IX, 270.14(b)(11)(iii through v) ~~[1-1-97]~~ **[6-14-00]**, any waste management units located within a 100-year floodplain at LANL will be addressed in Attachment A of TA-specific permit applications, permit modification requests, or permit renewal documents.

A.4 TOPOGRAPHIC MAPS [20 NMAC 4.1, Subpart IX, 270.14(b)(19)]

Due to the size of LANL, several maps and figures are provided or referenced to meet the requirements of 20 NMAC 4.1, Subpart IX, 270.14(b)(19) ~~[1-1-97]~~ **[6-14-00]**. All maps clearly show the map scale, the date of preparation, and a north arrow. The maps and figures used to fulfill these regulatory requirements include the following:

- A LANL-wide 100-year floodplain map is provided on page 36 of the report included as Supplement 5 of this document.

- A map showing surface waters, including intermittent streams, and flow direction is included in the LANL General Part A Permit Application (LANL, 1998a) and in the "Los Alamos National Laboratory's Response to Request for Supplemental Information: General Part A Permit Application, Revision 0.0" (LANL, 1998b).
- Surrounding land uses are shown on Figure A-1 of this appendix.
- Wind roses for LANL are shown on Figures A-4 and A-5 of this appendix.
- A map showing the legal boundaries of LANL is included in the LANL General Part A Permit Application (LANL, 1998a).
- Access ways and internal roads are shown on Figure A-3 in this appendix and on a figure(s) in Attachment A of TA-specific permit applications, permit modification requests, or permit renewal documents.
- Access control features (e.g., fences, gates) are shown on a figure(s) in Attachment A of TA-specific permit applications, permit modification requests, or permit renewal documents.
- A map showing supply wells, monitoring wells, test wells, springs, and surface-water sampling stations is included in the LANL General Part A Permit Application (LANL, 1998a) and in the "Los Alamos National Laboratory's Response to Request for Supplemental Information: General Part A Permit Application, Revision 0.0" (LANL, 1998b).
- Buildings and structures are shown on maps in the LANL General Part A Permit Application (LANL, 1998a).
- The locations of the hazardous and/or mixed waste management units at LANL are shown on maps in the LANL General Part A Permit Application (LANL, 1998a).
- A map showing National Pollutant Discharge Elimination System discharge structure locations is included in the LANL General Part A Permit Application (LANL, 1998a).
- Storm, sanitary, and process sewer systems at LANL are shown on Map A-1 of this appendix.
- Drainage control features (e.g., run-on/runoff) are shown on a figure(s) in TA-specific permit applications, permit modification requests, or permit renewal documents.
- Natural surface drainages are shown on maps in the LANL General Part A Permit Application (LANL, 1998a).
- Fire stations serving LANL and the County of Los Alamos are shown on Figure E-2 of Appendix E.
- An equipment cleanup area is located at TA-50-1. The location of TA-50-1 is shown on a map in the LANL General Part A Permit Application (LANL, 1998a).

Contour lines on all topographic maps are in intervals sufficient to detail natural drainage at LANL and in the vicinity of the waste management units. As provided in 20 NMAC 4.1, Subpart IX, 270.14(b)(19) ~~[1-1-97]~~ **[6-14-00]**, LANL has submitted the maps at these scales and contour intervals due to the size of the waste management units, the extent of the LANL facility, and the topographic relief in the area.

A.5 GROUNDWATER ~~MONITORING~~ [20 NMAC 4.1, Subpart IX, 270.14(c) and 20 NMAC 4.1, Subpart V, 264.90(a)]

In the Los Alamos area, groundwater occurs in three modes: (1) water in shallow alluvium and underlying tuff in some of the larger canyons, (2) intermediate perched zone groundwater (a perched groundwater body above a less permeable layer and separated from the underlying aquifer by an unsaturated zone), and (3) the regional aquifer of the Los Alamos area.

Alluvium that is as much as 100 feet thick has been deposited in the canyons of the Pajarito Plateau by intermittent and ephemeral stream flows. Alluvium in canyons that head in the Jemez Mountains is generally composed of sands, gravels, pebbles, cobbles, and boulders derived from the Tschicoma Formation and Bandelier Tuff on the flank of the mountains. Alluvium in canyons that head on the Pajarito Plateau is relatively fine-grained and consists of clays, silts, sands, and gravels derived from the Bandelier Tuff. Saturated hydraulic conductivity of the alluvium typically ranges from 10^{-2} centimeters per second (cm/s) for a sand to 10^{-4} cm/s for a silty sand (Abeele et al., 1981).

Unlike the underlying volcanic tuff and sediments, the alluvium is quite permeable. Ephemeral runoff in some canyons infiltrates the alluvium until downward movement is impeded by the less permeable underlying strata. The impeded downward movement results in a buildup of shallow alluvial groundwater. In some cases, relatively thin zones of shallow groundwater can also be contained in the weathered tuff or some other geologic unit immediately underlying the alluvium. The horizontal and vertical extent of the alluvial groundwater is limited by depletion via evapotranspiration and movement into the underlying rocks (Purtymun et al., 1977). The limited saturated thickness and extent of the alluvial groundwater preclude its use as a viable source of municipal and industrial supply to LANL and the surrounding community. Lateral flow of the alluvial groundwaters is down canyon and in an easterly direction. In Mortandad Canyon, tracer studies have shown that the velocity of alluvial water ranges from about 60 feet per day in the upper reach to about 7 feet per day in the lower reach of the canyon (Purtymun, 1974).

Intermediate perched zone groundwater is found in areas where a sufficient water source is present to maintain saturation within the deeper units. The presence of a perched zone is controlled by the occurrence of a perching layer that exhibits a lower permeability and causes

water to pond in a more permeable overlying horizon. Localized bodies of perched groundwater occur beneath several canyons in the eastern portion of LANL, along the eastern flanks of the Jemez Mountains west of LANL, and beneath the mesas and canyons at TA-16, which is located in the southwestern part of LANL near the Jemez Mountains. Perched groundwater bodies may also exist beneath other canyons in the south and central portions of LANL, which have not yet been investigated by drilling. Perched groundwater may be maintained beneath canyon bottoms by infiltration from the overlying stream, and within the Bandelier Tuff near the Jemez Mountains by seepage from streams exiting the mountains. In Los Alamos Canyon, for example, perching layers are found within the interbedded Cerros del Rio Basalt and the Puye Formation sediments, where they underlie the more permeable Guaje Pumice Bed. On the flanks of the Jemez Mountains and at TA-16, the presence of perched groundwater is apparently controlled by lithologic property contrasts within the Bandelier Tuff; these contrasts may exist at boundaries between flow units.

Intermediate perched zone groundwater occurs in the conglomerates and basalts beneath the alluvium in the mid- and lower reaches of Pueblo and Los Alamos Canyons and in the lower reach of Sandia Canyon. Depth to perched groundwater ranges from about 90 feet in the midreach of Pueblo Canyon to about 450 feet in lower Sandia Canyon. The vertical and lateral extent of the perched zones, the nature and extent of the perching units, and the potential for migration of perched groundwater to the regional aquifer are not yet fully understood.

