LA-14239-ENV
Approved for public release; distribution is unlimited

Environmental Surveillance
at Los Alamos during 2004

Los Alamos NATIONAL LABORATORY
EST. 1943

The World's Greatest Science Protecting America

Los Alamos National Laboratory's Governing Policy on Environment

It is the policy of Los Alamos National Laboratory that we will be responsible stewards of our environment. It is our policy to manage and operate our site in compliance with environmental laws and standards and in harmony with the natural and human environment; meet our environmental permit requirements; use continuous improvement processes to recognize, monitor, and minimize the consequences to the environment stemming from our past, present, and future operations; prevent pollution; foster sustainable use of natural resources; and work to increase the body of knowledge regarding our environment.

LA-14239-ENV

Issued: September 2005

Environmental Surveillance at Los Alamos during 2004

Environmental Surveillance Program:

Meteorology and Air Quality (Group ENV-MAQ)
505-665-8855

Water Quality and Hydrology (Group ENV-WQH)
505-665-0453

Solid Waste Regulatory Compliance (Group ENV-SWRC)
505-665-9527

Ecology (Group ENV-ECO)
505-665-8961

Los Alamos
NATIONAL LABORATORY
EST. 1943

Los Alamos NM 87545

Table of Contents

Environmental Surveillance at Los Alamos reports are prepared annually by the Los Alamos National Laboratory (the Laboratory) Environmental Stewardship Division, as required by US Department of Energy Order 5400.1, *General Environmental Protection Program* and US Department of Energy Order 231.1A, *Environment, Safety, and Health Reporting*.

These annual reports summarize environmental data that are used to determine compliance with applicable federal, state, and local environmental laws and regulations, executive orders, and departmental policies. Additional data, beyond the minimum required, are also gathered and reported as part of the Laboratory's efforts to ensure public safety and to monitor environmental quality at and near the Laboratory.

Chapter 1 provides an overview of the Laboratory's major environmental programs. Chapter 2 reports the Laboratory's compliance status for 2004. Chapter 3 provides a summary of the maximum radiological dose a member of the public and biota populations could have potentially received from Laboratory operations. The environmental surveillance and monitoring data are organized by environmental media (Chapter 4, air; Chapters 5 and 6, water; Chapter 7, soils; and Chapter 8, foodstuffs and biota) in a format to meet the needs of a general and scientific audience. A glossary and a list of acronyms and abbreviations are in the back of the report. Appendix A explains the standards for environmental contaminants, Appendix B explains the units of measurements used in this report, and Appendix C describes the Laboratory's technical areas and their associated programs.

In printed copies of this report or Executive Summary, we've also enclosed a disk with a copy of the full report in Adobe Acrobat (PDF) form and detailed supplemental tables of data from 2004 in Microsoft Excel format.

Inquiries or comments regarding these annual reports may be directed to

US Department of Energy **Office of Facility Operations** **528 35th Street** **Los Alamos, NM 87544**	**or**	**Los Alamos National Laboratory** **Environmental Stewardship Division** **P.O. Box 1663, MS K491** **Los Alamos, NM 87545**

To obtain copies of the report, contact

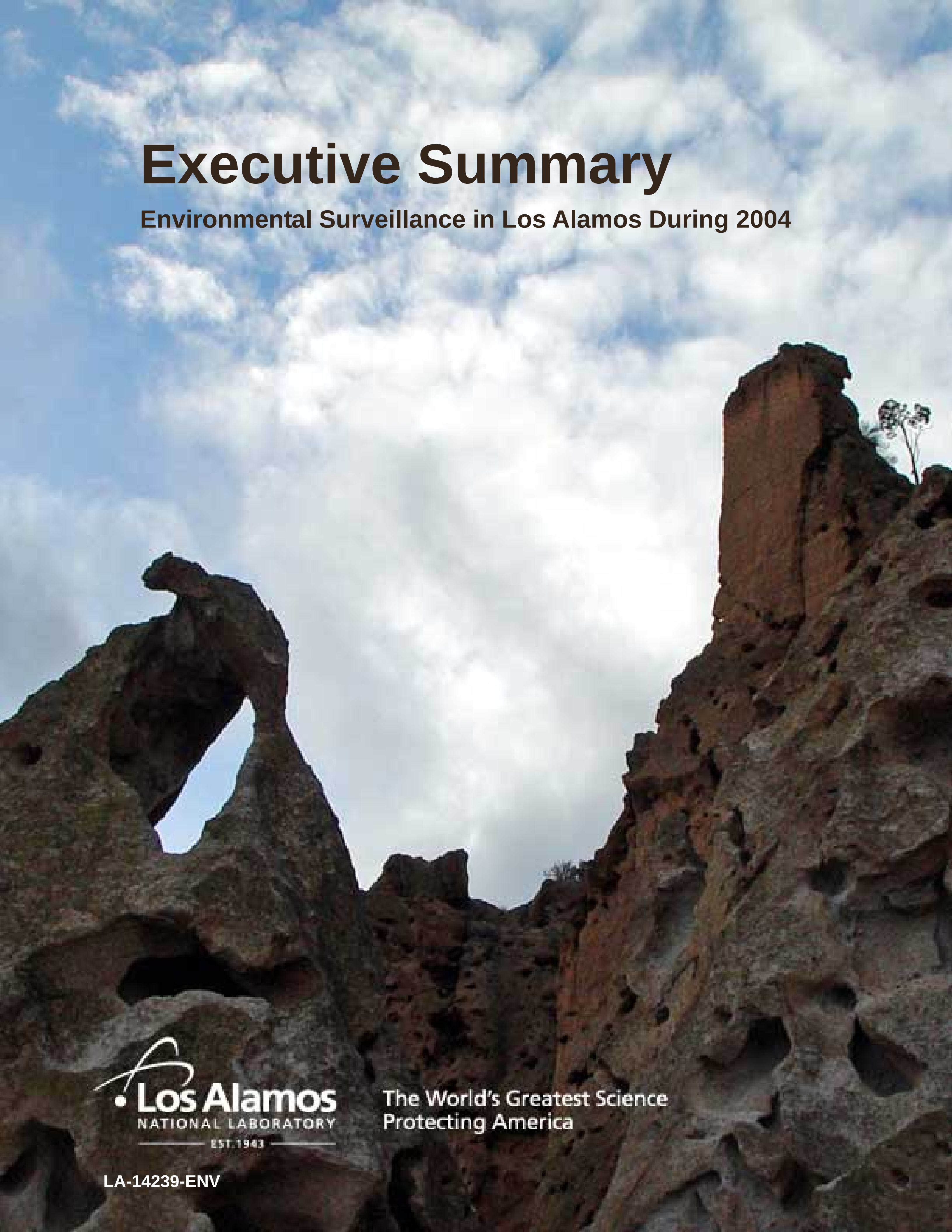
Terry Morgan
Los Alamos National Laboratory
P.O. Box 1663, MS J978
Los Alamos, NM 87545
Telephone: 505-665-0636
e-mail: *tlm@lanl.gov*

This report is also available on the World Wide Web at
http://www.airquality.lanl.gov/pdf/ESR/LA-14239-ENV.pdf

Abstract

Executive Summary

Environmental Surveillance in Los Alamos During 2004



Los Alamos NATIONAL LABORATORY EST. 1943

The World's Greatest Science Protecting America

LA-14239-ENV

Executive Summary – 2004

The Los Alamos National Laboratory (LANL) is located in Los Alamos County, in north-central New Mexico, approximately 60 miles north-northeast of Albuquerque and 25 miles northwest of Santa Fe (Figure ES-1). The 40-square-mile Laboratory is situated on the Pajarito Plateau, which consists of a series of mesas separated by deep east-to-west-oriented canyons cut by streams. Mesa tops range in elevation from approximately 7,800 ft on the flanks of the Jemez Mountains to about 6,200 ft above the Rio Grande Canyon. Most Laboratory and community developments are confined to the mesa tops. With the exception of the towns of Los Alamos and White Rock, the surrounding land is largely undeveloped; and large tracts of land north, west, and south of the Laboratory site are held by the Santa Fe National Forest, the US Bureau of Land Management, the Bandelier National Monument, the US General Services Administration, and the Los Alamos County. In addition, Pueblo de San Ildefonso borders the Laboratory to the east.

The mission of LANL is to develop and apply science and technology to (1) ensure the safety and reliability of the US nuclear deterrent, (2) reduce the threat of weapons of mass destruction, proliferation, and terrorism, and (3) solve national problems in defense, energy, environment, and infrastructure. Meeting this diverse mission requires excellence in science and technology to solve multiple national and international challenges. Inseparable from the Laboratory's focus on excellence in science and technology is the commitment to environmental stewardship and compliance. Part of LANL's commitment is to report on environmental performance of the Laboratory. This report

- Characterizes site environmental management,
- Summarizes environmental occurrences and responses,
- Describes compliance with environmental standards and requirements, and
- Highlights significant programs and efforts.

One of the Laboratory's strategic goals is to improve efficiency with which we achieve regulatory compliance and manage risk to support operational excellence.

Environmental Management System

LANL is implementing an Environmental Management System (EMS) pursuant to Department of Energy (DOE) Order 450.1. This order defines an EMS as "a continuous cycle of planning, implementing, evaluating, and improving processes and actions undertaken to achieve environmental missions and goals." The EMS provides a systematic method for assessing mission activities, determining the environmental impacts of those activities, prioritizing improvements, and measuring results.

In April 2004, the Laboratory Director approved a new environmental policy for the Laboratory. The Laboratory developed a sitewide approach and framework for the EMS. In addition, each division is implementing the system within its organization and ensuring internal systems are appropriate and tailored to its specific functions. The EMS Core team is supporting divisions by facilitating meetings, providing standard procedures, tools, environmental subject matter expertise, and training as needed. The divisions are conducting initial evaluations of products, activities, and processes to determine if they have significant potential environmental impacts. This evaluation is being used to guide development of objectives, targets, action plans, and continuous improvement plans.

Federal Facility Compliance Agreement

During 2004, the Laboratory entered into an agreement with the Environmental Protection Agency (EPA) and the NM Environment Department (NMED) on the requirements of a Federal Facility Compliance Agreement. The agreement establishes a compliance plan for the regulation of storm water discharges from specific types of point sources at the Laboratory until such time as those sources are regulated by an individual storm water permit issued by EPA. In good faith, the Laboratory began implementing the intent of the Federal Facility Compliance Agreement in 2004 before the completion of negotiations.

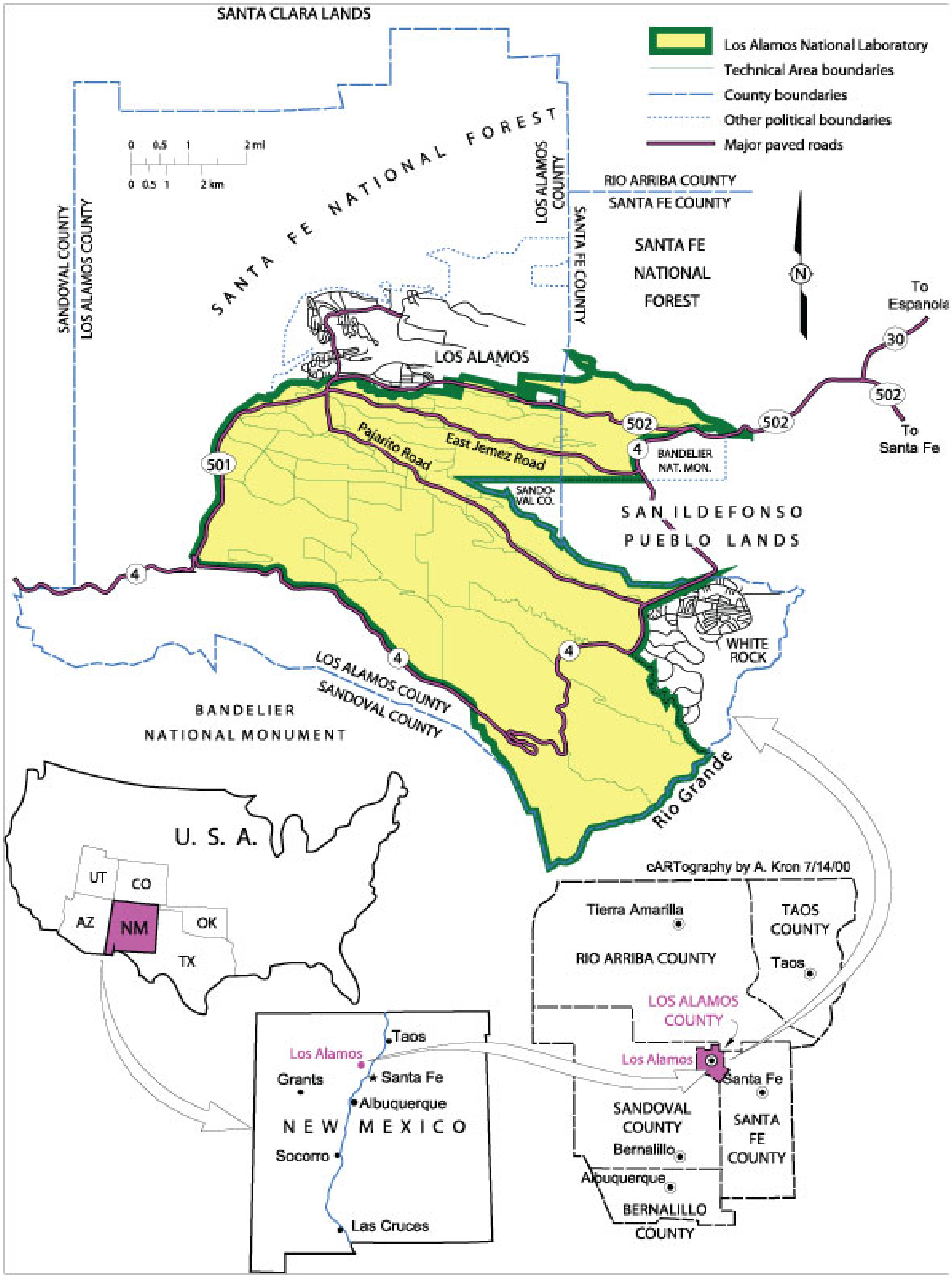
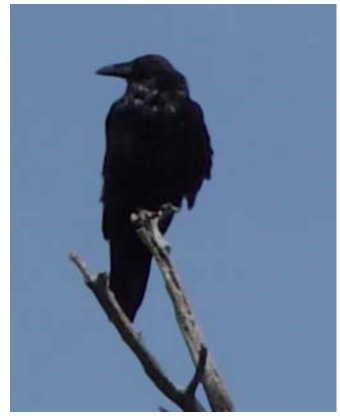


Figure ES-1. Regional location of Los Alamos National Laboratory.



Compliance Order on Consent (Consent Order)

A draft Compliance Order on Consent (Consent Order) was issued through the NMED in September 2004. The Laboratory continued to operate voluntarily in accordance with the November 26, 2002 Order and with the newly issued draft Consent Order. NMED, DOE, and University of California (UC) signed the final Consent Order on March 1, 2005. The Consent Order is the principal regulatory driver for the Laboratory's Environmental Remediation and Surveillance Program and replaces the corrective action requirements of the Hazardous and Solid Waste Amendments Module of the Laboratory's Hazardous Waste Facility Permit (Module VIII). The Consent Order contains requirements for investigation and cleanup of solid waste management units and areas of concern at the Laboratory. The major activities conducted by the Laboratory included investigations and cleanup actions. All of the Laboratory deliverables were submitted on time. In addition, several other plans and reports not required by the draft Consent Order schedules were submitted to NMED in calendar year 2004.

Improvement Targets

Improvement targets remain for the Laboratory and include continuing to improve Resource Conservation and Recovery Act (RCRA) compliance. While RCRA compliance improved in 2004, the NMED annual inspection identified four alleged violations in a Notice of Violation issued April 20, 2005. The Laboratory is improving processes, systems, and training to continue to reduce the number of possible violations in the future. The Laboratory made substantial progress in implementing an Environmental Management System that will require the identification and minimization of environmental impacts and waste sources. The Pollution Prevention Program continues to produce savings of several million dollars through recycling efforts, waste reduction, and support for sustainable design for the construction of new buildings. Though perchlorate is no longer discharged, the movement of perchlorate from past effluent discharges is being monitored to determine if it could pose a threat to water sources.

Design of Surveillance System and Sample Locations

LANL use a variety of materials to accomplish mission activities. Some materials are relatively benign, while other materials are hazardous or radioactive. Experiments and mission activities result in the release of some excess materials in the forms of air emissions, water discharges, and waste. These releases have the potential to affect many different receptors or components of the environment including humans, air quality, water quality, plants, and animals by one or many pathways such as by breathing in contaminants or coming into close proximity or contact with hazardous materials.

Monitoring (surveillance of) the complex activities and multiple receptors (people, air, water, plants, and animals) over a long time period requires a comprehensive monitoring plan and strategy. In addition, monitoring information has several uses including serving as a basis for policy and to identify actions to protect or improve the environment while accomplishing the mission effectively. Monitoring also contributes data needed to ensure and demonstrate compliance with regulations.

The Laboratory employs a tiered approach to monitor the environment and identify impacts from LANL operation. First, the Laboratory monitors the general region to establish a baseline of environmental conditions not influenced by LANL operations. Regional monitoring also demonstrates if LANL operations are impacting areas beyond the Laboratory's boundaries. Examples of regional monitoring include the radiological air-sampling network (AIRNET), and foodstuff and biota sampling locations. The second level of monitoring of the environment is at the LANL perimeter. This information helps determine if operations are impacting the general LANL property and neighboring property (e.g., pueblo and county lands). Perimeter monitoring can measure the highest potential impact to the public. The third level of monitoring is at specific project sites on LANL that are known or have the potential to result in emissions or discharges. Examples of locations with this type of monitoring include facility stacks for air emissions, the Dual Axis Radiographic Hydrodynamic Test (DARHT) Facility, the Los Alamos Neutron Science Center (LANSCE), remediation sites where legacy waste is being managed, decontamination and decommissioning projects, Area G at TA-54 (where waste is being handled and stored), and water discharge locations (outfalls). This tiered approach also provides the data used to demonstrate compliance with applicable environmental laws and regulations.

Compliance

Laboratory compliance continues to improve. In addition, the Laboratory continues to reduce releases to the environment, waste generated, and water discharges.

The Laboratory uses the status of compliance with environmental requirements as a key indicator of performance. Federal and state regulations provide specific requirements and standards to implement these statutes and maintain environmental qualities. The EPA and the NMED are the principal administrative authorities for these laws. The Laboratory also is subject to DOE requirements for control of radionuclides. Table ES-1 presents a summary of the Laboratory's status in regard to environmental statutes and regulations.

Environmental Radiological Dose Assessment (see Chapter 3)

Humans, plants, and animals potentially receive radiation doses from various Laboratory operations (Table ES-2). The DOE dose limits are the mandated criteria that are used to determine whether a measurement represents a hazard. Figure ES-2 shows trends of doses to the maximally exposed individual (MEI) over the last 12 years at an off-site location. We calculated potential radiological doses to members of the public that resulted from LANL emissions and discharges. During 2004, the population within 80 km of LANL received a collective dose of 0.90 person-rem. The total off-site MEI dose was approximately 1.68 mrem. The dose received by an average Los Alamos residence from Laboratory operations totaled about 0.04 mrem. Similarly, the total dose to an average White Rock residence from Laboratory operations totaled about 0.03 mrem.

Annual radiation doses to the public are evaluated for: inhalation, ingestion, and direct (or external) radiation pathways. We calculate doses for

(1) population within 80 km of LANL

(2) the on-site MEI (on LANL property)

(3) residents of Los Alamos and White Rock

Biota Dose

Biota dose was estimated for sites where contaminants are present from past and current activities. The Material Disposal Areas (MDAs) are of particular interest because deep-rooted plants can penetrate pockets of contamination and transport it to the surface. MDAs A, B, C, T, and G all show signs that some plants have penetrated the radioactive material. The preliminary assessment indicates that the biota doses for plants and animals at LANL are below the DOE limits. The locations with the highest radionuclide concentrations resulted in doses less than 20% of the 100 mrad/day limit for terrestrial animals and less than 10% of the 100 mrad/day limit for terrestrial plants and aquatic animals.

Table ES-1. Environmental Statutes under which LANL Operates and Compliance Status in 2004

Federal Statute	What it Covers	Status
Resource Conservation and Recovery Act (RCRA)	Generation, management, and disposal of hazardous waste and cleanup of inactive, historical waste sites.	NMED conducted one 'wall-to-wall' RCRA hazardous waste compliance inspection in 2004. NMED identified 4 alleged violations, a 64% reduction from the 11 violations identified in 2003. The Laboratory completed 1,095 self-assessments that resulted in a nonconformance finding rate of less than 3.5%. The Laboratory (under the Environmental Remediation and Surveillance Program) continued to operate in accordance with requirements. Additionally, the Laboratory voluntarily operated in accordance with the November 26, 2002 Order containing corrective action requirements and later replaced by the September 1, 2004 draft Compliance Order on Consent (Consent Order), both issued through the NMED. The Laboratory is in compliance with groundwater monitoring requirements. Five groundwater characterization wells were completed in 2004.
Emergency Planning and Community Right-to-Know Act (EPCRA)	The public's right to know about chemicals released into the community.	The Laboratory reported releases, waste disposal, and waste transfers totaling 58,516 lb of lead, 665 lb of nitric acid, and 37,553 lb of nitrate compounds.
Clean Air Act (CAA)	Air quality and emissions into the air from facility operations	The Laboratory met all permit limits for emissions to the air. Non-radiological air emissions continued to be reduced in comparison to previous years. In addition, use of refrigerants continued to decline. The dose to the Maximum Exposed Individual (MEI) from LANL air emissions was 1.68 mrem, much less than the annual limit of 10 mrem. The Los Alamos Neutron Science Center (LANSCE) was the principal contributor to the dose. The Laboratory self-reported the removal of asbestos by a contractor without appropriate advance notification, resulting in NMED issuing a Notice of Violation.
Clean Water Act (CWA)	Water quality and effluent discharges from facility operations	Two of the 1283 samples collected from industrial outfalls exceeded effluent limits; we implemented additional analytical procedures when matrix interference is suspected. None of the 145 samples collected from the Sanitary Wastewater Systems Plant's outfall exceeded effluent limits. Changes in analytical procedures were made to prevent future exceedances. About 70% of the Laboratory's permitted construction sites were compliant with National Pollutant Discharge Elimination System (NPDES) requirements. Corrective actions for the noncompliant sites are scheduled for 2005. Additionally, the LANL engineering standards were updated to ensure compliance. The Laboratory is in compliance with groundwater monitoring requirements. Five groundwater characterization wells were completed in 2004. The new regional well R-33 in Mortandad Canyon shows no contamination from nitrate, perchlorate, and tritium based on initial analytical results. However, the intermediate wells show impacts of perchlorate and nitrate.
Toxic Substances Control Act (TSCA)	Chemicals such as PCBs	The Laboratory disposed of 1,964 kg of capacitors and 4,792 kg of fluorescent light ballasts in 171 containers at EPA-permitted treatment and disposal facility.

Table ES-1. Environmental Statutes under which LANL Operates and Compliance Status in 2004 (Cont.)

Federal Statute	What it Covers	Status
Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)	Storage and use of pesticides	The Laboratory remained in compliance with regulatory requirements regarding use of pesticides and herbicides.
Endangered Species Act (ESA) & Migratory Bird Treaty Act (MBTA)	Rare species of plants and animals	The Laboratory maintained compliance with the ESA and MBTA. The Laboratory continued to monitor endangered species status.
National Historic Preservation Act (NHPA) and others	Cultural resources	The Laboratory maintained compliance with the NHPA. The laboratory continued to survey sites and buildings and consult with the pueblos.
National Environmental Policy Act (NEPA)	Projects evaluated for environmental impacts	The NEPA team completed 9 large environmental evaluations. No non-compliances were reported.

Table ES-2. Where are the Sources of Radiological Doses?

Pathway	Dose	Location	Trends
Air	1.52 mrem/yr	East Gate	None; remains well below regulatory limits
Direct irradiation	1.75 mrem/yr	TA-18 – onsite	None
	0.88 mrem/yr	San Ildefonso – offsite	
Food	<0.1 mrem/yr	All sites	None
Drinking water	<0.1 mrem/yr	All sites	None
Background	300 to 500 mrem/yr	All sites	N/A
Dose to terrestrial animals	<20 mrad/day	TA-15 EF site, TA-21 MDA B	None
Dose to aquatic animals	<85 mrad/day	TA-50 Effluent Canyon	None
Dose to terrestrial plants	<50 mrad/day	TA-21 MDA B	None

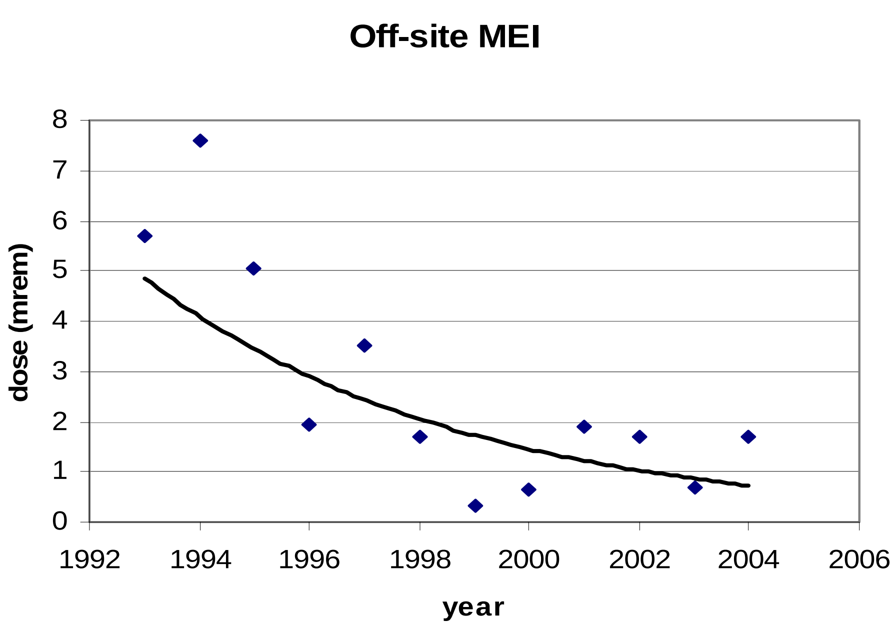


Figure ES-2. Trend of dose (mrem) to the maximally exposed individual off-site. Most years, this location is at East Gate, located along Highway 502 near the east end of the Los Alamos airport.

Air Emissions and Air Quality (see Chapter 4)

The Laboratory measures the emissions of radionuclides at the emission sources (building stacks). LANL categorizes its radioactive stack emissions into one of four types: (1) particulate matter, (2) vaporous activation products, (3) tritium, and (4) gaseous mixed activation products (GMAP). Similarly, the Laboratory takes air samples at general locations at LANL, at the perimeter, and regionally to estimate the extent and concentration of radionuclides that may be released from Laboratory operations. These radionuclides include plutonium, americium, uranium, and tritium.

- *Stack emissions were comparable with previous years.*
- *About 85% of radioactive air emissions were from LANSCE operations.*

Stack emissions were comparable to previous years and in most cases lower than previous years. LANL stack emissions during 2004 totaled approximately 5,230 Ci. Of this total, tritium emissions composed about 790 Ci, and air activation products from LANSCE stacks contributed nearly 4,440 Ci (85% of total emission). Combined airborne emissions of materials such as plutonium, uranium, americium, and thorium were less than 0.0001 Ci. Emissions of particulate/vapor activation products also were less than 1 Ci. Because of the close proximity of the LANSCE facility with the LANL site boundary, GMAP emissions from LANSCE remain the greatest source of off-site dose from the airborne pathway.

Radionuclide concentrations in 2004 from ambient air samples were generally comparable with concentrations in past years. Measurable concentrations of radionuclides were not detected at regional sampling locations. The highest annual mean radionuclide concentrations from air samples within LANL boundaries and at perimeter locations were well below 1% of the applicable EPA and DOE standards. Measurable amounts of tritium were found at most on-site locations and at perimeter locations; the highest concentrations of tritium were at TA-54 from waste emissions and at TA-21 related to decommissioning operations at a former tritium facility. The highest plutonium-238 concentration of 2.4 aCi/m^3 was from an on-site sample location at TA-54. One off-site perimeter sample location (Los Alamos Inn-South) had plutonium-239 concentrations averaging 20 aCi/m^3. This concentration was a result of resuspension of plutonium deposited during historical activities. Am-241 concentrations were highest at Area G. The maximum annual uranium concentrations were from natural uranium at locations with high dust levels from local soil disturbances such as dirt roads at the Los Alamos County Landfill and LANL's TA-54, Area G.

- *Measurable concentrations of radionuclides were not detected at regional sampling locations.*
- *The highest air concentrations on LANL and at perimeter locations were well below 1% of the applicable EPA and DOE guidelines.*

Air monitoring continued at one White Rock and two Los Alamos locations for particles with diameters of 10 micrometers (µm) or less (PM-10) and for particles with diameters of 2.5 µm or less (PM-2.5). The annual average for PM-10 was about 14 micrograms/m^3 and was 7 micrograms/m^3 for PM-2.5 at all locations. These averages are well below the EPA standards. In addition, the 24 hour maxima for both PM-2.5 and PM-10 at all three locations were much less than the EPA standards.

The Laboratory analyzed samples from 22 sites for beryllium. These sites are located near potential beryllium sources at LANL or in nearby communities. Previous results indicated that the source of beryllium in our AIRNET samples was naturally occurring beryllium in resuspended dust. Beryllium air concentrations for 2004 were similar to those measured in recent years. All values are equal to or less than 2% of the National Emission Standard for Hazardous Air Pollutants (NESHAP) standard.

