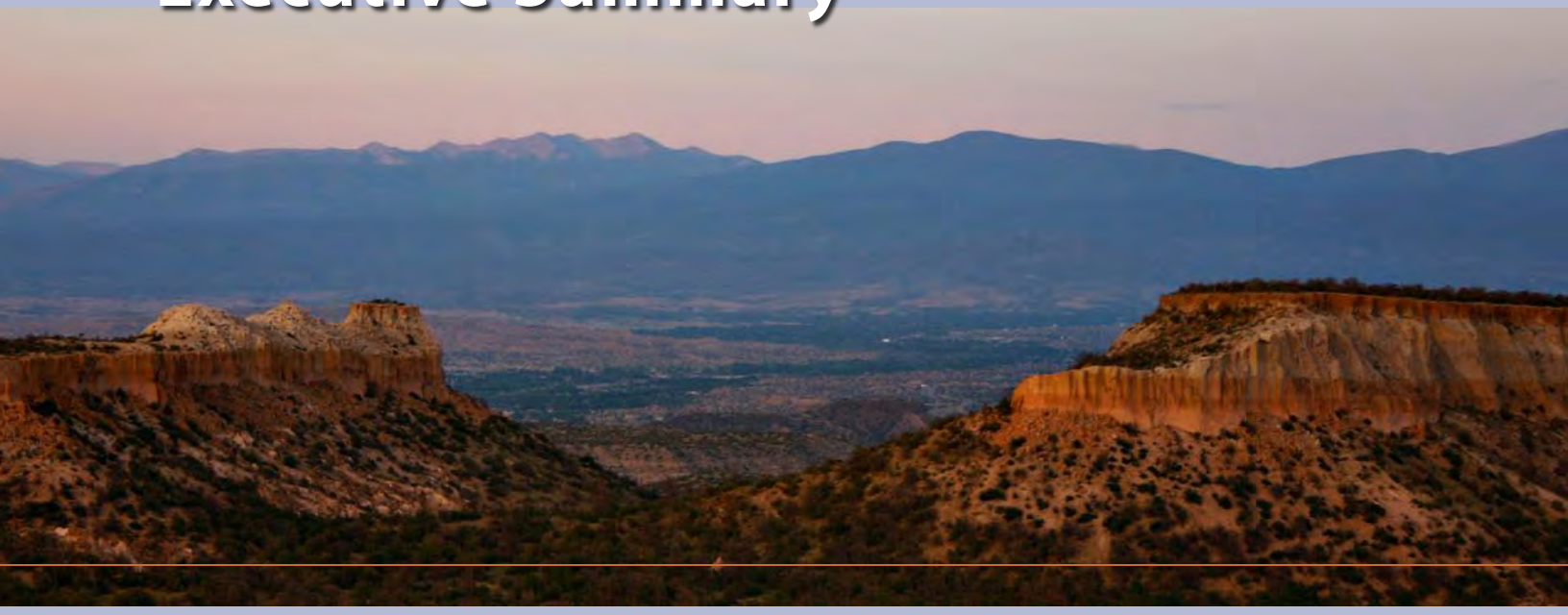
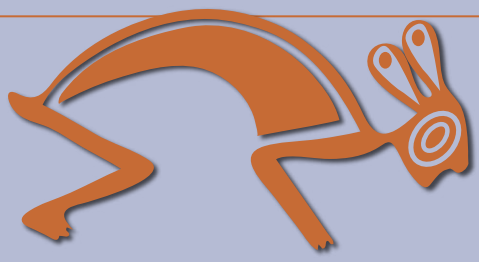
Environmental Surveillance at Los Alamos during 2008

Executive Summary





Los Alamos
NATIONAL LABORATORY
EST. 1943

LA-14407-ENV

Executive Summary

Los Alamos National Laboratory (LANL or the Laboratory) is located in Los Alamos County in north-central New Mexico (NM), 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, a series of mesas separated by deep east-to-west-oriented canyons cut by stream channels. 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 at White Rock Canyon. Most Laboratory and Los Alamos County 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, Bandelier National Monument, the US General Services Administration, and 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 global threats, and (3) solve other emerging national security challenges. 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 its commitment to environmental stewardship and full compliance with environmental protection laws. Part of LANL's commitment is to report on its environmental performance. This report

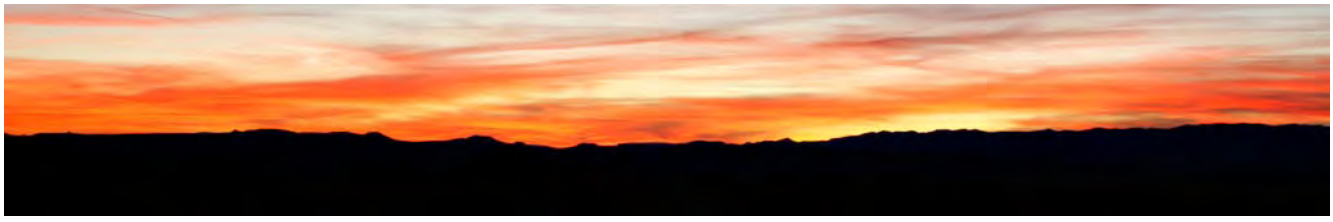
- characterizes LANL's environmental management, including effluent releases, environmental monitoring, and estimated radiological doses to the public and the environment,
- summarizes environmental occurrences and responses,
- confirms compliance with environmental standards and requirements, and
- highlights significant programs and efforts.

Environmental Management System

As part of its commitment to protect the environment and improve its environmental performance, LANL implemented an Environmental Management System (EMS) pursuant to US Department of Energy (DOE) Order 450.1A and the international standard (ISO) 14000:2004. DOE 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 and implementing improvements, and measuring results. In April 2006, LANL became the first National Nuclear Security Administration (NNSA) national laboratory and the first University of California-operated facility to receive full third-party certification of its EMS.

- ***Two additional surveillance audits in 2008 by an independent registrar concluded that the Laboratory's environmental management system continues to meet all requirements for full certification to the international standard.***
- ***NNSA again recognized the success of the EMS management by giving the Laboratory the 2009 NNSA "Best in Class Award" and the "DOE E-Star" Award for institutional improvements made in 2008.***

During 2008, the EMS was audited two additional times by an independent third-party ISO 14001 auditor who conducted three audits in 2006 and two audits in 2007. The auditors concluded that the LANL EMS continues to meet all the requirements of the ISO 14001:2004 standard with no major non-conformities and recommended that LANL maintain full certification.



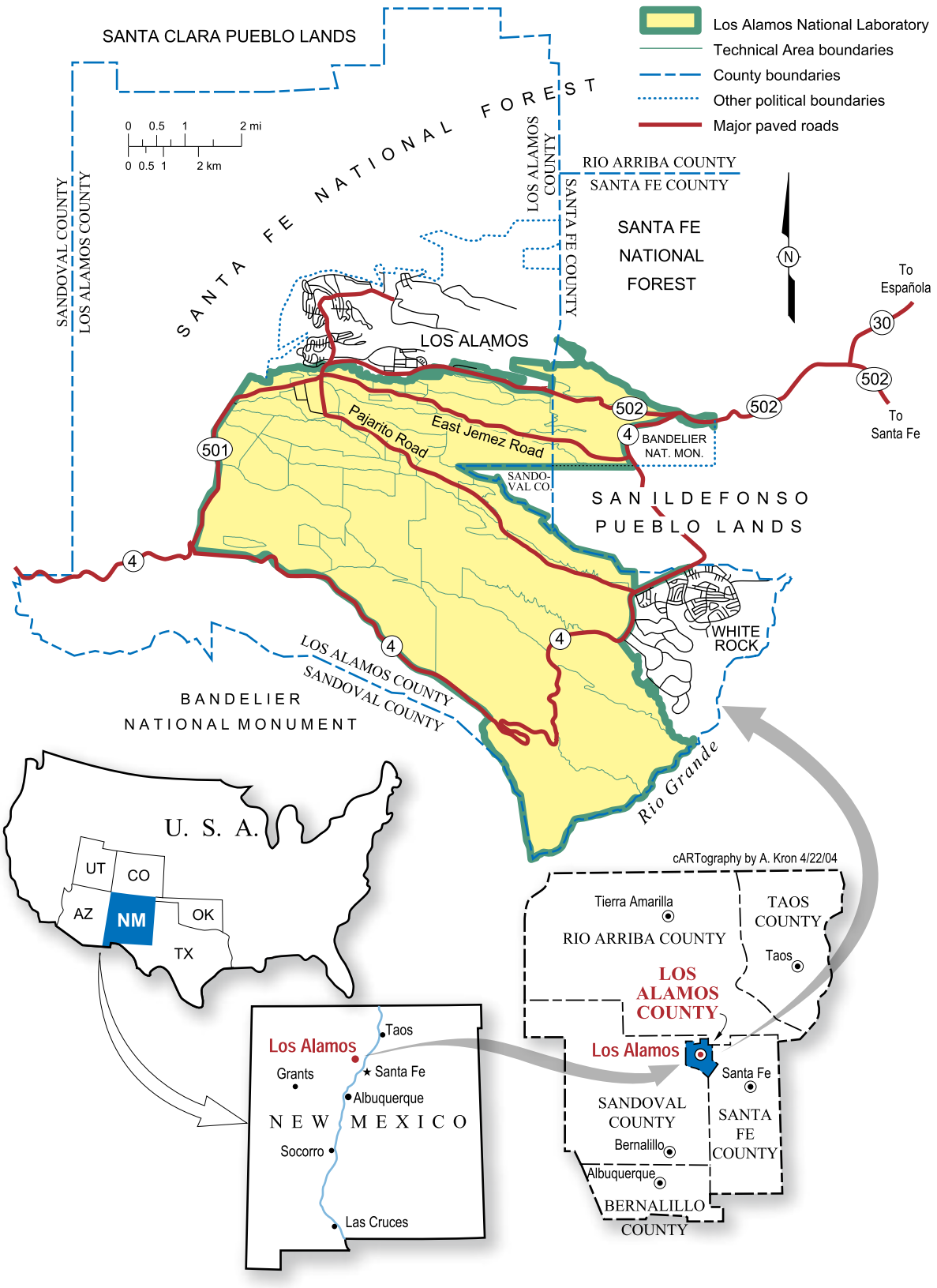


Figure ES-1. Regional location of Los Alamos National Laboratory.