Studies have shown that the intermediate perched zone groundwater in Pueblo Canyon is hydrologically connected to the stream in Pueblo Canyon (Abrahams and Purtymun, 1966). This perched zone water discharges at the base of the basalt at Basalt Spring, located on San Ildefonso Pueblo land east of LANL in lower Los Alamos Canyon. It has been estimated that the rate of movement of the perched groundwater in this vicinity is about 60 feet per day, or about 6 months from recharge to discharge (Purtymun, 1975).

Measurements of tritium in intermediate perched zone groundwater indicate that recharge to those depths has occurred during the last several decades. Observations made at four locations in Pueblo and Los Alamos Canyons show that levels of tritium in the perched zone are high enough to be attributed to recharge of surface water contaminated by effluent or other releases from LANL operations. In a test well in Pueblo Canyon (TW-2A), tritium has

been observed at concentrations between 2,000 and 3,000 picocuries per liter (pCi/L). Beginning in 1991, low-detection-limit tritium measurements have shown tritium levels of about 150 pCi/L in samples from a test well located in lower Pueblo Canyon near its confluence with Los Alamos Canyon (TW-1A), and in Basalt Spring, which is located in Los Alamos Canyon just downstream from its confluence with Pueblo Canyon. Measurements at these three locations are consistent with LANL's previous understanding that the intermediate perched zone groundwater in Pueblo Canyon has been affected by effluents discharged into the canyon. In the middle reach of Los Alamos canyon, about one mile down gradient of TA-2, tritium was detected in the intermediate perched zone at well LADP-3 (Broxton and Eller, 1995). Perched groundwater was encountered at a depth of about 320 to 330 feet at this well, and water samples contained about 6,000 pCi/L of tritium.

The regional aquifer of the Los Alamos area is the only aquifer known to be capable of providing a large-scale municipal water supply (Purtymun, 1984). The surface of the regional aquifer rises westward from the Rio Grande within the Santa Fe Group into the lower part of the Puye Formation beneath the central and western parts of the Pajarito Plateau. The depth to the regional aquifer below the mesa tops ranges from about 600 feet at the eastern margin of the plateau to about 1,200 feet along the western margin. According to Purtymun (1984), the regional aquifer exhibits artesian conditions in the eastern part along the Rio Grande. Throughout the plateau, continuously recorded water level measurements collected in test wells since the fall of 1992 indicate that the regional aquifer responds to barometric and earth tide effects in a manner typical of confined aquifers.

Thirteen deep water-supply wells in three well fields produce water for LANL and the communities of Los Alamos and White Rock. The well fields include the off-site Guaje well field and the on-site Pajarito and Otowi well fields. The Guaje well field is located northeast of LANL and contains seven wells, six of which had significant production during 1998. Due to their age, these older wells were planned to be retired after 1999. Four new wells were drilled in this field in 1998 to replace the older wells. The five wells comprising the Pajarito well field are located in Sandia and Pajarito Canyons and on mesa tops between these canyons. The Otowi well field is located in Los Alamos and Pueblo Canyons, and consist of two wells. Municipal water-supply pumpage during 1992 was 1.43 billion gallons, and yields from individual wells ranged from about 175 to 1,400 gallons per minute (Stoker et al., 1992).

The exact source of recharge to the regional aquifer is unknown. Groundwater elevation measurements suggest that groundwater flows from the Jemez Mountains east and southeast toward the Rio Grande, where a portion discharges into the river through seeps and springs. There is considerable uncertainty regarding recharge along the Jemez Mountains. Infiltration of stream flow probably occurs along the mountain flanks. Major recharge of the regional aquifer from the west is inferred because the piezometric surface slopes downward to the east. Three sources of recharge have been suggested by Cushman (1965): infiltration of runoff in canyons; underflow from the Valles caldera through the Tschicoma Formation; and infiltration on mesas. Natural recharge through undisturbed Bandelier Tuff on the mesa tops is believed to be insignificant (Purtymun and Kennedy, 1971; Kearl et al., 1986).

Isotope and age-dating measurements have been made in an effort to better understand the nature of recharge to the regional aquifer. Samples from test wells and water-supply wells that penetrate the regional aquifer were sampled and analyzed for carbon-14 and low-level tritium to allow tentative estimates of the age of the water in the regional aquifer at various locations. The interpretation of the carbon-14 data indicates that the minimum age of water in the regional aquifer varies. Under the western portion of the plateau, the minimum age is about 1,000 years. As the water moves eastward, the age increases. Near the Rio Grande, the age of water is about 30,000 years (Rogers et al., 1996). It is important to recognize that, because the samples were collected from water drawn from screened intervals of 600 to 3,100 feet, these ages are composite water ages. These ages may support an easterly flow direction, with younger water recharging at the plateau's western boundary and flowing towards the east. Another possibility is that these ages represent two separate groundwater bodies of different ages, and that a groundwater divide in the regional aquifer is located west of the Rio Grande. The region of waters with higher recharge elevations identified by Goff and Sayer (1980) correspond to the older ages near the Rio Grande, and the much older ages could reflect the longer flow path from the possible Sangre de Cristo recharge area. Groundwater samples collected at five locations in the regional aquifer near Los Alamos appear to show the presence of some recent (within the last 40 years) recharge, as indicated by several measurements of tritium by extremely low-detection-limit analytical methods (Environmental Protection Group, 1995, 1994). These locations include TW-1 in Pueblo Canyon near the confluence with Los Alamos Canyon, TW-3 in Los Alamos Canyon, old observation and water-

supply wells LA-1A and LA-2 in Los Alamos Canyon near its confluence with the Rio Grande, TW-8 in Mortandad Canyon, and in wells and springs at San Ildefonso Pueblo (Environmental Protection Group, 1995; Blake et al., 1995). The tritium levels measured range from less than a percent to less than a hundredth of a percent of current drinking water standards. In addition, these levels are less than the levels that could be detected by EPA-specified analytical methods normally used to determine compliance with drinking water regulations.

Based on an overall decline in regional aquifer levels across the Pajarito Plateau since pumping began in the 1950s, the total volume of annual recharge near the plateau is apparently less than the quantity of municipal water production, which is approximately 5,000 acre-feet per year. Rogers and Gallaher (1995) tabulated Bandelier Tuff core hydraulic properties from several boreholes at LANL to estimate recharge rates beneath the Pajarito Plateau. The direction and flux of water through the unsaturated zone were evaluated by Rogers et al. (1996) using hydraulic properties from seven boreholes that had sufficient data. The seven boreholes were from mesa top and canyon bottom locations, which represent two of the distinct hydrologic regimes on the Pajarito Plateau. Most head gradients determined for the boreholes were approximately unity, thus implying that flow is nearly steady state. One exception was found for boreholes at TA-54, Area G, where gradient reversals at depths of about 100 feet suggest that evaporative drying may be occurring. Infiltration rates for liquid water at the seven locations were approximated by Rogers et al. (1996), who used vertical head gradients and unsaturated hydraulic conductivity estimates in their calculations. The flux estimates presume that flow is vertical only. As such, the apparent fluxes beneath mesa top locations range from approximately 0.06 centimeters per year (cm/yr) beneath Area G to 245 cm/yr beneath the TA-53 surface impoundments. It is believed that high precipitation or surface disturbances (e.g., man-made ponds) lead to higher fluxes beneath some mesas, and that hypothesized evaporation resulting from air movement through Mesita del Buey at TA-54 apparently creates a barrier to infiltration beneath Area G. Beneath Cañada del Buey and Potrillo Canyon, two typically dry canyons, the apparent canyon-bottom infiltration rates range from 0.4 to 8.3 cm/yr. Beneath Mortandad Canyon, the only relatively wet canyon for which data are currently available, the canyon-bottom infiltration rates range from 1 to 10 cm/yr. Canyon-bottom infiltration rates beneath wetter canyons (e.g., Los Alamos Canyon) could be much greater; however, no data for those sites are currently available.