- *PM-10 and PM-2.5 measures were well below EPA standards.*
- *Beryllium air concentrations for 2004 were similar to past years and were equal to or less than 2% of the NESHAP standard.*

Groundwater Monitoring (see Chapter 5)

Groundwater at the Laboratory occurs as a regional aquifer at depths ranging from 600 to 1,200 ft and as perched groundwater of limited thickness and horizontal extent, either in canyon alluvium or at intermediate depths of a few hundred feet (Figure ES-3). All water produced by the Los Alamos County water supply system comes from the regional aquifer and meets federal and state drinking water standards. No drinking water is supplied from the alluvial and intermediate groundwater sources.

Liquid effluent disposal is the primary means by which Laboratory contaminants have had a limited effect on the regional aquifer. Liquid effluent disposal at the Laboratory has significantly affected the quality of alluvial groundwater in some canyons. In some canyons, six decades of liquid effluent disposal by LANL have degraded groundwater quality in the alluvium. Because flow through the underlying approximately 900-ft-thick zone of unsaturated rock is slow, the impact of effluent disposal is seen to a lesser degree in intermediate-depth perched groundwater and is only seen in some wells within the regional aquifer. Table ES-3 summarizes contaminants found in portions of the groundwater system.

In general, groundwater quality is improving as

- *outfalls are eliminated,*
- *quantity of discharges are reduced, and*
- *water quality of the discharges improves.*

Drainages that in the past received liquid radioactive effluents include Mortandad Canyon, Pueblo Canyon from its tributary Acid Canyon, and Los Alamos Canyon from its tributary DP Canyon; only Mortandad currently receives such effluent.

Water Canyon and its tributary Cañon de Valle formerly received effluents produced by high explosives (HE) processing and experimentation. In past years, Los Alamos County has operated three sanitary treatment plants in Pueblo Canyon; currently only one plant is operating. The Laboratory also operated numerous sanitary treatment plants.

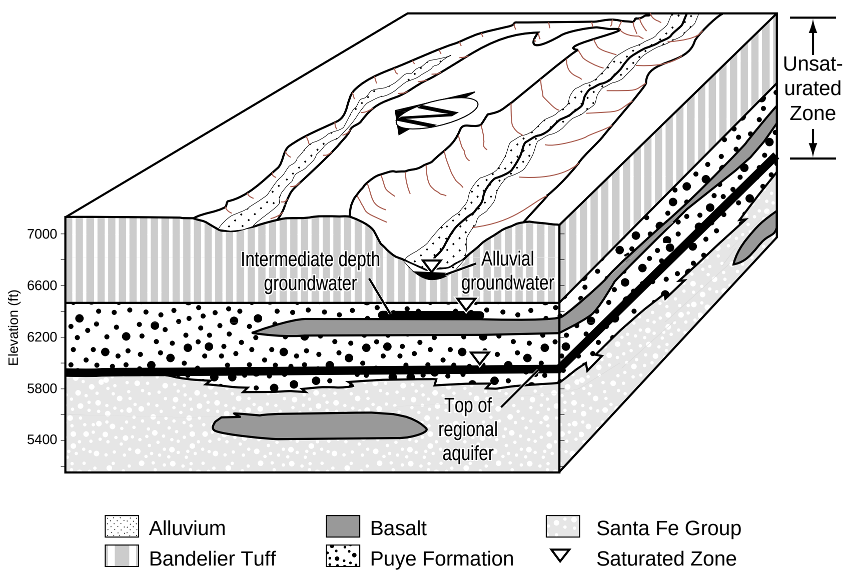


Figure ES-3. Illustration of geologic and hydrologic relationships in the Los Alamos area, showing the three modes of groundwater occurrence.

Table ES-3. Where Can We See LANL Impacts on Groundwater that Result in Values Near or Above Regulatory Standards or Risk Levels?

Chemical	On-Site	Off-Site	Significance	Trends
Tritium	Alluvial and intermediate groundwater in Mortandad Canyon	No	Not used as a drinking water supply	Activity decreasing as effluent quality improves
Other radionuclides	Alluvial groundwater in Mortandad Canyon	No	Not used as a drinking water supply; radionuclides have not penetrated to deeper groundwater	Some constituents are fixed in location; some are decreasing as effluent quality increases
Perchlorate	All groundwater zones in Mortandad Canyon, regional aquifer in Pueblo Canyon, alluvial groundwater in Cañon de Valle	Yes, in Pueblo Canyon	No established regulatory standard; values exceed EPA provisional risk level in all Mortandad Canyon groundwater zones; supply well with values below risk level is permanently off line	Decreasing in Mortandad Canyon alluvial groundwater as effluent quality improves; insufficient data for other groundwater
Nitrate	Intermediate groundwater in Mortandad Canyon, alluvial and intermediate groundwater in Pueblo Canyon	Yes, in Pueblo Canyon	Potential effect on drinking water, some above NM groundwater standards. In Pueblo Canyon, may be due to LA County's Bayo Sewage Treatment Plant	Insufficient data in Mortandad, values in Pueblo are variable
Molybdenum	Alluvial groundwater in Los Alamos Canyon	No	Not used as drinking water, limited in extent	Near NM GW limit for 10 years
Barium	Alluvial groundwater in Cañon de Valle	No	Not used as drinking water, limited in area	Insufficient data
High explosives	Alluvial and intermediate groundwater in Cañon de Valle	No	Limited in area, presence in regional aquifer uncertain	Insufficient data

[a] Shallow groundwater includes alluvial and intermediate groundwaters.

Naturally occurring uranium was the main radioactive element detected in the regional aquifer, springs, and wells throughout the Rio Grande Valley. Other naturally occurring radioactivity in groundwater samples comes from members of the uranium isotope decay chains, including isotopes of thorium and radium. Potassium-40 is also a source of natural radioactivity.

We compared radionuclide levels in all groundwater with drinking water and human health standards even though these standards only apply to drinking water sources. None of the radionuclide activities in perched alluvial groundwater were above the 100-mrem/yr DOE standard used to protect the public. For nonnatural radioactivity, only strontium-90 concentrations in alluvial groundwater from Mortandad and DP/Los Alamos canyons were near or exceeded the 4-mrem DOE derived concentration guide (which we use as a screening level) applicable to drinking water (Figure ES-4). The maximum strontium-90 values in

Mortandad and DP/Los Alamos Canyon alluvial groundwater were 7.6 and 4.6 times, respectively, the EPA drinking water standard. Total LANL-derived radioactivity exceeded the 4 mrem derived concentration guide in Mortandad Canyon alluvial groundwater samples.

The Radioactive Liquid Waste Treatment Facility, which discharges into Mortandad Canyon, has met all DOE radiological discharge standards for five consecutive years; has met all NPDES requirements for five consecutive years; and has met NM groundwater standards for fluoride, nitrate, and total dissolved solids for all but two weeks of the past five years.

During the last decade, the EPA has recognized the potential for perchlorate toxicity at concentrations in the ppb (µg/L) range. No EPA regulatory limit exists for perchlorate in drinking water, though several states have set limits in the range of 10 to 20 ppb, and California has a public health goal of 6 ppb. EPA Region VI has established a risk level of 3.7 ppb.

LANL and the NMED DOE Oversight Bureau have detected perchlorate in most groundwater samples analyzed from across northern New Mexico. The perchlorate concentrations in samples not affected by known contaminant sources range from about nondetect (<0.05 ppb) to 0.85 ppb. Water samples from most LANL locations show low perchlorate concentrations in this range, but samples taken downstream from inactive perchlorate release sites show higher values, that is above about 0.6 ppb. Figure ES-5 illustrates the perchlorate values found in alluvial groundwater downstream of the RLWTF discharge in Mortandad Canyon. Discharge of perchlorate from the plant effectively ceased in 2002 with installation of equipment designed to remove perchlorate from the effluent. As shown in Figure ES-5, the concentrations of perchlorate in groundwater and surface water have dropped since that time.

Watershed Monitoring (see Chapter 6)

Watersheds that drain the Laboratory are dry for most of the year. Of the 85 miles of watercourse, approximately 2 miles are naturally perennial, and approximately 3 miles are perennial waters created by effluent. No perennial surface water extends completely across the Laboratory in any canyon. Storm runoff occasionally extends across the Laboratory but is short-lived. Wildlife drink from the stream channels when water is present.

- *The overall quality of most surface water within the Los Alamos area is very good.*
- *Of the more than 100 analytes, most are within normal ranges or at concentrations far below regulatory standards or risk-based advisory levels.*
- *However, nearly every major watershed shows some effect from Laboratory operations.*

LANL activities have caused contamination of sediments in several canyons, mainly because of past industrial effluent discharges. These discharges and contaminated sediments also affect the quality of storm runoff, which carries much of this sediment for short periods of intense flow. In some cases, sediment contamination is present from Laboratory operations conducted more than 50 years ago. Table ES-4 shows the locations of LANL-impacted surface water and sediments. All radionuclide levels are well below protective guideline limits (Table ES-5).

Sediment radioactivity levels are above fallout background but substantially lower than screening action levels (SALs) in Los Alamos and Pueblo Canyons. Cesium-137 in Mortandad Canyon sediments is at elevated levels in an approximately 1.5-mile-long reach on-site and some samples exceed industrial site soil screening levels. Plutonium-239,240 in sediments extends off-site down Los Alamos Canyon into the Rio Grande, but levels remain well below the screening levels for unrestricted use of the land. Polychlorinated biphenyls (PCBs) are present in sediments in most watercourses that drain the Laboratory and are at concentrations below EPA industrial soil screening levels in Sandia Canyon sediments, where the highest levels occur. Channel sediments in Pueblo, Los Alamos, Sandia, and Mortandad Canyons contain polycyclic aromatic hydrocarbons (PAHs) of uncertain origin with maximum concentrations near or above applicable EPA soil screening levels. The overall pattern of radioactivity in channel sediments, such as along lower Los Alamos Canyon, has not greatly changed in 2004.

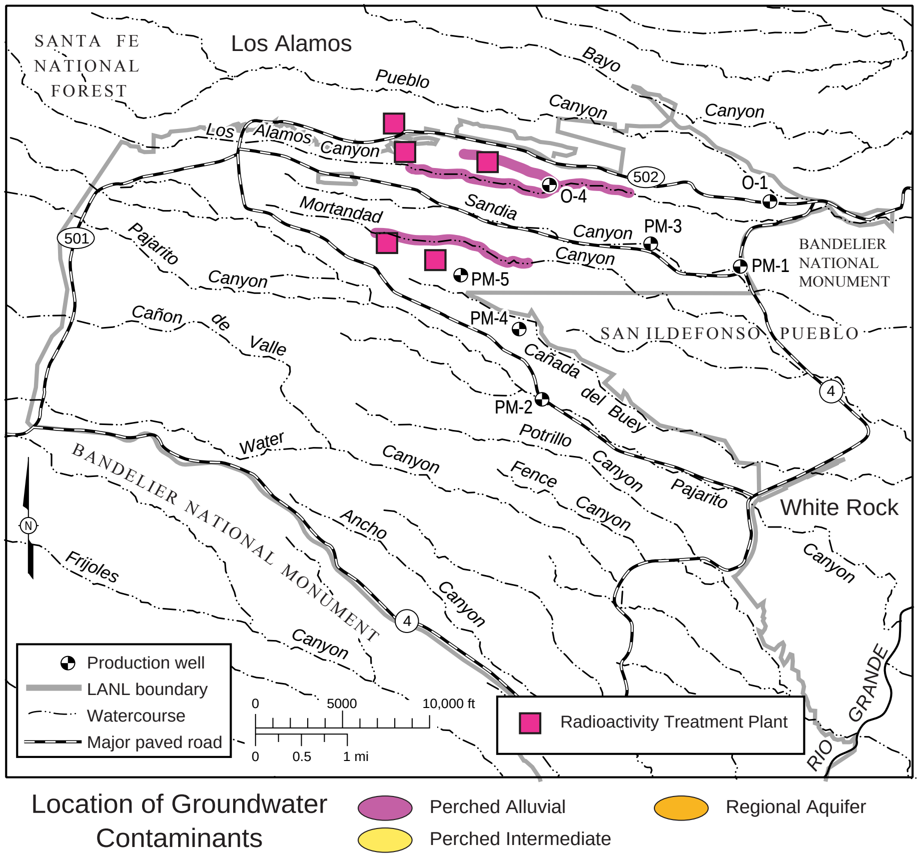


Figure ES-4. Location of groundwater contamination by strontium-90 above the 8 pCi/L EPA drinking water maximum contaminant limit. The extent of alluvial groundwater contamination lateral to the canyon is not to scale: contamination is confined to the alluvium within the canyon bottom and is narrow at the map scale.

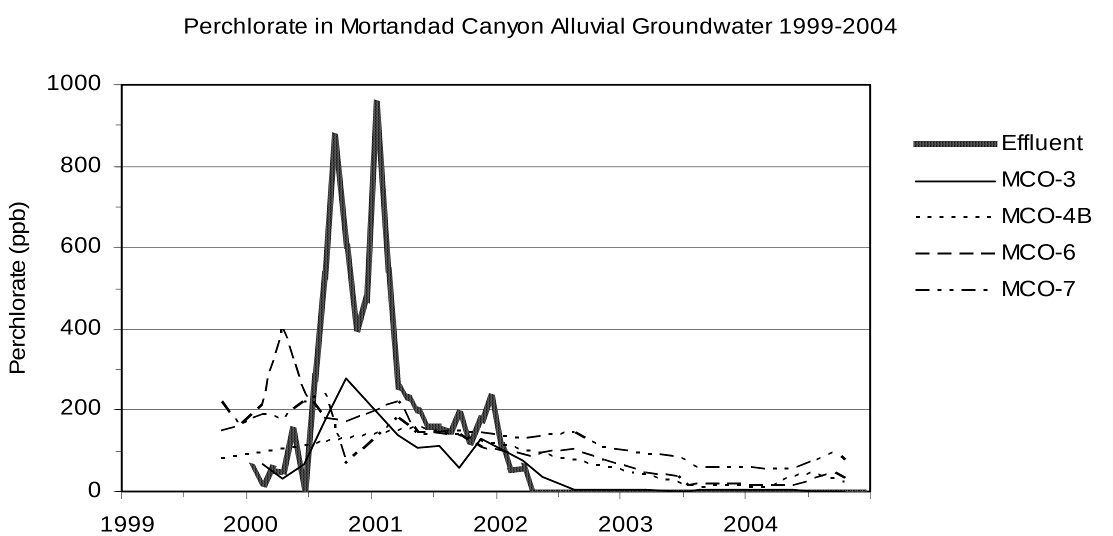


Figure ES-5. Perchlorate in Mortandad Canyon Alluvial Groundwater and RLWTF effluent, 1999–2004. Ion-exchange treatment was started in March 2002 to remove perchlorate to below 1 ppb.

Table ES-4. Where Can We See LANL Impacts on Surface Water and Sediments that Result in Values Near or Above Regulatory Standards or Risk Levels?

LANL Impact	On-Site	Off-Site	Significance	Trends
Radionuclides	Higher than background in sediments in Pueblo, DP, Los Alamos, Pajarito, and Mortandad canyons	Yes, in Los Alamos/ Pueblo canyons; slightly elevated in the Rio Grande and Cochiti Reservoir	Sediments below health concern except on-site along a short distance in Mortandad Canyon but exposure potential is limited	Increased transport in Pueblo Canyon in response to postfire flooding and increased urbanization
	Higher than background in runoff in Pueblo, DP, Los Alamos, and Mortandad canyons	Yes, in Los Alamos/ Pueblo Canyons	Minimal exposure potential because events are typically sporadic. Mortandad Canyon surface water 60% of DCG for year	Flows in Pueblo Canyon occurring more often after fire; flows in other LANL canyons recovered to near prefire levels
Polychlorinated biphenyls (PCBs)	Detected in sediment in nearly every canyon. Detected in Sandia Canyon runoff and base flow above NM stream standards	Yes, particularly in the Los Alamos/ Pueblo Canyons	Wildlife exposure potential in Sandia Canyon. Elsewhere findings include non-Laboratory and Laboratory sources	None
Dissolved copper	Detected in many canyons above NM acute standards	Yes, in Los Alamos Canyon	Origins uncertain, probably several sources	None
High-explosive residues and barium	Detections near or above screening values in Cañon de Valle base flow and runoff	No	Minimal potential for exposure	None
Benzo(a)pyrene	Detections near or above industrial screening levels in Los Alamos Canyon	Yes, in Los Alamos/Pueblo Canyons	Origins uncertain; probably multiple sources	None

Table ES-5. Estimated Annual Average Surface Water Concentrations of Radionuclides in Selected Canyons Compared with the DCGs[a] and BCGs[b].

	Estimated 2004 Average Concentration (pCi/L)					
Radionuclide	Lower Pueblo Canyon	DP Canyon below TA-21	LA Canyon between DP and SR-4	Mortandad Canyon below Effluent Canyon	Max Percent of DCG[a]	Max Percent of BCG[b]
H-3	0.7	64	14	12600	0.6	0.004
Sr-90	0.6	23	0.4	4	2	8
Cs-137	0.02	1	0.4	42	1	0.2
U-234	0.1	0.8	0.1	3	0.6	1
U-235,236	0.01	0.05	0.01	0.2	0.03	0.08
U-238	0.1	0.1	0.1	0.3	0.04	0.1
Pu-238	0.001	0.02	0.005	5	13	3
Pu-239,240	0.3	0.1	0.05	5	16	2
Am-241	0.01	0.2	0.07	8	27	2

[a] DCGs = 100-mrem Derived Concentration Guides for Public Exposures
[b] BCGs = Biota Concentration Guides

Radioactivity in surface water below current radioactive effluent discharges in Mortandad Canyon would result in only 60% of the 100-mrem/yr DOE limit for public exposure, but the water is not used as a drinking source and flows do not extend off-site (Figure ES-6). Samples of base flow (persistent surface waters) collected near the Laboratory or from the Rio Grande in 2004 met the New Mexico stream standards for livestock watering or wildlife habitat except for a PCB result from Sandia Canyon, which was greater than the wildlife habitat standard. A small number of the short-lived storm runoff events contained concentrations of some metals, gross alpha, and PCBs above the state stream standards or above background levels.

Soil Monitoring (see Chapter 7)

Soil acts as an integrating medium that can account for contaminants released to the environment. This year, we collected soil surface samples from two areas on Pueblo de San Ildefonso lands and additional samples at Area G and at DARHT. We had samples analyzed from these areas for radionuclides and heavy metals and then compared them with samples collected off-site from regional (background) areas located away from the Laboratory.

Radionuclide concentrations in soils from Pueblo de San Ildefonso were well below the concentration level that would result in exceeding the DOE dose limit of 100 mrem/yr. Radionuclide concentrations in most samples were either at a nondetect level or below the regional statistical reference level (RSRL). Non-radionuclide contaminant levels in most samples from Pueblo de San Ildefonso were at nondetect levels or below the RSRL. All samples were well below the screening level.

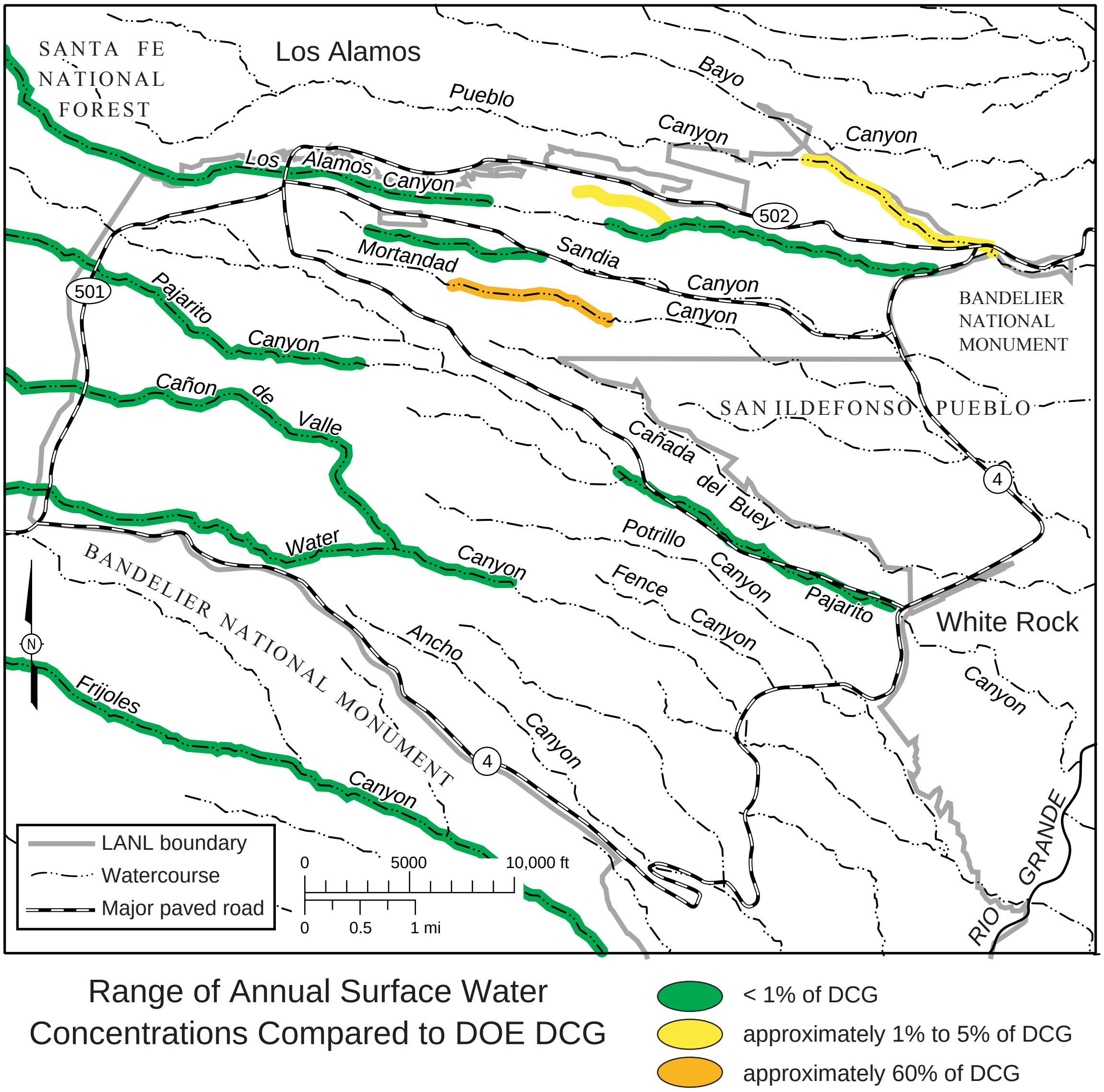


Figure ES-6. Annual average radioactivity in persistent surface waters compared with the DOE Derived Concentrations Guides (DGCs). The extent of contamination lateral to the canyon is not to scale: contamination is confined to the canyon bottom and is narrow at the map scale.

Foodstuffs and Nonfoodstuffs Biota Monitoring (see Chapter 8)

A wide variety of wild and domestic edible plant, fruit, and fish and animal products are harvested in the area surrounding the Laboratory. We collected foodstuff and nonfoodstuff biota within and near LANL property to determine whether they were impacted by Laboratory operations. Also, we collected nonfoodstuff biota at Area G, the Laboratory's principal low-level waste disposal area, and at the Laboratory's principal explosive test facility (DARHT). Concentrations, trends, and doses were assessed.

All radionuclides in domestic crop plants (vegetables and fruits) from all communities surrounding the Laboratory were indistinguishable from natural or fallout levels. Similarly, all trace element concentrations in vegetable and fruit samples collected were within or similar to the regional background levels and showed no increasing trends in concentrations.

Wild edible plants (oak acorns, wild spinach, and purslane) were sampled from Pueblo de San Ildefonso lands near the Laboratory boundary. Some radionuclides in these plants were at higher levels than natural or fallout levels; however, all were below levels that would result in a dose of 0.1 mrem for each pound of each consumed, which is 0.1% of the DOE dose limit of 100 mrem/yr.

All nonradionuclide contaminant concentrations, with the exception of barium, in these wild edible plants were either undetected or within the regional background levels. Barium concentrations were about three times higher than regional background concentrations reported for common produce plants. Bioaccumulation of barium by purslane plants is suspected to cause this elevated level.

No vegetation or small mammal samples were collected in 2004 from the overall site or the region. However, vegetation and small mammal samples were collected at TA-54 (Area G) and from TA-15 (DARHT). All radionuclide concentrations in vegetation were below a level that would result in 0.1 rad/day, which is 10% of the DOE dose limit of 1 rad/day for the protection of terrestrial plants. Radionuclide concentrations in small mammals varied; however, all concentrations would result in doses well below 10% of the DOE identified levels for biota.

- *All radionuclides in all crop plant samples were indistinguishable from natural or fallout levels.*
- *All radionuclide concentrations in wild edible plants were below levels that would result in a dose of 0.1 mrem per year per pound consumed (0.1% of the DOE dose limit of 100 mrem).*

PCB congener concentrations were measured in stationary semi-permeable membrane devices from the Rio Grande at two locations above LANL and three locations below LANL in 2002 and 2003. Semi-permeable membrane devices consist of a polyethylene membrane and triolein lipid, both of which mimic the accumulation of PCBs and other dissolved organic contaminants by fish. Results showed only a small amount of similarity between the type of aroclors indicated in the Rio Grande below LANL and aroclors known to exist at LANL. For the particular time periods studied, it was concluded that LANL was not likely contributing PCBs to the Rio Grande as indicated by the statistically similar total PCBs between the two stations above LANL and the station immediately below LANL.

1. Introduction

contributing author:
Ted Doerr

To Read About — **Turn to Page . . .**

A. Background and Report Objectives

1. Introduction to Los Alamos National Laboratory

In March 1943, a small group of scientists came to Los Alamos for Project Y of the Manhattan Project. Their goal was to develop the world's first nuclear weapon. Although planners originally expected that the task would require only 100 scientists, by 1945, when the first nuclear bomb was tested at Trinity Site in southern New Mexico, more than 3,000 civilian and military personnel were working at Los Alamos Laboratory. In 1947, Los Alamos Laboratory became Los Alamos Scientific Laboratory, which in turn became Los Alamos National Laboratory (LANL or the Laboratory) in 1981. The Laboratory is managed by the Regents of the University of California (UC) under a contract that is administered by the National Nuclear Security Administration (NNSA) of the Department of Energy (DOE) through the Los Alamos Site Office and the NNSA Service Center based in Albuquerque.

The Laboratory's original mission to design, develop, and test nuclear weapons has broadened and evolved as technologies, US priorities, and the world community have changed. The current mission is to develop and apply science and technology to

- ensure the safety and reliability of the US nuclear deterrent;
- reduce the threat of weapons of mass destruction, proliferation, and terrorism; and
- solve national problems in defense, energy, environment, and infrastructure (LANL 2005).

The Los Alamos National Laboratory's vision is to be "The trusted, competitive scientific solution for today's and tomorrow's national security challenges." Seven national security goals have been identified to implement the vision and mission:

- Create an integrating core competency for science-based prediction of complex systems linking experiment, simulation, and theory.
- Design and engineer manufacturable and certifiable replacement nuclear weapons without new nuclear testing.
- Be acknowledged as the premier laboratory for nonproliferation research and development.
- Be the preferred laboratory for providing the defense, intelligence, and homeland security communities with revolutionary, success-enabling science and technology.
- Be the best materials science and technology laboratory in the world in support of our mission.
- Use LANL expertise and capability to solve national problems in energy security.
- Be a strategic partner of the Office of Science to benefit their national missions and the science base critical to our national security missions.

Inseparable from the Laboratory's commitment to excellence in science and technology is the commitment to completing all work in a safe and secure manner. The Laboratory uses Integrated Safety Management (ISM) to set, implement, and sustain safety performance and meet environmental expectations. In addition, the Laboratory initiated an Environmental Management System (EMS) as part of

ISM to focus on environmental performance, protection, and stewardship (see Section C of this chapter for additional information). The foundation of the EMS and demonstration of the Laboratory's commitment is the April 2004 environmental policy:

> *It is the policy of Los Alamos National Laboratory that we will be responsible stewards of our environment. It is our policy to manage and operate our site in compliance with environmental laws and standards and in harmony with the natural and human environment; meet our environmental permit requirements; use continuous improvement processes to recognize, monitor, and minimize the consequences to the environment stemming from our past, present, and future operations; prevent pollution; foster sustainable use of natural resources; and work to increase the body of knowledge regarding our environment.*

2. Objectives

A part of the Laboratory's commitment to the policy is to monitor and report how Laboratory activities are affecting the environment. The objectives of this report, as directed by DOE Order 231.1 (DOE 2003a, DOE 2004), are

- Characterize site environmental management performance including effluent releases, environmental monitoring, and estimated radiological doses to the public.
- Summarize environmental occurrences and responses reported during the calendar year.
- Confirm compliance with environmental standards and requirements.
- Highlight significant programs and efforts. Include environmental performance indicators and/or performance measures programs.

B. Environmental Setting

1. Location

The Laboratory and the associated residential and commercial areas of Los Alamos and White Rock are located in Los Alamos County, in north-central New Mexico, approximately 60 miles north-northeast of Albuquerque and 25 miles northwest of Santa Fe (Figure 1-1). The 40-square-mile Laboratory is situated on the Pajarito Plateau, which consists of a series of finger-like mesas separated by deep east-to-west-oriented canyons cut by streams. Mesa tops range in elevation from approximately 7,800 ft on the flanks of the Jemez Mountains to about 6,200 ft near the Rio Grande Canyon. Most Laboratory and community developments are confined to the mesa tops. The surrounding land is largely undeveloped, and large tracts of land north, west, and south of the Laboratory site are held by the Santa Fe National Forest, the US Bureau of Land Management, the Bandelier National Monument, the US General Services Administration, and the Los Alamos County. Pueblo de San Ildefonso borders the Laboratory to the east.