NNSA and DOE recognized the success of the EMS and the unique approach by giving the Laboratory the 2009 NNSA "Best in Class" Award and the "DOE E-Star" for the institutional improvements identified and implemented through the EMS from 2006 through 2008.

The Pollution Prevention (P2) Program implements waste minimization, pollution prevention, sustainable design, and conservation projects to enhance operational efficiency, reduce life-cycle costs of programs or projects, and reduce risk to the environment. Reducing waste directly contributes to the efficient performance of the Laboratory's national security, energy, and science missions. LANL was awarded eight NNSA awards in 2008:

NNSA Best in Class Awards:

- Wastewater Recycling at the Radioactive Liquid Waste Treatment Facility (RLWTF)
- Ultrapure Carbon and Carbon Nitride Nanomaterials

NNSA Environmental Stewardship Awards:

- Steam Generator Optimization
- Perchloric Acid Exhaust System
- Recycling of Asphalt, Soil and Mulch
- Mixed Office Paper Recycling
- Integrating Safety and Security in the Environmental Management System
- Uninterruptible Power Supply Project

- ***The Consent Order is the principal regulatory driver for the Laboratory's environmental restoration activities and the Water Stewardship Program. It specifies actions that the Laboratory must complete to characterize contaminated sites and monitor the movement of contaminants.***
- ***The Laboratory met all major deliverables of the Consent Order.***
- ***The NMED issued a Notice of Violation to LANL and DOE related to a late (by 5 days) delivery of a scheduled status report and an NOV related to a waste storage inspection in 2007.***

Federal Facility Compliance Agreement

During 2008, the DOE and the Laboratory continued to monitor and sample storm water under the requirements of a Federal Facility Compliance Agreement (FFCA) with the US Environmental Protection Agency (EPA) and the NM Environment Department (NMED). The agreement establishes a compliance plan for the regulation of storm water point source discharges from solid waste management units (SWMUs) and areas of concern (AOCs) at the Laboratory. Under the FFCA, LANL added 20 new rain gages to the existing five meteorology stations, installed 202 new site-specific surface water samplers, maintained 60 runoff gage stations, collected 310 storm water samples, conducted over 2300 inspections at 290 sites, and continued negotiations with EPA and NMED on the development of an individual storm water permit for storm water discharges (the FFCA was replaced by an individual storm water permit issued by EPA in April 2009.)

Compliance Order on Consent

The March 2005 Compliance Order on Consent (the Consent Order) between LANL, DOE, and the NMED is the principal regulatory driver for LANL's environmental restoration programs including the Water Stewardship Program. The Consent Order contains requirements for investigation and cleanup of SWMUs and AOCs at the Laboratory. The major activities conducted by the Laboratory included investigations and cleanup actions. All major deliverables of the Consent Order were met by the Laboratory during 2008. The projects wrote and/or revised 24 work plans and 22 reports and submitted them to the NMED. Thirteen SWMUs and AOCs were granted Certificates of Completion under the Consent Order by the NMED in 2008. In January 2008, the NMED Hazardous Waste Bureau issued a Notice of Violation (NOV) to DOE and LANL for a late delivery (by five days) of a scheduled status report in 2007. An NOV was also issued for eight alleged violations of hazardous waste storage requirements during an inspection in 2007. In 2008, NMED found no violations during a hazardous wastes storage inspection.

Improvement Targets

Improvement goals for the Laboratory include continuing to improve Resource Conservation and Recovery Act (RCRA) compliance. The Laboratory completed 2,552 self-assessments with a nonconformance rate of 2.82% in 2008 (compared with 3.71% in 2007). The Laboratory continues to improve its processes, systems, and training to reduce the number of violations in the future. Under its EMS, the Laboratory must identify and minimize environmental impacts and waste sources. Chromium discharged from a cooling tower in the 1960s through 1972 was discovered in the regional aquifer in early 2006, and LANL installed five additional monitoring wells to evaluate the extent of this contamination. A total of 10 alluvial, three intermediate perched, and six regional aquifer wells were installed in 2008. Though perchlorate and high explosives residues from former processing and manufacturing facilities are no longer discharged, the Laboratory is monitoring their movement from past effluent discharges to determine if they could pose a threat to drinking water sources.

Design of Surveillance System and Sample Locations

The Laboratory uses data from monitoring (surveillance) of known release points and multiple receptors (people, air, water, soil, sediment, foodstuffs, plants, and animals) over a long time period as a basis for policy and to determine actions to protect the environment. We collect data from the surrounding region to establish baseline environmental conditions in areas not influenced by LANL operations. We conduct regional monitoring to determine whether LANL operations are impacting areas beyond LANL's boundaries. Examples of regional monitoring include the radiological ambient air sampling network (AIRNET); soil, foodstuffs, and biota (plants and animals) sampling as far away as Dixon, NM (40 direct miles away); and sediment monitoring along the Rio Grande as far upriver as Abiquiu Reservoir and downriver at Cochiti Reservoir. We also collect data on-site and at the Laboratory perimeter to determine if operations are impacting LANL or neighboring properties (e.g., Pueblo and County lands). Perimeter monitoring also measures the highest potential impact to the public. To better quantify releases, we monitor at specific discharge or release points or other locations on LANL property that are known to or have the potential to release contaminants. Examples of locations with this type of monitoring include facility stacks, 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 Technical Area (TA) -54 (where waste is being handled, stored, and disposed), and water discharge locations (outfalls). We use these data to demonstrate compliance with applicable environmental laws and regulations. During 2008, the Laboratory collected more than 7,780 environmental monitoring samples from more than 770 locations and received almost 297,000 analyses or measurements on these samples.

Risk Reduction

Risk is evaluated either as current (present-day) or prospective (future) risk. The Laboratory assesses hazards and the corresponding risks by evaluating environmental data, measurements, inventories of buried or stored materials, and potential exposure pathways and scenarios. We use models, data, and computer programs to assist with these estimates.

Over the years, the Laboratory has decreased its release of materials into the environment and has reduced the amount of legacy contamination. Examples include the reduction in both the number of outfalls (plant and process discharges) and the volume of water released, the reduction in air emissions, changes to effluent treatment processes at the TA-50 RLWTF, and the removal of contaminated material and waste at sites such as Material Disposal Area (MDA) P. These efforts have significantly reduced or eliminated potential exposure and risk to workers, the public, and the environment.

Examples of ongoing risk reduction activities include the transport of stored legacy transuranic waste from Area G to the Waste Isolation Pilot Plant (WIPP) in Carlsbad, NM; the planned cleanup and remediation of the former plutonium processing facility at TA-21; ongoing studies of groundwater contamination to evaluate future hazards and risks; and numerous investigations and corrective actions at potentially contaminated sites.

- *Past risk reduction successes include the reduction in the number of outfalls (plant and process discharges) and the volume of water released from them, the reduction in air emissions over the past several years, changes to effluent treatment processes at the TA-50 Radioactive Liquid Waste Treatment Facility, and the removal of contaminated material and waste at former waste disposal sites.*
- *Ongoing risk reduction efforts include the transport of waste from Area G to permanent disposal at WIPP, studies of the movement of contaminants in groundwater, and planned or active cleanup operations at former waste and radionuclide processing sites.*
- *The environmental surveillance programs can detect very low levels of potential contaminants and thus help determine whether a new hazard is present and evaluate the associated level of risk.*

The sensitivity of measurements obtained by LANL's environmental surveillance program allows detection of hazardous and radioactive materials and other contaminants released during cleanup or normal operations. We monitor all major pathways to people and the environment. The data from monitoring can be used to assist with possible mitigation of impacts. Air monitoring by the AIRNET system has regularly detected airborne contaminants where both known and unexpected contamination is present on the soil surface; in many cases, remediation was initiated to remove the source, though levels detected have never approached regulatory limits. The AIRNET system can detect low levels of radionuclides that are dispersed during cleanup operations, and we have added many additional samplers in anticipation of upcoming cleanup operations. The Direct Penetrating Radiation network detects neutrons and gamma rays from the stored waste at Area G and is used to monitor off-site radiation levels. We conduct biota and foodstuffs monitoring to ensure there is no spread of contamination into plants, animals, and food. The monitoring of constituents in groundwater keeps track of the movement of previously-released contaminants and their potential migration in the aquifers.