The hydraulic gradient of the regional aquifer averages about 60 to 80 feet per mile within the Puye Formation but increases to 80 to 100 feet per mile along the eastern edge of the Pajarito Plateau as the groundwater enters the less permeable sediments of the Santa Fe Group. In the upper section of the regional aquifer, the rate of movement of groundwater varies, depending on the materials in the aquifer. Groundwater travel time between Characterization Well R-25 and a distance equal to that of the nearest water supply well, PM-2, is estimated to range from 50 to 200 years based on plateau-wide average groundwater flow rates of between 95 and 345 feet per year, determined by Purtymun (1995). However, actual groundwater flow rates and flow direction in the vicinity of Well R-25 and elsewhere are not yet known.

Through Fiscal Year 1999, five deep characterization wells have been drilled, as required by the "Hydrogeologic Workplan" (LANL, 1998c) and as summarized in the "Groundwater Annual Status Report for Fiscal Year 1999" (LANL, 2000a). The characterization wells were drilled using air rotary/casing advance methods, and geologic core and water samples were collected at defined intervals during the drilling operations and analyzed for the presence of both natural and man-made constituents. The five characterization wells include Wells R-9, R-12, R-15, R-25, and R-31. Characterization Well R-9 is located in Los Alamos Canyon at the eastern boundary of LANL. During the drilling of the well to a total depth of 771 feet, five perched water zones were encountered. The regional aquifer was reached at a depth of 688 feet. Tritium levels were highest (347 pCi/L) in the uppermost perched zone and lowest (14 pCi/L) in the regional aquifer. These levels are far below the levels of health concern (20,000 pCi/L), but do indicate the movement of some water from the land surface to the groundwater zones within the past 40 or so years. Characterization Well R-12 is located in Sandia Canyon at the eastern boundary of LANL. This well was drilled to a total depth of 847 feet. An intermediate-depth perched groundwater zone was encountered at a depth of 424 feet, and the regional aquifer was reached at a depth of 805 feet. The perched groundwater at the 424-foot depth was found to contain 208.1 pCi/L of tritium. The presence of some recent recharge water is indicated at this regional aquifer location by tritium levels of 46.9 pCi/L. Characterization Well R-15 is located in Mortandad Canyon about 1.5 miles east of the Radioactive Liquid Waste Treatment Facility at TA-50. Both hollow stem auger and air rotary/casing advance methods were used in drilling this well. A definable intermediate perched zone was encountered at a depth of 646 feet, and the regional aquifer was reached at a depth of 964 feet. The total depth of Well R-15 is 1,107 feet. The deep perched zone contained tritium at concentrations of 3,770

± 850 pCi/L; these levels indicate infiltration of Laboratory-derived contaminants at this location, but the levels are well below federal drinking water standards. The tritium concentration in the regional aquifer at Well R-15 is less than detection. A perchlorate concentration of 12 parts per billion was detected in the perched water zone at Well R-15 in December 1999 (LANL, 2000b). LANL personnel are working to reduce perchlorate discharges with an eventual goal of zero discharges in the coming years. In addition, LANL personnel are monitoring the influent and effluent of the TA-50 Radioactive Liquid Waste Treatment Facility, which discharges treated effluent to Mortandad Canyon, to determine what levels of perchlorate are being discharged and to establish treatment and removal efficiencies. Modifications to treatment operations are also planned to reduce perchlorate concentrations in water discharged from the treatment facility. Characterization Well R-25 is located on a mesa top at TA-16 along the south rim of Cañon de Valle near the western boundary of LANL. The total depth of Well R-25 is 1,942 feet, and the regional aquifer was reached at a depth of 1,286 feet. Groundwater samples were collected at depths ranging from 747 to 1,942 feet, and most of these samples were found to contain HE compounds and their associated degradation products. The two contaminants of most concern are RDX and TNT because they exceeded EPA health advisory limits (2 µg/L) for drinking water. Down-gradient drinking water-supply wells were also sampled and found to contain no HE; the closest drinking water-supply well to R-25 is three miles to the east. Discharges from past HE-manufacturing activities at TA-16 are believed to be the source of the constituents found in Well R-25. Steps have been taken to reduce the amount of HE-processing water being discharged at TA-16, including installation of the High Explosives Wastewater Treatment Facility and elimination of 99 percent of the previous annual discharges to wastewater outfalls. Characterization Well R-31 is located at TA-39 in the north fork of Ancho Canyon near the southern boundary of LANL. This well was drilled to a total depth of 1,103 feet. The regional aquifer was encountered at 520 feet; no intermediate perched zones were encountered in this well (John Marin, 2000). Published geochemical data for this well are not yet available.

Low-level concentrations (2 to 3 parts per billion) of perchlorate were detected in late June 2000 in water samples collected from the Otowi-1 water-supply well located in lower Pueblo Canyon (LANL, 2000c). Perchlorate is a non-radioactive chemical compound used in a variety of industrial processes. At LANL, perchlorate is a byproduct of the perchloric acid used in nuclear chemistry research. The Otowi-1 well, which is part of the Los Alamos water-supply

system, has been in production status since 1998 and is sampled regularly as part of LANL's water-quality-assurance activities. Independent analytical laboratories corroborated LANL's analytical results, and in four separate samples collected between June 21, 2000, and July 6, 2000, perchlorate concentrations in the Otowi-1 well ranged from 2 to 3.5 parts per billion. A drinking water standard for perchlorate has not been established by the EPA, and an action level or regulatory standards have not been established by the State of New Mexico. The State of California has established a perchlorate water-supply action level for concentrations greater than 18 parts per billion. LANL began testing for perchlorate in December 1997 after the California Department of Health Services identified perchlorate as a contaminant of concern. A possible source for the contamination could be legacy waste that was discharged into Acid Canyon from LANL's TA-45 treatment plant, which operated from 1943 to 1964. The plant was decommissioned in 1966 and 1967. Prior to the June 2000 detection, perchlorate had not been detected in any water-supply wells. In the past, LANL has detected very low concentrations of tritium and nitrate in the Otowi-1 well. Samples collected from shallow-groundwater-monitoring wells (Wells MCO-3 through MCO-6) in Mortandad Canyon in December 1999 contained perchlorate concentrations ranging from 80 to 220 parts per billion.

The moisture content of the Bandelier Tuff at LANL varies. Generally, at depths below 10 feet, the moisture content of the tuff varies from approximately 6 percent to saturation in the canyons with perched aquifers and from about 4 to 6 percent on the mesas. In canyons where no perched aquifers are present, the moisture content of the tuff at depths below ten feet generally ranges from about 4 to 10 percent. At Characterization Well R-15 in Mortandad Canyon, the moisture content in the Otowi Member is about 20%. Moisture content in the underlying Cerros del Rio Basalt ranges from 0.5 to 14.6% (LANL, 2000a). At the mesa top Characterization Well R-25 at TA-16, relatively low moisture contents in the Tshirege Member of the Bandelier Tuff range from 2% to 5%. The moisture content increases through the lower units of this member to about 21% in the top of the Cerro Toledo interval. Moisture content in the upper portion of the Otowi Member is about 7%, and increases at depth to approximately 20%. Additional information on Los Alamos groundwater and vadose zone characteristics will be published in groundwater annual status reports and in drill hole completion reports.