2. Geology and Hydrology

The Laboratory lies at the western boundary of the Rio Grande Rift, a major North American tectonic feature. Three major potentially active local faults constitute the modern rift boundary. Recent studies indicate that the seismic surface rupture hazard associated with these faults is localized (Gardner et al., 1999). Most of the finger-like mesas in the Los Alamos area (Figure 1-2) are formed from Bandelier Tuff, which includes ash fall, ash fall pumice, and rhyolite tuff. Deposited by major eruptions in the Jemez Mountains' volcanic center 1.2–1.6 million years ago, the tuff is more than 1,000 ft thick in the western part of the plateau and thins to about 260 ft eastward above the Rio Grande.

On the western part of the Pajarito Plateau, the Bandelier Tuff overlaps onto the Tschicoma Formation, which consists of older volcanics that form the Jemez Mountains. The tuff is underlain by the conglomerate of the Puye Formation in the central plateau and near the Rio Grande. The Cerros del Rio Basalts interfinger with the conglomerate along the river. These formations overlie the sediments of the Santa Fe Group, which extend across the Rio Grande Valley and are more than 3,300 ft thick.

Surface water in the Los Alamos area occurs primarily as short-lived or intermittent reaches of streams. Perennial springs on the flanks of the Jemez Mountains supply base flow into the upper reaches of some

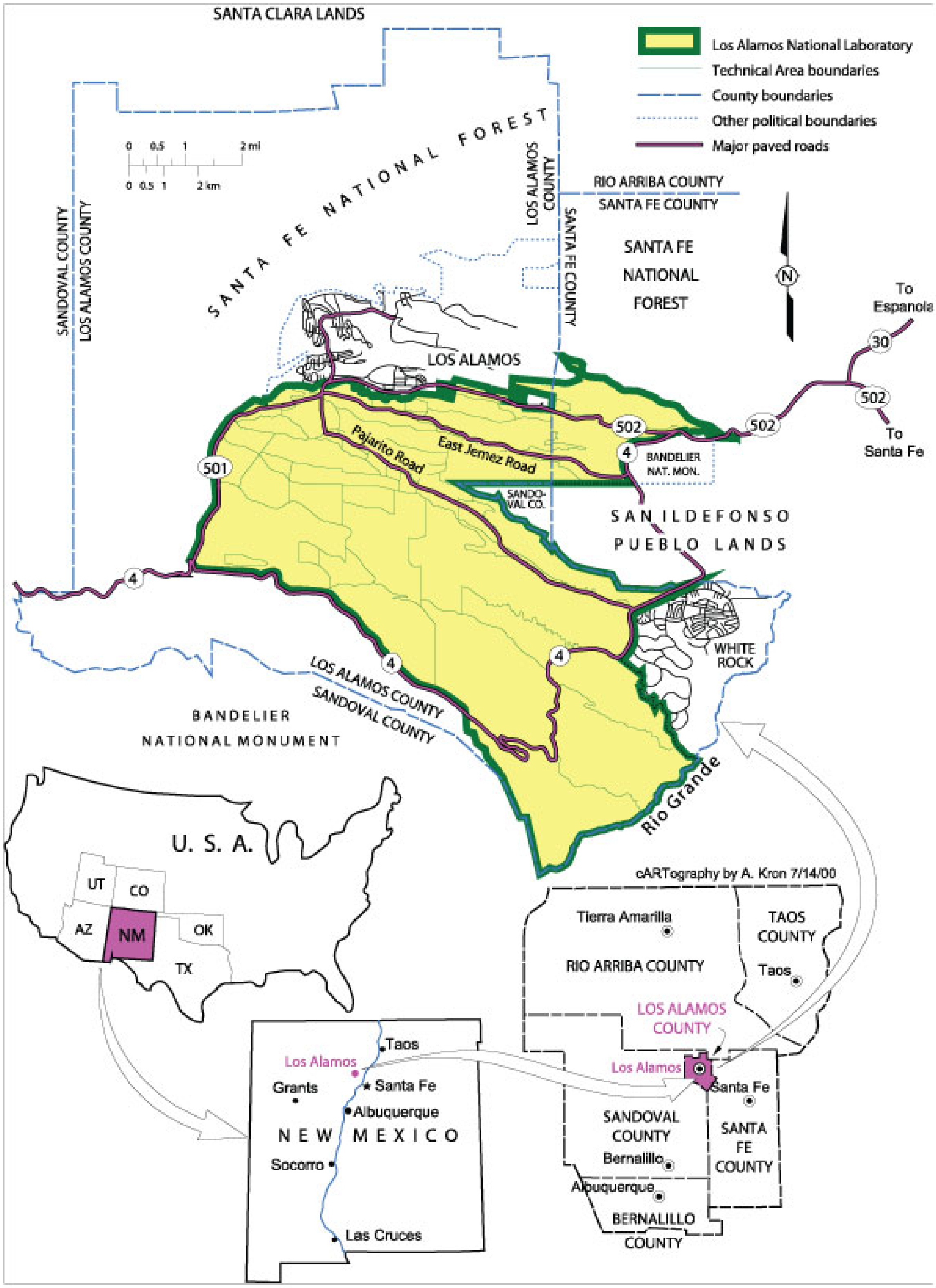


Figure 1-1. Regional location of Los Alamos National Laboratory.

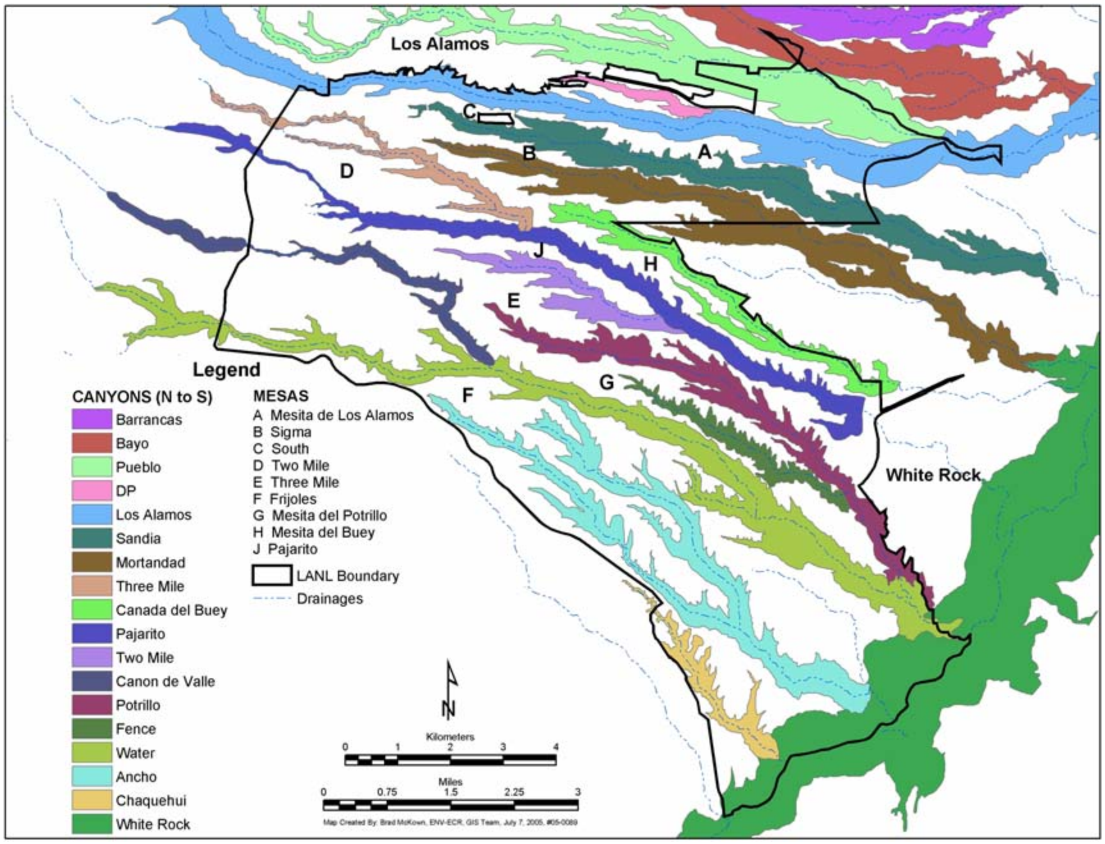


Figure 1-2. Major canyons and mesas.

canyons, but the volume is insufficient to maintain surface flows across the Laboratory site before the water is depleted by evaporation, transpiration, and infiltration.

Groundwater in the Los Alamos area occurs in three modes: (1) water in shallow alluvium in canyons, (2) perched water (a body of groundwater above a less permeable layer that is separated from the underlying main body of groundwater by an unsaturated zone), and (3) the regional aquifer of the Los Alamos area, which is the only aquifer in the area capable of serving as a municipal water supply. Water in the regional aquifer is in artesian conditions under the eastern part of the Pajarito Plateau near the Rio Grande (Purtymun and Johansen 1974). The source of most recharge to the aquifer appears to be infiltration of precipitation that falls on the Jemez Mountains. The regional aquifer discharges into the Rio Grande through springs in White Rock Canyon. The 11.5-mile reach of the river in White Rock Canyon, between Otowi Bridge and the mouth of Rio de los Frijoles, receives an estimated 4,300-5,500 acre feet of water from the aquifer.

3. Biological Resources

The Pajarito Plateau, including the Los Alamos area, is biologically diverse. This diversity of ecosystems is due partly to the dramatic 1,500-m (5,000-ft) elevation gradient from the Rio Grande on the east to the Jemez Mountains 20 km (12 mi) to the west and partly to the many steep canyons that dissect the area. Five major vegetative cover types are found in Los Alamos County. The juniper (*Juniperus monosperma* Englem. Sarg.)-savanna community is found along the Rio Grande on the eastern border of the plateau and extends upward on the south-facing sides of canyons at elevations between 1,700 to 1,900 m (5,600 to 6,200 ft). The piñon (*Pinus edulis* Engelm.)-juniper cover type, generally in the 1,900- to 2,100-m (6,200- to 6,900-ft) elevation range, covers large portions of the mesa tops and north-facing slopes at the lower elevations. Ponderosa pine (*Pinus ponderosa* P.& C. Lawson) communities are found in the western portion of the plateau in the 2,100- to 2,300-m (6,900- to 7,500-ft) elevation range. These three cover types predominate, each occupying roughly one-third of the LANL site. The mixed conifer cover type, at an elevation of 2,300 to 2,900 m (7,500 to 9,500 ft), overlaps the ponderosa pine community in the deeper canyons and on north-facing slopes and extends from the higher mesas onto the slopes of the Jemez Mountains. Spruce (*Picea* spp.)-fir (*Abies* spp.) is at higher elevations of 2,900 to 3,200 m (9,500 to 10,500 ft). Several wetlands and riparian areas enrich the diversity of plants and animals found on LANL lands.

In May 2000, the Cerro Grande fire burned over 17,200 ha (43,000 ac) of forest on and around LANL. Most of the habitat damage occurred on Forest Service property to the west and north of LANL. Approximately 3,110 ha (7,684 ac) or 28 percent of the vegetation at LANL was burned in some fashion during the fire. However, few areas on LANL were burned severely. Wetlands in Mortandad, Pajarito, and Water canyons received increased amounts of ash and hydromulch runoff because of the fire.

The extreme drought conditions prevalent in the Los Alamos area between 1998 and 2003 have resulted directly and indirectly in the mortality of many trees. To date, over 90% of the piñon trees greater than 3.0 m (10 ft) tall have died in the Los Alamos area. Lower levels of mortality are also occurring in ponderosa and mixed conifer stands. Mixed conifers on north-facing canyon slopes at lower elevations have experienced widespread mortality. These changes are ongoing and likely will have long-lasting impacts to vegetation community composition and distribution.

4. Cultural Resources

The Pajarito Plateau is an archaeologically rich area. Approximately 85% of DOE land in Los Alamos County has been surveyed for prehistoric and historic cultural resources, and more than 1800 sites have been recorded. More than 85% of the ruins date from the 14th and 15th centuries. Most of the sites are found in the piñon-juniper vegetation zone, with 80% lying between 5,800 and 7,100 ft. Almost three-quarters of all ruins are found on mesa tops. Buildings and structures from the Manhattan Project and the early Cold War period (1943–1963) are being evaluated for eligibility for listing in the National Register of Historic Places, and more than 275 buildings have been evaluated to date.

5. Climate

Los Alamos has a temperate, semiarid mountain climate. Large differences in locally observed temperature and precipitation exist because of the 1,000-ft elevation change across the Laboratory site and the complex topography. Four distinct seasons occur in Los Alamos. Winters are generally mild, with occasional winter storms. Spring is the windiest season. Summer is the rainy season, with frequent afternoon thunderstorms. Fall is typically dry, cool, and calm.

Daily temperatures are highly variable (a 23˚F range on average). Winter temperatures range from 30˚F to 50˚F during the daytime and from 15˚F to 25˚F during the nighttime. The Sangre de Cristo Mountains to the east of the Rio Grande valley act as a barrier to wintertime arctic air masses that descend into the central United States, making the occurrence of local subzero temperatures rare. Summer temperatures range from 70˚F to 88˚F during the daytime and from 50˚F to 59˚F during the nighttime.

The average annual precipitation (which includes both rain and the water equivalent for frozen precipitation) from 1971 to 2000 is 18.95 in., and the average annual snowfall amount is 58.7 in. July and August account for 36% of the annual precipitation and encompass the bulk of the rainy season, which typically begins in early July and ends in early September. Afternoon thunderstorms form as moist air from the Pacific Ocean and the Gulf of Mexico is convected and/or orographically lifted by the Jemez Mountains. The thunderstorms yield short, heavy downpours and an abundance of lightning. Local lightning density, among the highest in the USA, is estimated at 15 strikes per square mile per year. Lightning is most commonly observed between May and September (about 97% of the lightning activity).

The complex topography of Los Alamos influences local wind patterns. Often a distinct diurnal cycle of winds occurs. Daytime winds measured in the Los Alamos area are predominately from the south, consistent with the typical upslope flow of heated daytime air moving up the Rio Grande valley. Nighttime winds (sunset to sunrise) on the Pajarito Plateau are lighter and more variable than daytime winds and typically from the west, resulting from a combination of prevailing winds from the west and downslope flow of cooled mountain air. Winds atop Pajarito Mountain are more representative of upper-level flows and primarily ranged from the northwest to the southwest, mainly because of the prevailing westerly winds.

C. Laboratory Activities and Facilities

The Laboratory is divided into technical areas (TAs) that are used for building sites, experimental areas, support facilities, roads, and utility rights-of-way. (See Appendix C and Figure 1-3.) However, these uses account for only a small part of the total land area; much land provides buffer areas for security and safety and is held in reserve for future use.

The Laboratory has about 2,000 structures with approximately eight million square feet under roof, spread over an area of approximately 40 square miles. Facilities were identified as Key or Non-Key Facilities in the annual Site-Wide Environmental Impact Statement (SWEIS) Yearbook (LANL 2004). The Annual Yearbook makes comparisons between projects reported in the SWEIS for Continued Operation of Los Alamos National Laboratory (DOE 1999) projections and actual operations data.

Key facilities are defined as being critical to meeting mission assignments and house operations that have potential to cause significant environmental impacts, were of most interest or concern to the public (based on comments in the Site-Wide Environmental Impact Statement public hearings), or would be more subject to change because of DOE programmatic decisions.

The remainder of LANL was identified in the SWEIS Yearbook (2004) as “Non-Key,” not to imply that these facilities were any less important to accomplishment of critical research and development, but because they did not meet the above criteria.

Fifteen facilities were identified as Key Facilities in the annual SWEIS Yearbook (LANL 2004) (Table 1-1). The Key Facilities (as presented in the SWEIS) comprised 42 of the 48 Category 2 and Category 3 Nuclear Structures at LANL. These facilities represent the great majority of environmental risks associated with current LANL operations. Specifically, the Key Facilities contribute

- more than 99 percent of all radiation doses to the public,
- more than 90 percent of all radioactive liquid waste generated at LANL,
- more than 90 percent of all radioactive solid waste generated at LANL,
- more than 99 percent of all radiation doses to the LANL workforce, and
- approximately 30 percent of all chemical waste generated by LANL.

The Non-Key Facilities comprise all or the majority of 30 of LANL’s 48 TAs and approximately 14,224 acres of LANL’s 26,480 acres (Table 1-1). The Non-Key Facilities also currently employ about two-thirds of the LANL workforce. The Non-Key Facilities include such important buildings and operations as the Central Computing Facility, the TA-46 sewage treatment facility, and the main Administration Building.

D. Management of Environment, Safety, and Health

ISM provides the Laboratory with a comprehensive, systematic, standards-based performance-driven management system for setting, implementing, and sustaining safety performance and meeting environmental expectations. The term “integrated” is used to indicate that the safety and environmental management system is a normal and natural element of the performance of work. Safety, protection of the environment, and compliance with environment, safety, and health (ES&H) laws and regulations are how the Laboratory does business. ISM is the way that we meet the moral commitment to avoid injury to people or the environment and the business imperative to meet the safety and environmental requirements of the UC-DOE contract for managing and operating the Laboratory.

ISM is integral to accomplishing our mission. The goal of ISM is to establish “safety” (used generically to encompass all aspects of environment, safety, and health) as a fundamental value for operating the Laboratory, reflected in the attitudes and behaviors of all workers. ISM is structured to manage and control work at the institutional, the facility, and the activity levels, and seamless integration of ES&H with the work being done is fundamental. Inseparable from this concept is the important principle that line management is responsible for safety, with clear and unambiguous roles and lines of responsibility, authority, and accountability at all organizational levels, with full participation of the workforce. ISM requires that all work and all workers meet the safety and environmental requirements defined by the Laboratory requirements system.

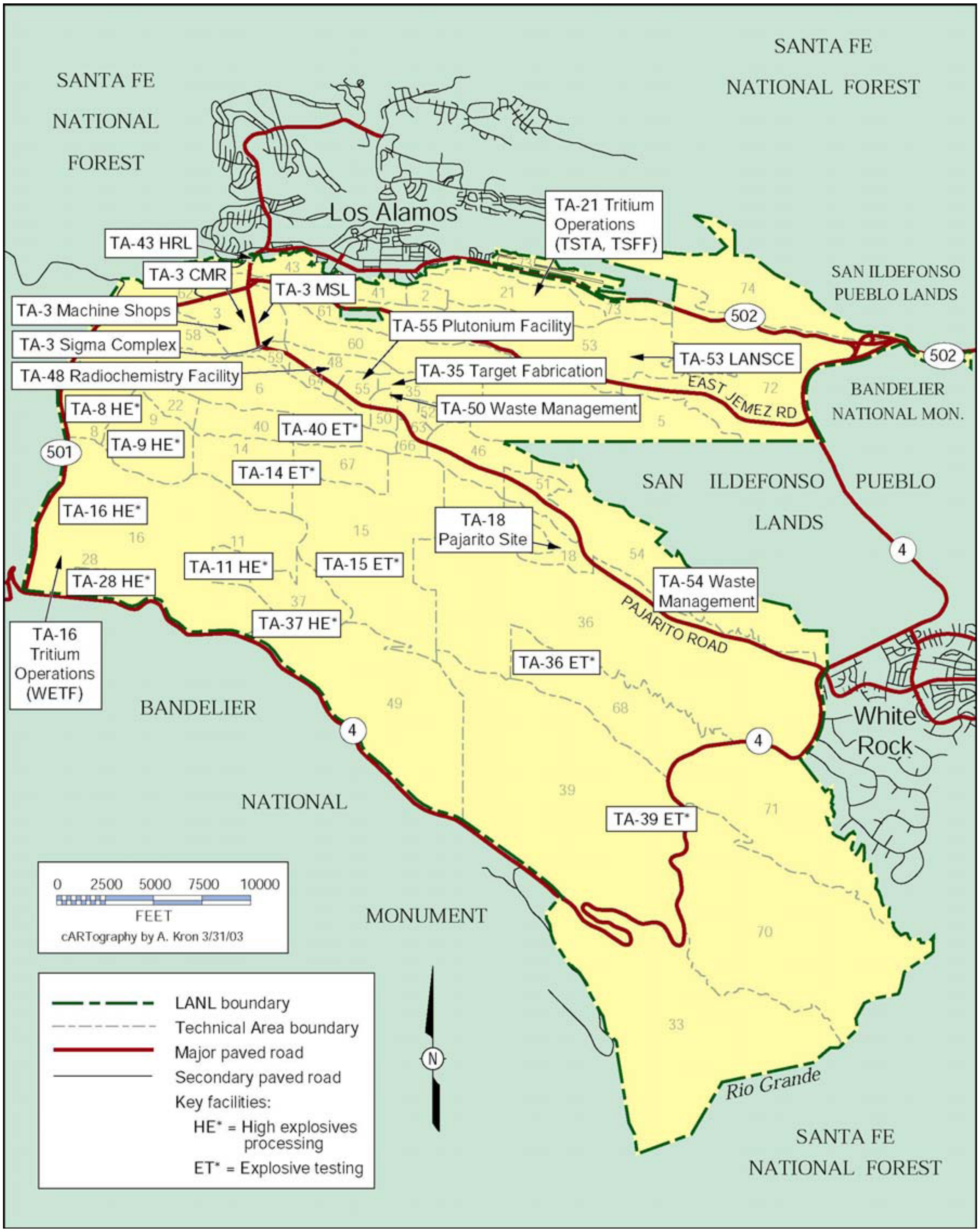


Figure 1-3. Technical Areas and key facilities of Los Alamos National Laboratory in relation to surrounding landholdings.

Table 1-1. Key and Non-Key Facilities[a].

Facility	Technical Areas	~Size (Acres)
Plutonium Complex	TA-55	93
Tritium Facilities	TA-16 & TA-2	312
Chemical and Metallurgy Research (CMR) Building	TA-03	14
Pajarito Site	TA-18	131
Sigma Complex	TA-03	11
MSL	TA-03	2
Target Fabrication Facility (TFF)	TA-35	3
Machine Shops	TA-03	8
High-Explosives Processing	TA-08, -09, -11, -16, -22, -28, -37	1,115
High-Explosives Testing	TA-14, -15, -36, -39, -40	8,691
LANSCE	TA-53	751
Biosciences Facilities (Formerly Health Research Laboratory)	TA-43, -03, -16, -35, -46	4
Radiochemistry Facility	TA-48	116
Radioactive Liquid Waste Treatment Facility (RLWTF)	TA-50	62
Solid Radioactive and Chemical Waste Facilities	TA-50 & TA-54	943
Subtotal, Key Facilities		12,256
Non-Key Facilities	30 of 48 TAs	14,224
LANL acreage		26,480

[a]Table is from SWEIS Yearbook – 2003 (LANL 2004).

1. Environmental Management Program

The Laboratory is committed to protecting the environment while conducting its important national security and energy-related missions. In support of this commitment, LANL is implementing an Environmental Management System (EMS) pursuant to DOE Order 450.1, Environmental Protection Program. This order mandates that the EMS be integrated with an existing IMS already established pursuant to DOE Policy 450.4 using ISO (International Standards Organization) 14001 standards as a model. An EMS is a systematic method for assessing mission activities, determining the environmental impacts of those activities, prioritizing improvements, and measuring results. DOE Order 450.1 defines an EMS as "a continuous cycle of planning, implementing, evaluating, and improving processes and actions undertaken to achieve environmental missions and goals."

The EMS program met several milestones in 2004. An EMS Core Team and EMS Element Teams (Policy, Planning, Implementation Checking and Corrective Action, and Management Review) were chartered. The Core Team developed an EMS Program Plan, an institutional process, and procedures. The current LANL ISM Description Document was revised to reflect EMS requirements. In March 2004, the LANL Director issued an ISO-compliant LANL Environmental Policy that has been incorporated into LANL Governing Policies. Element Teams have completed work describing environmental aspects and impacts and are completing the prioritization process. A communications plan detailing internal and external communication pathways was drafted. A Memorandum of Agreement was approved between LANL and major subcontractors to assure site-wide coordination of EMS development. LANL groups, divisions, management units, and the NNSA Site Office are receiving regular progress briefings. Tools have been developed and implemented to integrate EMS with ISM at the job level. Future work approval requires evaluation of environmental hazards, controls, and pollution prevention opportunities to meet many DOE Order 450.1 requirements.

A second important component of the EMS is the institutional environmental stewardship and management support programs. These programs, described below, assist with the integration of job and work-specific evaluations and ensure natural and cultural resources are managed from a Laboratory-wide perspective.

a. Waste Management Program. Research programs to support the Laboratory's mission generate waste contaminated with material that must receive proper management to avoid a risk to human health, the environment, or national security. The Laboratory generates Resource Conservation and Recovery Act regulated waste, Toxic Substances Control Act regulated waste, low-level radioactive waste, mixed low-level waste, transuranic waste, wastewater, administratively controlled waste, medical waste, New Mexico Special Waste, and solid waste. Certain wastes are also treated and/or disposed of at the Laboratory.

The Laboratory's goal is to conduct waste operations in a manner that minimizes hazardous and non-hazardous waste generation as much as is technically and economically feasible and maintains excellence in matters related to safety, compliance, environment, health, and waste management operations. This goal is accomplished through

- ensuring a safe and healthy workplace;
- minimizing adverse impact to the general public;
- minimizing adverse impact to the environment; and
- ensuring compliance with all applicable laws, standards, and regulations governing environment, safety, and health.

b. Pollution Prevention Program. The Pollution Prevention (P2) program implements waste minimization, pollution prevention, sustainable design, and conservation projects to increase operational efficiency, reduce life-cycle costs, and reduce risk. Reducing waste directly contributes to the efficient performance of the Laboratory's national security, energy, and science missions. Specific P2 activities include

- collecting data and reporting on DOE P2 goals;
- forecasting waste volume to identify P2 opportunities;
- conducting pollution prevention opportunity assessments for customer divisions;
- funding specific waste reduction projects through the Generator Set-Aside Fund program;
- managing affirmative procurement efforts;
- conducting an annual LANL P2 awards program to recognize achievement;
- supporting sustainable design for the construction of new buildings; and
- communicating P2 issues to the Laboratory community.

The Laboratory's P2 Program continues to be recognized for its accomplishments. The Laboratory received two national NNSA Pollution Prevention awards for Laboratory projects in fiscal year 2004. Projects in fiscal years 2003 and 2004 yielded over $7,000,000 in savings to the Laboratory. The P2 Program was instrumental in incorporating preventive measures and compliance into the Integrated Work Management process. The Pollution Prevention performance index for the 2005 DOE Pollution Prevention goals is 94%.

c. Environmental Remediation and Surveillance Program. The Laboratory's Environmental Restoration Project (renamed in 2005 to Environmental Remediation and Surveillance Program) is part of a national DOE effort to reduce risk to human health and the environment at its facilities. The goal of the program is to ensure that residual materials and contaminants from past Laboratory operations do not threaten human or environmental health and safety. To achieve this goal, the program is investigating and, as necessary, remediating sites contaminated by past Laboratory operations. Fieldwork at several sites was either implemented, ongoing, or completed in calendar year 2004. Ongoing fieldwork included sampling of groundwater monitoring wells and monitoring of water levels.

A major characterization activity reported on in calendar year 2004 was the Los Alamos and Pueblo Canyons investigation. This multiyear investigation addressed sediment, surface water (including springs), alluvial groundwater, and biota potentially impacted by Laboratory solid waste management units and areas of concern located within the Los Alamos and Pueblo Canyons watershed. The objectives included defining the nature and extent of contamination in sediment, surface water, and alluvial groundwater and assessing potential risks to human health and the environment from the contaminants. The results of the investigation indicated that contaminants released from solid waste management units and areas of concern are below New Mexico Environment Department (NMED) and DOE human-health risk/dose target levels for present day and foreseeable future land use (i.e., recreational activities) and indicated no adverse effects to terrestrial and aquatic biota in the watershed.

Another major remediation activity reported on in 2004 was the removal of three surface impoundments at TA-53. The remediation activities included the excavation of the sludge, liner, and contaminated soil/tuff, as well as excavation of radioactively contaminated soil and sediment from the drainage leading from the mesa top impoundments to the canyons. Environmental samples were collected following the remediation from within and around the impoundments, including from boreholes drilled to characterize potential releases beneath the site and the drainage. The analytical results showed that the nature and extent of residual contamination is defined. The analysis detected inorganic chemicals, organic chemicals, and radionuclides in the soil, sediment, and tuff and found that they decreased with distance (vertically and laterally) from the impoundments. The contaminant concentrations are below NMED and DOE human health risk/dose target levels for present day and foreseeable future land uses (i.e., industrial activities). An ecological screening assessment also indicated no potential for adverse effects to biota.

d. Compliance and Surveillance Programs

i. Air Resources. The Laboratory maintains a vigorous air quality compliance program for the emissions of both radionuclide and nonradionuclide air pollutants. The Laboratory operates under a number of air emissions permits issued by NMED and approvals for construction of new facilities/operations by the Environmental Protection Agency (EPA). These permits and approvals require pollution control devices, stack emissions monitoring, and routine reporting. This report describes these permits and reports; they are also available on the World Wide Web at www.airquality.lanl.gov. Proposals for new Laboratory operations and facilities are reviewed to determine the requirements for permitting, monitoring, and reporting of air emissions.

In addition to the compliance program, the Laboratory operates an extensive network of ambient air quality monitoring stations and direct penetrating radiation monitoring stations. The network includes station locations on-site, in adjacent communities, and in regional locations. These stations are operated to assure that air quality and ambient radiation doses meet EPA and DOE standards. These data are published in this report and on the Web at www.airquality.lanl.gov.