Compliance

The Laboratory uses the status of compliance with environmental requirements as a key indicator of its environmental performance. Federal and state regulations provide specific requirements and standards to implement these statutes and maintain environmental quality. The EPA and the NMED are the principal administrative authorities for these laws. The Laboratory is also 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 for 2008.

Table ES-1
Environmental Statutes under which LANL Operates and Compliance Status in 2008

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	The Laboratory completed 2,552 self-assessments that resulted in a non-conformance finding rate of 2.8%. All major deliverables required by the Consent Order were submitted to NMED on time. NMED issued a Notice of Violation (NOV) to DOE and LANL for a required status report that was submitted five days late in 2007. Also in 2008, NMED issued another NOV to DOE and LANL for alleged violations during a RCRA inspection conducted in early 2007. The NMED conducted a RCRA hazardous waste compliance inspection and did not issue any findings. LANL discovered four instances of improper storage or labeling of hazardous wastes. All instances were corrected and did not result in actual or potential hazards to the environment or personnel. The Laboratory is in compliance with groundwater monitoring requirements. LANL installed 10 alluvial, three intermediate perched, and six regional aquifer wells.
Clean Air Act (CAA)	Air quality and emissions into the air from facility operations	The Laboratory was well below all permit limits for emissions to the air. Non-radiological air emissions were lower than the previous year for all but nitrogen oxides and carbon monoxide, both of which increased by less than 5%. The annual dose to the maximally exposed individual (MEI) from radioactive air emissions was 0.55 mrem, which is similar to the very low dose for the previous year.
Comprehensive Environmental Response and Liability Act (CERCLA)	Pollution and contaminants on property	LANL transferred three parcels of land to Los Alamos county after completing all CERCLA-required Environmental Baseline Survey Reports. A National Resources Damage Assessment was re-initiated and a pre-assessment report completed in December 2008.
Clean Water Act (CWA)	Water quality and effluent discharges from facility operations	Six of 1,300 samples collected from industrial outfalls and none of the 77 samples collected from the Sanitary Wastewater Systems Plant's outfall exceeded effluent limits. All exceedences were for either pH or residual chlorine levels. The Laboratory conducted 542 storm water inspections and 99% of the Laboratory's 51 permitted construction sites were compliant with National Pollutant Discharge Elimination System (NPDES) requirements. The Laboratory added 20 rain gages to a network of gages used to trigger sampling or inspections of sites, installed 202 new site-specific samplers, maintained 60 stream gage stations, collected 310 storm water samples, conducted 2,287 inspections at 290 sites, and installed and maintained Best Management Practices to manage pollutants and runoff at these locations.
Groundwater Discharge Plans	Discharges of water to groundwater	The Laboratory operated under one approved and two pending Discharge Plans submitted to or approved by the NMED. The approved plan regulates discharges from the sanitary wastewater treatment facility at TA-46 and the pending plans cover the TA-50 RLWTF and 21 domestic septic systems.
Aboveground Storage Tank Compliance Program	Liquid storage tank monitoring and compliance	One tank system at LANSCE (TA-53) was closed out with NMED in 2008 leaving a total of 19 regulated tanks. LANL performed additional characterization of the 2002 diesel release from a tank at TA-21.
Toxic Substances Control Act (TSCA)	Chemicals such as polychlorinated biphenyls (PCBs)	The Laboratory shipped 22 containers of PCB waste, 30 lbs of capacitors, and 1,617 lbs of fluorescent light ballasts for disposal or recycling to EPA-permitted disposal and treatment facilities.

Table ES-1 (continued)

Federal Statute	What it Covers	Status
Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)	Storage and use of pesticides and herbicides	The Laboratory remained in compliance with regulatory requirements regarding use of pesticides and herbicides. The Laboratory used 313.75 oz of insecticides and 682.5 gal. of herbicides, 600 lbs of fertilizers, 5,340 lbs plus 5.5 gal. of water treatment chemicals, and 5 gal. of color marker.
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 14,520 lbs of lead, mostly at the firing range. No updates to Emergency Planning Notifications were necessary in 2008. Chemical Inventory Reports were updated to the Los Alamos County fire and police departments for 30 chemicals or explosives. There were no releases that triggered state or federal reporting requirements.
Endangered Species Act (ESA) and Migratory Bird Treaty Act (MBTA)	Rare species of plants and animals	The Laboratory maintained compliance with the ESA and MBTA and reviewed 629 excavation permits and 122 project profiles for potential impacts to threatened or endangered species. The Laboratory conducted annual surveys for Mexican spotted owl, southwestern willow flycatcher, Jemez Mountain salamander, and grey vireo. LANL prepared biological assessments for one project regarding potential impacts on federally listed threatened or endangered species.
National Historic Preservation Act (NHPA) and others	Cultural resources	The Laboratory maintained compliance with the NHPA. The Laboratory conducted 38 projects that required some field verification of previous survey information and identified 11 new archaeological sites and 27 new historic buildings. Eight historic buildings were determined eligible for the National Register of Historic Places.
National Environmental Policy Act (NEPA)	Projects evaluated for environmental impacts	The Laboratory and NNSA released the final Site-Wide Environmental Impact Statement for continued operation of LANL. A limited Record of Decision was issued in September 2008 that accepts some elements of the Expanded Operations Alternative.

Unplanned Releases

There were no unplanned airborne releases and no unplanned releases of radioactive liquids from LANL in 2008. There were 12 spills or releases of potable water, steam condensate, or domestic wastewater and one spill of about 2 quarts of motor oil with about 2 gallons of antifreeze into a canyon. LANL reported all liquid releases to NMED; the releases will be administratively closed upon final inspection.

Radiological Dose Assessment

Humans, plants, and animals potentially receive radiation doses from various Laboratory operations (Table ES-2). The DOE dose limits for the public and biota are the mandated criteria that are used to determine whether a measurement represents a potential exposure concern. Figure ES-2 shows doses to the hypothetical maximally exposed individual (MEI) via the air pathway over the last 15 years at an off-site location; this location was at East Gate in 2008, as it was through 2005. (In 2006, it was at the Los Alamos County Airport terminal and in 2007 at a location along DP Road.) The annual dose to the MEI for the airborne pathway was approximately 0.55 mrem, compared with the dose of 0.52 mrem in 2007 and a regulatory limit of 10 mrem (Figure ES-2). During 2008, the population within 80 km of LANL received a collective dose of about 0.79 person-rem, up from 0.36 person-rem in 2007. The doses received in 2008 from LANL operations

- *The location of the hypothetical maximally exposed individual (MEI) for airborne radionuclides was determined to be at East Gate near the eastern edge of Los Alamos. This location received a combination of low levels of radiation from LANSCE and other stack emissions.*
- *Radiation dose to the MEI was only slightly higher than the very low levels calculated in 2006 and 2007.*

by an average Los Alamos residence and an average White Rock residence totaled about 0.047 mrem and 0.038 mrem, respectively. The maximum all-pathways dose, composed almost entirely of direct radiation from waste stored at TA-54, Area G, could result in an exposure of 0.9 mrem per year to a hypothetical individual in the adjacent sacred area of Pueblo de San Ildefonso.

Table ES-2
What are the Sources of Radiological Doses?

Source	Recipient	Dose	Location	Trends
Background (includes man-made sources)	Humans	~700 mrem/yr	Not applicable	Increased from previous years due to new information about average medical doses.
Air	Humans	0.55 mrem/yr	East Gate in eastern Los Alamos	Similar to very low level in previous two years
Direct radiation	Humans	0.9 mrem/yr	San Ildefonso – offsite	Same as previous year
Food	Humans	<0.1 mrem/yr	All sites	Steady
Drinking water	Humans	<0.1 mrem/yr	All sites	Steady
All	Terrestrial animals	<20 mrad/day*	TA-15 "EF site", TA-21 MDA B	Steady
All	Terrestrial plants	<50 mrad/day*	TA-21 MDA B	Steady