Regulated units (surface impoundments, waste piles, land treatment units, and landfills, as provided by 20 NMAC 4.1, Subpart V, 264.90(a)(2) [6-14-00]), will meet the requirements

specified in 20 NMAC 4.1, Subpart V, 260.90-101 [6-14-00], as appropriate. The LANL "Hydrogeologic Workplan" will be used to characterize the hydrogeologic regime at the facility as a preliminary basis for potential monitoring or demonstration of groundwater monitoring waiver. The groundwater wells constructed in the workplan program may be used for monitoring regulated units, if deemed necessary and appropriate. Relevant groundwater monitoring provisions for regulated units will be addressed in TA-specific permit applications, permit modification requests, and permit renewal documents. Appropriate groundwater monitoring provisions for LANL's solid waste management units will be addressed through the HSWA portion of the permit.

~~Requirements for groundwater monitoring and protection specified in 20 NMAC 4.1, Subpart IX, 270.14(c), and 20 NMAC 4.1, Subpart V, 264.90(a) [1-1-97], apply to owners and operators of the following "regulated units" only: surface impoundments, waste piles, land treatment units, and landfills. Any units subject to permitting requirements that have associated groundwater monitoring requirements are included in the "Hydrogeologic Workplan," approved by the NMED on March 25, 1998 (LANL, 1998c).~~

A.6 OTHER PERMIT ACTIVITIES

Other types of RCRA permits will be addressed in TA-specific permit applications, permit modification requests, or permit renewal documents.

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APPENDIX A

FACILITY DESCRIPTION

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LIST OF ABBREVIATIONS/ACRONYMS

AASHTO	American Association of State Highway & Transportation Officials
amsl	above mean sea level
cm/s	centimeters per second
cm/yr	centimeters per year
D&D	decontamination and decommissioning
DOE	U.S. Department of Energy
HE	high explosives
LANL	Los Alamos National Laboratory
20 NMAC 4.1	New Mexico Administrative Code, Title 20, Chapter 4, Part 1
pCi/L	picocuries per liter
R&D	research and development
RCRA	Resource Conservation and Recovery Act
TA	technical area

APPENDIX A
FACILITY DESCRIPTION

The information provided in this appendix is submitted in accordance with the applicable requirements of the New Mexico Administrative Code, Title 20, Chapter 4, Part 1 (20 NMAC 4.1), revised June 14, 2000 [6-14-00]. The following subject areas are addressed in this appendix or are referenced to technical area (TA)-specific permit applications, permit modification requests, or permit renewal documents:

- A general description of the Los Alamos National Laboratory (LANL) facility (20 NMAC 4.1, Subpart IX, 270.14(b)(1) [6-14-00]);
- Traffic patterns, volume, and control (20 NMAC 4.1, Subpart IX, 270.14(b)(10)) [6-14-00];
- Facility location information for compliance with the seismic standard and floodplain requirements (20 NMAC 4.1, Subpart IX, 270.14(b)(11), 270.14(b)(19)(ii), and 20 NMAC 4.1, Subpart V, 264.18(a) and (b) [6-14-00]);
- Topographic map requirements (20 NMAC 4.1, Subpart IX, 270.14(b)(19) [6-14-00]).

A.1 GENERAL DESCRIPTION [20 NMAC 4,1, Subpart IX, 270.14(b)(1)]

LANL is located in Los Alamos County, an incorporated county, in north-central New Mexico, approximately 60 miles north-northeast of Albuquerque and 25 miles northwest of Santa Fe. The regional location of LANL is shown on Figure A-1. LANL is divided into TAs, as shown on Figure A-2. LANL, which occupies an area of 43 square miles, and the associated residential and commercial areas of Los Alamos County, which occupy an area of 109 square miles, are situated on the Pajarito Plateau. The plateau consists of a series of finger-like mesas separated by deep east-west trending canyons. Ephemeral, interrupted, or intermittent streams lie at the bottoms of all the canyons. The mesa tops range in elevation from approximately 7,800 feet above mean sea level (amsl) at the flank of the Jemez Mountains, located to the west of Los Alamos, to about 6,200 feet amsl at their eastern extent, where they terminate above the Rio Grande.

LANL's central mission is the reduction of global nuclear danger supported by research that also contributes to conventional defense, civilian, and industrial needs. This includes programs in nuclear safeguards and stockpile stewardship; nuclear, medium energy, and space physics; hydrodynamics; conventional explosives; chemistry; metallurgy; radiochemistry; space nuclear systems; controlled thermonuclear fusion; laser research; environmental technology; geothermal, solar, and fossil energy research; biomedicine, health, and biotechnology; and industrial partnerships. LANL is owned by

the U.S. Department of Energy (DOE) and is operated jointly by DOE and the University of California. The facility mailing address is P.O. Box 1663, Los Alamos, New Mexico, 87545.

LANL is an existing treatment, storage, and disposal facility. Hazardous waste is generated at LANL primarily from research and development (R&D) activities, general facility operations, and decontamination and decommissioning (D&D) projects. Mixed low-level waste is generated mainly from R&D activities, processing and recovery operations, general facility operations, D&D projects, and environmental restoration activities. Mixed transuranic waste is generated primarily from R&D activities, processing and recovery operations, and D&D projects. High explosives (HE)-contaminated waste is generated mainly from R&D activities, environmental restoration activities, water treatment processes, and building maintenance and modification activities. Brief descriptions of specific hazardous and mixed waste management units at LANL are presented in Attachment A of TA-specific permit applications, permit modification requests, or permit renewal documents. Waste generated from R&D activities, processing and recovery operations, and environmental restoration activities may be received from off-site facilities, as described in Supplement 6 of this General Part B Permit Application.

A.2 TRAFFIC PATTERNS [20 NMAC 4.1, Subpart IX, 270.14(b)(10)]

The traffic pattern information presented below is general in nature. More detailed information is addressed in TA-specific permit applications, permit modification requests, or permit renewal documents.

A.2.1 General

The rugged topography of alternating mesas and canyons present at LANL limits traffic circulation to only a few major arterial roads. Approximately 85 miles of paved roads are present within LANL (Pan Am World Services Inc., 1986). The major roads are shown on Figure A-3. There are approximately 19 miles of highway, 22 miles of TA access roads, and 44 miles of roads in LANL's TAs.

The main access route to LANL is State Road 502; the majority of traffic to LANL approaches from the east on State Road 502 and East Jemez Road. Alternate access routes are available from the south on State Roads 4 and 501 (West Jemez Road).

The pattern of east-west trending canyons at LANL prohibits north-south automobile travel in nearly all portions of LANL, with the exception of Diamond Drive and part of West Jemez Road.

Los Alamos Canyon is spanned at Diamond Drive by an 820-foot-long steel-arch bridge that was completed in 1951 and improved in 1993. This bridge provides the main access between LANL facilities located on either side of Los Alamos Canyon.