The Laboratory also participates with and assists neighboring communities and pueblos in performing ambient air and meteorological monitoring.

ii. Water Resources. The LANL Groundwater Protection Program and Water Quality and Hydrology monitoring program manage and protect groundwater and surface water resources. The Laboratory conducts these programs to comply with the requirements of DOE Orders, and New Mexico and federal regulations.

Groundwater resource management and protection efforts at the Laboratory focus on (1) the regional aquifer underlying the region, (2) the perched groundwater found within canyon alluvium, and (3) the perched groundwater at intermediate depths above the regional aquifer. The objectives of the Laboratory's groundwater programs are to determine compliance with waste-discharge requirements and to evaluate any impact of Laboratory activities on groundwater resources. This program addresses environmental monitoring, resource management, aquifer protection, and hydrogeologic investigations.

Surface water protection efforts focus on monitoring surface water and stream sediments in northern New Mexico to evaluate the potential environmental effects of Laboratory operations. The objectives of the surface water program are to address water pollution control compliance, environmental surveillance, watershed management, surface and ground water protection, drinking water quality protection, pesticide protection obligations, and public assurance needs. The Laboratory analyzes samples for several parameters such as radionuclides, high explosives, metals, a wide range of organic compounds, and general chemistry.

iii. Biological Resources. The LANL biological resources program focuses on assisting Laboratory projects and programs to comply with federal and state laws and regulations, DOE Orders, and LANL directives related to natural resources. DOE/NNSA and LANL administrators determined that management of natural resources strongly benefits the Laboratory (DOE 1996). The Laboratory began initial planning for a comprehensive biological resources management plan in 1997. The Mitigation Action

Plan for the Site-Wide Environmental Impact Statement for Continued Operation of the Los Alamos National Laboratory (DOE 1999) formalized this effort by requiring LANL to (1) mitigate the danger of wildfire and (2) develop a comprehensive plan for integrated natural resources management. One of the lasting results of wildfires that have occurred in and around LANL has been a significant increase in a regional, multi-agency approach to managing biological resources.

The current approach to managing biological resources at LANL includes the development of an institutional biological resources management plan and on-the-ground resource management activities (e.g., forest thinning and fuels treatment). The plan is currently being developed to address the need to integrate short- and long-term mission activities and compliant and effective management of LANL's biological resources. The plan uses a combined discipline- and geographic-based approach to identify and integrate actions for management of biological resources. It addresses the following biological resources elements: forest and range, wildlife, sensitive species and habitats (including wetlands), and biocontaminants. In addition, intensive forest management is currently being conducted under an institutional wildfire hazard reduction project that is implemented through the Wildfire Hazard Reduction Project Plan.

iv. Cultural Resources. The Laboratory manages the diverse cultural resources according to the requirements of the National Historic Preservation Act and the other federal laws and regulations concerned with cultural resource protection. Cultural resources include archeological sites, historic buildings and artifacts, and traditional cultural places of importance to Native American and other ethnic groups. The act's goal is for federal agencies to act as responsible stewards of our nation's resources when their actions potentially affect historic properties. Section 106 of the act requires federal agencies to take into account the effects their projects may have on historic properties and to allow for comment by the Advisory Council on Historic Preservation. The Section 106 regulations outline a project review process that is conducted on a project-by-project basis.

The Laboratory is developing a Cultural Resources Management Plan as an institutional comprehensive plan that defines the responsibilities, requirements, and methods for managing its cultural properties. The plan will provide an overview of the cultural resources program, establish a set of procedures for effective compliance with applicable historic preservation laws, address land-use conflicts and opportunities, ensure public awareness of DOE's cultural heritage stewardship actions at LANL, and provide a 10-year road map that summarizes and prioritizes the steps necessary to manage these resources.

2. Organizations Implementing Environmental Management

Safety, environmental protection, and compliance with ES&H laws and regulations are an integral part of the way the Laboratory does business. The Laboratory uses ISM to create a worker-based safety culture, where people are committed to safety in their daily work. Environmental protection, like safety, is an underlying value, not a priority that can be ignored when other priorities seem more important.

Each Laboratory organization is responsible for its own environmental management and performance. Line management provides leadership and ensures ES&H performance within the context of the Laboratory's values and mission. Laboratory managers establish and manage ES&H initiatives, determine and communicate expectations, allocate resources, assess performance, and are held accountable for safety performance. These line organizations are supported by ES&H specialists in the Technical Services Directorate.

The Laboratory established the Technical Services Directorate in 2004 to improve the Laboratory's performance in the areas of environmental stewardship, general health and safety, project management, internal security, facility engineering standards, quality assurance, and nuclear and hazardous operations. The Environmental Stewardship Division (ENV) was established under the Technical Services Directorate. The restructure enhances the visibility and effectiveness of all functions.

ENV Division represents the Laboratory on environmental issues with regulators and external stakeholders. ENV Division provides a broad range of technical expertise and assistance to internal customers. This expertise and assistance is in areas of environmental protection, waste management, pollution prevention, air quality, water quality, National Environmental Policy Act requirements, wildfire protection, and natural and cultural resources management. ENV Division is responsible for performing environmental monitoring, surveillance, and compliance activities to help ensure that Laboratory operations do not adversely affect human health and safety or the environment.

1. Introduction

The Laboratory conforms to applicable environmental regulatory and reporting requirements of DOE Orders 450.1 (DOE 2003b), 5400.5 (DOE 1993), and 231.1-1A (DOE 2004). ENV Division has the responsibility and the authority to serve as the central point of institutional contact, coordination, and support for interfaces with regulators, stakeholders, and the public, including the DOE/NNSA, Environmental Protection Agency, and the US Defense Nuclear Facilities Safety Board.

ENV Division develops and manages the Laboratory programs for environmental regulatory compliance. This work is conducted in four ENV Division groups: Meteorology and Air Quality (MAQ), Water Quality and Hydrology (WQH), Solid Waste Regulatory Compliance (SWRC), and Ecology (ECO). With assistance from Laboratory legal counsel, ENV Division works to define and recommend Laboratory policies for applicable federal and state environmental regulations and laws and DOE orders and directives. ENV Division is responsible for communicating environmental policies to Laboratory employees and makes appropriate environmental training programs available. The ENV groups work with line managers to prepare and review required environmental documentation. The four groups also initiate and manage Laboratory programs for environmental assessment and are responsible for executing environmental surveillance work under the auspices of the division's Environmental Protection Program.

ENV Division uses approximately 600 sampling locations for routine environmental monitoring. The maps in this report present the general location of monitoring stations. For 2004, Laboratory personnel performed more than 250,000 routine analyses for chemical and radiochemical constituents on more than 12,000 routine environmental samples. Laboratory personnel also collected many additional samples in continuing efforts to monitor the effects of the Cerro Grande fire that occurred in 2000, which burned more than 7,500 acres of Laboratory property. Samples of air particles and gases, water, soils, sediments, foodstuffs, and associated biota are routinely collected at monitoring stations and then analyzed. These analyses help identify whether impacts occurred from LANL operations. Trained personnel collect and analyze additional samples to obtain information about particular events, such as major surface-water runoff events, nonroutine radiation releases, or special studies.

E. References

DOE 1993: US Department of Energy, "Radiation protection of the public and the environment," US Department of Energy Order 5400.5 (January 7, 1993).

DOE 1996: US Department of Energy, "Land Use and Facility Use Planning" DOE P 430.1 (July 9, 1996).

DOE 1999: US Department of Energy, "Site-wide environmental impact statement for the continued operation of the Los Alamos National Laboratory," DOE/EIS-0238 (July 1999).

DOE 2003a: US Department of Energy, "Environmental safety and health reporting," US Department of Energy Order 231.1A (August 19, 2003).

DOE 2003b: US Department of Energy, "Environmental protection program," DOE Order 450.1 (January 15, 2003).

DOE 2004: US Department of Energy, "Environment safety and health reporting," US Department of Energy Order 231.1A (June 3, 2004).

Gardner et al., 1999: J. N. Gardner, A. Lavine, G. WoldeGabriel, D. Krier, D. Vaniman, F. Caporuscio, C. Lewis, P. Reneau, E. Kluk, and M. J. Snow, "Structural geology of the northwestern portion of Los Alamos National Laboratory, Rio Grande Rift, New Mexico: implications for seismic surface rupture potential from TA-3 to TA-55," Los Alamos National Laboratory report LA-13589-MS (March 1999).

LANL 2004: SWEIS Yearbook, 2003. Los Alamos National Laboratory document LA-UR-04-6024.

LANL 2005: Los Alamos National Laboratory, "Goals and plans," http://int.lanl.gov/goals/.

Purtymun and Johansen 1974: W. D. Purtymun and S. Johansen, "General Geohydrology of the Pajarito Plateau," New Mexico Geological Society Guidebook (25th Field Conference, Ghost Ranch, New Mexico, 1974).

2. Compliance Summary

contributing authors:
Debra Archuleta, Gian Bacigalupa, Marc Bailey, Alice Barr, Bob Beers, Kevin Buckley, Steve Cossey, Kelly Collins, Albert Dye, Joe English, Greg Erpenbeck, David Fuehne, Pat Gallagher, Kari Garcia, Gil Gonzales, Kathleen Gorman-Bates, Mark Haagenstad, Leslie Hansen, Jackie Hurtle, Richard Mirenda, Peggy Powers, Susan Radzinski, Richard Reynolds, Robin Reynolds, Geri Rodriguez, Virginia Smith, Marjorie Stockton, Steven Veenis, Brad Vierra, Monica Witt

To Read About **Turn to Page . . .**

A. Introduction

Many activities and operations at Los Alamos National Laboratory (LANL or the Laboratory) use or produce liquids, solids, and gases that may contain nonradioactive hazardous and/or radioactive materials. Laboratory policy implements Department of Energy (DOE) requirements by directing employees to protect the environment and meet compliance requirements of applicable federal and state environmental-protection regulations. Federal and state environmental laws address (1) handling, transporting, releasing, and disposing of contaminants, pollutants, and wastes; (2) protecting ecological, archaeological, historic, atmospheric, soil, and water resources; and (3) conducting environmental impact analyses. Regulations provide specific requirements and standards to ensure maintenance of environmental qualities. The Environmental Protection Agency (EPA) and the New Mexico Environment Department (NMED) are the principal administrative authorities for these laws. DOE and its contractors are also subject to DOE-administered requirements for control of radionuclides. Table 2-1 presents the environmental permits or approvals these organizations issued that the Laboratory operated under in 2004 and the specific operations and/or sites affected. Table 2-2 lists the various environmental inspections and audits conducted at the Laboratory during 2004. The following sections summarize the Laboratory's regulatory compliance performance during calendar year 2004.

B. Compliance Status

Laboratory compliance with environmental regulations continues to improve. Similarly, the Laboratory continued to comply with all applicable biological and cultural requirements.

The Laboratory completed 1,095 Resource Conservation and Recovery Act (RCRA) self-assessment that resulted in a nonconformance finding rate of less than 3.5%. Similarly, Laboratory performance on NMED inspections continue to improve. Only seven violations were identified which was a 67% reduction in violations compared to 2003. The Laboratory continued to address cleanup and legacy waste issued in accordance with NMED requirements. The Laboratory met all permit limits for emissions to the air. In addition, use of refrigerants continued to decline.

The Laboratory continues to meet requirements under the Clean Water Act. None of the 145 samples collected from the Sanitary Waste System Plant's outfall exceeded Clean Water Act effluent limits; however, 2 of 1283 samples collected from industrial outfalls exceeded effluent limits. The majority of the Laboratory's permitted construction sites were compliant with National Pollutant Discharge Elimination System (NPDES) requirements. Corrective actions for the noncompliant sites are scheduled for 2005 and the LANL engineering standards were updated to ensure compliance.

The Laboratory is in full compliance with RCRA groundwater monitoring requirements. However, the Laboratory increased its monitoring program in response to perchlorate and nitrate concerns.

1. Resource Conservation and Recovery Act

a. Introduction. The Laboratory produces a variety of hazardous wastes, mostly in small quantities relative to industrial facilities of comparable size. The RCRA, as amended by the Hazardous and Solid

Table 2-1. Environmental Permits or Approvals under which the Laboratory Operated during 2004

Category	Approved Activity	Issue Date	Expiration Date	Administering Agency
RCRA[a] Hazardous Waste Facility	Hazardous waste Facility Permit- and mixed-waste storage and treatment permit	November 1989	November 1999***	NMED[b]
	TA-50 Part B Permit Renewal Application Revision 3.0	August 2002	– – –	NMED
	General Part B Permit Renewal Application, Revision 2.0	August 2003	– – –	NMED
	TA-54 Part B Permit Renewal Application, Revision 3.0	June 2003	– – –	NMED
	TA-16 Part B Permit Renewal Application, Revision 4.0	June 2003	– – –	NMED
	TA-55 Part B Permit Application, Revision 2.0	September 2003	– – –	NMED
	General Part A Permit Application, Revision 4.0	December 2004	– – –	NMED
HSWA[c]	RCRA corrective activities	March 1990	December 1999***	NMED
TSCA[d]	Disposal of PCBs[e] at TA-54, Area G	June 25, 1996	June 25, 2001***	EPA[f]
CWA[g]/NPDES[h]	Outfall permit for the discharge of industrial and sanitary liquid effluents	February 1, 2001	January 31, 2005***	EPA
	MSGP[i] for the discharge of storm water from industrial activities	October 30, 2000	October 30, 2005*	EPA
	Construction General Permits (21) for the discharge of storm water from construction activities	varies	July 1, 2008**	EPA
CWA Sections 404/401	COE[j] Nationwide Permits (2)	varies	varies	COE[j]/NMED
Groundwater Discharge Plan, TA-46 SWWS Plant[l]	Discharge to groundwater	January 7, 1998	January 7, 2003***	NMED
Groundwater Discharge Plan, TA-50, Radioactive Liquid-Waste Treatment Facility	Discharge to groundwater	Submitted August 20, 1996 approval pending	– – –	NMED
Air Quality Operating Permit (20.2.70 NMAC[m])	LANL air emissions	April 30, 2004	April 29, 2009	NMED

Table 2-1. Environmental Permits or Approvals under which the Laboratory Operated during 2004 (Cont.)

Category	Approved Activity	Issue Date	Expiration Date	Administering Agency
Air Quality (20.2.72 NMAC)	Portable rock crusher	June 16, 1999	None	NMED
	TA-3 Power Plant	September 27, 2000	None	NMED
			Revised, November 26, 2003	
			Modified, July 30, 2004	NMED
	Generator at TA-33	October 10, 2002	None	NMED
	Asphalt Plant at TA-60	October 29, 2002	None	NMED
	Data disintegrator	October 22, 2003	None	NMED
Air Quality (NESHAP)[n]	Beryllium machining at TA-3-102	March 19, 1986	Closed, February 20, 2004	NMED
	Beryllium machining at TA-3-141	October 30, 1998	None	NMED
	Beryllium machining at TA-35-213	December 26, 1985	None	NMED
	Beryllium machining at TA-55-4	February 11, 2000	None	NMED
Open Burning	TA-11 Fuel/wood fire testing	December 27, 2002	December 27, 2007	NMED
	TA-14 Burn cage	December 27, 2002	December 27, 2007	NMED
	TA-16 Flash pad	December 27, 2002	December 27, 2007	NMED
	TA-36 Sled track and open burn area	December 27, 2002	December 27, 2007	NMED

[a]Resource Conservation and Recovery Act
[b]New Mexico Environment Department
[c]Hazardous and Solid Waste Amendments
[d]Toxic Substances Control Act
[e]Polychlorinated biphenyls
[f] Environmental Protection Agency
[g]Clean Water Act
[h]National Pollutant Discharge Elimination System
[i]Multi-Sector General Permit
[j]US Army Corps of Engineers
[k]New Mexico Oil Conservation Division
[l]Sanitary Wastewater Systems Plant
[m]New Mexico Administrative Code
[n]National Emission Standards for Hazardous Air Pollutants

*MSGP expiration date
**Construction General Permit (CGP) expiration date
***Permit has been administratively continued

Table 2-2. Environmental Inspections and Audits Conducted at the Laboratory during 2004

Date	Purpose	Performing Agency
03/23/04	Asbestos inspection at TA-48, Bldg. 1	NMED[a]
03/23/04	Asbestos inspection at TA-3, Trench	NMED
05/26/04	Asbestos inspection at TA-16-370	NMED
11/01/04	Asbestos inspection at TA-15, Hollow complex	NMED
12/29/04	Asbestos inspection at TA-3-246, -247, -379	NMED
03/22/04–04/13/04	Hazardous waste compliance inspection (NMED Closeout 4/22/2004)	NMED
4/15/04	Aboveground storage tank inspection	NMED-PSTB[b]
5/20/04	Aboveground storage tank inspection	NMED-PSTB[b]
5/26/04	Aboveground storage tank inspection	NMED-PSTB[b]

(No PCB[c], NPDES[d], FIFRA[e], Section 401/404, or Groundwater Discharge Plan inspections were conducted in 2004.)
[a]New Mexico Environment Department
[b]New Mexico Environment Department-Petroleum Storage Tank Bureau
[c]Polychlorinated biphenyls
[d]National Pollutant Discharge Elimination System
[e]Federal Insecticide, Fungicide, and Rodenticide Act

Waste Amendments (HSWA) of 1984, establishes a comprehensive program to regulate hazardous wastes from generation to ultimate disposal. The EPA has authorized the State of New Mexico to implement the requirements of the program, which it does through the New Mexico Hazardous Waste Act and state regulations of New Mexico Administrative Code (NMAC) Title 20, Chapter 4, Part 1, as revised October 1, 2003 (20.4.1 NMAC). Federal and state laws regulate management of hazardous wastes based on a combination of the facility's status; large- or small-quantity generation; and the types of treatment, storage, and disposal conducted by the facility.

Certain operations may require an operating permit, called a hazardous waste facility permit, or a RCRA permit. The LANL hazardous waste facility permit expired in 1999 but was administratively continued beyond the expiration date as allowed by the permit and by 20.4.1.900 NMAC. In anticipation of the permit's expiration, and by agreement with the NMED, the Laboratory submitted preliminary permit renewal applications for NMED review starting in 1996. The final set of Part B permit applications was submitted in 2003 for final NMED review.

b. Resource Conservation and Recovery Act Permitting Activities. To reflect consolidations in hazardous waste management units in accordance with the annual unit audit, the Laboratory's General Part A RCRA Permit Application was revised in December 2004. The motivation for this submittal was proposed fee regulation changes that NMED presented for comment in October 2004.

The Laboratory submitted a version of the LANL hazardous waste facility permit containing all previously submitted permit modifications in September 2004 in an attempt to begin to bring the permit up to date with current operations. In October and November of 2004, an additional twenty Class 1 modifications were submitted to further update this version.

Closure activities for several waste management units were completed, and NMED approved them in 2004. These closures included the interim status container storage units at Technical Area (TA) -50-1, Room 59 and TA-50-37; the Exhaust System at TA-50-37; the container storage unit at TA-50-114; and the container storage unit at TA-50-37, Room 117. The Laboratory received approval for these closures in November 2004. Closure activities began for the sand filters at TA-16-401 and -406 and were completed for the container storage unit at TA-55-PF 4-B38 in 2004. The Laboratory will draft final closure certification reports and submit them to NMED for final approval.

c. Other Resource Conservation and Recovery Act Activities. The compliance assurance program, managed by the Environmental Stewardship Division's Solid Waste Regulatory Compliance Group (ENV-SWRC), performs Laboratory self-assessments to determine that hazardous and mixed waste is managed to meet the requirements of federal and state regulations, DOE orders, and Laboratory policy. ENV-SWRC communicates findings from these self-assessments to waste generators, waste-management coordinators, and waste managers who help line managers implement appropriate actions to ensure continual improvement in LANL's hazardous waste program. In 2004, the Laboratory completed 1,095 self-assessments that resulted in a nonconformance finding rate of less than 3.5%.

d. Resource Conservation and Recovery Act Compliance Inspection. From March 22 to April 13, 2004, the NMED conducted a hazardous-waste-compliance inspection at the Laboratory (Table 2-2). NMED identified four alleged RCRA violations for this inspection in a Notice of Violation issued on April 20, 2005.

e. Site Treatment Plan. In October 1995, the State of New Mexico issued a Federal Facility Compliance Order to the DOE and the University of California (UC), requiring compliance with the Site Treatment Plan. The plan documents the use of off-site facilities for treating and disposing of mixed waste generated at LANL and stored for more than one year. The Laboratory met all 2004 Site Treatment Plan deadlines and milestones by treating and disposing of more than 7 cubic meters (m^3) of Site Treatment Plan low-level mixed waste.

f. Solid-Waste Disposal. The Laboratory closed an on-site landfill that had been used to dispose of solid waste and New Mexico special waste. Material Disposal Area J, located at TA-54, was subject to New Mexico Solid Waste Management Regulations. Area J is now under long-term post-closure care and monitoring.

LANL sends sanitary solid waste (trash), concrete/rubble, and construction and demolition debris for disposal to the Los Alamos County Landfill on East Jemez Road. The DOE owns the property and leases it to Los Alamos County under a special-use permit. Los Alamos County operates this landfill and is responsible for obtaining all related permits for this activity from the state. The landfill is registered with the NMED Solid Waste Bureau. Laboratory trash placed in the landfill in 2004 included 1,560 tons of trash and 607 tons of construction and demolition debris. Through LANL recycling efforts, 3,831 tons of material did not go to the landfill in 2004.

g. Compliance Order on Consent (Consent Order). For calendar year 2004, the Laboratory (under the Environmental Remediation and Surveillance Program) continued to operate in accordance with the requirements of Module VIII of the Laboratory's Hazardous Waste Facility Permit, which specifies conditions for compliance with the Hazardous and Solid Waste Amendments to the Resource Conservation and Recovery Act. Additionally, while negotiating a compliance order on consent, the Laboratory voluntarily operated in accordance with the November 2002 Order issued by NMED containing corrective action requirements. After September 1, 2004, the Laboratory voluntarily complied with a draft schedule of deliverables negotiated by NMED, DOE, and LANL.

NMED, DOE, and UC signed the final Compliance Order on Consent (Consent Order) for corrective action on March 1, 2005. The Consent Order is the principal regulatory driver for the Environmental Stewardship – Environmental Remediation and Surveillance Program and replaces the corrective action requirements of the Hazardous and Solid Waste Amendments Module of the Laboratory's Hazardous Waste Facility Permit (Module VIII). The Consent Order contains requirements for investigation and cleanup of solid waste management units (SWMUs) and areas of concern (AOCs) at the Laboratory. The Consent Order includes the following major activities:

Investigation of canyon watersheds;

Investigation of material disposal areas (MDAs) at TAs-21, -49, -50, and -54;

Completion of ongoing investigations and cleanups begun under Module VIII; and

Investigation of SWMUs and AOCs within watershed aggregate areas.

The Consent Order contains enforceable deadlines for submitting the investigation work plans associated with the above investigations and for completing corrective actions in each watershed. The Consent Order also contains specific technical requirements for implementing investigations, conducting corrective measures, and preparing documents. It establishes cleanup levels for groundwater, soil, and surface water. NMED is the administrative authority for all corrective actions conducted at SWMUs and AOCs under the Consent Order. DOE is the administrative authority for corrective actions associated with radionuclides, which are specifically excluded from the Consent Order.

Table 2-3. Investigation Work Plans and Investigation Reports Submitted for Review and/or Approved in 2004

Plan Title	Date Submitted	Date Approved
Investigation Work Plans		
Mortandad Canyon Groundwater Work Plan, Revision 1	1/16/2004	2/11/2004
MDA T [SWMU 21-016(a)-99] Investigation Work Plan	2/27/2004	
SWMU 16-003(o) Investigation Work Plan	3/31/2004	6/28/2004
Addendum to the Sampling and Analysis Plan for Middle Mortandad/Ten Site Canyon Aggregate	3/31/2004	6/25/2004
Remedy Design Work Plan for the Airport Landfill [SWMUs 73-001(a-d), 73-004(d)]	4/30/2004	9/2/2004
MDA G [SWMU 54-013(b)-99] Investigation Work Plan, Revision 1	6/14/2004	11/5/2004
MDA V [SWMU 21-018(a)-99] Investigation Work Plan	6/30/2004	11/5/2004
MDA B (SWMU 21-015) Investigation Work Plan	6/30/2004	12/24/2004
DP Site Aggregate Area Investigation Work Plan	8/31/2004	
MDA U [SWMU 21-017(a)-99] Investigation Work Plan	11/30/2004	
Groundwater Investigation Work Plan for SWMU 03-010(a)		3/30/2004
Accelerated Corrective Action Work Plan for Former TA-19	1/28/04	6/23/2004
MDA L Investigation Work Plan, Revision 1		9/28/2004
Investigation Reports		
TA-53 Surface Impoundments [SWMU 53-002(a)-99 and AOC 53-008] Investigation Report	1/31/2004	
Interim Measures Completion Report for the Airport Drainages	3/1/2004	
Los Alamos and Pueblo Canyons Investigation Report	4/30/2004	
Phase III Resource Conservation and Recovery Act Facility Investigation Report for SWMU 16-021(c)-99		6/23/2004
Voluntary Corrective Action Completion Report for SWMU 21-024(f) and AOCs 21-030 and C-21-015		6/21/2004
Completion Report for the Voluntary Corrective Action at SWMUs 0-030(l), 0-033(a), and 0-030(a), and AOCs 0-004, 0-010(b), 0-033(b), and 0-029 (a,b,c)		6/21/2004

All of the Laboratory deliverables (plans and reports) scheduled in 2004 under the November 2002 Order and the September 2004 negotiated draft schedule were submitted on time to NMED (Table 2-3). In addition, the Laboratory submitted several other plans and reports not specifically required by the November 2002 Order to NMED during 2004.

2. Comprehensive Environmental Response, Compensation, and Liability Act

As part of the Conveyance and Transfer project, the Laboratory prepared environmental baseline survey documents for three subparcels of land during 2004. One survey was completed for A-5 Airport South. The other two surveys (A-10 DP Road East and A-18 TA-74 South) are waiting for “no further action” determinations from DOE’s Los Alamos Site Office (LASO) for an AOC at these sites. These documents contain the Comprehensive Environmental Response, Compensation, and Liability Act 120(h) information required to transfer these properties to private ownership and indicate that “no hazardous substances exist on these sites,” that “all remedial action necessary to protect human health and the environment has been taken,” or that certain restrictions on use are required. These documents provide sufficient information to demonstrate that no environmental impacts exist that would trigger actions under the Comprehensive Environmental Response, Compensation, and Liability Act.

3. Emergency Planning and Community Right-to-Know Act (EPCRA)

a. Introduction. The Laboratory is required to comply with the Emergency Planning and Community Right-to-Know Act of 1986 and Executive Order 12856.

b. Compliance Activities. In 2004, the Laboratory submitted two annual reports to fulfill its requirements under Emergency Planning and Community Right-to-Know Act, as shown on Table 2-4 and described here.

Table 2-4. Compliance with Emergency Planning and Community Right-to-Know Act during 2004

Statute	Brief Description	Compliance
EPCRA Sections 302-303 Planning Notification	Requires emergency planning notification to state and local emergency planning committees.	No changes to the notification has been made since the July 30, 1999 notification and an update in 2000.
EPCRA Section 304 Release Notification	Requires reporting of releases of certain hazardous substances over specified thresholds to state and local emergency planning committees and to the National Response Center.	No leaks, spills, or other releases of chemicals into the environment required EPCRA Section 304 reporting during 2004.
EPCRA Sections 311-312 Material Safety Data Sheets and Chemical Inventories	Requires facilities to provide appropriate emergency response personnel with an annual inventory and other specific information for any hazardous materials present at the facility over specified thresholds.	The presence of 50 hazardous materials stored at LANL over specified quantities in 2004 required submittal of a hazardous chemical inventory to the state emergency response commission and the Los Alamos County Fire and Police Department.
EPCRA Section 313 Annual Releases	Requires all federal facilities to report total annual releases of listed toxic chemicals used in quantities above reportable thresholds.	Use of lead compounds, nitric acid, and nitrate compounds exceeded the reporting thresholds in 2004, requiring submittal of Toxic Chemical Release Inventory Reporting Forms (Form Rs) to the EPA and the state emergency response commission.

Emergency Planning Notification. Title III, Sections 302–303, of Emergency Planning and Community Right-to-Know Act require the preparation of emergency plans for more than 360 extremely hazardous substances if stored in amounts above threshold limits. The Laboratory is required to notify state and local emergency planning committees (1) of any changes at the Laboratory that might affect the local emergency plan or (2) if the Laboratory's emergency planning coordinator changes. No updates to this notification were made in 2004.

Emergency Release Notification. Title III, Section 304, of Emergency Planning and Community Right-to-Know Act requires facilities to provide emergency release notification of leaks, spills, and other releases of listed chemicals into the environment, if these chemicals exceed specified reporting quantities. Releases must be reported immediately to the state and local emergency planning committees and to the National Response Center. The Laboratory did not have any leaks, spills or other releases that exceeded any reporting thresholds in 2004.

Material Safety Data Sheet/Chemical Inventory Reporting. Title III, Sections 311–312, of Emergency Planning and Community Right-to-Know Act require facilities to provide an annual inventory of the quantity and location of hazardous chemicals that are above specified thresholds present at the facility. The inventory includes hazard information and storage location for each chemical. The Laboratory submitted a report to the state emergency-response commission and the Los Alamos County fire and police departments listing 50 chemicals and explosives at the Laboratory that were stored on-site in quantities that exceeded threshold limits during 2004.