* Highest reported dose from all sample years

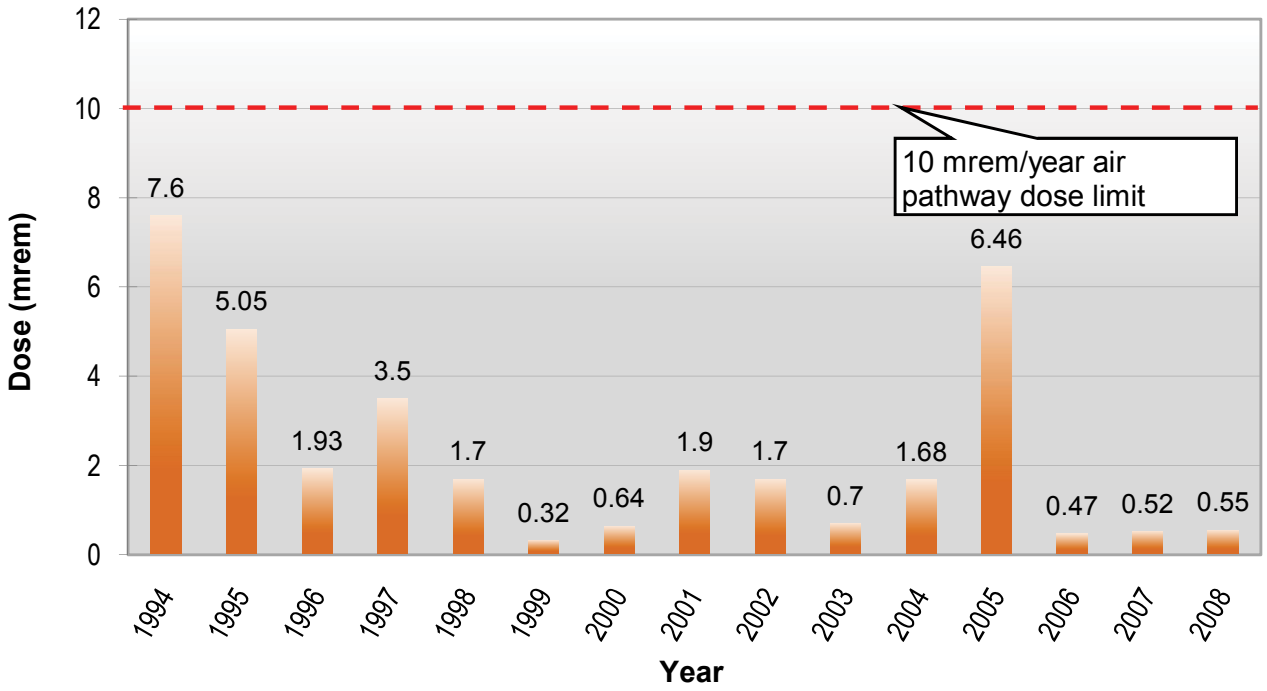


Figure ES-2. Annual airborne pathway dose (mrem) to the off-site MEI over the past 15 years. The 2008 location of the calculated MEI is at East Gate near the eastern side of Los Alamos County.

Biota Dose

The DOE biota dose limits are intended to protect populations of plants and animals, especially with respect to preventing the impairment of reproductive capability within the biota population. All radionuclide concentrations in vegetation sampled in 2008 were far below the plant 0.1 rad/day biota dose screening level (10% of 1 rad/day dose limit), and all radionuclide concentrations in terrestrial animals sampled in 2008 were far below the terrestrial animal 0.01 rad/day biota dose screening level (10% of 0.1 rad/day dose limit).

Table ES-2 reports the highest biota doses calculated for all sample years. There were three cases in 2008 in which surface water concentrations exceeded the general biota screening levels for aquatic systems. However, the locations of these surface water samples did not coincide with aquatic habitats. So, terrestrial biota dose assessments were performed for these locations. All dose rates determined from the assessments were far below the applicable dose limits.

Nonradiological Risk Assessment

The environmental data collected in 2008 and previous years show that there is no potential public-health risk from nonradiological materials released from LANL.

Air Emissions and Air Quality

The Laboratory measures the emissions of radionuclides at the emission sources (building stacks) and categorizes these radioactive stack emissions into one of four types: (1) particulate matter, (2) vaporous activation products, (3) tritium, and (4) air activation products (radioactive elements created by the LANSCE particle accelerator beam). In addition, the Laboratory collects air samples at general locations within LANL boundaries, at the LANL perimeter, and regionally to estimate the extent and concentration of radionuclides that may be released from Laboratory operations. These radionuclides include isotopes of plutonium, americium, uranium, and tritium.

- *Emissions of short-lived air activation products from LANSCE and emissions of tritium from other stacks increased from the relatively low levels last year. Emissions of tritium reflect a return to past levels after an extended maintenance period in 2007.*
- *Combined airborne emissions of radionuclides other than tritium and short-lived air activation products were similar to last year.*

Total stack emissions during 2008 were approximately 1,300 curies (Ci), an increase from 477 Ci in 2007. Diffuse emissions from the LANSCE facility and other smaller sources contributed another 74.6 Ci. Tritium emissions composed about 480 Ci of the total (260 in 2006) and reflect a slight increase over 2007 but were lower than the levels of the past several years. Short-lived air activation products from LANSCE stacks and diffuse emissions contributed 890 Ci (301 Ci in 2007) of the total. Most of the curies from LANSCE are from very short-lived radionuclides that decay significantly before reaching the location of the MEI. Combined airborne emissions of other radionuclides, such as plutonium, uranium, americium, and thorium, were less than 0.000012 Ci (same as 2007) and emissions of particulate/vapor activation products were similar to last year at 0.021 Ci.

- *Increased concentrations of radionuclides in ambient air were not detected at regional sampling locations nor at most perimeter locations.*
- *As in previous years, there were no detections of radionuclides above background at Pueblo and regional locations.*
- *The highest mean air concentrations at perimeter locations were below 1% of the applicable EPA limits.*

Radionuclide concentrations in ambient air samples in 2008 were generally comparable with concentrations in prior years. As in past years, the AIRNET system detected slightly elevated radionuclides from known areas of contamination. No new or increased airborne radioactivity was detected. At regional locations away from Los Alamos, all air sample measurements were consistent with background levels. Annual mean radionuclide concentrations at all LANL perimeter stations were less than 1% of the EPA dose limit for the public. Measurable amounts of tritium were reported at most on-site locations and at perimeter locations, but no elevated levels were detected in 2008. The highest off-site tritium concentration (measured at station #26 along State Road 4 near Bandelier National Monument) was 4.3 pCi/m^3 (0.3% of the EPA public dose limit of 1,500 pCi/m^3). The highest on-site tritium measurement (less than 1% of the DOE limit for worker exposure) was made at Area G near areas containing tritium-contaminated waste. No plutonium-238 was detected above normal levels. Plutonium-239/240 from historical activities at LANL's old main technical area was detected near the Ashley Hotel and Suites (formerly Los Alamos Inn) at about 23 aCi/m^3 or about 1% of the EPA public dose limit, and at very low levels near MDA B where soil disturbance from road construction occurred in preparation for remediation of the MDA. On-site detections of plutonium

occurred at Area G (an area with known low levels of contamination) at levels substantially below 0.5% of the DOE limit for workplace exposure. Americium-241 was detected near Area G at levels less than 0.05% of worker exposure limits and at seven off-site locations at levels less than 0.3% of public exposure limits. The maximum annual uranium concentrations were from natural uranium at locations with high dust levels from local soil disturbances. The regional and Pueblo samples had higher average concentrations of natural uranium isotopes than the perimeter group. There was one tentative detection of depleted uranium (which has lower radioactivity than natural uranium) in one sample near the LANL perimeter.

LANL demonstrated full compliance with all Clean Air Act requirements and met all permit reporting requirements and deadlines. One permit deviation regarded a calculation method that greatly overestimated emissions and NMED agreed the calculation needed to be changed. Emissions of criteria pollutants (nitrogen oxides, sulfur oxides, carbon monoxide, particulate matter, volatile organic compounds, and hazardous air pollutants) from 2004 through 2008 are very similar and remained relatively constant. In 2008, the TA-3 power plant and boilers located across the Laboratory were the major contributors of nitrogen oxides, carbon monoxide, and particulate matter. Science research and development activities were responsible for most of the volatile organic compound and hazardous air pollutant emissions.

Air monitoring 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) continued at one White Rock and one Los Alamos location. The annual averages at both locations for PM-10 was about 14 micrograms (μg)/m^3 and about 8 μg/m^3 for PM-2.5 and were mostly caused by natural dust and wildfire smoke. These averages are the same as measured in 2007 and are 28% and 53% of the EPA standards, respectively. In addition, the 24-hour maxima for both PM-10 and PM-2.5 at all three locations did not exceed 35% and 26% of the respective EPA standards.

- ***As in previous years, PM-10 and PM-2.5 particulate measurements in ambient air were well below EPA standards.***
- ***Most of the dust measured by the PM-10 and PM-2.5 samplers is from natural sources such as dust and wildfire smoke.***

The Laboratory analyzed air filter samples from 36 sites for beryllium. These sites are located near potential beryllium sources at LANL and in nearby communities. Beryllium air concentrations for 2008 were similar to those measured in recent years and are equal to or less than 2% of the National Emission Standard for Hazardous Air Pollutants (NESHAP) standard. Past studies closely correlated beryllium concentrations with aluminum concentrations, which indicates that all measurements of beryllium are from naturally occurring beryllium in re-suspended dust.

Groundwater Monitoring

Groundwater at the Laboratory occurs as a regional aquifer (water-bearing rock capable of yielding significant quantities of water to wells and springs) at depths ranging from 600 to 1,200 feet 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.