Approximately 10,000 people are currently employed at LANL (including full-time, part-time, and casual LANL personnel and subcontractors). Roughly 4,000 people commute to LANL daily from communities outside Los Alamos County.

A.2.2 Waste Collection Areas

Hazardous and mixed waste is generated at TAs throughout LANL. Small quantities of waste are generally accumulated in containers at less-than-90-day storage areas or satellite accumulation areas and then packed in containers, such as drums, boxes, or crates, for transport to storage or treatment areas, as necessary. Bulk liquid waste is contained primarily in drums or tanks. Because hazardous and mixed waste may be generated throughout LANL, waste transport may occur on nearly all roads within LANL. Off-site wastes may be received at LANL on a limited basis. Waste collection areas for these off-site wastes will be discussed in TA-specific permit applications, permit modification requests, or permit renewal documents.

A.2.3 Routes of Travel

Information addressing unit-specific travel routes is presented in Attachment A of TA-specific permit applications, permit modification requests, or permit renewal documents.

A.2.4 Traffic Volumes

According to a 1997 traffic study, the peak traffic periods are between 7:30 and 8:30 a.m., 12:15 and 1:15 p.m., and 4:30 and 5:30 p.m. (Los Alamos County, 1997). The 1997 traffic study was limited to the intersection of Diamond Drive and Trinity Drive, just north of the TA-3 area. Consequently, the data presented in the study should reflect the existing traffic conditions in the TA-3 area at LANL. TA-3 will typically have higher vehicular volumes than the rest of LANL; thus, this study provides a conservative estimate of facilitywide traffic volumes. Maps and data from the cited study depicting vehicular traffic-count movements at the intersection of Diamond and Trinity Drives are included in Supplement 4 of this document. Based on the 1997 traffic study, the Diamond Drive and Trinity Drive intersection had a volume of 3,152 vehicles from 7:30 to 8:30 in the morning, and 2,815 vehicles from 4:30 to 5:30 in the afternoon.

Maps and data from a traffic count conducted at the same intersection in April 1998 are also included in Supplement 4 (Los Alamos County, 1998). The peak traffic periods for the 1998 study are between 7:15 and 8:15 a.m., 12:30 and 1:30 p.m., and 5:00 and 6:00 p.m. The traffic volume from 7:15 to 8:15 in the morning was 2,428 vehicles. From 5:00 to 6:00 in the afternoon, the volume was 2,648 vehicles. The count is biased low because Los Alamos High School was on spring break during this traffic study.

Additional traffic volume information is provided in Attachment A of TA-specific permit applications, permit modification requests, or permit renewal documents.

A.2.5 Traffic Control Signals

Sitewide traffic flow at LANL is controlled by traffic lights, stop signs, and yield signs. Traffic lights are in place at all major intersections. Traffic signs are used at "T" intersections throughout LANL. Access to high security TAs is controlled by security guards or special access gates. Only personnel having appropriate security clearance and identification or escorted visitors are allowed access to the high security TAs. Vehicles and personnel entering these TAs are subject to periodic search by security personnel.

Unit-specific information addressing traffic control signals is presented in Attachment A of TA-specific permit applications, permit modification requests, or permit renewal documents.

A.2.6 Road Load-Bearing Capacity

Roads at LANL carrying the greatest traffic volumes include Diamond Drive, Pajarito Road, and East and West Jemez Roads. These roads are typically constructed with an 8-inch-thick base overlain with a 5-inch-thick asphaltic concrete surface. They were designed and built in conformance with American Association of State Highway & Transportation Officials (AASHTO) specification HS-20. This specification is intended to accommodate truck loading capacities of 32,000 pounds per axle. Roads within TAs are generally two-lane roads with asphaltic concrete surfaces. These roads are typically constructed with a 6-inch-thick base overlain with a 3-inch-thick asphaltic concrete surface. These roads were also designed and constructed to meet AASHTO specification HS-20.

A.3 LOCATION INFORMATION

A.3.1 Seismic Standard [20 NMAC 4.1, Subpart IX, 270.14(b)(11)(i and ii) and 20 NMAC 4.1, Subpart V, 264.18(a)]

LANL is located in Los Alamos, New Mexico; therefore, pursuant to 20 NMAC 4.1, Subpart IX, 270.14(b)(11)(i) and 20 NMAC 4.1, Subpart V, Appendix VI [6-14-00], the seismic standard of 20 NMAC 4.1, Subpart V, 264.18(a) [6-14-00], is applicable. Unit-specific information addressing the seismic standard requirements of 20 NMAC 4.1, Subpart IX, 270.14(b)(11)(ii), and 20 NMAC 4.1, Subpart V, 264.18(a) [6-14-00], is presented in Attachment A of TA-specific permit applications, permit modification requests, or permit renewal documents.

A.3.2 Floodplain Standard [20 NMAC 4.1, Subpart IX, 270.14(b)(11)(iii through v) and 270.14(b)(19)(ii); 20 NMAC 4.1, Subpart V, 264.18(b)]

As required in "Module VIII: Special Conditions Pursuant to the 1984 Hazardous and Solid Waste Amendments to RCRA for Los Alamos National Laboratory, EPA I.D. NM0890010515" (EPA, 1994), LANL has mapped all 100-year floodplain boundaries within the LANL complex. A report was published documenting the floodplain mapping procedures (McLin, 1992). This report is included as Supplement 5 of this document. A LANL-wide 100-year floodplain map is provided on page 36 of that report. The floodplain-boundary map resides on LANL's Facility for Information Management, Analysis, and Display system, a geographical information system. These maps are being revised as a result of the Cerro Grande Fire, and new maps and supporting calculations will be submitted, as they become available.

In accordance with 20 NMAC 4.1, Subpart IX, 270.14(b)(11)(iii through v) [6-14-00], any waste management units located within a 100-year floodplain at LANL will be addressed in Attachment A of TA-specific permit applications, permit modification requests, or permit renewal documents.

A.4 TOPOGRAPHIC MAPS [20 NMAC 4.1, Subpart IX, 270.14(b)(19)]

Due to the size of LANL, several maps and figures are provided or referenced to meet the requirements of 20 NMAC 4.1, Subpart IX, 270.14(b)(19) [6-14-00]. All maps clearly show the map scale, the date of preparation, and a north arrow. The maps and figures used to fulfill these regulatory requirements include the following:

- A LANL-wide 100-year floodplain map is provided on page 36 of the report included as Supplement 5 of this document.
- A map showing surface waters, including intermittent streams, and flow direction is included in the LANL General Part A Permit Application (LANL, 1998a) and in the "Los Alamos

National Laboratory's Response to Request for Supplemental Information: General Part A Permit Application, Revision 0.0" (LANL, 1998b).