Toxic Release Inventory Reporting. Executive Order 12856 requires all federal facilities to comply with Title III, Section 313, of Emergency Planning and Community Right-to-Know Act. This section requires reporting of total annual releases to the environment of listed toxic chemicals that exceed activity thresholds. Beginning with reporting year 2000, new and lower chemical-activity thresholds were put in place for certain persistent, bioaccumulative, and toxic chemicals and chemical categories. The thresholds for these chemicals range from 0.1 g to 100 lb. Until this change went into effect, the lowest threshold was 10,000 lb. LANL exceeded three thresholds in 2004 and, therefore, was required to report the uses and releases of these chemicals. The reported materials were lead compounds, nitric acid, and nitrate compounds. The largest use of reportable lead is at the on-site firing range where security personnel conduct firearms training. The largest use of nitric acid is at the plutonium processing facility. In 2004, the facility continued operation of a process called mixed oxides fuels. The goal of the project is to demonstrate that surplus plutonium can be used in the form of mixed-oxide fuel to generate electricity in existing commercial reactors. The Laboratory has a nitric acid recycle system in place; however, the mixed oxides fuels project cannot use the recycled nitric acid because it has not been demonstrated to meet quality specifications. Therefore, spent nitric acid from the mixed oxides fuels project is sent to the Radiological Liquid Waste Treatment Facility (RLWTF) for treatment and disposal. The waste nitric acid stream is neutralized with sodium hydroxide, forming sodium nitrate. The sodium nitrate created during this treatment step is part of the listed nitrate compound category and must be reported under Emergency Planning and Community Right-to-Know Act Section 313 if quantities exceed 25,000 lb. Table 2-5 summarizes the reported releases for the three Emergency Planning and Community Right-to-Know Act Section 313 reportable chemicals for 2004.

Table 2-5. Summary of 2004 Reported Releases under EPCRA Section 313

	Lead Compounds (lb)	Nitric Acid (lb)	Nitrate Compounds (lb)
Air Emissions	5.0	248	0
Water Discharges	422	0	12,571
On-Site Land Disposal	5,536	0	11,524[b]
Off-Site Waste Transfers	52,518[a]	417	13,478[b]

[a]Off-site waste disposal of lead includes 45,008 lb lead from the Dynamic Experimentation Division (DX) firing site cleanup project.
[b]Nitrate bottoms from RLWTF are transferred off-site for dewatering, then returned to LANL for on-site disposal. Per EPA guidance, this activity must be reported as both waste transfer when shipped out and as on-site land release when disposed on-site.

4. Toxic Substances Control Act

Because the Laboratory's activities are research and development (R&D) and do not involve commercial manufacturing of chemicals to sell, the polychlorinated biphenyls (PCB) regulations and import/export of R&D chemical substances have been the Laboratory's main concern under the Toxic Substances Control Act (TSCA). The PCB regulations govern substances including, but not limited to, dielectric fluids, contaminated solvents, oils, waste oils, heat-transfer fluids, hydraulic fluids, slurries, soils, and materials contaminated by spills.

During 2004, the Laboratory shipped 171 containers of PCB waste off-site for disposal. The quantities of waste disposed of include 1,964 kg of capacitors and 4,792 kg of fluorescent light ballasts. The Laboratory manages all wastes in accordance with 40 CFR 761 manifesting, record keeping, and disposal requirements. PCB wastes go to EPA-permitted disposal and treatment facilities. Light ballasts go off-site for recycling. The primary compliance document related to 40 CFR 761.180 is the annual PCB report that the Laboratory submits to the EPA, Region 6.

The Laboratory disposes of nonliquid wastes that contain PCBs and are contaminated with radioactive constituents at its TSCA-authorized landfill located at TA-54, Area G. Radioactively contaminated PCB liquid wastes are stored at the TSCA-authorized storage facility at TA-54, Area L. Although some of these items have exceeded TSCA's one-year storage limitation, radioactively contaminated PCB liquid wastes are currently in storage as allowed by TSCA.

The five-year letter of authorization to use Area G for PCB disposal expired in July 2001, and the EPA granted an administrative extension to LANL for continued use of Area G during the review process. Approval of a renewal request is expected to occur in 2005. During 2004, the EPA did not perform any PCB inspections, and approximately 26 TSCA reviews were conducted on imports and exports of chemical substances for the Laboratory's Property Management Group Customs office.

5. Federal Insecticide, Fungicide, and Rodenticide Act

The Federal Insecticide, Fungicide, and Rodenticide Act regulates the manufacturing of pesticides and the protection of workers who use these chemicals. Sections of this act that are applicable to the Laboratory include requirements for certification of workers who apply pesticides. The New Mexico Department of Agriculture has the primary responsibility to enforce pesticide use under the act. The New Mexico Pesticide Control Act applies to the Laboratory's licensing and certifying of pesticide workers, record keeping, applying of pesticides, inspecting of equipment, storing of pesticides, and disposing of pesticides.

The NM Department of Agriculture did not conduct assessments or inspections of the Laboratory's pesticide application program in 2004. The Laboratory conducted four quarterly inspections of the pesticide storage area in 2004 and found that the storage area was being maintained in accordance with RCRA regulations.

Amounts of pesticides used during 2004 included the following:

Herbicides		Insecticides	
VELPAR L (Liquid)	44 gal.	TEMPO (Powder)	50 oz
TELAR (Granule)	14 g	STINGER WASP (aerosol)	50 oz
2-4-D Amine (Liquid)	11 gal.		

6. Clean Air Act

In April 2004, the Air Quality Bureau of the NMED issued Operating Permit No P100 to the Regents of the University of California for LANL pursuant to the federal Clean Air Act Amendments and Title 20 of the New Mexico Administrative Code, Chapter 2, Part 70 – Operating Permits (20.2.70 NMAC). The operating permit conditions mirror existing source specific permit conditions applicable to operating requirements, record keeping, monitoring, and reporting. Implementing the Title V Operating permit requires increased record keeping, increased frequency of reporting, and an annual compliance certification. Complying with the conditions of the Title V Operating permit is deemed to be compliance with all applicable requirements existing at the date of permit issuance.

As part of the Title V Operating Permit program, LANL reports on a semiannual basis emissions for sources included in the Operating Permit. These sources, as defined in the Title V Operating Permit Application, include multiple boilers and generators, two steam plants, a paper shredder (decommissioned in July 2004), carpenter shops, three degreasers, a rock crusher (retired in July 2004), and asphalt production. LANL also reports emissions from chemical use associated with R&D and permitted beryllium activities.

LANL staff calculates air emissions using emission factors source tests, manufacturer's data, and EPA documentation. Calculated emissions are based on actual or maximum production rates, fuel and fuel usage, and/or material throughput. To satisfy requirements set forth in the Title V Operating Permit, LANL completed and submitted to NMED its first semiannual emissions report in 2004.

LANL is a major source under the Title V Operating Permit program based on the potential to emit nitrogen oxides (NO_X), carbon monoxide (CO), and volatile organic compounds. In 2004, small boilers and heaters were the major contributors of NO_X and CO, whereas R&D activities were responsible for most of the VOC emissions. Another significant contributor of NO_X and CO is the TA-3 power plant (Table 2-6 and Figure 2-1).

Hazardous air pollutant emissions reported from R&D activities generally reflect the quantities procured during the calendar year. Reporting procured quantities assures a conservative estimate of hazardous air pollutant emissions. In a few cases, LANL evaluated procurement values and operational processes in more

Table 2-6. Calculated Actual Emissions for Regulated Pollutants (tons) Reported to NMED

	Pollutants					
Emission Units	**NO_x**	**SO_x**	**PM**	**CO**	**VOC**	**HAPs**
Asphalt Plant[a]	0	0	0	0	0	0
TA-21 Steam Plant	1.58	0.012	0.12	1.33	0.09	0.03
TA-3 Steam Plant	16.34	0.29	2.16	11.26	1.54	0.51
Regulated Boilers	6.55	0.041	0.61	4.5	0.38	0.13
R&D Chemical Use	NA	NA	NA	NA	7.95	5.71
Air Curtain Destructors[b]	0	0	0	0	0	0
Degreaser	NA	NA	NA	NA	0.011	0.011
Paper Shredder	NA	NA	0.055	NA	NA	NA
Rock Crusher	0	0	0	0	0	0
Carpenter Shop (TA-3-38)	NA	NA	0.023	NA	NA	NA
Storage Tanks	NA	NA	NA	NA	0.047	NA
Stationary Standby Generators[c]	5.9	1.1	0.3	1.4	0.3	0.003
Miscellaneous Small Boilers[c]	20.17	0.147	1.578	16.97	1.13	0.34
TOTAL	**50.5**	**1.6**	**4.8**	**35.5**	**11.4**	**6.7**

[a]The old asphalt plant was shut down in 2003. A new asphalt plant is under construction but did not operate in 2004.

[b]The air curtain destructors were taken out of service in October 2003.

[c]Emissions from these source categories reported for the first time in 2004 as the Title V Operating Permit requires. Emissions units in these categories are exempt from construction permitting and annual emission inventory reporting requirements.

detail to report actual emission in place of the procured values. See Table 2-6 for reported values of hazardous air pollutant emissions for 2004.

Two sources listed in the Title V Operating Permit saw changes in the permit status as described in the Title V Operating Permit Application. These sources were the asphalt plant and the paper shredder.

Construction of a BDM Engineering asphalt plant, Model Number TM 2000, permitted under Air Quality Permit No GCP-3-2195G, started in 2004. The BDM Engineering asphalt plant construction was started to replace the Barber-Greene plant that was dismantled in 2003. Construction delays caused by the Mexican Spotted Owl nesting season and the asphalt plant's proximity to a mating area prevented completion and start-up in 2004. LANL produces asphalt only when outside asphalt contractors are unavailable to provide support. Production is solely for use in minor road patching and paving.

The data disintegrator was installed at TA-52-11 in July of 2004. This building had previously housed a paper shredder that had operated there since 1991. The paper shredder was taken offline and removed in July 2004 to make room for the data disintegrator. The data disintegrator was permitted for installation under New Source Review Air Quality Permit No. 2195-H issued by NMED in October 2003. Data disintegrator operations began in August 2004 and is capable of data destruction of paper, microfiche, film, plastic magnetic tape, and compact discs.

As part of the Operating Permit Program, the NMED collects annual fees (20.2.71 NMAC) from facilities. For LANL, the fees are based on the allowable emissions from activities and operations as reported in the 1995 operating permit application. LANL's fees for 2004 were approximately $12,800.

a. New Mexico Air Quality Control Act.

i. Construction Permits. The Laboratory operates under several permits issued by NMED (Table 2-1). During 2004, the Laboratory submitted a Notice of Intent for a soil vapor extraction system, and received 1 permit modification for a 24.6-MW output turbine. Also, five sources were exempt from construction permitting but required written notification to the NMED (20.2.72 NMAC).

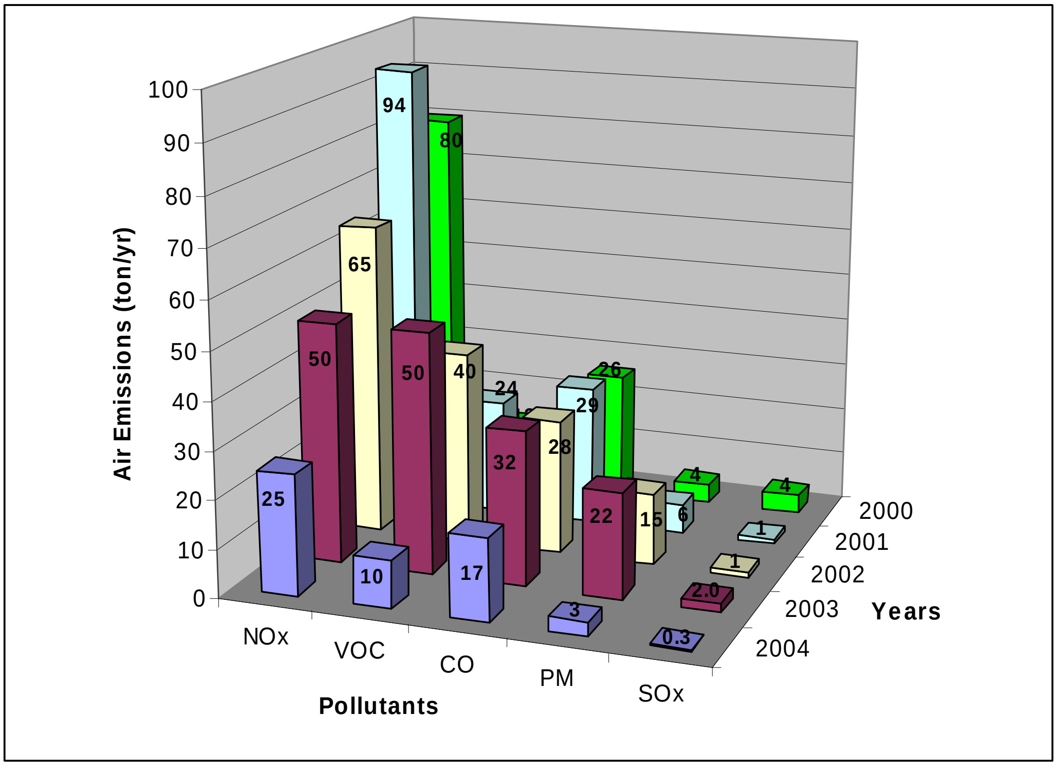


Figure 2-1. Criteria pollutant emissions from LANL 2000–2004.

In July, NMED issued a permit modification to add a combustion turbine at the TA-3 power plant. The power plant intends to operate the 24.6-MW output turbine as a standby or peaking unit. The turbine will augment, not replace, the existing boilers' electric generation capacity. Construction is expected to start in 2005.

LANL submitted a Notice of Intent for a soil vapor extraction system for use at TA-54 Material Disposal Area L. NMED determined no permit was required for installation and operation of the unit.

ii. Open Burning. LANL has four open burning permits (20.2.60 NMAC) for operational burns conducted to thermally treat or dispose of high explosives or material contaminated with high explosives and to test accident scenarios involving fire. All operational burns for 2004 were conducted within the terms specified in the permits. The Laboratory reports the results of these operations annually to the NMED to document compliance with permit requirements.

As required by the revised open burn regulation, 20.2.60 NMAC, LANL prepared and submitted to NMED applications under 20.2.72 NMAC, Construction Permits, for open burn activities at the DX TA-36 sled track, the ESA TA-16 flash pad, and the ESA TA-11 wood and fuel fire test site. As part of the application process, LANL made public notice through certified letters to local municipalities and pueblos, a radio announcement, and newspaper advertisements in the Los Alamos Monitor. In addition, NMED decided that notice to owners of property within 100 feet of the LANL boundary was appropriate. In response, LANL sent certified letters to approximately 450 property owners. LANL continues to operate under existing open burn permits until new permits are issued under 20.2.72 NMAC.

iii. Asbestos. The National Emission Standard for Hazardous Air Pollutants (NESHAP) for Asbestos requires that LANL provide advance notice to the NMED for large renovation jobs that involve asbestos and for all demolition projects. The Asbestos NESHAP further requires that all activities involving asbestos be conducted in a manner that mitigates visible airborne emissions and that all asbestos-containing wastes be packaged and disposed of properly.

LANL continued to perform renovation and demolition projects in accordance with the requirements of the Asbestos NESHAP. Major activities in 2004 included 27 large renovation jobs and demolition projects for which the NMED received advance notice. These projects, combined with other smaller activities, generated approximately 645 m^3 of asbestos waste. All asbestos wastes were properly packaged and disposed of at approved landfills.

To ensure compliance, the Laboratory conducted internal inspections of job sites and asbestos packaging approximately monthly. In addition, NMED conducted five inspections during the year and identified no violations. The Quality Assurance Project Plans for for the Asbestos Report Project and the Rad NESHAP Compliance Project are available at http://www.airquality.lanl.gov/QA.shtml on the World Wide Web.

b. Federal Clean Air Act.

i. Ozone-Depleting Substances. Title VI of the Clean Air Act contains specific sections that establish regulations and requirements for ozone-depleting substances, such as halons and refrigerants. The main sections applicable to the Laboratory prohibit individuals from knowingly venting an ozone-depleting substance into the atmosphere during maintenance, repair, service, or disposal of halon fire-suppression systems and air-conditioning or refrigeration equipment. All technicians who work on refrigerant systems must be EPA-certified and must use certified recovery equipment. The Laboratory is required to maintain records on all work that involves refrigerants and the purchase, usage, and disposal of refrigerants. The Laboratory's standards for refrigeration work are covered under Criterion 408, "EPA Compliance for Refrigeration Equipment," of the Operations and Maintenance manual.

In addition to routine compliance demonstration, DOE has established two goals to eliminate usage of class 1 refrigerants. These goals include the following:

retrofit or replace, by the year 2005, all chillers with greater than 150 tons of cooling capacity and manufactured before 1984 and

eliminate the use of the remaining equipment by 2010.

Figure 2-2 shows the decrease in total refrigerants used from 2001 to 2004 for all equipment. In 2004, LANL replaced the remaining four chillers subject to the 2005 phaseout goal. In addition, over 4000 lb of refrigerant in eighteen units subject to the 2010 goal were replaced.

ii. Radionuclides. Under the National Emission Standard for Hazardous Air Pollutants for Radionuclides (Rad-NESHAP), the EPA limits the effective dose equivalent of radioactive airborne releases from a DOE facility, such as LANL, to any member of the public to 10 mrem/yr. The 2004 TEDE (as calculated using EPA-approved methods) was 1.68 mrem. The location of the highest dose was at East Gate. Operations at the Los Alamos Neutron Science Center made the principal contribution to that highest dose. The QA Project Plan for the Rad NESHAP Compliance Project is available at http://www.airquality.lanl.gov/QADocs/RadN-QAPP-R3.pdf on the World Wide Web.

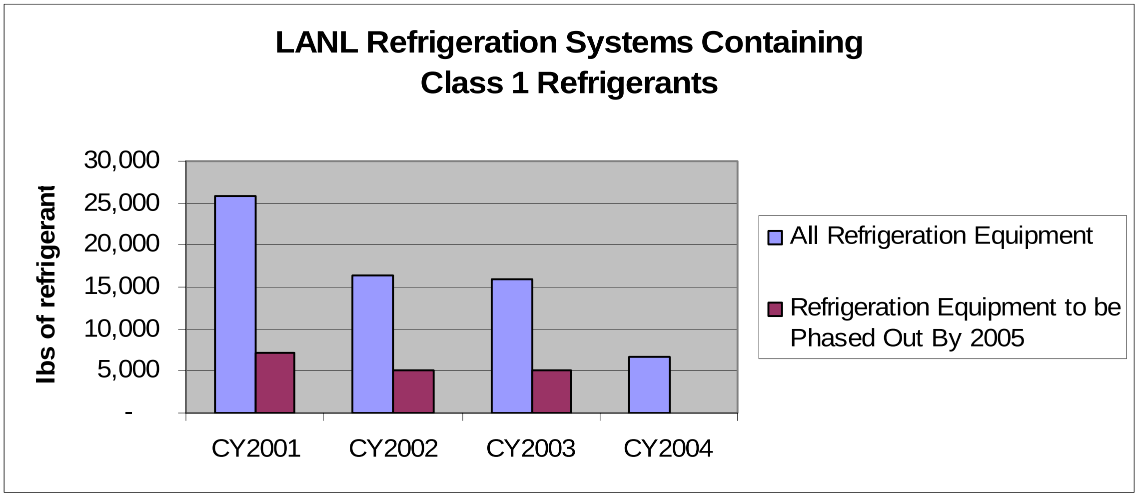


Figure 2-2. LANL refrigeration systems containing class 1 refrigerants.

LANL reviews plans for new and modified projects, activities, and operations to identify the need for emissions monitoring and prior approval from the EPA. During 2004, more than 60 reviews involved the evaluation of air-quality requirements associated with the use of radioactive materials. No projects reviewed in 2004 met the criteria requiring EPA pre-approval. However, one new project did meet the criteria for notification to EPA because the requirement for approval was waived under Section 61.96 of the regulation. The project involves research on very-low-energy ("ultra-cold") neutrons, and a byproduct of the experiments is the low-level production of tritium. The project started in April 2004 and is expected to continue into 2005.

7. Clean Water Act

a. National Pollutant Discharge Elimination System Industrial Point Source Outfall Self-Monitoring Program. The primary goal of the Clean Water Act (CWA) is to restore and maintain the chemical, physical, and biological integrity of the nation's waters. The act established the requirements for National Pollutant Discharge Elimination System (NPDES) permits for point-source effluent discharges to the nation's waters. The NPDES outfall permit establishes specific chemical, physical, and biological criteria that the Laboratory's effluent must meet before it is discharged.

UC and the DOE/National Nuclear Security Administration (NNSA) are co-permittees of the NPDES permit covering Laboratory operations. The EPA Region 6 in Dallas, Texas, issues and enforces the permit. The NMED certifies the EPA-issued permit and performs some compliance-evaluation inspections and monitoring for the EPA. The Laboratory's current industrial point-source NPDES permit contains 21 permitted outfalls that include 1 sanitary outfall and 20 industrial outfalls. To view the Laboratory's NPDES permit link to http://eweb.lanl.gov/Downloads/npdes_permit2001.pdf on the World Wide Web.

The Laboratory's long-term objectives require that outfall owners continue evaluating outfalls for possible elimination and that new construction designs and modifications to existing facilities provide for reduced or no-flow effluent discharge systems. No NPDES outfalls were deleted in 2004; however, four outfalls were not included in the Laboratory's NPDES Permit re-application submitted to EPA on July 30, 2004. The Laboratory's new NPDES point-source permit is anticipated to be issued in 2005 and will include one sanitary outfall and 16 industrial outfalls for a total of 17 permitted outfalls.

The Laboratory's NPDES outfall permit requires weekly, monthly, and quarterly sampling to demonstrate compliance with effluent quality limits. The Laboratory also collects annual water-quality samples at all outfalls. Analytical results are reported to the EPA and the NMED at the end of the monitoring period for each respective outfall category. During 2004, none of the 145 samples collected from the Sanitary Wastewater Systems (SWWS) Plant's outfall exceeded effluent limits; however, two of the 1283 samples collected from industrial outfalls exceeded effluent limits. Monitoring data obtained from sampling at NPDES permitted outfalls is available online at: http://wqdbworld.lanl.gov/.

The following is a summary of the corrective actions taken by the Laboratory during 2004 to address the NPDES outfall permit noncompliances cited above.

TA-3 Sigma Cooling Tower. On November 15, 2004, a total residual chlorine concentration of 0.28 mg/L exceeded the NPDES monthly average and daily maximum permit limit of 0.011 mg/L (counts as two instances of exceedance). The noncompliance was attributed to the following possible causes: (1) matrix interferences in the field analysis of total residual chlorine and (2) an adjacent, leaking pipe that resulted in steam condensate infiltrating into the clay outfall pipe. A chlorine-based biocide is not used at this cooling tower, and the dechlorinator (to neutralize any chlorine in the supply water) was working properly. Investigations could not confirm that the steam condensate was entering the outfall pipe. The current analytical procedure will be revised to include additional procedures to follow when matrix interference is suspected.

b. National Pollutant Discharge Elimination System Sanitary Sewage Sludge Management Program. The Laboratory's WA-Site (TA-46) SWWS Plant is an extended-aeration, activated-sludge sanitary wastewater treatment plant. The activated-sludge treatment process requires periodic disposing of excess sludge (waste-activated sludge) from the plant's clarifiers to synthetically lined drying beds. After air-drying for a minimum of 90 days to reduce pathogens, the dry sludge is first characterized and then disposed of as a New Mexico Special Waste. Monitoring data obtained from routine characterization of SWWS Plant sludge is available online at: http://wqdbworld.lanl.gov/. During 2004, the SWWS Plant generated approximately 33.3 dry tons (66,642 dry lb) of sewage sludge. All of this sludge was disposed of as a New Mexico Special Waste at a landfill authorized to accept this material.

c. National Pollutant Discharge Elimination System Permit Compliance Evaluation Inspection. The NMED Surface Water Quality Bureau did not conduct any NPDES Outfall Compliance Evaluation Inspections in calendar year 2004.

d. National Pollutant Discharge Elimination System Storm Water Construction Program. The NPDES Construction General Permit (CGP) Program regulates storm water discharges from construction activities disturbing one or more acres, including those that are part of a larger common plan of development collectively disturbing one or more acres.

At most construction sites, LANL and the General Contractor apply individually for NPDES CGP coverage and are co-permittees for the site. Compliance with the NPDES CGP includes the development and implementation of a Storm Water Pollution Prevention (SWPP) Plan before soil disturbance begins and site inspections once soil disturbance has been initiated. A SWPP Plan describes the project activities, site conditions, and best management practices required to reduce pollution in storm water discharges and protect endangered or threaten species and critical habitat. Compliance with the NPDES CGP is demonstrated through inspections and reports that document the condition of the site.

During 2004, the Laboratory implemented and maintained 67 SWPP Plans and addendums to SWPP Plans and performed 616 storm water inspections. At the end of 2004, 70% of the Laboratory's permitted sites were compliant with NPDES CGP requirements. The noncompliant sites were primarily those where all soil disturbing activities had ceased, but final vegetative stabilization and/or the removal or maintenance of temporary best management practices were not satisfactorily completed. Corrective actions for the noncompliant sites are scheduled for 2005. Additionally, to reduce future noncompliances, during late 2004 the LANL engineering standards were updated to more accurately reflect storm water requirements, and additional protocols were established to enhance communication with project site owners.

The NPDES CGP Program has also developed a Geographic Information System-based system to manage project information and generate status reports that facilitate Appendix F reporting.

e. National Pollutant Discharge Elimination System Industrial Storm-Water Program. The NPDES Industrial Storm Water Permit Program regulates storm-water discharges from identified industrial activities (including Solid Waste Management Units). UC and the DOE are co-permittees under the NPDES Multi-Sector General Permit 2000 (MSGP-2000) for LANL. The permit requires the development and implementation of SWPP Plans and the monitoring of storm water discharges from permitted sites. In 2004, LANL maintained and implemented 15 SWPP plans for its industrial activities. LANL is currently conducting stream monitoring and storm water monitoring (1) at the confluence of the major canyons, (2) in certain segments of these canyons, and (3) at a number of site-specific facilities. In addition, LANL conducts voluntary monitoring in the major canyons that enter and leave LANL property. The flow-discharge information for the preceding period is reported in Shaull (2004) and in Discharge Monitoring Reports submitted to the EPA and to the NMED.

Compliance with the permit may be achieved primarily in two ways:

First, by identifying potential pollutants that may impact surface water quality and providing controls to limit the impact of those pollutants.

Second, by monitoring storm water runoff which encompasses (1) Laboratory surface waters that receive storm-water runoff should meet state surface-water-quality standards; (2) certain types of industrial sectors found at LANL that require "benchmark parameter monitoring" or "sector-specific monitoring" under the storm water permit; and (3) visually inspecting storm water runoff to assess odor, floating solids, foam, oil sheen, and other indicators of storm water pollution.

The current strategy for implementing the MSGP-2000 at LANL includes developing and implementing the following elements: (1) SWPP plans at 23 industrial activity locations; (2) a Storm-Water Monitoring Plan that provides detail on collecting storm water runoff at watershed-based and site-specific facility gauging stations; and (3) a best management practice installation, inspection, and maintenance program. See also Section C (Current Issues and Actions) regarding the Federal Facilities Compliance Agreement and Administration.

f. National Pollutant Discharge Elimination System Storm-Water Program Inspection. Neither the NMED nor the EPA conducted inspections at MSGP-regulated facilities during 2004.

g. Aboveground Storage Tank Compliance Program. The Laboratory's Aboveground Storage Tank (AST) Compliance Program is responsible for ensuring compliance with the requirements established by the EPA (CWA, 40 CFR, Part 112) and the NMED Petroleum Storage Tank Bureau (PSTB) Regulations (20.5 NMAC). During 2004, the Laboratory was in full compliance with both EPA and NMED requirements.

The Spill Prevention Control and Countermeasures (SPCC) Plan establishes the federal requirements for the AST Compliance Program, as required by the CWA (40 CFR, Part 112, Oil Pollution Prevention Regulations). Comprehensive SPCC Plans are developed to meet EPA requirements that regulate water pollution from oil spills.

On August 15, 2004, the EPA extended deadlines for new regulatory requirements under the federal Clean Water Act (40 CFR, Part 112). New regulations require the Laboratory to modify its SPCC Plans by February 17, 2006. The Laboratory must implement the modifications to the SPCC Plans before August 18, 2006. The primary modifications address AST storage capacity, inspection frequency, and integrity testing requirements. In 2004, the Laboratory developed or modified 14 SPCC Plans to comply with the new regulations. The Laboratory has completed all modifications to existing and new SPCC Plans and has begun to implement those modifications.

On August 15, 2003, the NMED-PSTB implemented new regulations that combined requirements for underground storage tanks and ASTs (20.5 NMAC). The new regulations require the development of Corrosion Prevention Plans and upgrades for AST systems before August 15, 2004. The Laboratory completed these requirements for AST systems before the compliance deadline. In July 2004, the Laboratory paid annual AST registration fees ($100 per AST) to NMED-PSTB.

During 2004, four AST systems were removed from the Laboratory's SPCC Plan list and/or NMED-PSTB registration list. ASTs that were removed are under temporary closure status with NMED-PSTB because they are no longer in service. The Laboratory is in the process of removing and decommissioning these ASTs. Additionally, five new AST systems were added to the Laboratory SPCC Plan list, and of those five, one was added to the NMED-PSTB registration list.

NMED-PSTB conducted AST inspections on April 15, 2004; May 20, 2004; and May 26, 2004, at various facilities at the Laboratory. The NMED cited no violations during these inspections.