- ***In general, alluvial and intermediate groundwater quality at LANL continues to improve as a result of past efforts that have eliminated outfalls, reduced the quantity of discharges, and improved the quality of discharges.***
- ***Contamination may be discovered in additional locations, however, as groundwater characterization continues.***

In 2008, LANL installed 10 alluvial monitoring wells, three intermediate monitoring wells, and six regional monitoring wells. The alluvial wells were installed in Pajarito Canyon as part of the Pajarito Canyon investigation. Wells SCI-2, R-35a, R-36, and R-43 were installed in Sandia Canyon as part of the ongoing chromium contamination investigation.

Regional well R-42 was installed in Mortandad Canyon as part of the same investigation. Intermediate aquifer wells R-25b and R-25c were installed adjacent to existing well R-25, a 9-screen completion, in the western side of LANL to replace screens 1 and 3, respectively. Regional wells R-38 (Cañada del Buey) and R-39 (Pajarito Canyon) were installed to augment the existing groundwater-monitoring network around MDAs G, H, and L.

- *LANL detected chromium contamination in the regional aquifer under one canyon at concentrations 16 times the NM Groundwater Standard and under an adjacent canyon at 46% of the standard.*
- *The contamination is likely the result of cooling tower discharges containing chromate from the late 1950s to early 1970s.*
- *No drinking water wells have been affected by the chromium contamination.*

Monitoring network well assessments conducted in all of the Pajarito Plateau watersheds in 2007 and 2008 determined the adequacy of wells in each watershed for producing representative groundwater quality and the need for additional wells. As part of these assessments, we identified the existing wells that could be adequate if rehabilitated. We rehabilitated two wells in 2007, three in 2008, and two will be rehabilitated in 2009. Rehabilitation involves both active cleaning of the well, redevelopment of conditions near the screens, and conversion to a well with fewer screens and a different sampling system.

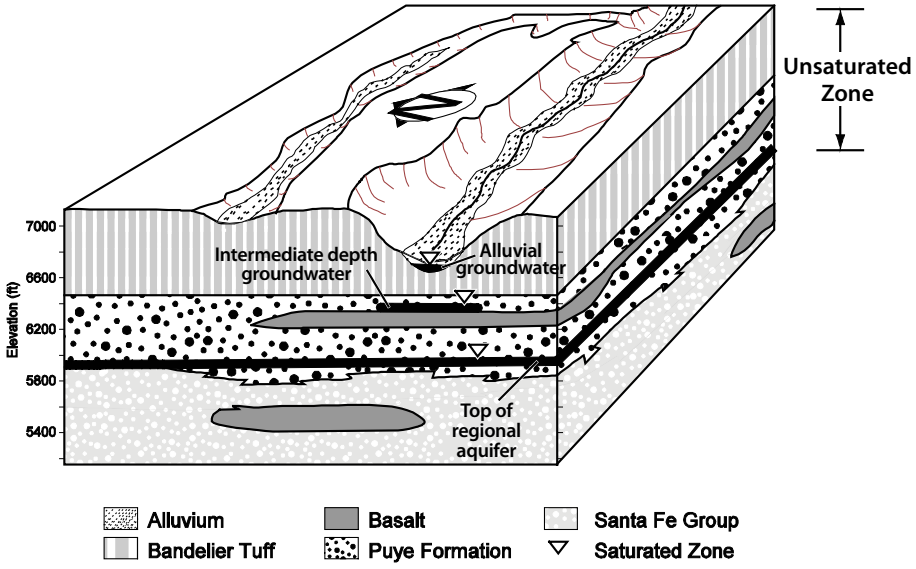


Figure ES-3. Illustration of geologic and hydrologic relationships in the Los Alamos area, showing the three modes of groundwater occurrence.

Laboratory contaminants have affected deep groundwater, including intermediate perched zones and the regional aquifer, primarily through liquid effluent disposal. Since the early 1990s, the Laboratory has significantly reduced both the number of industrial outfalls (from 141 to 15 active) and the volume of water released (by more than 86%). From 1993 to 1997, total estimated average release was 1,300 million gal./yr; in 2006 through 2008, the annual releases were 222 million gal., 178 million gal., and 158 million gal., respectively. All discharges in 2008 met applicable federal and state standards except for minor exceedances of pH or residual chlorine on six occasions. Where Laboratory contaminants are found at depth, the setting is either a canyon where alluvial groundwater is usually present (perhaps because of natural runoff or Laboratory effluents) or a location where large amounts of liquid effluent have been discharged (e.g., Mortandad Canyon and upper Sandia Canyon). During 2008, LANL received and evaluated almost 198,000 analytical results for groundwater wells alone. Table ES-3 summarizes contaminants detected in portions of the groundwater system.

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

Chemical	On-Site	Off-Site	Significance	Trends
Tritium	Intermediate groundwater in Mortandad Canyon	No	Not used as a drinking water supply	Slight decline over four years of sampling
Strontium-90	Alluvial groundwater in DP/Los Alamos and Mortandad Canyons	No	Not used as a drinking water supply; has not penetrated to deeper groundwater	Mainly fixed in location; some decrease due to effluent quality improvement
Perchlorate	Alluvial, intermediate, and regional groundwater in Mortandad Canyon; intermediate in Los Alamos Canyon; regional aquifer in Pueblo Canyon	Yes, in Pueblo Canyon	Reflects past outfall discharges that have ceased	Decreasing in Mortandad Canyon alluvial groundwater as effluent quality improves; insufficient data for other groundwater
Chloride, total dissolved solids	Alluvial groundwater in Pueblo, DP, Sandia, Mortandad, Pajarito Canyons, intermediate groundwater near TA-3 main warehouse and in Sandia Canyon	Yes, in Pueblo Canyon	May be caused by road salt in snowmelt runoff, except intermediate groundwater in Sandia Canyon	Values generally highest in winter or spring samples
Nitrate	Alluvial and intermediate groundwater in Pueblo and lower Los Alamos Canyons, regional groundwater in Sandia Canyon, and Mortandad Canyon	Yes, in Pueblo and Los Alamos Canyons	In Pueblo and lower Los Alamos Canyons, result may be due to Los Alamos County's Bayo Sewage Treatment Plant; otherwise due to effluent discharges	Generally steady
Fluoride	Intermediate groundwater in Pueblo Canyon, alluvial groundwater in DP and Mortandad Canyons	Yes, in Pueblo Canyon	Result of past effluent releases; not affecting drinking water supply wells	Slow decrease in concentration due to effluent quality improvement
Fluoride, uranium, nitrate, TDS	No	Yes, Pine Rock Spring, Pueblo de San Ildefonso	Water quality apparently affected by irrigation with sanitary effluent at Overlook Park	Steady over several years
Boron	Intermediate groundwater in Cañon de Valle	No	Not used as drinking water supply; limited in extent	Generally stable, seasonal fluctuations
Barium	Alluvial groundwater in Cañon de Valle and Water Canyon, Pajarito, and Mortandad Canyons	No	Not used as drinking water supply; limited in extent	Generally stable, seasonal fluctuations

Table ES-3 (continued)

Chemical	On-Site	Off-Site	Significance	Trends
Chromium	Regional aquifer in Sandia and Mortandad Canyons, intermediate groundwater in Mortandad Canyon	No	Found in regional aquifer above groundwater standards; not affecting drinking water supply wells; source eliminated in 1972.	Fairly steady over four years
Dioxane[1,4-]	Intermediate groundwater in Mortandad and Pajarito Canyons	No	Not used as drinking water supply; limited in extent	Fairly steady over three years in Mortandad; seasonal variation in Pajarito
Bis(2-ethylhexyl) phthalate	Several wells, including regional aquifer monitoring well R-42	No	Used in plastics and sometimes appears in samples from wells with new sampling equipment or recent drilling	None
Tetrachloroethene [1,1,1-], Trichloroethene	Alluvial and intermediate groundwater in Cañon de Valle	No	Not used as drinking water supply; limited in extent	Generally stable, seasonal fluctuations
Trichlorothane [1,1,1-]; dichloroethene[1,1-]	Intermediate groundwater near main warehouse	No	Not used as drinking water supply; limited in extent	Seasonally variable
RDX	Alluvial and intermediate groundwater in Cañon de Valle, intermediate groundwater in Pajarito Canyon	No	Not used as drinking water supply; limited in extent	Generally stable, seasonal fluctuations

Drainages that received liquid radioactive effluents in the past include Mortandad Canyon, Pueblo Canyon from its tributary Acid Canyon, and Los Alamos Canyon. Mortandad continues to receive discharges of treated effluent from the RLWTF. For the past eight years, this facility has met DOE radiological discharge standards in all but two months, met all NPDES requirements, and voluntarily met NM groundwater standards for fluoride, nitrate, and total dissolved solids in all but two weeks. Voluntary perchlorate limits were exceeded for a short time as explained below.