- Surrounding land uses are shown on Figure A-1 of this appendix.
- Wind roses for LANL are shown on Figures A-4 and A-5 of this appendix.
- A map showing the legal boundaries of LANL is included in the LANL General Part A Permit Application (LANL, 1998a).
- Access ways and internal roads are shown on Figure A-3 in this appendix and on a figure(s) in Attachment A of TA-specific permit applications, permit modification requests, or permit renewal documents.
- Access control features (e.g., fences, gates) are shown on a figure(s) in Attachment A of TA-specific permit applications, permit modification requests, or permit renewal documents.
- A map showing supply wells, monitoring wells, test wells, springs, and surface-water sampling stations is included in the LANL General Part A Permit Application (LANL, 1998a) and in the "Los Alamos National Laboratory's Response to Request for Supplemental Information: General Part A Permit Application, Revision 0.0" (LANL, 1998b).
- Buildings and structures are shown on maps in the LANL General Part A Permit Application (LANL, 1998a).
- The locations of the hazardous and/or mixed waste management units at LANL are shown on maps in the LANL General Part A Permit Application (LANL, 1998a).
- A map showing National Pollutant Discharge Elimination System discharge structure locations is included in the LANL General Part A Permit Application (LANL, 1998a).
- Storm, sanitary, and process sewer systems at LANL are shown on Map A-1 of this appendix.
- Drainage control features (e.g., run-on/runoff) are shown on a figure(s) in TA-specific permit applications, permit modification requests, or permit renewal documents.
- Natural surface drainages are shown on maps in the LANL General Part A Permit Application (LANL, 1998a).
- Fire stations serving LANL and the County of Los Alamos are shown on Figure E-2 of Appendix E.
- An equipment cleanup area is located at TA-50-1. The location of TA-50-1 is shown on a map in the LANL General Part A Permit Application (LANL, 1998a).

Contour lines on all topographic maps are in intervals sufficient to detail natural drainage at LANL and in the vicinity of the waste management units. As provided in 20 NMAC 4.1, Subpart IX, 270.14(b)(19) [6-14-00], LANL has submitted the maps at these scales and contour intervals due to the size of the waste management units, the extent of the LANL facility, and the topographic relief in the area.

A.5 GROUNDWATER [20 NMAC 4.1, Subpart IX, 270.14(c) and 20 NMAC 4.1, Subpart V, 264.90(a)]

In the Los Alamos area, groundwater occurs in three modes: (1) water in shallow alluvium and underlying tuff in some of the larger canyons, (2) intermediate perched zone groundwater (a perched groundwater body above a less permeable layer and separated from the underlying aquifer by an unsaturated zone), and (3) the regional aquifer of the Los Alamos area.

Alluvium that is as much as 100 feet thick has been deposited in the canyons of the Pajarito Plateau by intermittent and ephemeral stream flows. Alluvium in canyons that head in the Jemez Mountains is generally composed of sands, gravels, pebbles, cobbles, and boulders derived from the Tschicoma Formation and Bandelier Tuff on the flank of the mountains. Alluvium in canyons that head on the Pajarito Plateau is relatively fine-grained and consists of clays, silts, sands, and gravels derived from the Bandelier Tuff. Saturated hydraulic conductivity of the alluvium typically ranges from 10^{-2} centimeters per second (cm/s) for a sand to 10^{-4} cm/s for a silty sand (Abeele et al., 1981).

Unlike the underlying volcanic tuff and sediments, the alluvium is quite permeable. Ephemeral runoff in some canyons infiltrates the alluvium until downward movement is impeded by the less permeable underlying strata. The impeded downward movement results in a buildup of shallow alluvial groundwater. In some cases, relatively thin zones of shallow groundwater can also be contained in the weathered tuff or some other geologic unit immediately underlying the alluvium. The horizontal and vertical extent of the alluvial groundwater is limited by depletion via evapotranspiration and movement into the underlying rocks (Purtymun et al., 1977). The limited saturated thickness and extent of the alluvial groundwater preclude its use as a viable source of municipal and industrial supply to LANL and the surrounding community. Lateral flow of the alluvial groundwaters is down canyon and in an easterly direction. In Mortandad Canyon, tracer studies have shown that the velocity of alluvial water ranges from about 60 feet per day in the upper reach to about 7 feet per day in the lower reach of the canyon (Purtymun, 1974).

Intermediate perched zone groundwater is found in areas where a sufficient water source is present to maintain saturation within the deeper units. The presence of a perched zone is controlled by the occurrence of a perching layer that exhibits a lower permeability and causes water to pond in a more permeable overlying horizon. Localized bodies of perched groundwater occur beneath several canyons in the eastern portion of LANL, along the eastern flanks of the Jemez Mountains west of LANL, and beneath the mesas and canyons at TA-16, which is located in the southwestern part of LANL near the Jemez Mountains. Perched groundwater bodies may also exist beneath other

canyons in the south and central portions of LANL, which have not yet been investigated by drilling. Perched groundwater may be maintained beneath canyon bottoms by infiltration from the overlying stream, and within the Bandelier Tuff near the Jemez Mountains by seepage from streams exiting the mountains. In Los Alamos Canyon, for example, perching layers are found within the interbedded Cerros del Rio Basalt and the Puye Formation sediments, where they underlie the more permeable Guaje Pumice Bed. On the flanks of the Jemez Mountains and at TA-16, the presence of perched groundwater is apparently controlled by lithologic property contrasts within the Bandelier Tuff; these contrasts may exist at boundaries between flow units.

Intermediate perched zone groundwater occurs in the conglomerates and basalts beneath the alluvium in the mid- and lower reaches of Pueblo and Los Alamos Canyons and in the lower reach of Sandia Canyon. Depth to perched groundwater ranges from about 90 feet in the midreach of Pueblo Canyon to about 450 feet in lower Sandia Canyon. The vertical and lateral extent of the perched zones, the nature and extent of the perching units, and the potential for migration of perched groundwater to the regional aquifer are not yet fully understood.

Studies have shown that the intermediate perched zone groundwater in Pueblo Canyon is hydrologically connected to the stream in Pueblo Canyon (Abrahams and Purtymun, 1966). This perched zone water discharges at the base of the basalt at Basalt Spring, located on San Ildefonso Pueblo land east of LANL in lower Los Alamos Canyon. It has been estimated that the rate of movement of the perched groundwater in this vicinity is about 60 feet per day, or about 6 months from recharge to discharge (Purtymun, 1975).

Measurements of tritium in intermediate perched zone groundwater indicate that recharge to those depths has occurred during the last several decades. Observations made at four locations in Pueblo and Los Alamos Canyons show that levels of tritium in the perched zone are high enough to be attributed to recharge of surface water contaminated by effluent or other releases from LANL operations. In a test well in Pueblo Canyon (TW-2A), tritium has been observed at concentrations between 2,000 and 3,000 picocuries per liter (pCi/L). Beginning in 1991, low-detection-limit tritium measurements have shown tritium levels of about 150 pCi/L in samples from a test well located in lower Pueblo Canyon near its confluence with Los Alamos Canyon (TW-1A), and in Basalt Spring, which is located in Los Alamos Canyon just downstream from its confluence with Pueblo Canyon. Measurements at these three locations are consistent with LANL's previous understanding that the intermediate perched zone groundwater in Pueblo Canyon has been affected by effluents discharged into the canyon. In the middle reach of Los Alamos canyon, about one mile down gradient of TA-2,

tritium was detected in the intermediate perched zone at well LADP-3 (Broxton and Eller, 1995). Perched groundwater was encountered at a depth of about 320 to 330 feet at this well, and water samples contained about 6,000 pCi/L of tritium.