On February 21, 2002, the Laboratory notified the EPA, the NMED, and the National Response Center of a discharge of approximately 48,000 gallons of diesel fuel into the environment from the TA-21-57 AST. Soil removal and sampling were performed in accordance with Laboratory, state, and federal regulatory requirements to determine the extent of the leak. The Laboratory completed characterization of the release in December 2003 and is continuing to work with NMED on a path forward for mitigation efforts.

On April 3, 2003, the Laboratory notified the NMED of the discovery of diesel-contaminated soil near the TA-3 Power Plant AST (TA-3-26). The Laboratory completed initial characterization of the diesel-contaminated soil in April 2004 and is continuing to work with NMED on a path forward for mitigation efforts.

h. Dredge and Fill Permit Program. Section 404 of the CWA requires the Laboratory to obtain permits from the US Army Corps of Engineers to perform work within perennial, intermittent, or ephemeral watercourses. Section 401 of the CWA requires states to certify that Section 404 permits issued by the Corps will not prevent attainment of state-mandated stream standards. The NMED reviews Section 404/401 joint permit applications and then issues separate Section 401 certification letters, which may include additional permit requirements to meet state stream standards for individual Laboratory projects. In addition, the Laboratory must comply with 10 CFR 1022, which specifies how DOE sites comply with Executive Order 11988, Floodplain Management, and Executive Order 11990, Protection of Wetlands.

During 2004, one Section 404/401 permit was issued to the Laboratory for the Hillside 137 Erosion Control Project in Los Alamos Canyon. Nationwide Permit No. 43 authorized work conducted by this storm water management and erosion control project. The Laboratory also conducted work under a 2003 Section 404/401 permit, Nationwide Permit No. 33, for the remediation of a drilling fluid release in Two Mile Canyon. In addition, LANL reviewed 582 excavation permits and 135 project profiles (through the

Permits and Requirements Identification System]) for potential impacts to floodplains or wetlands. One Floodplain/Wetland Assessment was prepared in support of NNSA/DOE for publication in the Federal Register.

No violations of the DOE Floodplains/Wetlands Environmental Review Requirements were recorded. The NMED and the Corps of Engineers did not inspect active sites permitted under the Section 404/401 regulations during 2004.

8. Safe Drinking Water Act

Los Alamos County, as owner and operator of the Los Alamos Water Supply System, is responsible for compliance with the requirements of the federal Safe Drinking Water Act (SDWA) and the New Mexico Drinking Water Regulations (NMEIB 2002). The SDWA requires Los Alamos County to collect samples from various points in the water-distribution systems at the Laboratory, Los Alamos County, Bandelier National Monument, and from the water-supply wellheads to demonstrate compliance with SDWA maximum contaminant levels (MCLs). The EPA has established MCLs for microbiological organisms, organic and inorganic constituents, and radioactivity in drinking water. The state has adopted these standards in the New Mexico Drinking Water Regulations. The EPA has authorized the NMED to administer and enforce federal drinking-water regulations and standards in New Mexico. In 2004, the Laboratory conducted additional, confirmation monitoring of the Los Alamos Water Supply System for Quality Assurance purposes. Chapter 5 presents these data.

In 2004, the county and the NMED conducted sampling for microbiological organisms, nitrate+nitrite (as N), radiochemical, total trihalomethanes, and total haloacetic acids in drinking water for SDWA compliance purposes. Results showed no exceedences of SDWA MCLs. More information on the quality of the drinking water from the Los Alamos Water Supply System is in Los Alamos County's annual Consumer Confidence Report, available online at: http://www.lac-nm.us/.

The NMED did not conduct an inspection of the drinking-water system in 2004.

9. Groundwater

a. Groundwater Protection Compliance Issues. DOE Order 450.1 requires the Laboratory to prepare a groundwater protection management program plan to protect groundwater resources in and around the Los Alamos area and ensure that all groundwater-related activities comply with the applicable federal and state regulations. Task III of Module VIII of the RCRA Hazardous Waste Facility Permit, the HSWA Module, requires the Laboratory to collect information about the environmental setting at the facility and to collect data on groundwater contamination.

During 2004, the Laboratory was in compliance with all applicable RCRA groundwater monitoring requirements. Groundwater-monitoring waiver applications for the Laboratory's regulated units were submitted to NMED with the Laboratory's Hazardous Waste Facility permit application in the 1980s and early 1990s. In May 1995, the NMED issued a letter to the Laboratory that indicated that there is insufficient information on the hydrogeologic setting upon which to base approval of the groundwater monitoring waiver demonstrations, and the waiver demonstrations were denied. By letter dated August 17, 1995, NMED required that a site-wide hydrogeologic characterization be completed that would satisfy both the RCRA operating permit and the HSWA module requirements (Section III. A. 1 of the HSWA portion of the RCRA permit requires that the hydrogeologic setting be characterized). Thus, groundwater monitoring requirements for RCRA-regulated units at Los Alamos National Laboratory are held in abeyance until the completion of the site-wide hydrogeologic characterization (NMED letter, August 17, 1995) described in the Hydrogeologic Workplan approved by NMED on May 22, 1998.

The Hydrogeologic Workplan (LANL 1998) was completed in 1997—describing a multiyear drilling and hydrogeologic analysis program to characterize the hydrogeologic setting of the Pajarito Plateau (Figure 2-3). The information from the program will be used to design an adequate monitoring system that could detect releases of groundwater contaminants from waste management operations. The goal of the project is to develop greater understanding of the geology, groundwater flow, and geochemistry beneath the 40-square-mile Laboratory area for monitoring system design and to assess any impacts that Laboratory activities may have had on groundwater quality. A report describing the findings and conclusions of the hydrogeologic characterization program is anticipated to be published in September 2005.

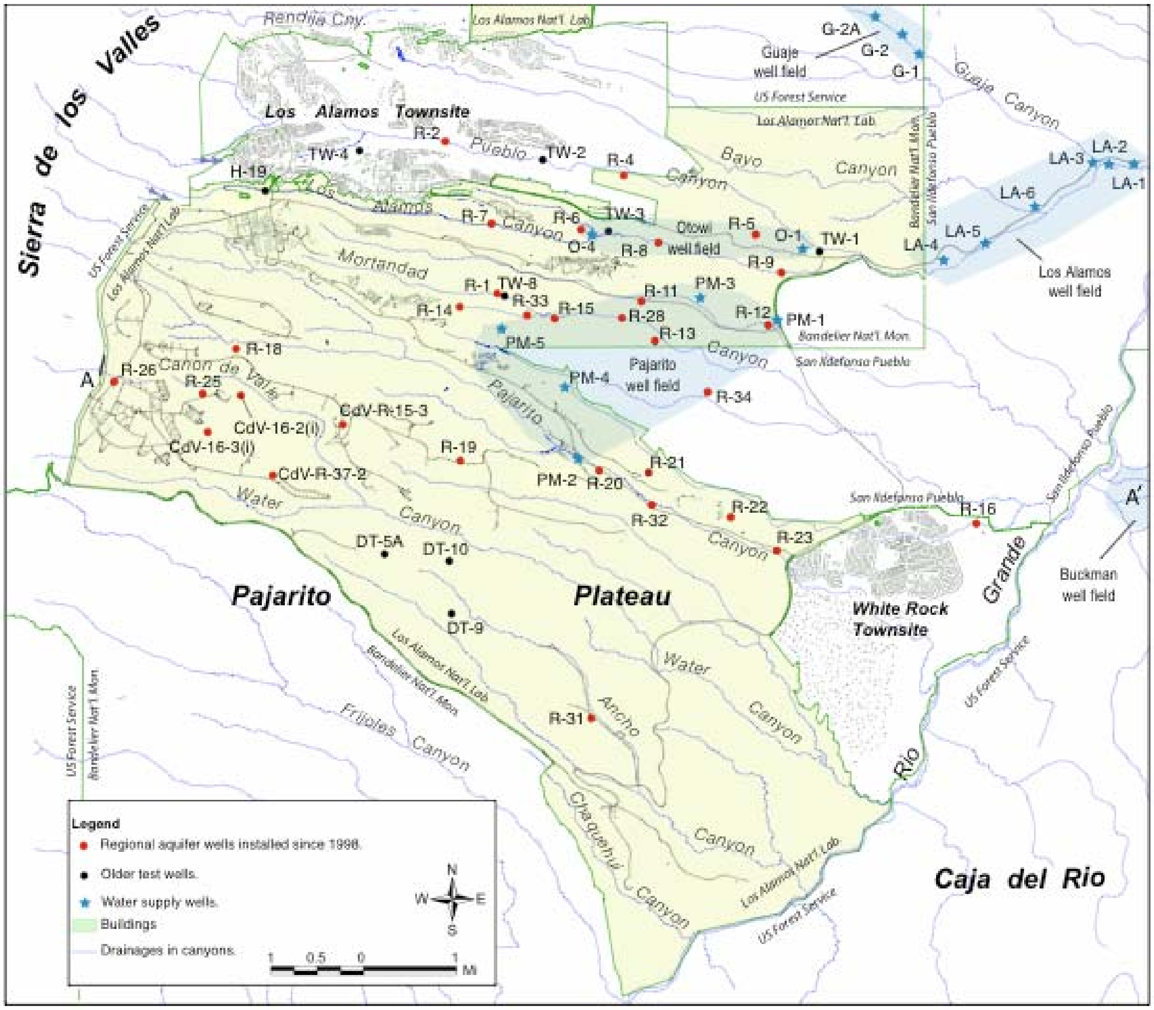


Figure 2-3. Map of hydrogeologic workplan regional aquifer characterization wells. Note that this map shows the LANL boundary from 2003, which is larger only in the northeast corner.

New Mexico Water Quality Control Commission (NMWQCC) regulations control liquid discharges onto or below the ground surface to protect all groundwater in New Mexico. Under the regulations, when required by the NMED, a facility must submit a groundwater discharge plan and obtain NMED approval (or approval from the Oil Conservation Division for energy/mineral-extraction activities). Subsequent discharges must be consistent with the terms and conditions of the discharge plan.

In 2004, the Laboratory had one approved groundwater discharge plan to meet NMWQCC regulations (Table 2-1) for the TA-46 SWWS Plant. On August 27, 2003, the Laboratory submitted a renewal application for the SWWS Plant groundwater discharge plan. Approval was pending by the NMED at the end of 2004. On August 20, 1996, the Laboratory submitted a groundwater discharge plan application for the RLWTF at TA-50. As of December 31, 2004, NMED approval of the plan was still pending.

b. Compliance Activities. As part of the Hydrogeologic Characterization Program, and described in the Hydrogeologic Workplan, 29 hydrogeologic characterization wells have been installed in the regional aquifer and 6 characterization wells in intermediate saturated zones over the past six years, and each of the wells has been sampled. Data collected from these wells have provided new information on the regional aquifer and details of the hydrogeologic conditions. Five characterization wells were completed in 2004.

The characterization wells were drilled using air rotary in the vadose zone and rotary with water, foam or EZ Mud (a polymer) in the saturated zone. Geologic core was collected in the upper vadose zone in some of the wells, and geologic cuttings were collected at defined intervals during the drilling operations and described to record the stratigraphy encountered. Geophysical logging conducted in each well will enhance the understanding of the stratigraphy and rock characteristics. The five characterization wells completed in 2004 include the following:

R-6 and R-6i in DP Canyon,

R-18 in Pajarito Canyon, and

R-33 and R-34 in Mortandad Canyon

R-6 is located in DP Canyon, a tributary in the Los Alamos Canyon watershed. The primary purpose of the well is to serve as an upgradient sentinel well for water supply well Otowi-4. Drilling started in October 2004 and was completed at a total depth of 1,303 ft in November 2004. The regional aquifer water table is at a depth of 1,158 ft in the Older Fanglomerate unit. The well was constructed with a single screen at the water table. R-6i was drilled to characterize an intermediate perched zone encountered while drilling R-6. It has a total depth of 697 ft and was completed with a single screen.

R-18 is located in upper Pajarito Canyon, within TA-14. The primary purpose of the well is to characterize groundwater in the intermediate-depth perched groundwater (if present) and regional groundwater down gradient from several Laboratory technical areas. Drilling started in November 2004 and was completed at a total depth of 1440 ft in December 2004. The regional aquifer water table is at a depth of 1286 ft in the fanglomerates of the Puye Formations. The well was constructed with a single screen at the water table.

R-33 is located in Mortandad Canyon. R-33 will be used to provide sentinel contaminant monitoring for supply well PM-5 along with wells R-14 and R-15. Drilling started in August 2004 and was completed at a total depth of 1140 ft in October 2004. The regional aquifer water table is at a depth of 979 ft in the Puye Formation. The well was constructed with two screens, one at the water table and the second in the Totavi Lentil. Water samples taken from both screens in the well during development did not have detectable levels of nitrate or perchlorate (Longmire and Counce 2005).

R-34 is located in lower Mortandad Canyon, on Pueblo de San Ildefonso lands. The primary purpose of the well is to determine regional aquifer water quality down gradient of the LANL boundary and to establish a regional aquifer monitoring point on Pueblo de San Ildefonso lands. Drilling started in July 2004 and was completed at a total depth of 1065 ft in August 2004. The regional aquifer water table is at a depth of 796 ft in the Puye Formation. The well was constructed with a single screen at the water table.

In addition to the site-wide hydrogeologic characterization, substantial progress was made on the Mortandad Canyon Groundwater Investigation, as described in the Mortandad Canyon Groundwater Work Plan (LANL 2003). In the fall of 2004. the following work was completed:

Six intermediate depth wells (I-1, I-4, I-5, I-6, I-8, and I-10) with about 2,185 ft of core collected for contaminant and moisture profile analysis.

Thirteen alluvial wells (A-1, A-2, A3a-f, A-4, A-5, A-6, A-7, and A-9) with about 410 ft of core collected

Fourteen characterization boreholes (no wells constructed) resulting in 1300 ft of core collected.

Three boreholes (no wells constructed) to evaluate the relationship between the results from the 2002 resistivity survey and the moisture profiles and potential perched groundwater in the upper vadose zone. About 590 ft of core was collected from these boreholes.

Preliminary results from the Mortandad Canyon Groundwater Investigation are (Longmire and Counce 2005):

The new regional well R-33 shows no contamination with respect to nitrate, perchlorate, and tritium based on initial analytical results.

The intermediate wells show concentrations of perchlorate and nitrate that are of similar magnitude or lower than in previously drilled intermediate depth wells.

Recharge to perched saturated zones in Mortandad Canyon probably occurs east of well I-8, based on the lack of contaminants in the initial analytical results.

The Laboratory's "Hydrogeologic Synthesis Report" is expected to be published in September 2005, and it will provide a synthesis of all information on groundwater data collected as part of Hydrogeologic Workplan activities. Additionally, sample, water-level, well-construction, and other programmatic data can be reviewed online on the Laboratory's Water Quality Database (http://wqdbworld.lanl.gov/).

10. National Environmental Policy Act

The following Environmental Impact Statements (EIS), Supplement Analyses (SA), and Environmental Assessments (EA) were prepared or reviewed in 2004.

a. Environmental Impact Statement for the Proposed Chemistry and Metallurgy Research Building Replacement Project. The NNSA issued the Record of Decision for the proposed Chemistry and Metallurgy Research Building (CMR) Replacement Project EIS in the Federal Register on February 12, 2004 (69 FR 6967). NNSA decided to implement the preferred alternative, which is the construction of a new CMR Replacement facility at LANL's TA-55. The new facility would include a single aboveground, consolidated special-nuclear-material-capable, Hazard Category 2 laboratory building (construction option 3) with a separate administrative office and support functions building. The existing CMR building at LANL would be decontaminated, decommissioned, and demolished in its entirety (disposition option 3).

b. Supplement Analysis to the Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory for the Recovery and Storage of Strontium-90 (Sr-90) Fueled Radioisotope Thermal Electric Generators at Los Alamos National Laboratory. This Supplement Analysis (SA) considered if the Site-Wide Environmental Impact Statement for Continued Operations of Los Alamos National Laboratory (SWEIS) (DOE/EIS-0238) adequately addressed the environmental effects of recovery and storage for disposal of six strontium-90 (Sr-90) -fueled radioisotope thermal electric generators at LANL TA-54, Area G. This SA specifically compared key impact assessment parameters of this proposal with the off-site source recovery program evaluated in the SWEIS and a subsequent SA that evaluated a change to the approach of a portion of the recovery program. The NNSA found that the environmental effects of the Proposed Action are adequately bounded by the analyses in the SWEIS.

c. Supplement Analysis to the 1999 Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory for the Proposed Disposition of Certain Large Containment Vessels. This SA considered if the SWEIS adequately addressed the environmental effects of introducing a proposed project for the clean out and decontamination of certain large containment vessels into the CMR Building located at LANL TA-3. This SA specifically evaluated key impact assessment parameters of the proposed project action in support of DOE's long-term hydrodynamic testing program at LANL and the waste disposal capabilities. DOE found that the potential environmental effects of the proposed relocation of the clean out and decontamination of certain large containment vessels, and the associated actinide precipitation capability, to the CMR Building from the Plutonium Facility are bounded by the analyses in the SWEIS.

d. NEPA Compliance Review for Proposed Modifications to the Security Perimeter Project at Los Alamos National Laboratory. This SA evaluated the potential environmental consequences to resources that would result from implementing proposed modifications to the Security Perimeter Project previously analyzed in EA-1429 *Environmental Assessment for Proposed Access Control and Traffic Improvements at Los Alamos National Laboratory, Los Alamos, New Mexico,* and the five other applicable EAs. Specifically, this project proposed vehicle security measures at the intersection of Diamond Drive and Jemez Road within TA-3, and at the intersection of West Jemez Road and NM 4 that would reconfigure both of these intersections. NNSA would also pave and improve a short portion of roadway that is currently unpaved to provide public access to the Pajarito Mountain ski area and Camp May without traversing West Jemez Road. The TA-3 east and west bypass roads and street modifications within TA-3 analyzed in EA-

1429 would not be implemented. The analysis concluded that the consequences would likely be less than previously analyzed and therefore are bounded by EA-1429 and the other applicable EAs.

e. Supplement Analysis to the 1999 Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory for the Proposed Horizontal Expansion of the Restricted Airspace up to 5,000 Feet at Los Alamos National Laboratory. This SA considered if the SWEIS adequately addressed the environmental effects of modifying the restricted airspace boundaries near TA-33 and TA-54 at LANL, or if the SWEIS needed to be supplemented. The SA specifically compared key impact assessment parameters of this proposal with the accident analysis in the SWEIS. The SA concluded that the environmental effects of the Proposed Action were adequately bounded by the analyses in the SWEIS.

f. Supplement Analysis to the 1999 Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory. In mid-2004, NNSA undertook the preparation of a SA for the SWEIS pursuant to the DOE's regulatory requirement to evaluate site-wide NEPA documents at least every 5 years (10 CFR 1021.330) to determine whether the existing EIS remains adequate or whether to prepare a new site-wide EIS or a supplement to the existing EIS. In October 2004, NNSA decided to update and supplement the original LANL SWEIS by preparing a Supplemental SWEIS. This document will consider impacts of proposed new activities, impacts resulting from changes in the environmental setting, and cumulative impacts associated with ongoing activities on-site.

g. Environmental Assessment for Proposed Corrective Measures at Material Disposal Area H within Technical Area 54 at Los Alamos National Laboratory. This EA assesses the potential environmental consequences of implementing three containment corrective measure options and two excavation and removal corrective measure options at MDA H. The DOE-preferred corrective measure was Replacement of the Existing Surface with an Engineered Evapotranspiration Cover. This corrective measure option was recommended for implementation to the State of New Mexico in the CMS Report. The NNSA issued a finding of no significant impact for this EA on June 14, 2004.

h. Environmental Assessment for Proposed Closure of the Airport Landfills within Technical Area 73 at Los Alamos National Laboratory. This EA analyzes the environmental consequences of implementing corrective measures at the airport landfills. The alternatives analyzed include two containment corrective measure options and one excavation and removal corrective measure option.

11. Endangered Species Act

The Endangered Species Act is a federal law that (among other things) requires federal agencies to ensure that agency action is not likely to jeopardize the continued existence of any threatened or endangered species and to consult with the US Fish and Wildlife Service on any prospective action that will likely affect a listed threatened or endangered species.

The Laboratory was in full compliance with the Endangered Species Act during 2004. During 2004, LANL reviewed 582 excavation permits and 135 project profiles (Permits and Requirements Identification System) for potential impacts to threatened or endangered species. LANL prepared Biological Assessments for the following five NNSA/DOE projects in support of informal consultations with the US Fish and Wildlife Service:

Characterizing and Remediating MDAs B and V

Covering the Airport Landfill

Power Grid Infrastructure Upgrade Project

Security Perimeter Project Modifications

TA-33 Bunker 87 Complex Refurbishment

12. Migratory Bird Treaty Act

Under the provisions of the Migratory Bird Treaty Act, it is unlawful "by any means or manner to pursue, hunt, take, capture [or] kill" any migratory birds except as permitted by regulations issued by the

US Fish and Wildlife Service. The unauthorized take of migratory birds is a strict liability criminal offense that does not require knowledge or specific intent on the part of the offender. As such, even when engaged in an otherwise legal activity where the intent is not to kill or injure migratory birds, violations can occur if bird death or injury results. The US Fish and Wildlife Service has enforced the Migratory Bird Treaty Act with discretion, focusing on individuals or organizations that take birds with disregard for the law, particularly where no valid conservation measures have been employed. In doing so, the Service has been able to focus its limited resources on working cooperatively with various industries, agencies and individuals to reduce impacts on migratory birds.

During 2004, a draft Migratory Bird Management Plan was prepared for Laboratory Operations. In addition, best management practices for protecting migratory birds were incorporated into the Laboratory's Job Hazard Analysis Tool.

13. Cultural Resources

The goal of the National Historic Preservation Act is to have federal agencies act as responsible stewards of the nation's resources when their actions affect historic properties. Section 106 of the National Historic Preservation Act requires federal agencies to take into account the effects their projects may have on historic properties and to allow for comment by the Advisory Council on Historic Preservation. The Section 106 regulations outline a project review process that is conducted on a project-by-project basis.

In 2004, the Laboratory conducted 26 projects that required some field verification of previous survey information. In addition to the four new archaeological sites identified this fiscal year, we identified five historic buildings. Although no archaeological sites were determined eligible for the National Register of Historic Places, three historic buildings were determined eligible.

The Laboratory began the third year of a multiyear program of archaeological excavation in support of the Land Conveyance and Transfer project. The DOE/NNSA is in the process of conveying to the County of Los Alamos approximately 2,000 acres of Laboratory lands. Twenty-eight archaeological sites have been excavated during the first three field seasons, with over 150,000 artifacts and 2,000 samples being recovered. Together, these sites provide new insights into past lifeways on the Pajarito Plateau from 5000 B.C. to A.D. 1943. From a compliance perspective, these excavations resolve the anticipated adverse effects to archaeological sites from the future development of lands to be acquired by Los Alamos County. These sites are also ancestral places to the Pueblo people. Therefore representatives from the Pueblos of San Ildefonso and Santa Clara acted as tribal consultants and monitors on the project.

In support of LANL's fiscal year 2004 decontamination and decommissioning program, the Laboratory conducted historic building assessments and other documentation work related to seven proposed projects as required under the provisions of the National Historic Preservation Act (TA-6, "The Hollow" at TA-15, TA-16-370, TA-16-540, TA-21-21, TA-36-22, and TA-69-3). This work included field visits to historic properties (including interior and exterior inspections), digital photography, and architectural documentation (using standard LANL building recording forms). Additional documentation included the production of location maps for each of the evaluated projects. Historical research was also conducted using source materials from the LANL archives and records center, historical photography, the Environmental Characterization and Remediation reading room, and previously conducted oral interviews.

Work in 2004 also included the completion of six reports finalizing several Memoranda of Agreements between the DOE, NNSA, LASO and the New Mexico State Historic Preservation Division related to the demolition of properties at TA-2 (The Omega Reactor), TA-3 (the Sherwood and Scyllac buildings), TA-6, TA-15 (The Hollow), TA-21, and TA-41. These Memoranda Of Agreements contained stipulations to resolve the adverse effects stemming from the demolition of historically significant buildings and structures at LANL. Memoranda Of Agreement documentation measures included the production of archival-quality black and white photographs and the verification and creation, if necessary, of as-built elevations and plan drawings. Maps showing the construction history and current layouts of LANL technical areas were also produced, and detailed histories of the properties and associated technical areas were written as part of the final documentation.

The long-term monitoring program at the ancestral pueblo of Nake'muu continued as part of the Dual-Axis Radiographic Hydrodynamic Test (DARHT) Facility Mitigation Action Plan (LANL 1995). Nake'muu is the only pueblo at LANL that still contains its original standing walls. During the seven-year monitoring program, the site has witnessed a 0.7 percent displacement rate of chinking stones and 0.3

percent displacement of masonry blocks. Statistical analyses indicate that these displacement rates are significantly correlated with annual snowfall, but not with annual rainfall or shots from the DARHT Facility.

Native American consultation is ongoing with respect to the identification and protection of Traditional Cultural Properties, human remains, and sacred objects in compliance with the National Historic Preservation Act of 1966 (as amended) and Native American Graves Protection and Repatriation Act. Work for the Land Conveyance and Transfer project included consultation with San Ildefonso and Santa Clara Pueblos for project monitoring, the development of a Native American Graves Protection and Repatriation Act intentional excavation agreement, identification of potential reburial locations, protection of Traditional Cultural Properties, and student internships. Other projects include the Nake'muu noise vibration study, TA-3 University House Traditional Cultural Properties, and Cerro Grande Rehabilitation project.

C. Current Issues and Actions

1. Federal Facilities Compliance Agreement and Administration

During 2004, the Laboratory entered into negotiations with the EPA and the NMED on the requirements of a Federal Facility Compliance Agreement. The intent of the agreement was to establish a compliance plan for the regulation of storm water discharges from SWMU and AOC point sources at the Laboratory until such time as those sources are regulated by an individual storm water permit issued by EPA pursuant to the NPDES program. The purpose of the compliance program is to provide a schedule to ensure compliance with the NPDES storm water permitting program. The scope of the agreement is limited to providing a compliance program for the regulation of storm water discharges from SWMUs and AOCs at the Laboratory in lieu of the Laboratory's Storm Water Multi-Sector General Permit.

In good faith, the Laboratory began implementing the intent of the Federal Facility Compliance Agreement in 2004 before the completion of negotiations. In 2004, the Laboratory completed the following tasks:

(1) Developed a draft Storm Water Monitoring Plan that describes how the telemetry based network of monitoring stations would be used to implement watershed scale monitoring at the Laboratory;

(2) Developed a draft Storm Water Pollution Prevention Plan for SWMU/AOCs that describes site-specific monitoring and erosion control program at SWMU/AOCs;

(3) Collected 146 storm water samples at (43) monitoring stations and 168 samples at (38) site-specific locations; and

(4) Submitted the first half of the Individual Permit Application for Storm Water Discharges From SWMUs/AOCs to the EPA. The complete permit application is scheduled for submittal in March 2005.

2. New Mexico Hazardous Waste Management Compliance Orders

In February 2004, NMED's Hazardous Waste Bureau issued the UC and the DOE a Compliance Order (04-02) identifying seven alleged violations noted during the 2001 inspection of the Laboratory and included in a subsequent Notice of Violation. The initial penalty assessed was $854,087. DOE and UC timely responded to the compliance order and requested a hearing, admitting two of the alleged violations and denying the remainder. DOE and UC provided information to NMED on the denied violations prior to negotiating a settlement of the compliance order. After reviewing the additional information provided, NMED dismissed four of the disputed claims and the parties agreed to settle the matter for $26,187.

NMED also issued another Compliance Order (04-03 in February 2004) resulting from twenty-one alleged findings during the 2003 inspection and subsequent Notice of Violation. The initial penalty assessed was $1,413, 931. UC and DOE timely responded to the compliance order and requested a hearing, admitting seven of the alleged violations and denying the remainder. DOE and UC provided information to NMED on the denied violations prior to negotiating a settlement of the compliance order. After reviewing the additional information provided, NMED dismissed ten of the disputed claims and the parties agreed to settle the matter for $68,736.

3. Asbestos

In April 2004, the NMED issued a Notice of Violation to KSL Services for a March 3, 2004, incident in which KSL Services removed asbestos flooring at TA-48 RC-1 without appropriate advance notification to the NMED. The original project allowed for the piecemeal removal of walls/floor/ceiling to remove rodent infestation. As the work proceeded, the scope of the job increased and exceeded the regulatory requirements for notification. This change in scope resulted in a failure to make a timely notification to the NMED in writing of the Laboratory's intention to abate asbestos as required by 40 CFR 61 Subpart M. The incident was self reported by project personnel, and LANL and KSL Services took the appropriate action.

D. References

ESP 2004: Environmental Surveillance Program, "Environmental surveillance at Los Alamos during 2002," Los Alamos National Laboratory report LA-14085-ENV (January 2004).

LANL 1995: Dual-Axis Radiographic Hydrodynamic Test Facility Mitigation Plan

LANL 1998: Water Quality & Hydrology Group, "Hydrogeologic Workplan," Final Version, Los Alamos National Laboratory (May 1998).