- ***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.***
- ***One drinking water supply well, Otowi-1, has been affected by levels of perchlorate at 16% of the EPA interim health advisory for drinking water. No water from this well is used by Los Alamos County.***

The contaminated alluvial and intermediate perched groundwater bodies are separated from the regional aquifer by hundreds of feet of dry rock, so infiltration from the shallow groundwater occurs slowly. As a result, less contamination reaches the regional aquifer than the shallow perched groundwater bodies, and impacts on the regional aquifer are small.

- *Beginning in 1999, LANL made significant upgrades to the RLWTF treatment system, which discharges into Mortandad Canyon.*
- *The facility has met all DOE radiological discharge standards and all NPDES (outfall) requirements for the past eight years.*
- *The facility has met NM groundwater standards for fluoride, nitrate, and total dissolved solids for seven years except for fluoride in two weekly composite samples in 2003.*

Water Canyon and its tributary Cañon de Valle formerly received effluents produced by high explosives 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 many sanitary treatment plants but currently operates only one plant that discharges into Sandia Canyon.

The high explosive compound research department explosive (RDX) continued to be detected in the regional aquifer at Pajarito Canyon regional well R-18. The concentration was at 8% of the EPA tap water screening level.

The Laboratory detected hexavalent chromium and nitrate in several regional aquifer monitoring wells. The hexavalent chromium was found at eight and 16 times above the NM groundwater standard in two regional aquifer wells in Mortandad canyon and at 46% of the standard in a regional well in nearby Sandia Canyon (down from 70% in 2007). A new intermediate zone well in Sandia Canyon contains chromium at 11.2 times the standard and supports LANL's model for the path of the chromium contamination from Sandia Canyon downward and slightly south into the regional aquifer below Mortandad Canyon. Nitrate was 60% of the NM groundwater standard in three regional aquifer monitoring wells. Perchlorate was also above the NM screening level in two regional aquifer wells.

Naturally occurring uranium was the main radioactive element detected in the regional aquifer and is found in wells throughout the Rio Grande Valley. High concentrations of naturally occurring arsenic are also found in groundwater samples from some regional aquifer wells and springs. Many of the other metals found at high concentrations in groundwater samples at LANL result from well sampling and well construction issues rather than from LANL contamination.

One drinking water well in the Los Alamos area has been impacted by past Laboratory discharges of perchlorate. Well O-1 in Pueblo Canyon contains perchlorate at up to 16% of the EPA interim health advisory for perchlorate in drinking water of 15 µg/L. This well is not used by Los Alamos County for drinking water supply. Perchlorate is detected in most groundwater samples analyzed across northern NM. Naturally occurring perchlorate concentrations range from about 0.1 µg/L to 1.8 µg/L. Water samples from most LANL locations show low perchlorate concentrations in this range, but samples from Mortandad Canyon alluvial and intermediate groundwater show values near or above the NM Consent Order screening level of 4 µg/L and the EPA interim health advisory level of 15 µg/L. Due to treatment upgrades, the concentration of perchlorate in discharge from the RLWTF dropped to an undetectable level in 2002. However, for a three-month period in early 2008, the ion exchange resin became spent and levels averaged between 2.6 and 8.0 µg/L. After replacing the resin, levels returned to below detection level. No effects on downstream surface or ground water concentrations were seen. Perchlorate levels below the facility outfall have been steadily decreasing in the alluvial groundwater since 2000.

- *Polychlorinated biphenyls (PCBs) are often measured in storm water in Sandia and Los Alamos Canyons above screening levels.*
- *Radioactive elements from past Laboratory operations are being transported by runoff events. All radionuclide levels are well below applicable guidelines or screening levels.*
- *PCBs, radionuclides, and other contaminants adsorb onto sediment particles and thus overall water concentrations can be reduced by slowing the stream flows, reducing erosion, and allowing suspended sediment to settle out.*

The intermediate groundwater in various locations shows localized levels of tritium, organic chemicals (RDX, chlorinated solvents, dioxane[1,4-]), and inorganic chemicals (hexavalent chromium, barium, boron, perchlorate, fluoride, and nitrate) from Laboratory operations.

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

The Laboratory uses federal and state drinking water and human health standards as "screening levels" to evaluate radionuclide concentrations in all groundwater, even though many of these standards only apply to drinking water. Only in the alluvial groundwater in portions of Mortandad and DP/Los Alamos Canyons does the total radionuclide activity from LANL discharges exceed the guidance that is applicable to drinking water (4 mrem/yr). This is mainly due to the presence of strontium-90. The maximum strontium-90 concentrations in Mortandad Canyon and DP/Los Alamos Canyon alluvial groundwater were also above the EPA's drinking water standard though this water is not used for drinking water supply.

Watershed Monitoring

Watersheds that drain LANL property are dry for most of the year. Of the more than 80 miles of watercourse, approximately two miles are naturally perennial and approximately three miles are perennial water created by effluent discharges (most notably in upper Sandia Canyon). Storm water runoff occasionally extends across the Laboratory but is short-lived. The surface water within the Laboratory is not a source of municipal, industrial, or irrigation water, though wildlife does use the water. It is not a source of livestock watering west of NM route 4 because there are no livestock in this area.

Occasional floods can redistribute sediment downstream. None of the streams within the Laboratory boundary average more than one cubic foot per second (cfs) of flow annually. It is unusual for the combined mean daily flow from all LANL canyons to be greater than 10 cfs, although two storms in 2008 resulted in an estimated combined mean daily runoff from LANL of about 18 cfs on January 28 and 29 (a rain-on-snow event) and 15 cfs on August 4. By comparison, the average daily flow in the Rio Grande at Otowi Bridge during those events was 774 and 970 cfs, respectively, or approximately 50 to 65 times higher.

Total runoff leaving the Laboratory in 2008 measured at downstream gages in the canyons was estimated at about 197 acre-feet (ac-ft) of which about 35 ac-ft was from the rain-on-snow event in January, 118 ac-ft from other snowmelt runoff, and 44 ac-ft from storm water runoff in the summer and early fall. In addition, approximately 130 ac-ft of effluent released from the Los Alamos County wastewater treatment plant (WWTP) is estimated to have passed the eastern LANL boundary in Pueblo Canyon. The volume of storm water runoff in 2008 was the least since 1995, the first year for which runoff estimates are available for all the canyons.

On July 4 and 5, 2008, a break in a fire-suppression water line at TA-21 released approximately 3.9 million gallons of potable water (1.3 ac-ft) that flowed over SWMU 21-027(a), eroding sediment on the canyon wall and transporting sediment into the canyon bottom. Runoff events in August 2008 transported some of this sediment downstream to the Los Alamos Canyon weir.

The overall quality of most surface water in the Los Alamos area is good, with low levels of dissolved solutes. Of the more than 100 analytes measured in sediment and surface water within the Laboratory, most are at concentrations far below standards and screening levels. However, nearly every major watershed indicates some effect from Laboratory operations, often for just a few analytes. Table ES-4 lists the locations of Laboratory-impacted surface water. All radionuclide levels are well below applicable guidelines or standards (Table ES-5).

Laboratory activities have caused contamination of sediment in several canyons, mainly because of past industrial effluent discharges. These discharges and contaminated sediment also affect the quality of storm water runoff, which carries much of this sediment during short periods of intense flow. In some cases, sediment contamination is present from Laboratory operations conducted more than 50 years ago. However, all measured sediment contaminant levels are below screening levels for recreational uses.

Table ES-4
Where Can We See LANL Impacts on Surface Water that Result in Values Near or Above Screening Levels?

LANL Impact	On-Site	Off-Site	Significance	Trends
Specific radionuclides	No	No	Exposure potential is limited. Los Alamos Canyon surface water at 40% of DOE biota concentration guide for year; dose mainly from radium-226 that is of natural origin	Steady
Gross alpha radioactivity	Mortandad, Pueblo, and Los Alamos Canyons	No	57% of surface water results greater than screening level. Major source is naturally occurring radioactivity in sediments, except in Mortandad, Pueblo, and Los Alamos Canyons where there are LANL contributions	Steady
Copper	Multiple watersheds	No	From site monitoring locations or tributary drainages. All samples from major canyons were below screening level. Origins uncertain; probably several sources	Steady
Lead	Threemile Canyon	No	Elevated in one sample collected at a site monitoring area in Threemile Canyon	Steady
Selenium	Water Canyon	No	Elevated in one sample from TA-11 during major storm, not detected in next sample from this location.	Steady
Zinc	Acid, Los Alamos, Mortandad, Sandia, Ten Site, Twomile Canyons	No	Elevated zinc only from site monitoring areas or tributary drainages. All samples from major canyons were below screening level.	Steady
Chromium	Cañada del Buey, Los Alamos Canyon, Sandia	No	Above screening level in three nonfiltered samples and associated with suspended sediment. Filtered samples well below screening level.	Steady
Cyanide	Acid, Los Alamos, Mortandad, Pueblo, Sandia Canyons	No	Above screening level in 12 samples. Non-LANL source in Pueblo Canyon, possibly associated with burned areas.	Steady
Silver	Cañon de Valle, other canyons	No	In Cañon de Valle, from known former photography processing laboratory.	Steady
Polychlorinated biphenyls (PCBs)	Many canyons	No	Above screening levels. Wildlife exposure potential in Sandia Canyon.	Steady
Semi-volatile organic compounds (SVOCs)	Water, Pajarito, Sandia Canyons	No	Infrequently detected; commonly derived from runoff from developed areas.	Steady
RDX	Cañon de Valle	No	Confined to LANL; subject of focused investigations	Steady