The regional aquifer of the Los Alamos area is the only aquifer known to be capable of providing a large-scale municipal water supply (Purtymun, 1984). The surface of the regional aquifer rises westward from the Rio Grande within the Santa Fe Group into the lower part of the Puye Formation beneath the central and western parts of the Pajarito Plateau. The depth to the regional aquifer below the mesa tops ranges from about 600 feet at the eastern margin of the plateau to about 1,200 feet along the western margin. According to Purtymun (1984), the regional aquifer exhibits artesian conditions in the eastern part along the Rio Grande. Throughout the plateau, continuously recorded water level measurements collected in test wells since the fall of 1992 indicate that the regional aquifer responds to barometric and earth tide effects in a manner typical of confined aquifers.

Thirteen deep water-supply wells in three well fields produce water for LANL and the communities of Los Alamos and White Rock. The well fields include the off-site Guaje well field and the on-site Pajarito and Otowi well fields. The Guaje well field is located northeast of LANL and contains seven wells, six of which had significant production during 1998. Due to their age, these older wells were planned to be retired after 1999. Four new wells were drilled in this field in 1998 to replace the older wells. The five wells comprising the Pajarito well field are located in Sandia and Pajarito Canyons and on mesa tops between these canyons. The Otowi well field is located in Los Alamos and Pueblo Canyons, and consist of two wells. Municipal water-supply pumpage during 1992 was 1.43 billion gallons, and yields from individual wells ranged from about 175 to 1,400 gallons per minute (Stoker et al., 1992).

The exact source of recharge to the regional aquifer is unknown. Groundwater elevation measurements suggest that groundwater flows from the Jemez Mountains east and southeast toward the Rio Grande, where a portion discharges into the river through seeps and springs. There is considerable uncertainty regarding recharge along the Jemez Mountains. Infiltration of stream flow probably occurs along the mountain flanks. Major recharge of the regional aquifer from the west is inferred because the piezometric surface slopes downward to the east. Three sources of recharge have been suggested by Cushman (1965): infiltration of runoff in canyons; underflow from the Valles caldera through the Tschicoma Formation; and infiltration on mesas. Natural recharge through undisturbed Bandelier Tuff on the mesa tops is believed to be insignificant (Purtymun and Kennedy, 1971; Kearl et al., 1986).

Isotope and age-dating measurements have been made in an effort to better understand the nature of recharge to the regional aquifer. Samples from test wells and water-supply wells that penetrate the regional aquifer were sampled and analyzed for carbon-14 and low-level tritium to allow tentative estimates of the age of the water in the regional aquifer at various locations. The interpretation of the carbon-14 data indicates that the minimum age of water in the regional aquifer varies. Under the western portion of the plateau, the minimum age is about 1,000 years. As the water moves eastward, the age increases. Near the Rio Grande, the age of water is about 30,000 years (Rogers et al., 1996). It is important to recognize that, because the samples were collected from water drawn from screened intervals of 600 to 3,100 feet, these ages are composite water ages. These ages may support an easterly flow direction, with younger water recharging at the plateau's western boundary and flowing towards the east. Another possibility is that these ages represent two separate groundwater bodies of different ages, and that a groundwater divide in the regional aquifer is located west of the Rio Grande. The region of waters with higher recharge elevations identified by Goff and Sayer (1980) correspond to the older ages near the Rio Grande, and the much older ages could reflect the longer flow path from the possible Sangre de Cristo recharge area. Groundwater samples collected at five locations in the regional aquifer near Los Alamos appear to show the presence of some recent (within the last 40 years) recharge, as indicated by several measurements of tritium by extremely low-detection-limit analytical methods (Environmental Protection Group, 1995, 1994). These locations include TW-1 in Pueblo Canyon near the confluence with Los Alamos Canyon, TW-3 in Los Alamos Canyon, old observation and water-supply wells LA-1A and LA-2 in Los Alamos Canyon near its confluence with the Rio Grande, TW-8 in Mortandad Canyon, and in wells and springs at San Ildefonso Pueblo (Environmental Protection Group, 1995; Blake et al., 1995). The tritium levels measured range from less than a percent to less than a hundredth of a percent of current drinking water standards. In addition, these levels are less than the levels that could be detected by EPA-specified analytical methods normally used to determine compliance with drinking water regulations.

Based on an overall decline in regional aquifer levels across the Pajarito Plateau since pumping began in the 1950s, the total volume of annual recharge near the plateau is apparently less than the quantity of municipal water production, which is approximately 5,000 acre-feet per year. Rogers and Gallaher (1995) tabulated Bandelier Tuff core hydraulic properties from several boreholes at LANL to estimate recharge rates beneath the Pajarito Plateau. The direction and flux of water through the unsaturated zone were evaluated by Rogers et al. (1996) using hydraulic properties from seven boreholes that had sufficient data. The seven boreholes were from mesa top and canyon bottom

locations, which represent two of the distinct hydrologic regimes on the Pajarito Plateau. Most head gradients determined for the boreholes were approximately unity, thus implying that flow is nearly steady state. One exception was found for boreholes at TA-54, Area G, where gradient reversals at depths of about 100 feet suggest that evaporative drying may be occurring. Infiltration rates for liquid water at the seven locations were approximated by Rogers et al. (1996), who used vertical head gradients and unsaturated hydraulic conductivity estimates in their calculations. The flux estimates presume that flow is vertical only. As such, the apparent fluxes beneath mesa top locations range from approximately 0.06 centimeters per year (cm/yr) beneath Area G to 245 cm/yr beneath the TA-53 surface impoundments. It is believed that high precipitation or surface disturbances (e.g., man-made ponds) lead to higher fluxes beneath some mesas, and that hypothesized evaporation resulting from air movement through Mesita del Buey at TA-54 apparently creates a barrier to infiltration beneath Area G. Beneath Cañada del Buey and Potrillo Canyon, two typically dry canyons, the apparent canyon-bottom infiltration rates range from 0.4 to 8.3 cm/yr. Beneath Mortandad Canyon, the only relatively wet canyon for which data are currently available, the canyon-bottom infiltration rates range from 1 to 10 cm/yr. Canyon-bottom infiltration rates beneath wetter canyons (e.g., Los Alamos Canyon) could be much greater; however, no data for those sites are currently available.

The hydraulic gradient of the regional aquifer averages about 60 to 80 feet per mile within the Puye Formation but increases to 80 to 100 feet per mile along the eastern edge of the Pajarito Plateau as the groundwater enters the less permeable sediments of the Santa Fe Group. In the upper section of the regional aquifer, the rate of movement of groundwater varies, depending on the materials in the aquifer. Groundwater travel time between Characterization Well R-25 and a distance equal to that of the nearest water supply well, PM-2, is estimated to range from 50 to 200 years based on plateau-wide average groundwater flow rates of between 95 and 345 feet per year, determined by Purtymun (1995). However, actual groundwater flow rates and flow direction in the vicinity of Well R-25 and elsewhere are not yet known.