LANL 2003: Water Quality & Hydrology Group, "Mortandad Canyon groundwater work plan," Los Alamos National Laboratory document LA-UR-03-6221 (August 2003)

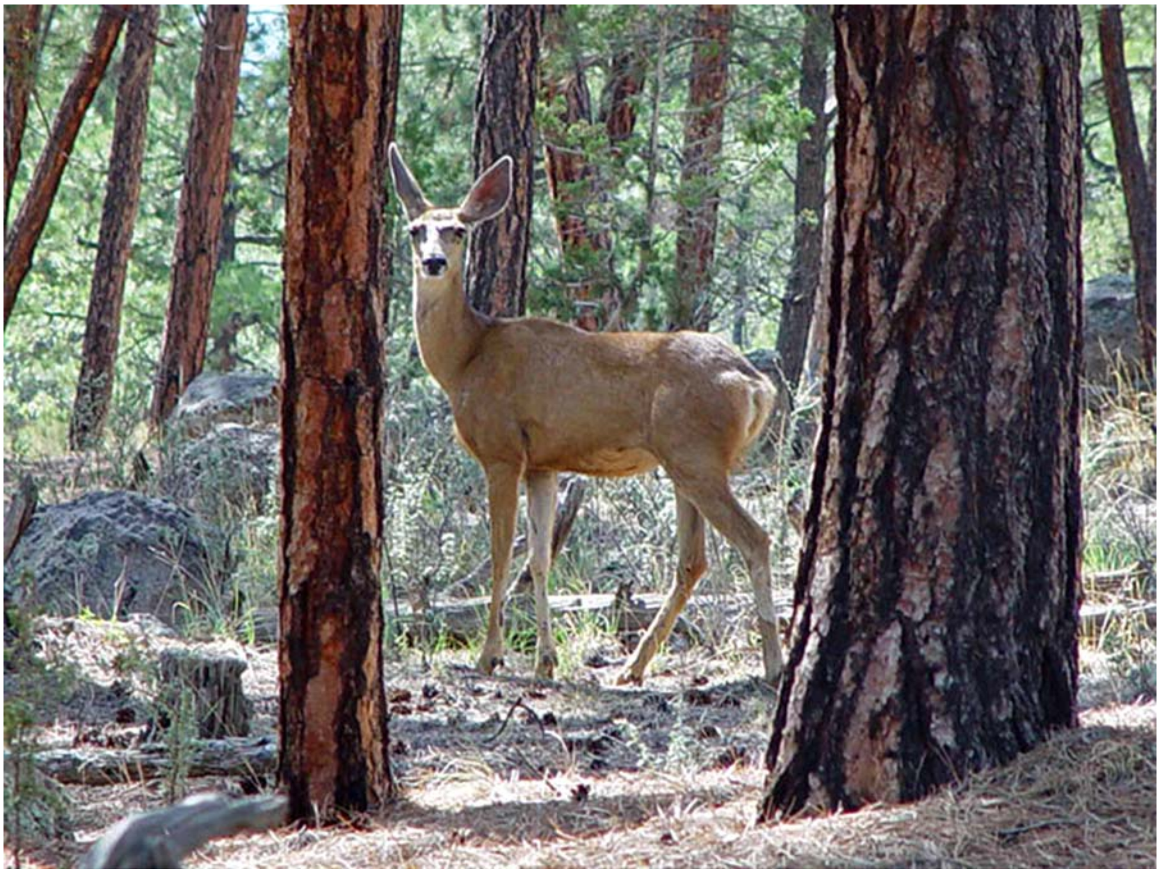
Longmire and Counce 2005: P. Longmire and D. Counce, "Water chemistry results for wells R-1, R-2, R-4, R-11, R-26, and R-28," presentation at Groundwater Protection Program Quarterly Meeting, April 12, 2004, in Pojoaque, NM [Los Alamos National Laboratory document LA-UR-04-2387 (2005)].

Longmire and Counce 2005: P. Longmire and D. Counce, "Progress report on Mortandad Canyon groundwater investigation," presentation at LANL Groundwater Protection Program Quarterly Meeting, February 2, 2005, Santa Fe, NM.

NMEIB 2002: New Mexico Environmental Improvement Board, State of New Mexico, "Drinking water regulations" (as amended through December 2002).

Shaull 2004: D. A. Shaull, "Surface water data at Los Alamos National Laboratory: 2003 water year," Los Alamos National Laboratory report LA-14131-PR (March 2004).

3. Environmental Radiological Dose Assessment



3. Environmental Radiological Dose Assessment

primary authors:
Michael McNaughton, Keith Jacobson, Andrew Green, and William Eisele

To Read About **Turn to Page . . .**

A. Introduction

The purpose of this chapter is to determine if the doses to the public and to biota are below the limits in Department of Energy (DOE) orders. This chapter also provides a measure of the significance of environmental radioactivity in the context of its importance to humans and biota. In this respect, the human dose assessment provides a different perspective from the biota dose assessment. The human dose is received near the publicly accessible boundaries, whereas biota dose is potentially received throughout the interior of the Los Alamos National Laboratory (LANL or the Laboratory), usually at locations rarely visited by humans.

As defined by the DOE Standard (DOE 2002), biota are divided into plants and animals. Plants receive the highest dose because they live their whole lives at one location. Animals range over a wider area, which usually dilutes their dose. Humans receive the lowest dose because they limit their time in areas with residual radioactivity, and they do not eat the vegetation or drink the water in these areas. Therefore, locations with no significant human dose may become significant from the perspective of potential biota dose.

B. Human Dose Assessment

1. Overview of Radiological Dose Equivalents

Radiological dose equivalents presented here are calculated using standard methods. The "effective dose equivalent" referred to here as "dose," is calculated using radiation weighting factors and tissue weighting factors to adjust for the various types of radiation and the various tissues in the body. The final result, measured in mrem, is a measure of the overall risk to an individual, whether from external radiation or contact with radioactive material. For example, 1 mrem of gamma radiation is effectively equivalent to 1 mrem from inhalation of plutonium.

Federal government standards limit the dose that the public may receive from Laboratory operations. The DOE (DOE 1993) public dose limit to any individual is 100 mrem/year received from all pathways (i.e., all ways in which people can be exposed to radiation, such as inhalation, ingestion, and direct radiation). The dose received from airborne emissions of radionuclides is further restricted by the dose standard of the Environmental Protection Agency (EPA) of 10 mrem/year, which is codified in the Code of Federal Regulations (40 CFR 61, EPA 1986). These doses are in addition to exposures from natural background, consumer products, and medical sources. Doses from public water supplies are also limited according to the Clean Water Act, either by established maximum contaminant levels for some radionuclides or by dose (4 mrem/year for man-made radionuclides, beta/photon emitters) (EPA 2000). (See Appendix A.)

2. Public Dose Calculations

a. Scope. The objective of our dose calculations is to report incremental (above-background) doses caused by LANL operations. Therefore, we don't include dose contributions from radionuclides present in our natural environment or from radioactive fallout.

Annual radiation doses to the public are evaluated for three principal exposure pathways: inhalation, ingestion, and direct (or external) radiation. We calculate doses for the following cases:

(1) the entire population within 80 km of the Laboratory;

(2) the maximally exposed individual (MEI) who is not on LANL/DOE property (referred to as the off-site MEI);

(3) the on-site MEI, defined as a member of the public who is on LANL/DOE property, such as Pajarito Road;

(4) residents in Los Alamos and White Rock.

b. General Considerations. We use the standard methods recommended by federal agencies to determine radiation doses (DOE 1988a, 1988b, 1991; EPA 1988, 1993, 1997; and NRC 1977). We begin with measurements and extend these with calculations using the standard methods that are used worldwide.

As we discuss in Section B.4, the dose rate from naturally occurring radioactivity is about 400 mrem/year. It is extremely difficult to measure doses from LANL that are less than 0.1% of natural doses. As the dose rates become smaller, the estimates become less certain and less significant. Generally, we conclude that a dose rate less than 0.1 mrem/year is essentially zero.

i. Direct Radiation Exposure. Direct radiation from gamma photons or neutrons is measured at about 100 locations near LANL (Chapter 4, Section C). Doses above natural background were observed near Technical Area (TA) -54 and TA-18.

To receive a measurable dose, a member of the public must be within a few hundred meters of the source, e.g., on Pajarito Road. At distances more than 1 km, the inverse-square law combined with scattering and attenuation or shielding in the air reduces the dose to much less than 0.1 mrem/year, which cannot be distinguished from natural background radiation. In practice, this means the only significant doses from direct radiation are near TA-54 (Section B.3.b of this chapter) and near TA-18 (Section B.3.c).

To estimate the dose to the public, we combine the measurements of gamma and neutron dose with an occupancy factor. The measurements reported in Chapter 4 would apply to an individual who is at the particular location continuously, i.e., 24 hours/day and 365 days/year. We follow standard guidance and assume continuous occupancy for residences and places of business. For all other locations, we multiply the measured dose by an occupancy factor of 1/16 (NCRP 1976).

ii. Airborne Radioactivity (Inhalation Pathway). At distances more than a few hundred meters from LANL sources, the dose to the public is almost entirely from airborne radioactive material. Whenever possible, we use the direct measurements of airborne radioactivity concentrations measured by AIRNET and reported in Chapter 4, Section A. Where local concentrations are too small to measure, we calculate the doses using the standard model CAP88, an atmospheric dispersion and dose calculation computer code that combines source-term information with meteorological data to estimate where the released radioactive material went.

Some of the nuclide emissions from the Los Alamos Neutron Science Center (LANSCE) are not measured by AIRNET. These are measured at the stacks (Chapter 4, Section B), and the resulting doses are calculated by CAP88 (Chapter 3, Section B.3.b). Because the radioactive half-lives are short, these doses decrease steeply with distance; e.g., the annual dose is approximately 1.52 mrem at East Gate from LANSCE, 1 km to the north of LANSCE, and is 0.007 mrem at a location in Los Alamos 5 km to the west-northwest.

iii. Water (Ingestion Pathway). The majority of radionuclides detected in ground water samples collected from potential drinking water sources (e.g., Los Alamos County water supply wells, the regional aquifer, and springs) during 2004 resulted from the presence of natural radioactivity in ground water sources. These radionuclides include natural uranium and its decay products such as Ra-226. The only radionuclide detected in ground water samples that could possibly be attributed to Laboratory operations was tritium. The highest concentration of tritium (303 pCi/L) was measured in a sample from a regional aquifer test well which is not used for drinking water supply. This concentration is far below the federal community drinking water standard of 20,000 pCi/L and would thus result in a dose less than 0.1 mrem/year. Certain springs in White Rock Canyon that are supplied by the regional aquifer showed tritium concentrations approaching 10 pCi/L which is less than levels of tritium in rain water (about 30 pCi/L; Holloway 1993). The dose received from using these springs as the sole source of drinking water would be much less than 0.01 mrem per year.

In 2004, stream flow was intermittent and there were no realistic means for members of the public to regularly ingest surface waters containing radionuclides associated with Laboratory operations. Those surface waters that contained concentrations of radionuclides above applicable standards resulted from storm runoff and contained levels of sediment that would make these waters unsuitable for drinking water purposes. These surface waters would have only been available anywhere from 1% to 11% of the time during calendar year 2004, were generally present only on Laboratory property, and would have required ingesting at least 70 liters of this turbid and sediment-ladened water to receive a dose greater than 0.1 mrem.

iv. Soil (Direct Exposure Pathway). We report measurements of radionuclide concentrations in surface soil in Chapter 7. As described in Chapter 7, Section C.1., soil samples were collected on the perimeter of Pueblo de San Ildefonso land downwind of Area G. Some samples had radionuclide concentrations above the RSRLs (Regional Statistical Reference Levels), specifically U-234, U-235, and U-238 at the Tsankawi/PM-1 sample location and Pu-238 and Pu-239,240 at the Pueblo de San Ildefonso sample site. (RSRLs represent background concentrations plus three standard deviations in media such as soil, sediments, and crops collected or harvested in regional areas far from the influence of the Laboratory averaged over a period of five years.) However, the resulting dose from soil (from external gamma exposure, dust inhalation, and soil ingestion) at either sample location would be much less than 0.1 mrem/year. As the Sr-90 and Cs-137 soil concentrations at both sample locations are much less than the RSRLs for both radionuclides, it is reasonable to state that all or almost all are from global fallout and not from LANL. The tritium is mainly from three sources: cosmic rays, nuclear weapons testing, and LANL; however, the dose from tritium in soil is virtually nonexistent at both sample sites. Similarly, the transuranics may include a small contribution from LANL, but the dose is much less than 0.01 mrem/year. Finally, the isotopic mixture of uranium is consistent with natural uranium. In summary, we conclude that the LANL contribution to dose from soil is too small to measure and is much less than 0.1 mrem/year.

v. Food (Ingestion Pathway). We report measurements of the radioactive content of foods in Chapter 8. For the most part, the results are similar to those reported in previous years. Of those radionuclide concentrations that were detected in fruits, vegetables, and grains collected, almost all were below the RSRLs. With the exception described below, the concentrations are consistent with global fallout and the presence of naturally occurring uranium in soil or are insignificant when compared with counting uncertainties.

Of those radionuclide concentrations that were found to be above the RSRLs, three samples (two of purslane and one of wild spinach) collected from Pueblo de San Ildefonso lands in Mortandad Canyon were higher compared with historical levels. Refer to Supplemental Table S8-3 for specific radionuclide concentration values. Taking into account these radionuclide concentrations and other radionuclides measured in these samples and those radionuclides measured in a third sample of acorns that were below the RSRLs, the total dose received from consuming a pound each of purslane, spinach, and acorns would be much less than 0.1 mrem. Further study of wild foodstuffs in this particular area will be pursued as stated in Section A.6.b. of Chapter 8.

We conclude that the LANL contribution to the dose from consuming foodstuffs is too small to measure and much less than 0.1 mrem/year.

vi. Release of Items. The Laboratory releases miscellaneous surplus items of salvageable office and scientific equipment to the general public. The requirements for release of such items are found in Laboratory Implementation Requirement LIR-402-700-01.2, "Occupational Radiation Protection Requirements, Chapter 14, Part 3. Releasing Items." In keeping with the principle of maintaining radiation dose levels to "As Low as Reasonably Achievable," it is a Laboratory goal to not knowingly release any items with residual radioactivity. According to the best of our knowledge, there is no additional dose to the general public through the release of items for uncontrolled use by the general public.

3. Dose Calculations and Results

a. Population within 80 Kilometers. We used the local population distribution to calculate the dose from Laboratory operations during 2004 to the population within 80 km (50 miles) of LANL. Approximately 280,000 persons live within an 80-km radius of the Laboratory. We used county population estimates provided by the University of New Mexico Bureau of Business and Economic Research. These statistics are available at http://www.unm.edu/~bber/.

The collective dose from Laboratory operations is the sum of the estimated doses for each member of the public within an 80-km radius of LANL; for example, if two persons each receive 3 mrem, the collective dose is 6 person-mrem. This dose results from airborne radioactive emissions; other potential sources, such as direct radiation, are essentially zero. We calculated the collective dose by modeling the transport of radioactive air emissions using CAP88.

The 2004 collective population dose attributable to Laboratory operations to persons living within 80 km of the Laboratory was 0.90 person-rem, which compares with 0.88 person-rem reported for 2003. Tritium contributed about 45% of the dose, and short-lived air activation products such as C-11, N-13, and O-15 from LANSCE contributed about 53%.

No observable health effect is expected from these doses.

Population doses for the past 12 years have declined from a high of about 4 person-rem in 1994 to less than 1 person-rem in 2004 (Figure 3-1). LANSCE is the major contributor to the population dose. Generally, the year-to-year fluctuations are the result of variations in the number of hours that LANSCE runs, whereas the overall downward trend is the result of efforts to reduce the LANSCE emissions by installing delay lines and fixing small leaks.

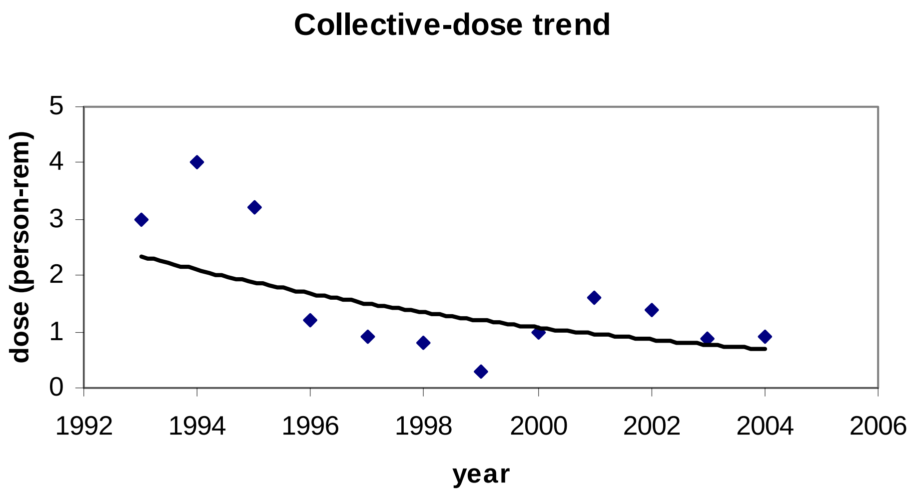


Figure 3-1. Trend of collective dose (person-rem) to the population within 80 km of LANL.

b. Off-Site Maximally Exposed Individual. The off-site MEI is a hypothetical member of the public who, while not on DOE/LANL property, received the greatest dose from LANL operations. During 2004, there were two potential MEI locations: one location was at East Gate along State Road 502 entering the east side of Los Alamos County; the other is the boundary between LANL TA-54 and the Pueblo de San Ildefonso Sacred Area, north of Area G.

East Gate is normally the location of greatest exposure because of its proximity to LANSCE. During LANSCE operations, short-lived positron emitters, such as C-11, N-13, and O-15, are released from the stacks and diffuse from the buildings. These emitters release photon radiation as they decay, producing a potential radiation dose. We modeled the dose from LANSCE and from the LANL stacks using CAP88, an atmospheric dispersion and dose calculation computer code. The CAP88-modeled doses (Jacobson 2005) were approximately 1.52 mrem from LANSCE and 0.12 mrem from other LANL stacks and diffuse emissions sources. We added 0.04 mrem from the radionuclides measured at the AIRNET station, though this dose is primarily from tritium, most of which was in the CAP-88 modeled doses. Thus, the total dose at East Gate was approximately 1.68 mrem.

The second location is the boundary of the Pueblo de San Ildefonso Sacred Area north of Area G. Transuranic waste at Area G awaiting shipment to the Waste Isolation Pilot Plant emits neutrons. The measured neutron dose at the boundary was 16 mrem. After subtracting a 2-mrem neutron background value and applying the standard occupancy factor of 1/16 (NCRP 1976), the individual neutron dose is 14/16 = 0.875 mrem. (A gamma photon dose is not calculated for this location because the low-energy photons emitted from the transuranic waste are absorbed in the intervening air layer between Area G and the Sacred Area.) To estimate the contributions from airborne radionuclides at this location, we calculated the dose from the LANL stacks: 0.040 mrem/16 = 0.003 mrem. We then added the maximum dose measured by the AIRNET stations along the northern boundary of Area G, 0.18 mrem, and applied the occupancy factor of 1/16 to obtain a dose of 0.011 mrem. Thus, we conclude that the MEI dose at this location was 0.89 mrem, which is less than the MEI dose at East Gate.

The off-site MEI dose, 1.68 mrem, is far below the currently applicable standards; based on previous studies, we conclude it causes no observable health effects.

The off-site MEI dose for the past 12 years has declined from a high of nearly 8 mrem in 1994 to less than 2 mrem in 2004 (Figure 3-2). LANSCE is the major contributor to the MEI dose. Generally, the year-to-year fluctuations are the result of variations in the number of hours that LANSCE runs, whereas the overall downward trend is the result of efforts to reduce the LANSCE emissions by installing delay lines and fixing small leaks. In comparison, the total annual dose from sources other than LANL is approximately 300–500 mrem.

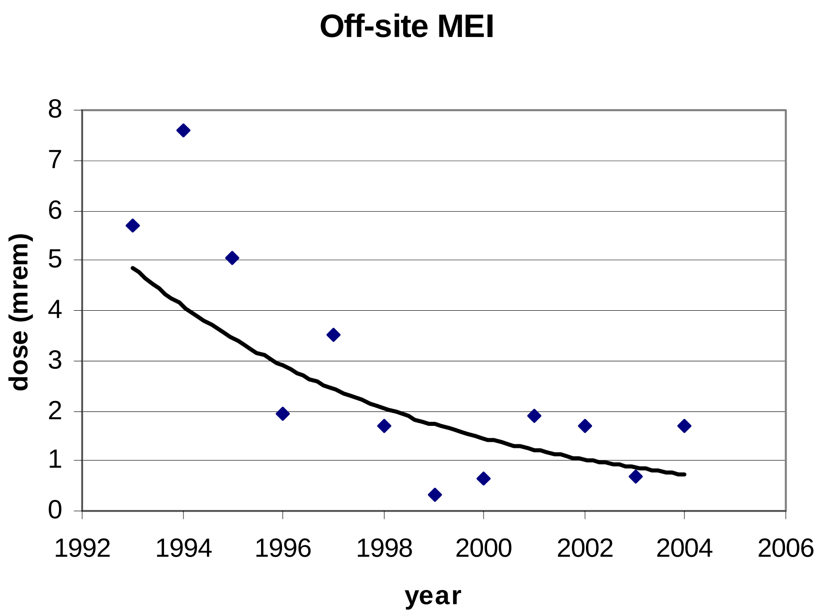


Figure 3-2. Trend of dose (mrem) to the maximally exposed individual off-site.

c. On-Site Maximally Exposed Individual. The on-site MEI is a member of the public on Pajarito Road who passes LANL TA-18.

Dosimeters that are sensitive to neutron and gamma photon radiation are located on Pajarito Road. We collected data continuously throughout 2004 (Chapter 4, Section C), and these data allow us to calculate doses that might have been received by members of the public. The measured neutron dose was 21 mrem (during 24 hours a day and 365 days a year). A 2-mrem neutron background value is subtracted from the measured value to provide the background-corrected neutron dose of 19 mrem. We then apply a gamma photon correction factor of 1.05 to provide a neutron plus gamma dose of 20 mrem. Following the guidance of the NCRP (NCRP 1976), we multiplied this total by1/16 to account for occupancy. This calculation indicates a dose of 1.25 mrem to a member of the public on Pajarito Road during 2004 derived from the dosimeter measurements.

In addition, we calculate a single event dose from operation of one of the critical assemblies within TA-18. This calculation indicates a neutron plus gamma dose of 1.75 mrem to a member of the public on Pajarito Road who would be present during the single event operation of the assembly.

We then select the higher of the two doses to represent the on-site MEI dose attributable to direct radiation, which would be 1.75 mrem. All other pathways at the Pajarito Road Location, including CAP88 calculations for the air pathway, add less than 0.1 mrem to the calculated direct radiation dose, taking intermittent occupancy into account. Because we assume that the member of the public is a resident of Los

Alamos, we also add the Los Alamos resident dose of 0.04 mrem (refer to section 3.d.i below) to the 1.75 mrem on-site MEI direct radiation dose, resulting in a total dose of 1.79 mrem. This dose is approximately 1.8% of the DOE public all-pathway dose limit of 100 mrem.

d. Doses in Los Alamos and White Rock. We used background-corrected AIRNET data (reported in Chapter 4, Section A) to calculate an annual dose at each of the AIRNET stations for the two collections of perimeter stations that represent the Los Alamos resident and the White Rock resident. The measured AIRNET concentrations were converted to doses using the factors in EPA 1986. To these doses, we added the dose contributions from LANSCE, calculated using CAP88 for these Los Alamos and White Rock perimeter AIRNET station locations. The summed AIRNET and CAP88 doses for the Los Alamos stations and the White Rock stations were then averaged to provide the representative Los Alamos resident and the White Rock resident air pathway doses.

i. Los Alamos. During 2004, the measurable contributions to the dose at an average Los Alamos residence were 0.02 mrem from tritium and 0.01 mrem from LANSCE. Other radionuclides each contribute less than 0.01 mrem, amounting to a total of 0.04 mrem.

ii. White Rock. During 2004, the measurable contributions to the dose at an average White Rock residence were 0.01 mrem from tritium and 0.01 mrem from LANSCE. Other radionuclides each contribute less than 0.01 mrem, amounting to a total of 0.03 mrem.

The contributions from direct radiation, food, water, and soil are discussed in Chapter 3, Section B.2; each was too small to measure. In summary, the total annual dose to an average resident from all pathways was less than 0.1 mrem. No observable health effect is expected from these doses.

4. Estimation of Radiation Dose Equivalents for Naturally Occurring Radiation

In this section, we discuss the LANL contribution relative to natural radiation and radioactive materials in the environment (NCRP 1975, 1987a, 1987b).

External radiation comes from two sources that are approximately equal: cosmic radiation from space and terrestrial gamma radiation from radionuclides naturally in the environment. Doses from cosmic radiation range from 50 mrem/year at lower elevations near the Rio Grande to about 90 mrem/year in the mountains. Doses from terrestrial radiation range from about 50 to 150 mrem/year depending on the amounts of natural uranium, thorium, and potassium in the soil.

The largest dose from radioactive material is from the inhalation of naturally occurring radon and its decay products, which contribute about 200 mrem/year. An additional 40 mrem/year results from naturally occurring radioactive materials in the body, primarily K-40, which is present in all food and in all living cells.

In addition, members of the US population receive an average dose of 50 mrem/year from medical and dental uses of radiation, 10 mrem/year from man-made products such as stone or adobe walls, and less than 1 mrem/year from global fallout from nuclear-weapons tests (NCRP 1987a). Therefore, the total annual dose from sources other than LANL is approximately 300–500 mrem. The estimated LANL-attributable 2004 dose to the MEI (on-site), 1.79 mrem, is less than 1% of this dose.

5. Effect to an Individual from Laboratory Operations

Health effects from radiation exposure have been observed in humans at doses in excess of 10 rem (10,000 mrem). However, doses to the public from LANL operations are much smaller. According to the 1996 Position Statement of the Health Physics Society (HPS 1996), “Below 10 rem, risks of health effects are either too small to be observed or are nonexistent.” Therefore, the doses reported here are not expected to cause observable health effects.

C. Biota Dose Assessment

1. Biota Dose Assessment Approach

a. Overview. The biota-dose-assessment methods are described in detail in the DOE Standard (DOE 2002) and in the computer program RESRAD-BIOTA (http://web.ead.anl.gov/resrad/home2/biota.cfm). Because the calculations apply to all types of biota and all types of ecosystems, the DOE methods are general in nature and allow specific parameters to be adjusted according to local conditions. The site-specific methods used at LANL are discussed in detail in the Biota Dose Assessment Quality Assurance

Project Plan, ENV-MAQ-BIOTA, and McNaughton 2005 describes in detail the application of these methods to specific locations at LANL.

It is not possible to assess the dose to every animal and every plant at LANL. Therefore, following the guidance of the DOE Standard (DOE 2002) and the ENV-ECR group (LANL 2004, LA-UR-04-8246), we calculate the dose to selected plants and animals. Trees of the pine family (pinaceae) are representatives for plants because they are radiosensitive (UNSCEAR 1996) and because their deep roots tap into buried contamination (Foxx 1984a, b; Tierney 1987). Deer mice are representatives for animals because of their relatively small home range, which means the maximally exposed mouse spends a large fraction of its time in the most contaminated location. These plants and animals are common and widespread at LANL and in the region.

b. Biota Dose Limits. The DOE biota dose limits (DOE 2002) are applied to biota populations rather than to individual plants and animals as it is the goal of DOE to protect populations, especially with respect to preventing the impairment of reproductive capability within the population. For animals, we use the population area for deer mice: 3 ha (30,000 m2) (Ryti 2004; LANL 2004). We also average the dose to plants over this same area.

The DOE dose limits to biota populations are:

- Terrestrial animals: 100 mrad/day
- Terrestrial plants: 1,000 mrad/day
- Aquatic animals: 1,000 mrad/day

c. Methods. To ensure that the assessment is comprehensive, it begins with an initial screening (DOE 2002) that compares the maximum radionuclide concentrations in soil, sediment, and water with the DOE "Biota Concentration Guides" (BCGs). The BCGs are only the first step. The DOE Standard (DOE 2002) states: "An important point is that exceeding the BCGs should not force a mandatory decision regarding remediation of the evaluation area, but rather is an indication that further investigation is likely necessary." If the BCGs are exceeded, a site-specific assessment is conducted that uses average concentrations and incorporates site-specific bioaccumulation factors.

We have applied the initial screening to every location affected by radionuclides from present or past LANL operations, including the Material Disposal Areas (MDAs). However, following the guidance of the DOE Standard (DOE 2002), we have not included external-radiation dose from experimental facilities such as the Dual Axis Radiographic HydroTest facility and LANSCE.

For the MDAs, the biota dose cannot easily be calculated from the soil concentrations for three reasons: the radioactive material is unevenly distributed, it is packaged, and it is buried. It is unevenly distributed because of the variety of items. It is packaged, usually in a form that is relatively inaccessible to biota, in order to protect the health of the workers transporting the waste to the burial site. And most of the waste is buried below the depths usually accessed by biota. In some cases, the pits or shafts are protected by a biological barrier such as concrete. Therefore, at some of the MDAs, the biota doses are essentially zero.

According to the best available data, 14 locations failed the initial screening. Therefore, as required by the DOE Standard, each of these locations was subjected to a site-specific assessment using RESRAD-BIOTA (http://web.ead.anl.gov/resrad/home2/biota.cfm).

The bioaccumulation factor for Cs-137 in terrestrial biota is between 0.01 and 0.1 (Bennett 1996; Fresquez 1997a and b, 1998, 2000a, b, and c; Hakonson 1973, 1975, and 1976; and White 1981). Thus, the Cs-137 dose is almost entirely external dose, which is calculated using the DOE external dose conversion factor.

For Sr-90, the bioaccumulation factor in terrestrial biota is between 0.1 and 1 (Fresquez 1997a, 1998, 2000a, b, and c). We assume it is equal to 1, which implies the internal and external doses are the same. Therefore, the Sr-90 dose is obtained from the dose conversion factor in the DOE Standard (DOE 2002, Module 3, Table 2.3 or Table 2.4) multiplied by the concentration in the soil or the concentration in the plant, whichever is greater.