Table ES-5
Estimated Annual Average Non-Filtered Surface Water Concentrations of Radionuclides in Selected Canyons Compared with the Biota Concentration Guides (pCi/L)

Radionuclide	BCG[a] (pCi/L)	Acid Canyon above Pueblo Canyon (pCi/L)	Lower Pueblo Canyon (pCi/L)	DP Canyon below TA-21 (pCi/L)	Los Alamos Canyon above DP Canyon (pCi/L)	Los Alamos Canyon above Weir (pCi/L)	Los Alamos Canyon near Rio Grande (pCi/L)	Mortandad Canyon below Effluent Canyon (pCi/L)	Maximum percent of BCG
Am-241	400	0.02	0.08	0.02	0.4	1.0	0.1	4	1%
Cs-137[b]	20,000	ND[c]	ND	ND	ND	1.2	ND	18	0.09%
H-3 (tritium)	300,000,000	2.7	1.2	38	ND	ND	1.1	580	<0.01%
Pu-238	200	<0.01%	0.01	ND	0.5	0.1	0.02	2.0	1%
Pu-239/240	200	0.5	2.0	0.03	11	1.3	3.0	3.2	6%
Ra-226	4	0.03	0.5	0.01	0.3	0.4	0.6	0.9	22%
Sr-90[b]	30,000	0.1	0.3	94	0.2	1.5	ND	1.1	0.3%
U-234	200	0.05	0.6	1.1	0.7	0.8	1.1	1.2	0.6%
U-235/236	200	ND	ND	ND	0.03	0.06	0.07	0.1	0.07%
U-238	200	0.02	0.5	0.4	0.6	0.5	1.0	1.1	0.5%

[a] BCG = DOE Biota Concentration Guides

[b] The BCG for cesium-137 and strontium-90 are site-specific modified BCGs

[c] ND = not detected in 2008

Consistent with previous years, most surface water samples in 2008 had gross alpha radiation greater than the surface water standard of 15 pCi/L for livestock watering. Of the 195 non-filtered samples analyzed from the Pajarito Plateau, 73% exceeded 15 pCi/L including samples from sites with no upstream releases of radionuclides from Laboratory activities (such as Guaje Canyon). Laboratory impacts are relatively small and the majority of the alpha radiation in surface water on the plateau is due to the decay of naturally occurring isotopes in sediment and soil carried in storm water runoff from uncontaminated areas. This is supported by the generally positive correlation between gross alpha radiation and suspended sediment in non-filtered surface water samples.

- ***The highest concentrations of several radionuclides in surface water samples were measured in Mortandad Canyon downstream from the TA-50 RLWTF outfall. All measurements are consistent with previous years and are below standards and screening levels.***
- ***The highest concentrations of most radionuclides in sediment, at levels slightly higher than the previous year, were obtained from one flood-associated fine-grained sample from the sediment retention basin behind the Los Alamos Canyon weir, but all are below recreational screening levels.***

We measured the highest concentrations of several radionuclides in surface water samples in Mortandad Canyon downstream from the TA-50 RLWTF outfall, including americium-241, cesium-137, plutonium-238, and tritium. The highest concentration of plutonium-239/240 was measured in Los Alamos Canyon upstream from DP Canyon and downstream from the site at TA-21 that experienced erosion during a potable water line break on July 4 and 5, 2008. We measured the highest concentration of strontium-90 in DP Canyon downstream from a former radioactive treatment plant effluent outfall at TA-21. We measured the highest concentrations of uranium-234, uranium-235, and uranium-238 at a site-monitoring area location in the Potrillo Canyon watershed below a firing site in TA-15. With the exception of the plutonium-239/240 in Los Alamos Canyon, all the other measurements discussed above are consistent with previous years.

The highest concentrations of most radionuclides in sediment were obtained in one fine-grained sample from the sediment retention basin behind the Los Alamos Canyon weir, including the highest values for americium-241, cesium-137, plutonium-239/240, and strontium-90. The sampled sediment was a thin layer (maximum of 7 cm thick) that was probably deposited by a flood in August 2008 which remobilized sediment associated with the potable water line break at TA-21. The highest concentration of thorium-228 was also measured in a fine-grained sample from the retention basin, the only result for this isotope above the LANL sediment background value (although less than concentrations in Bandelier Tuff). Except for cesium-137, these values are higher than previous results from the retention basin (LANL 2008g) but are below recreational screening levels.

The types of organic chemicals that we analyzed for varied depending on the sampling location and included the following suites: dioxins and furans, explosive compounds, herbicides, pesticides, PCBs, semi-volatile organic compounds (SVOCs), total petroleum hydrocarbons-diesel range organics (TPH-DRO), and volatile organic compounds (VOCs). Under the Federal Clean Water Act §303(d) list, the state of NM has listed parts of three canyons within LANL as impaired for PCBs in the water column: Los Alamos, Pueblo, and Sandia Canyons. The most commonly detected PCBs were Aroclor-1254 and Aroclor-1260, which were detected in 7% and 8% of the samples, respectively. Two measurements were also reported for Aroclor-1242. All samples with detected PCBs had concentrations above the water screening level of 0.00064 µg/L, including site monitoring areas and canyon bottom locations in the watersheds of DP, Los Alamos, Mortandad, Sandia, and Ten Site Canyons. We measured the highest PCB concentrations in storm water at an site monitoring area (SMA) in the Los Alamos Canyon watershed. In 2001, the Laboratory excavated PCB-contaminated soil at a former transformer storage area in the Sandia Canyon watershed, and in 2008, we began an interim measure to address the transport of PCBs in storm water in Los Alamos and Pueblo Canyons. Monitoring results show no measurable levels of PCBs from LANL in the Rio Grande.

We detected no herbicides in any surface water samples.

Concentrations of many metals are elevated in Rio Grande and Cochiti Reservoir bottom sediment relative to background levels in Pajarito Plateau sediment, which is likely due to different background source rock types along the Rio Grande. For example, the highest concentrations in 2008 were obtained from sediment samples from Abiquiu Reservoir for 11 inorganic chemicals (arsenic, barium, cadmium, calcium, cobalt, copper, iron, magnesium, nickel, vanadium, and zinc), demonstrating regional differences in sediment background and non-LANL sources. Five inorganic chemicals have their highest concentrations in Cochiti Reservoir bottom sediment (aluminum, beryllium, manganese, potassium, and selenium), but these are also elevated in Abiquiu Reservoir relative to Pajarito Plateau samples.

- ***Concentrations of many metals are elevated in Rio Grande and Cochiti Reservoir bottom sediment relative to background levels in Pajarito Plateau sediment, but these may largely or entirely reflect different background conditions along the Rio Grande than on the plateau or upriver sources.***
- ***Monitoring results show no measurable effects of PCBs from LANL in the Rio Grande.***

We obtained PCB congener data from 10 sediment samples along the Rio Grande in December 2008, five samples were taken upriver from Los Alamos Canyon and downriver from Mortandad Canyon, below White Rock, collected when the river was at low-water conditions. The congener data allow evaluation of similarities or differences in the PCBs present above and below the primary LANL sources and also allows further comparison with PCBs present in LANL canyons. PCB congeners were detected in all of the upriver samples and four of the downriver samples. The mixtures of PCB congeners upriver and downriver from LANL sources are essentially identical, but different than the homolog signature from a potential LANL source (Sandia Canyon). These congener data therefore show no measureable evidence of LANL contributions to PCBs along the Rio Grande.

Soil Monitoring

Table ES-6 summarizes soil sampling results. We conduct large-scale soil sampling within and around the perimeter of LANL every three years. The last soil sampling event was in 2006. In general, results of that investigation showed that soil samples from on-site and perimeter areas contained radionuclides at very low (activity) concentrations and most were either not detected or below regional statistical reference levels (RSRLs) (equal to the average plus three standard deviations). The few samples with radionuclide concentrations above the RSRLs were collected near known or expected areas of contamination. These samples are below residential screening levels and thus do not pose a potential unacceptable dose to the public.

Table ES-6
Where Can We See LANL Impacts on Mesa-Top Surface Soil that Result in Values Near or Above Background or Screening Levels?