Through Fiscal Year 1999, five deep characterization wells have been drilled, as required by the "Hydrogeologic Workplan" (LANL, 1998c) and as summarized in the "Groundwater Annual Status Report for Fiscal Year 1999" (LANL, 2000a). The characterization wells were drilled using air rotary/casing advance methods, and geologic core and water samples were collected at defined intervals during the drilling operations and analyzed for the presence of both natural and man-made constituents. The five characterization wells include Wells R-9, R-12, R-15, R-25, and R-31. Characterization Well R-9 is located in Los Alamos Canyon at the eastern boundary of LANL. During

the drilling of the well to a total depth of 771 feet, five perched water zones were encountered. The regional aquifer was reached at a depth of 688 feet. Tritium levels were highest (347 pCi/L) in the uppermost perched zone and lowest (14 pCi/L) in the regional aquifer. These levels are far below the levels of health concern (20,000 pCi/L), but do indicate the movement of some water from the land surface to the groundwater zones within the past 40 or so years. Characterization Well R-12 is located in Sandia Canyon at the eastern boundary of LANL. This well was drilled to a total depth of 847 feet. An intermediate-depth perched groundwater zone was encountered at a depth of 424 feet, and the regional aquifer was reached at a depth of 805 feet. The perched groundwater at the 424-foot depth was found to contain 208.1 pCi/L of tritium. The presence of some recent recharge water is indicated at this regional aquifer location by tritium levels of 46.9 pCi/L. Characterization Well R-15 is located in Mortandad Canyon about 1.5 miles east of the Radioactive Liquid Waste Treatment Facility at TA-50. Both hollow stem auger and air rotary/casing advance methods were used in drilling this well. A definable intermediate perched zone was encountered at a depth of 646 feet, and the regional aquifer was reached at a depth of 964 feet. The total depth of Well R-15 is 1,107 feet. The deep perched zone contained tritium at concentrations of 3,770 ± 850 pCi/L; these levels indicate infiltration of Laboratory-derived contaminants at this location, but the levels are well below federal drinking water standards. The tritium concentration in the regional aquifer at Well R-15 is less than detection. A perchlorate concentration of 12 parts per billion was detected in the perched water zone at Well R-15 in December 1999 (LANL, 2000b). LANL personnel are working to reduce perchlorate discharges with an eventual goal of zero discharges in the coming years. In addition, LANL personnel are monitoring the influent and effluent of the TA-50 Radioactive Liquid Waste Treatment Facility, which discharges treated effluent to Mortandad Canyon, to determine what levels of perchlorate are being discharged and to establish treatment and removal efficiencies. Modifications to treatment operations are also planned to reduce perchlorate concentrations in water discharged from the treatment facility. Characterization Well R-25 is located on a mesa top at TA-16 along the south rim of Cañon de Valle near the western boundary of LANL. The total depth of Well R-25 is 1,942 feet, and the regional aquifer was reached at a depth of 1,286 feet. Groundwater samples were collected at depths ranging from 747 to 1,942 feet, and most of these samples were found to contain HE compounds and their associated degradation products. The two contaminants of most concern are RDX and TNT because they exceeded EPA health advisory limits (2 µg/L) for drinking water. Down-gradient drinking water-supply wells were also sampled and found to contain no HE; the closest drinking water-supply well to R-25 is three miles to the east. Discharges from past HE-manufacturing activities at TA-16 are believed to be the source of the constituents found in Well R-25. Steps have been taken to reduce the amount of HE-processing water being discharged at TA-16, including installation of the High Explosives Wastewater Treatment Facility and elimination

of 99 percent of the previous annual discharges to wastewater outfalls. Characterization Well R-31 is located at TA-39 in the north fork of Ancho Canyon near the southern boundary of LANL. This well was drilled to a total depth of 1,103 feet. The regional aquifer was encountered at 520 feet; no intermediate perched zones were encountered in this well (John Marin, 2000). Published geochemical data for this well are not yet available.

Low-level concentrations (2 to 3 parts per billion) of perchlorate were detected in late June 2000 in water samples collected from the Otowi-1 water-supply well located in lower Pueblo Canyon (LANL, 2000c). Perchlorate is a non-radioactive chemical compound used in a variety of industrial processes. At LANL, perchlorate is a byproduct of the perchloric acid used in nuclear chemistry research. The Otowi-1 well, which is part of the Los Alamos water-supply system, has been in production status since 1998 and is sampled regularly as part of LANL's water-quality-assurance activities. Independent analytical laboratories corroborated LANL's analytical results, and in four separate samples collected between June 21, 2000, and July 6, 2000, perchlorate concentrations in the Otowi-1 well ranged from 2 to 3.5 parts per billion. A drinking water standard for perchlorate has not been established by the EPA, and an action level or regulatory standards have not been established by the State of New Mexico. The State of California has established a perchlorate water-supply action level for concentrations greater than 18 parts per billion. LANL began testing for perchlorate in December 1997 after the California Department of Health Services identified perchlorate as a contaminant of concern. A possible source for the contamination could be legacy waste that was discharged into Acid Canyon from LANL's TA-45 treatment plant, which operated from 1943 to 1964. The plant was decommissioned in 1966 and 1967. Prior to the June 2000 detection, perchlorate had not been detected in any water-supply wells. In the past, LANL has detected very low concentrations of tritium and nitrate in the Otowi-1 well. Samples collected from shallow-groundwater-monitoring wells (Wells MCO-3 through MCO-6) in Mortandad Canyon in December 1999 contained perchlorate concentrations ranging from 80 to 220 parts per billion.

The moisture content of the Bandelier Tuff at LANL varies. Generally, at depths below 10 feet, the moisture content of the tuff varies from approximately 6 percent to saturation in the canyons with perched aquifers and from about 4 to 6 percent on the mesas. In canyons where no perched aquifers are present, the moisture content of the tuff at depths below ten feet generally ranges from about 4 to 10 percent. At Characterization Well R-15 in Mortandad Canyon, the moisture content in the Otowi Member is about 20%. Moisture content in the underlying Cerros del Rio Basalt ranges from 0.5 to 14.6% (LANL, 2000a). At the mesa top Characterization Well R-25 at TA-16, relatively low moisture contents in the Tshirege Member of the Bandelier Tuff range from 2% to 5%. The

moisture content increases through the lower units of this member to about 21% in the top of the Cerro Toledo interval. Moisture content in the upper portion of the Otowi Member is about 7%, and increases at depth to approximately 20%. Additional information on Los Alamos groundwater and vadose zone characteristics will be published in groundwater annual status reports and in drill hole completion reports.

Regulated units (surface impoundments, waste piles, land treatment units, and landfills, as provided by 20 NMAC 4.1, Subpart V, 264.90(a)(2) [6-14-00]), will meet the requirements specified in 20 NMAC 4.1, Subpart V, 260.90-101 [6-14-00], as appropriate. The LANL "Hydrogeologic Workplan" will be used to characterize the hydrogeologic regime at the facility as a preliminary basis for potential monitoring or demonstration of groundwater monitoring waiver. The groundwater wells constructed in the workplan program may be used for monitoring regulated units, if deemed necessary and appropriate. Relevant groundwater monitoring provisions for regulated units will be addressed in TA-specific permit applications, permit modification requests, and permit renewal documents. Appropriate groundwater monitoring provisions for LANL's solid waste management units will be addressed through the HSWA portion of the permit.

A.6 OTHER PERMIT ACTIVITIES

Other types of RCRA permits will be addressed in TA-specific permit applications, permit modification requests, or permit renewal documents.

A.7 REFERENCES

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CERTIFICATION

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Dennis J. Erickson
Division Director for Environment, Safety, and Health Division
Los Alamos National Laboratory
Operator

November 1, 2000
Date Signed

David A. Gurulé, P.E.
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11/6/00
Date Signed