2. Biota Dose Results

A site-specific assessment was performed on each of the locations that failed the initial screening. The assessments are described in detail in McNaughton 2005 and are summarized in each section below and in Table 3-1.

The background dose from naturally occurring radioactive material is 2 to 10 mrad/day and has not been included. Doses less than 0.5 mrad/day are listed as zero.

TA-5, Mortandad Canyon. Mortandad Canyon received radioactive liquid waste from several technical areas, beginning in the 1950s with waste from TA-35 and continuing today with waste from TA-50. Mortandad Canyon tributaries include Pratt Canyon and Effluent Canyon. Pratt Canyon is included in the TA-35 section of this report, and the aquatic environment of Effluent Canyon is in the TA-50 section.

Mortandad Canyon has been studied extensively (Hakonson 1973, 1975, and 1976; Miera 1977; White 1981; Nyhan 1978 and 1982; Bennett 1996; LANL 1997; and Reneau 2003). The part of Mortandad Canyon that fails the initial screening extends about 3 km from the TA-50 outfall to Mortandad Canyon Observation Well MCO-8.2 in TA-5. Near the TA-50 outfall (reach M2), the radionuclide concentrations are higher and the canyon is narrower. In the middle reaches (M3 and M4), the concentrations are lower and the canyon is wider. When the concentrations are averaged over the standard population area of 3 ha, the resulting population doses for M2, M3, and M4 are all similar and amount to less than 10 mrad/day for both plants and animals (Table 3-1).

The predominant radionuclide in Mortandad Canyon is Cs-137, which contributes about 5 mrad/day. Sr-90, tritium, and the transuranics each contribute about 1 mrad/day, and uranium contributes much less than 1 mrad/day.

In 2005, Mortandad Canyon biota will be studied further. Meanwhile, the biota dose in Mortandad Canyon is estimated to be below the DOE limits for plant and animal populations (Table 3-1).

TA-10, Bayo Canyon. Bayo Canyon was the site of TA-10, which was contaminated during the radioactive lanthanum project during the 1940s and 1950s. TA-10 was decommissioned in 1963, and the land was transferred to Los Alamos County in 1967.

From the perspective of biota dose, the only significant contamination is in an area of about 0.1 ha that is part of solid waste management unit (SWMU) 10-002(a)-99. In this location, residual Sr-90 is being brought to the surface through plant roots (Fresquez 1995; LANL 1997). Averaged over 3 ha, the biota concentrations are less than 10 pCi/g, and population doses to animals and plants are essentially zero (Table 3-1).

TA-15, EF Site. U-238 is widespread at LANL; it is present at most firing sites and buried in most disposal pits. The aerial surveys (EGG 1989; DOE 1998) demonstrate that the firing site with the highest concentration is EF Site (SWMU 15-004(f)-99). It contains about half the U-238 dispersed in explosive tests at LANL (Becker 1992; LANL 1998). Therefore, EF Site represents the worst case for U-238.

The U-238 concentration at the firing point is 1,000 to 2,000 pCi/g and decreases to about 200 pCi/g at 50 m from the firing point (Hanson 1976, 1977, and 1978; White 1979 and 1980). The average concentration over 3 ha is 300 pCi/g, which results in a population dose of about 20 mrad/day to both plants and animals. Thus, the biota dose from uranium at EF Site is 20% of the limit for animals and 2% of the limit for plants (Table 3-1). Because EF Site is the worst case, this assessment indicates the biota doses do not exceed the DOE limits at other LANL locations with uranium.

TA-21, Material Disposal Area, MDA A. MDA A was established in 1945 to collect plutonium that could not be recovered with the technology of the time. The plutonium is in sealed steel tanks that are isolated from biota, so the biota dose from the tanks is zero. The surrounding soil contains about 30 pCi/g of transuranics (Rogers 1977; LANL 1991), which causes a population dose of about 1 mrad/day to plants and less to animals. Therefore, we conclude the doses to plants and animals at MDA A are less than 1% of the DOE limits (Table 3-1).

TA-21, Material Disposal Area, MDA B. MDA B, established in 1944, is a 2.4-ha area south of and parallel to DP Road. The contents are not well known (Rogers 1977; LANL 1991), but based on existing measurements in biota (Wenzel 1987), we estimate the population doses are about 50 mrad/day to plants and 20 mrad/day to animals, mostly from transuranics brought to the surface by deep-rooted plants.

TA-21, Material Disposal Area, MDA T. MDA T was established in 1945 to receive liquid effluent from the liquid-waste-treatment facilities located in buildings TA-21-35 and TA-21-257. The earliest disposal method used absorption beds, 1.2 m deep, that are now covered with 1.8 m of crushed tuff. Later, the effluent was disposed of in shafts covered with 0.6 m of concrete and 1.2 m of tuff (Rogers 1977; Nyhan 1984 and 1985; LANL 1991). Thus, the radioactive material is partly but not completely isolated from biota.

Based on biota measurements (LANL 1991), we estimate the population dose is about 10 mrad/day to both plants and animals, mostly from Am-241, with small contributions from Pu-239, Cs-137, and Sr-90.

TA-21, DP Canyon. DP Canyon, north of TA-21, is a tributary of Los Alamos Canyon. It was contaminated more than 20 years ago, primarily by the outfall from TA-21-257 at SWMU 21-011(k) (Hakonson 1973; Miera 1977 and 1978; Rogers 1977; LANL 1991, 1995, and 2003). Since that time, the location was remediated in 1996 and again in 2003 (LANL 2003). The data demonstrate that the population dose to both plants and animals is about 2 mrad/day, mostly from Cs-137. These amounts are 2% or less of the DOE limits.

TA-35, Material Disposal Area, MDA W. MDA W is the burial site of two stainless-steel tubes from the LAMPRE-1 reactor (LANL 1990). The steel tubes are encased in a vault of 0.2-m-thick concrete. The area will be investigated in 2005 to ensure that the vault is secure. Meanwhile, pending these results, we conclude the radioactive material is isolated from biota, and therefore the biota dose is zero.

TA-35, Pratt Canyon. Pratt Canyon was contaminated between 1951 and 1963, primarily with 0.2 Ci of Sr-90 from a liquid-waste treatment facility east of building TA-21-2 (LANL 1992 and 1997a; Jarmer 1997). A douglas fir and a clump of gambel oaks contain about 3,000 pCi/g of Sr-90, which causes about 350 mrad/day to these trees. The area of contamination is small, however. Averaging over 3 ha, the population dose is about 1 mrad/day to both animals and plants (Table 3-1).

TA-49, Material Disposal Area, MDA AB. MDA AB was used for a series of underground weapon safety tests in 1962. Almost all the radioactive material is 30 m below the surface and is not accessible to biota (LANL 1990). At the surface, there is some Pu-239 with concentrations up to 5 pCi/g, which is the result of human actions such as drilling (Purtymun 1987; Hansen 1980; Soholt 1990). The resulting individual doses are less than 1 mrad/day, and the population doses are essentially zero.

TA-50, Aquatic Environment and Effluent Canyon. The Radioactive Liquid Waste Treatment Facility at TA-50 discharges treated liquid waste through a permitted outfall into Effluent Canyon, north of building TA-50-1. Table 6-2 in Chapter 6 lists the concentrations of radionuclides in the water.

The stream is less than a meter wide and flows for about 1–2 km before the streambed dries up. Animals such as deer and elk drink the water and insect larvae live in the water, but terrestrial animals do not obtain a significant fraction of their diet from aquatic animals in the stream.

At LANL, the bioaccumulation factor for Cs-137 in soil is between 0.01 and 0.1 (Hakonson 1973; Fresquez 1997a and b, 1998, 2000a, b, and c), but it has not been measured in water. For this preliminary site-specific assessment, we used the Cs-137 bioaccumulation factor of 100, which is the value for daphnia, a surrogate for aquatic animals on-site (Baker 1992). Using this value, the dose is 5 mrad/day to terrestrial animals and 85 mrad/day to aquatic animals. These values are less than 10% of the DOE limit.

TA-50, Terrestrial Environment and MDA C. The contamination at the head of Ten-Site Canyon resulted from a 1974 radioactive-liquid-waste spill that spread a few hundred meters east of TA-50-1 (Emility 1996). The environmental restoration database shows one soil sample with a decay-corrected Sr-90 concentration of 45 pCi/g. The maximum dose at this location to an individual plant is 1 mrad/day, and the maximum to an individual animal is less than 1 mrad/day.

The TA-50 population area includes MDA C, which is a 5-ha area containing disposal pits and shafts dating from 1948 (Rogers 1977). Gross-alpha data (Neptune 2003) indicate that two pine trees penetrated radioactive material, but the specific radionuclide was not identified, and the trees have been removed. Assuming the radionuclide was Pu-239, the population dose was about 40 mrad/day to the trees and 10 mrad/day to animals (Table 3-1). These doses are less than 10% of the DOE limits.

TA-54, Material Disposal Area, MDA G. MDA G is the largest material disposal area at LANL and the only one still in use for radioactive material. Most of the radioactive material is stored in sealed drums that exclude contact with plants or animals.

The underground radioactive material available to biota can be deduced from the biota measurements (Gonzales 2000; Bennett 2002; Nyhan 2002 and 2004; Soholt 2003; Budd 2004; and Fresquez 2003, 2004a, 2004b, 2005). For example, Gonzales and Budd (Gonzales 2000 and Budd 2004) measured a tritium concentration of 522,000 pCi/mL in plants above the tritium shafts near the south fence of MDA G. This measurement implies a similar concentration of tritium underground. Also, Fresquez (LA-14181-PR, 2004b) measured 83,000 pCi/mL in trees adjacent to the shafts. Averaging over 3 ha, we estimate the population dose from tritium is 3 mrad/day to plants and 1 mrad/day to animals.

In another location, Fresquez (LA-14193-MS, 2005) measured 15 pCi/g of Pu-239 and 5 pCi/g of Pu-238 in and on a single sample of mice. Using the worst-case assumption that all of this was in the carcass rather than on the pelt, this result indicates an individual dose of 86 mrad/day. The population dose based on the average concentrations in mice is 4 mrad/day. These population doses are about 1% of the DOE limits.

TA-54, Material Disposal Area, MDA H. MDA H is a 0.1-ha inactive area with 9 shafts, 18 m deep, capped with 1 m of tuff plus 1 m of concrete (LANL 1990; LANL 1998). Thus, the radioactive material in the shafts is partially isolated from biota. In 1969, moisture samples from a depth of 12 m were reported to be 2 million pCi/mL of tritium (LANL 1998). After correcting for decay, this concentration is approximately equal to the BCG. However, biota do not penetrate to a depth of 12 m. At the surface, the only radioactivity above background is tritium at a concentration of 2,500 pCi/g, which results in a dose of 1 mrad/day to the maximally exposed plant and animal. Averaging over 3 ha, the population dose is 1/30 mrad/day, which is essentially zero.

Table 3-1. Biota population dose (mrad/day) and predominant radionuclide at LANL locations that fail the initial screening.

Location	Biota Population Dose (mrad/day)			Predominant Radionuclide
	Terrestrial Plant	Aquatic Animal	Terrestrial Animal	
DOE limit	**1,000**	**1,000**	**100**	
TA-5, Mortandad Canyon	9		7	Cs-137
TA-10, Bayo Canyon	0		0	Sr-90
TA-15, EF Site	20		20	U-238
TA-21, MDA A	1		1	Pu-239
TA-21, MDA B	50		20	Pu-239
TA-21, MDA T	13		8	Am-241
TA-21, DP Canyon	2		2	Cs-137
TA-35, MDA W	0		0	Pu-239
TA-35, Pratt Canyon	1		1	Sr-90
TA-49, MDA AB	0		0	Pu-239
TA-50, Effluent Canyon		85	5	Pu-239
TA-50, MDA C	40		10	Gross alpha
TA-54, MDA G	3		1	H-3
TA-54, MDA H	0		0	H-3

3. Biota Dose Summary

Fourteen locations at LANL have maximum radionuclide concentrations above the DOE default BCGs and so trigger a site-specific assessment. Table 3-1 summarizes the results of preliminary site-specific assessments.

The MDAs are a particular concern because deep-rooted plants can penetrate pockets of contamination and transport it to the surface, as noted by Foxx and Tierney (Foxx 1984a and b; Tierney 1987). MDAs A, B, C, T, and G all show signs that plants have penetrated the radioactive material. At these locations, the doses from Am-241, Pu-239, and U-238 are probably high by a factor of 2–4, because we have used an alpha radiation-weighting factor of 20, which is appropriate for humans, whereas for biota the best estimate "appears to lie in the range of about 5–10" (DOE 2002, page M2-77).

In summary, although the present data are incomplete, the preliminary assessments indicate that the biota doses for plants and animals at LANL are below the DOE limits.

D. References

Baker 1992: D. A. Baker and J. K. Soldat, "Methods for estimating doses to organisms from radioactive materials released into the aquatic environment," PNL-8150, UC-602 (1992).

Becker 1992: Naomi M. Becker, "Quantification of uranium transport away from firing sites at LANL," Los Alamos National Laboratory document LA-UR-92-283 (1992).

Bennett 1996: K. Bennett, J. Biggs, P. Fresquez, "Radionuclide contaminant analysis of small mammals, plants, and sediments within Mortandad Canyon, 1994," Los Alamos National Laboratory report LA-13104-MS (1996).

Bennett 2002: K. D. Bennett, R. J. Robinson, and P. R. Fresquez, "Radionuclide contaminant analysis of small mammals at Area G, Technical Area-54, 1998 (with cumulative summary for 1994–1998)," Los Alamos National Laboratory report LA-13874-MS (1998).

Budd 2004: Budd, R.L., G. J. Gonzales, P. R. Fresquez, and E. A. Lopez. "The uptake and distribution of buried radionuclides by pocket gophers (*Thomomys bottae*)" *Journal of Environmental Science and Health Part A—Toxic/Hazardous Substances and Environmental Engineering*, **39**(3): 611–625 (2004).

DOE 1988a: US Department of Energy, "External dose conversion factors for calculating dose to the public," US Department of Energy report DOE/EP-0070 (July 1988).

DOE 1988b: US Department of Energy, "Internal dose conversion factors for calculating dose to the public," US Department of Energy report DOE/EP-0071 (July 1988).

DOE 1991: US Department of Energy, "Environmental regulatory guide for radiological effluent monitoring and environmental surveillance," US Department of Energy report DOE/EH-0173T (January 1991).

DOE 1993: US Department of Energy, "Radiation protection of the public and the environment," US Department of Energy Order DOE 5400.5 (January 1993).

DOE 1998: An aerial survey of the Los Alamos National Laboratory and surrounding area, DOE/NV/11718-107 (1998).

DOE 2002: US Department of Energy, "A graded approach for evaluating radiation dose to aquatic and terrestrial biota," US Department of Energy Technical Standard 1153-2002 (August 2000). [Available at *http://homer.ornl.gov/oepa/public/bdac/*]

EGG 1989: A. E. Fritzsche, "An aerial radiological survey of TA-15 and surroundings at LANL," EGG-10282-1095 (1989).

Emility 1996: L. A. Emility, "A history of radioactive liquid waste management at Los Alamos," Los Alamos National Laboratory document LA-UR-96-1283 (1996) Appendix I.

EPA 1986: US Environmental Protection Agency, "National emission standards for hazardous air pollutants," Code of Federal Regulations, Title 40, Part 61 (1986).

EPA 1988: Environmental Protection Agency, "Limiting values of radionuclide intake and air concentration and dose conversion factors for inhalation, submersion, and ingestion," EPA-520/1-88-020, Federal Guidance Report No. 11 (September 1988).

EPA 1993: Environmental Protection Agency, "External Exposure to Radionuclides in the Air, Water, and Soil," EPA-402-R-93-081, Federal Guidance Report No. 12 (September 1993).

EPA 1997: Environmental Protection Agency, "Exposure factors handbook," EPA/600/C-99/001 (August 1997).

EPA 2000: US Environmental Protection Agency, "Primary drinking water regulations; radionuclides; final rule," Code of Federal Regulations, Title 40, Parts 9, 141, and 142 (December 2000).

Foxx 1984a: T. S. Foxx, G. D. Tierney, and J. M. Williams, "Rooting depths of plants on low-level waste disposal sites," Los Alamos National Laboratory report LA-10253-MS (1984).

Foxx 1984b: T. S. Foxx, G. D. Tierney, and J. M. Williams, "Rooting depths of plants relative to biological and environmental factors," Los Alamos National Laboratory report LA-10254-MS (1984).

Fresquez 1995: P. R. Fresquez, T. S. Foxx, and L. Naranjo, Jr., "Strontium concentrations in chamisa (*Chrysothamnus nauseosus*) shrub plants growing in a former liquid waste disposal area in Bayo Canyon," Los Alamos National Laboratory report LA-13050-MS (1995).

Fresquez 1997a: P. R. Fresquez et al., "Radionuclide concentrations in pinto beans, sweet corn, and zucchini squash grown in Los Alamos Canyon at LANL," Los Alamos National Laboratory report LA-13304-MS (1997)

Fresquez 1997b: P. R. Fresquez, D. R. Armstrong, and L. H. Pratt, "Radionuclides in bees and honey within and around LANL," *J. Environ, Sci. Health*, **A32**(5), 1309–1323 (1997).

Fresquez 1998: P. R. Fresquez, D. A. Armstrong, M. A. Mullen, and L. Naranjo, Jr., "The uptake of radionuclides by beans, squash, and corn growing in contaminated alluvial soils at Los Alamos National Laboratory," *Journal of Environmental Science and Health* **B33** (1) 99–115 (1998).

Fresquez 2000a: P. R. Fresquez, J. D. Huchton, M. A. Mullen, and L. Naranjo, Jr., " Piñon pine tree study, Los Alamos National Laboratory: source document," Los Alamos National Laboratory report LA-13693-MS (2000).

Fresquez 2000b: P. R. Fresquez, J. Huchton, M. A. Mullen, and L. Naranjo, Jr., "Radionuclides in piñon pine (*Pinus edulis*) tree shoots and nuts from Los Alamos National Laboratory lands," *Health Physics* **78** (6): S83 (2000).

Fresquez 2000c: P. R. Fresquez, J. Huchton, M. A. Mullen, and L. Naranjo, Jr., "Radionuclides in piñon pine (*Pinus edulis*) nuts collected from Los Alamos National Laboratory lands and the dose from consumption," *Journal of Environmental Science and Health* **35** (5): 611–622 (2000).

Fresquez 2003: P. R. Fresquez, L. Vasquez-Tator, and E. A. Lopez, "Tritium concentrations in vegetation as a function of distance from a low-level waste site at Los Alamos National Laboratory," Los Alamos National Laboratory report LA-14091-MS (2003).

Fresquez 2004a: P. R. Fresquez, J. W. Nyhan, and E. Lopez, "Radionuclide concentrations in soils and vegetation at low-level radioactive waste disposal Area G during the 2003 growing season," Los Alamos National Laboratory report LA-14108-PR (2004).

Fresquez 2004b: P. R. Fresquez, and E. Lopez, "Radionuclide concentrations in soils and vegetation at low-level radioactive waste disposal Area G during the 2004 growing season," Los Alamos National Laboratory report LA-14181-PR (2004).

Fresquez 2004c: P. R. Fresquez, J. K. Ferenbaugh, L. Naranjo, Jr., "Moisture conversion ratios for the foodstuffs and nonfoodstuffs biota environmental surveillance programs at LANL," Los Alamos National Laboratory document LA-UR-04-4122 (2004).

Fresquez 2005: P. R. Fresquez, Lars Soholt, and Ed Lopez. "Radionuclide contaminant analysis of small mammals at Area G, Technical Area 54, 2001 through 2003 (with a cumulative summary for 1994 through 2003)," Los Alamos National Laboratory report LA-14193-MS (2005).

Gonzales 2000: G. J. Gonzales, R. L. Budd, P. R. Fresquez, W. J. Wechsler, "Source document: the relationship between pocket gophers (*Thomomys bottae*) and the distribution of buried radioactive waste at the Los Alamos National Laboratory," Los Alamos National Laboratory report LA-13179-MS (July 2000).

Hakonson 1973: T. E. Hakonson, L. W. Nyhan, L. J. Johnson, and K. V. Bostick, “Ecological investigation of radioactive materials in waste discharge areas at Los Alamos,” Los Alamos Scientific Laboratory report LA-5282-MS (1973).

Hakonson 1975: T. E. Hakonson and K. V. Bostick, “Cesium-137 and plutonium in liquid waste discharge areas at Los Alamos,” in *Radioecology and Energy Resources*, Proceedings of the Fourth National Symposium on Radioecology, Ed. Colbert E. Cushing, Jr., (Dowden, Hutchingon, and Ross, 1975).

Hakonson 1976: T. E. Hakonson and K. V. Bostick, “The availability of environmental radioactivity to honeybee colonies at Los Alamos,” *J. of Environmental Quality* **5**, 307–310, (1976).

Hansen 1980: W. R. Hansen, D. L. Mayfield, and L. J. Walker, “Interim environmental surveillance plan for LASL radioactive waste areas,” Los Alamos National Laboratory document LA-UR-80-3110 (1980).

Hanson 1976: W. C. Hanson and F. R. Miera, “Long-term ecological effects of exposure to uranium,” Los Alamos Scientific Laboratory report LA-6269 (1976).

Hanson 1977: W. C. Hanson and F. R. Miera, “Continued studies of long term ecological effects of exposure to uranium,” Los Alamos Scientific Laboratory report LA-6742 (1977).

Hanson 1978: W. C. Hanson and F. R. Miera, “Further studies of long term ecological effects of exposure to uranium,” Los Alamos Scientific Laboratory report LA-7162 (1978).

Holloway 1993: R.W. Holloway, "Tritium in the Surface Waters of the Western United States", Radiochemica Acta 62, 217 (1993)

HPS 1996: Health Physics Society, “Radiation risk in perspective,” Health Physics Society Position Statement, *HPS Newsletter* (March 1996).

Jacobson 2005: K. W. Jacobson, “US DOE Report: 2004 LANL radionuclide air emissions,” Los Alamos National Laboratory report LA-14233 (2005).

Jarmer 1997: D. Jarmer and J. Lyman, “Human dose assessment for the radionuclides 90Sr and 90Y at TA-35 SWMU 35-003r and Ten Site Canyon,” Los Alamos National Laboratory report LA-13206-MS (1997).

LANL 1990: “Solid waste management units report,” Los Alamos National Laboratory document LA-UR-90-3400 (1990).

LANL 1991: “TA-21 operable unit RFI work plan for ER,” Los Alamos National Laboratory document LA-UR-91-962 (1991).

LANL 1992: “RFI work plan for Operable Unit 1129,” Los Alamos National Laboratory document LA-UR-92-800 (1992).

LANL 1995: “Task/site work plan for Operable Unit 1049, Los Alamos and Pueblo Canyon,” Los Alamos National Laboratory document LA-UR-95-2053 (1995).

LANL 1997: “Work plan for Mortandad Canyon,” Los Alamos National Laboratory document LA-UR-97-3291 (1997).

LANL 1997: “Interim action report for PRS 10-002(a-b), 10-003(a-o), 10-004(a-b), 10-007,” EM/ER:97:220 (1997).

LANL 1998: “Work plan for Pajarito Canyon,” Los Alamos National Laboratory document LA-UR-98-2550 (1998).

LANL 2003: “Voluntary corrective measure completion report for SWMU 21-011(k) at TA-21,” Los Alamos National Laboratory document LA-UR-03-7293, ER2003-0633, RRES-RS (2003).

LANL 2004: "Screening-level ecological risk assessment methods, Revision 2," Los Alamos National Laboratory document LA-UR-04-8246, ER2004-0519 (2004).

McNaughton 2005: "Biota dose assessment at LANL," Los Alamos National Laboratory document LA-UR-05-4699.

Miera 1977: F. R. Miera, K. V. Bostick, T. E. Hackonson, J. W. Nyhan, "Biotic survey of Los Alamos radioactive liquid-effluent receiving areas," Los Alamos National Laboratory report LA-6503-MS (1977).

Miera 1978: F. R. Miera and T. E. Hakonson, "Radiation dose to rodents inhabiting a radioactive waste receiving area," *Health Physics* **34**, 603–609 (1978).

NCRP 1975: National Council on Radiation Protection and Measurements, "Natural background radiation in the United States," National Council on Radiation Protection and Measurements report 45 (November 1975).

NCRP 1976: National Council on Radiation Protection and Measurements, "Structural shielding and evaluation for medical use of x-rays and gamma rays of energies up to 10 MeV, recommendations of the National Council on Radiation Protection and Measurements," National Council on Radiation Protection and Measurements report 49 (1976).

NCRP 1987a: National Council on Radiation Protection and Measurements, "Ionizing radiation exposure of the population of the United States," National Council on Radiation Protection and Measurements report 93 (September 1987).

NCRP 1987b: National Council on Radiation Protection and Measurements, "Exposure of the population in the United States and Canada from natural background radiation," National Council on Radiation Protection and Measurements report 94 (December 1987).

NRC 1977: Nuclear Regulatory Commission, "Calculation of annual doses to man from routine releases of reactor effluents for the purpose of evaluating compliance with 10 CFR 50, Appendix I," Nuclear Regulatory Commission Report, Regulatory Guide 1.109 (October 1977).

Neptune 2003: R. Perona, K. Lockhart, J. Markwiese, Neptune and Company, "MDA C, field summary, sample selection rationale and field laboratory screening results," September 30, 2003.

Nyhan 1978: J. W. Nyhan, T. E. Hakonson, F. R. Miera, K. V. Bostick, "Temporal changes in the distribution of 137Cs in alluvial soils at Los Alamos," Los Alamos National Laboratory report LA-7298-MS, ER ID 5726 (1978).

Nyhan 1982: J. W. Nyhan, G. C. White, G. Trujillo, "Soil plutonium and cesium in stream channels and banks of Los Alamos effluent-receiving areas," *Health Physics* **43** 531–541 (1982).

Nyhan 1984: J. W. Nyhan, et al., "Distribution of radionuclides and water in Bandelier tuff beneath a former Los Alamos liquid waste disposal site after 33 years," Los Alamos National Laboratory report LA-10159-LLWM (1984).

Nyhan 1985: J. W. Nyhan, B. J. Drennon, W. V. Abeele, M. L. Wheeler, W. D. Purtymun, G. Trujillo, W. J. Herrera, and J. W. Booth, "Distribution of plutonium and americium beneath a 33-year-old liquid waste disposal site at Los Alamos, NM," *J. Environ. Qual.* **14:** 501–509 (1985).

Nyhan 2002: J. Nyhan, P. R. Fresquez, R. Velasquez, and E. Lopez, "Radionuclide concentrations in soils and vegetation at low-level radioactive waste disposal Area G during the 2001 growing season," Los Alamos National Laboratory report LA-13942-PR (2002).

Nyhan 2004: J. Nyhan, P. R. Fresquez, R. Velasquez, and E. Lopez, "Radionuclide concentrations in soils and vegetation at low-level radioactive waste disposal Area G during the 2002 growing season. (with a summary of radionuclide concentrations in soils and vegetation since 1980)," Los Alamos National Laboratory report LA-14095-PR (2004).

Purtymun 1987: W. D. Purtymun and A. K. Stoker, "Environmental status of TA-49," Los Alamos National Laboratory report LA-11135-MS (1987).

Reneau 2003: S. Reneau, R. Ryti, P. Drakos, T. Mercier, "Status of Mortandad Canyon sediment investigations," Los Alamos National Laboratory document LA-UR-03-5997 (2003).

Rogers 1977: M. A. Rogers, "History and environmental setting of LASL near surface land disposal facilities for radioactive wastes (areas A, B, C, D, E, F, G, and T)," Los Alamos Scientific Laboratory report LA-6848-MS (page A-9) (1977)

Ryti 2004: R. T. Ryti, J. Markwiese, R. Mirenda, L. Soholt, "Preliminary remediation goals for terrestrial wildlife," *Human and Ecological Risk Assessment* **10:** 437–450 (2004).

Soholt 1990: L. F. Soholt, et al., "Environmental surveillance of low-level radioactive-waste-management areas at Los Alamos during 1987," Los Alamos National Laboratory report LA-UR-90-3283 (1990).

Soholt 2003: L. Soholt, G. J. Gonzales, P. R. Fresquez, K. Bennett and E. Lopez, "Estimating radiological doses to predators foraging on a low-level waste management area," Los Alamos National Laboratory report LA-13999 (2003).

Tierney 1987: G. D. Tierney and T. S. Foxx, "Root lengths of plants on Los Alamos National Laboratory Lands," Los Alamos National Laboratory report LA-10865-MS (1987).

UNSCEAR 1996: United Nations Scientific Committee on the Effects of Atomic Radiation, 1996 Report to the General Assembly, "Sources and effects of ionizing radiation," United Nations, New York (ISBN 92-1-142219-1) (1996).

Wenzel 1987: W. J. Wenzel, T. S. Foxx, A. F. Gallegos, G. Tierney, J. C. Rodgers, "Cesium-137, plutonium-239,240, total uranium, and scandium in trees and shrubs growing in transuranic waste at Area B," Los Alamos National Laboratory report LA-11126-MS (1987)

White 1979: G. C. White, E. S. Gladney, K. V. Bostick, W. C. Hanson, "Studies of long-term ecological effects of exposure to uranium, IV," Los Alamos Scientific Laboratory report LA-7750 (1979).

White 1980: G. C. White, J. C. Simpson, K. V. Bostick, "Studies of long-term ecological effects of exposure to uranium, V," Los Alamos National Laboratory report LA-8221 (1980).

White 1981: G. C. White, T. E. Hakonson, A. J. Ahlquist, "Factors affecting radionuclide availability to vegetables grown at Los Alamos," Journal of Environmental Quality 10 294–299 (1981).