LANL Impact	On-Site	Off-Site	Significance	Trends
Tritium	Yes, above background at some sites, particularly at TA-54, Area G	No	Far below residential screening levels	Consistently detected in the south sections of Area G, but not increasing
Plutonium-239/240	Yes, above background along State Road 502 at TA-73 (downwind of TA-21) and at TA-54, Area G	Yes, above background along State Road 502 on the west side of the airport (downwind of TA-21) and at LANL/Pueblo de San Ildefonso boundary	Far below residential screening levels	Plutonium-239/240 downwind of TA-21 is highly variable from sample to sample but is generally not increasing. Also, it is consistently detected on the north, northeast, and eastern sections of Area G, mostly not increasing
Other Radionuclides	Mostly depleted uranium at DARHT	Mostly no	Far below residential screening levels	Uranium-238 at DARHT increased through 2006 but decreased in 2007 likely because of the use of steel containment vessels
Inorganic Chemicals	Few detections	Few detections	Far below residential screening levels	Steady
PCBs	Most samples below detection limits. Aroclors 1254 and 1260 detected at Los Alamos Weir	No	Far below residential screening levels	Steady at Los Alamos Canyon weir
High Explosives	Not detected	No	Minimal potential for exposure	None
SVOCs	One sample along State Road 502 at TA-73 in 2006 detected SVOCs	No	Far below residential screening levels; from asphalt (not a LANL source)	None

Although large-scale soil sampling was not conducted in 2008, we annually collect soil samples from two locations on the Pueblo de San Ildefonso land downwind of TA-54, Area G. Radionuclides and metals in these soil samples were below background or near background and were consistent with levels measured in previous years.

- *Soil samples from most off-site locations show radionuclides and metals have not increased over the past years and are mostly at background levels.*
- *Soil samples from most on-site locations show no increases and some decreases of radionuclides and metals from previous years.*

We sampled other soil monitoring sites routinely in 2008 from around the perimeter of Area G and DARHT. Soil samples from around the perimeter of Area G contain above-background concentrations of tritium, americium-241, plutonium-238, and plutonium-239/240. The highest levels of tritium around Area G were detected at the southern end and the highest levels of the americium and plutonium were detected around the northern, northeastern, and eastern sections. Americium-241, plutonium-238, and plutonium-239/240 in soil along the northern, northeastern, and eastern sections of Area G are slightly elevated but consistent with data from previous years, though all levels are well below residential screening levels used to trigger investigations and decrease rapidly with distance from Area G. At DARHT, tritium and uranium-238 were elevated in only one sample from near a firing site but well below residential screening levels. Other constituents such as PCBs, high explosives, and SVOCs were not analyzed in 2008 but were not detected in 2007.

Foodstuffs Monitoring

In 2008, the foodstuffs monitoring focused on the sampling of fish in the Rio Grande and Chama River. We collected fish from three locations upstream (background) of LANL (Abiquiu Reservoir on the Rio Chama and from reaches near Lyden and Pueblo de San Ildefonso on the Rio Grande) and from three locations on the Rio Grande downstream of LANL (at the confluence of Los Alamos Canyon, at the confluence of Sandia/Mortandad Canyons, and from Cochiti Reservoir). We collected two types of fish for study based on their principal feeding strategy: top feeders (or predator fish) and bottom feeders. Fish were analyzed for radionuclides, metals, and PCB congeners. Radionuclide concentrations, for the most part, are similar to past fish surveys and show either no detections or were below background levels. Metals were also not elevated except for mercury, which is generally higher in upstream (above LANL canyons) than downstream fish, indicating no measureable LANL impact. Mercury levels exceed EPA screening levels and are near or above Food and Drug Administration consumption restrictions. Likewise, PCB concentrations are also generally higher directly upstream than downstream, indicating that LANL is not a significant source of PCBs to the Rio Grande. Also, based on the congener and homolog data, the PCBs in fish upstream and downstream of LANL are from the same general source. Fish collected from all upstream and downstream locations exceeded EPA consumption restrictions for PCBs to varying degrees.

- *Both mercury and PCB levels in fish from upstream locations are generally slightly higher than downstream, indicating no measureable LANL contributions.*
- *The types of PCBs are the same in upstream and downstream fish, indicating the same general source.*
- *Both mercury and PCBs in Rio Grande fish are near or above EPA and/or Food and Drug Administration consumption advisory levels.*

Biota Monitoring

Table ES-7 summarizes biota sampling results. In plants collected around Area G, only tritium and plutonium were detected in a few samples closest to the boundary fence and adjacent to known sources of these radionuclides.

Table ES-7
Where Can We See LANL Impacts on Foodstuffs and Biota that Result in Values Near or Above Background or Screening Levels?

Media	LANL Impact	On-Site	Off-Site	Significance	Trends
Wild edible plants	Radionuclides	Tritium in plants from Cañada del Buey	Above background concentrations for strontium-90 in plants from Mortandad Canyon on Pueblo de San Ildefonso land in 2006	Far below screening level; higher strontium-90 in wild plants is a function of low calcium in the soil and not a result of increased contamination levels	Steady
	Inorganic chemicals	No	No	No data	Steady
Native vegetation	Radionuclides	Mostly tritium and plutonium-239/240 at Area G; and depleted uranium at DARHT	No	Far below screening levels	Tritium and plutonium-239/240 are steady at Area G; uranium-238 in trees at DARHT increased through 2006, decreased in 2007
	Inorganic chemicals	Few detections: arsenic in one plant sample at DARHT	No	No	Steady for most metals
Small mammals, bees, and birds	Radionuclides	Depleted uranium at DARHT; some radionuclides in biota upstream of the Los Alamos Canyon Weir and the Pajarito Canyon Flood Retention Structure	No	Far below screening levels	Steady for most radionuclides
	Inorganic chemicals	Some detections in a bird at DARHT	No	One sample out of two	Steady
	PCBs	Detected in mice at the Los Alamos Canyon weir	No	Far below screening levels	Steady
	Species diversity	Abundance and species diversity of birds at DARHT during operations are similar to baseline	None collected	No stress to birds at DARHT	Steady

- *Vegetation at Area G contained elevated levels of radionuclides near known sources.*
- *Biota samples at DARHT contained depleted uranium but the levels were lower than previous years probably because of new contained testing measures.*
- *Biota and sediment samples collected above the Los Alamos Canyon Weir contained slightly elevated levels of some radionuclides and PCBs but far below screening levels.*

In vegetation around the DARHT facility, no significantly elevated levels of radionuclides were detected; the levels are lower than in previous years which may be because testing is now conducted in metal vessels instead of in the open. Mice at DARHT were not elevated in any radionuclides. Bees contained slightly higher levels of barium and copper than previous years. Bird monitoring near the DARHT facility showed a return to baseline (pre-operational) levels of number of birds, number of bird species, and bird diversity and evenness.

Upgradient of the Los Alamos Canyon weir, we measured slightly elevated levels of plutonium, uranium, strontium, and americium in plants. Aroclor 1260 (a type of PCB) was detected in both sediment and mice. The concentrations of all radionuclides, metals, and PCBs in all biotic and abiotic media collected upgradient of the weir were below residential screening levels and do not pose a potential unacceptable dose from radionuclides or risk from non-radionuclides to humans (sediment) or to the biota sampled. Above the Pajarito Canyon Flood Retention Structure, no contaminants are significantly elevated.

Environmental Restoration Program

Corrective actions proposed and/or conducted at LANL in 2008 follow the requirements of the NMED Consent Order. The goal of the investigation efforts is to ensure that waste and contaminants from past operations do not threaten human or environmental health and safety. The investigation activities are designed to characterize SWMUs, AOCs, consolidated units, aggregate areas, and watersheds. The characterization activities conducted include surface and subsurface sampling, drilling boreholes, geophysical studies, and installation of monitoring wells. Corrective action activities performed included the removal of structures (e.g., buildings, septic systems, sumps, and drainlines), excavation of contaminated media, and confirmatory sampling. These activities defined the nature and extent of contamination and determined the potential risks and doses to human health and the environment.

- *Characterization and cleanup of sites contaminated or potentially contaminated by past LANL activities follow the Consent Order.*
- *LANL submitted 24 investigation work plans and 22 investigation reports to NMED in 2008.*
- *Thirteen sites were granted certificates of completion.*

Accomplishments include the completion of investigation activities, approvals of proposed investigation activities, and approvals of the work completed at some sites. Numerous sampling activities were conducted in 2008 and included sampling of many locations in the area of the original Laboratory technical areas in Los Alamos townsite; borehole sampling and excavation of soil at former firing sites and explosives development buildings; sampling and digging of test pits in Bayo Canyon where radioactive materials were used; sampling of former septic systems that served abandoned or decommissioned buildings; installing and testing vapor extraction systems near the TA-54 Area G waste storage site; sampling of sediment deposits in the Pajarito Canyon watershed; studying biota including sampling and nest box monitoring in Sandia Canyon; sampling of sediment in Cañada del Buey; and removal of soil and tuff at TA-21. After results are received and interpreted, LANL will document these investigation activities in reports to the NMED. During 2008, environmental restoration activities collected more than 3,400 samples from more than 920 locations and requested more than 423,000 analyses or measurements on these samples.

Under the Consent Order, LANL submitted 24 new or revised investigation work plans and 22 investigation reports to NMED. Three historical investigation reports were also submitted as companion documents to some work plans. In 2008, NMED approved a total of 15 investigation work plans and 9 investigation reports, most with modifications or directions. A total of 13 SWMUs and AOCs were granted certificates of completion, which signifies that the investigations and any necessary cleanups have been completed. In addition, LANL submitted to NMED 24 periodic monitoring reports on sampling activities, 22 reports on groundwater monitoring well activities, and four miscellaneous reports or plans.