ERID-228664
EP2012-5251

Los Alamos National Laboratory
Environmental Report 2011

Los Alamos NATIONAL LABORATORY EST. 1943

LA-14461-ENV
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Los Alamos National Laboratory Governing Policy for Environment

- We are committed to act as stewards of our environment to achieve our mission in accordance with all applicable environmental requirements.
- We set continual improvement objectives and targets, measure and document our progress, and share our results with our workforce, sponsors, and public.
- We reduce our environmental risk through legacy cleanup, pollution prevention, and long-term sustainability programs.

LA-14461-ENV
Issued September 2012

Los Alamos National Laboratory Environmental Report 2011

Environmental Protection Division
505-667-2211

Environmental Data and Analysis Group
505-665-0808

Environmental Stewardship Group
505-665-8855

Water Quality and RCRA Group
505-665-0666

Environmental Programs Directorate
505-606-2337

Corrective Actions Program
505-665-3388

Engineering & Technology
505-667-3460

Los Alamos
NATIONAL LABORATORY
EST. 1943

Introduction

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 36-square-mile Laboratory is situated on the Pajarito Plateau, a series of mesas separated by deep east-to-west-oriented canyons. Mesa tops range in elevation from approximately 7,800 feet on the flanks of the Jemez Mountains to about 6,200 feet above the Rio Grande at White Rock Canyon. Most Laboratory and Los Alamos County 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, and as such, this report does the following:

- 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 Monitoring

The Laboratory monitors emissions, effluents, and environmental media to meet environmental compliance requirements, determine actions to protect the environment, and monitor the long-term health of the local environment. LANL monitoring includes the radiological ambient air sampling network (AIRNET); groundwater, soil, foodstuffs, and biota (plants and animals) sampling as far away as Dixon, NM (40 direct miles away); and sediment monitoring in watersheds crossing LANL and along the Rio Grande as far upriver as Abiquiu Reservoir and as far downriver as Cochiti Reservoir. LANL's environmental compliance and surveillance programs monitor for environmental hazards and impacts by regularly collecting samples and comparing results with previous results and applicable regulatory standards. During 2011, the Laboratory collected samples from air, water, soil, sediment, foodstuffs, and associated biota at approximately 1,800 locations (Table ES-1). Results for each of these monitoring programs are presented in Chapters 2 to 10 of this report. The Laboratory also works with and assists neighboring communities and pueblos in performing environmental monitoring.

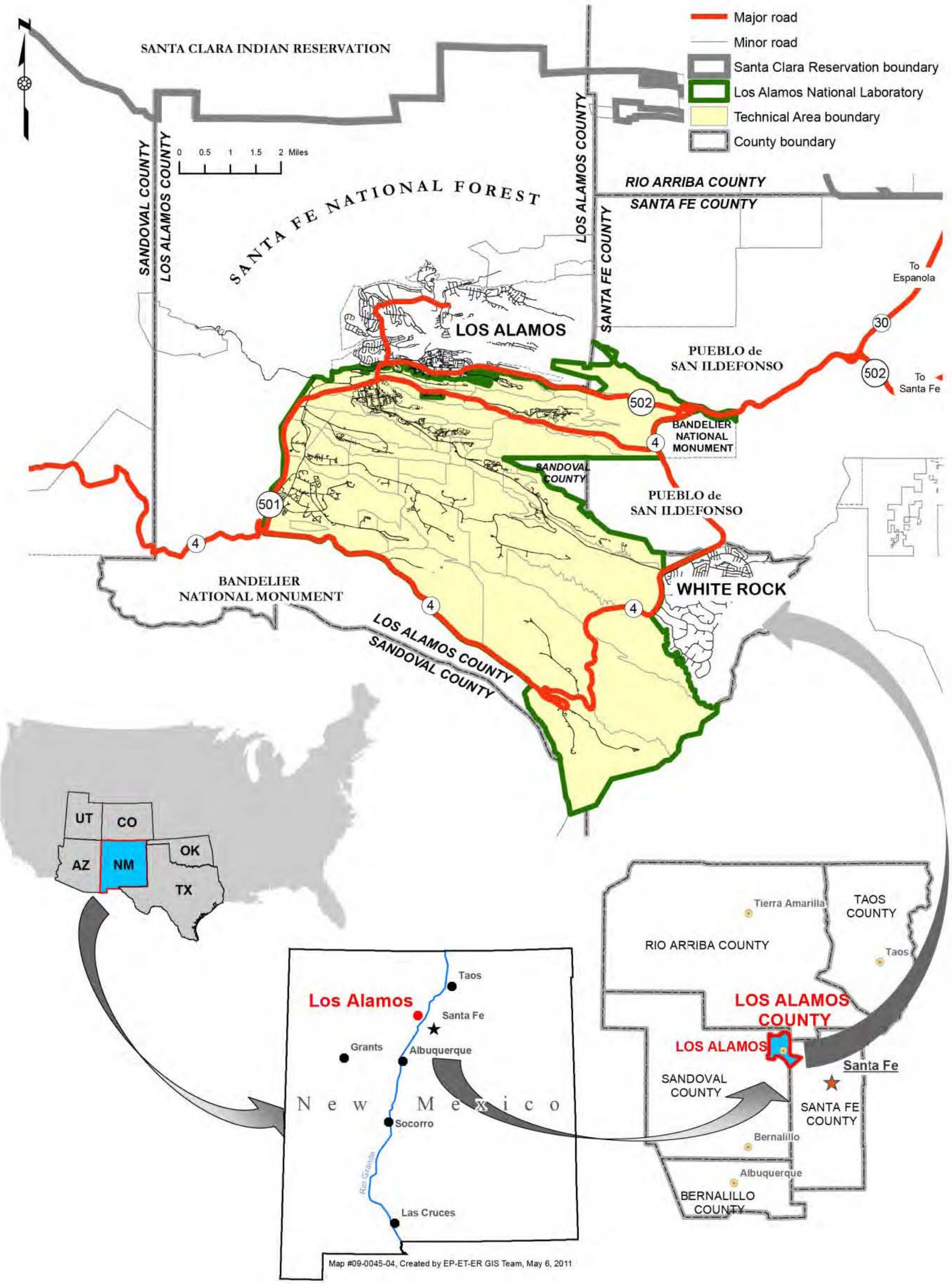

Figure ES-1 Regional location of Los Alamos National Laboratory.

Table ES-1
Approximate Number of Environmental Samples, Locations, and Analytes Collected in 2011

Sample Type or Media	No. of Locations	Frequency of Sampling[a]	No. of Analytes or Measurements
Ambient air	59	Biweekly	7,300[b]
Stack monitoring	28	Weekly	22,000
Biota	22	Annually	2,290
Routine soil surveillance sampling	25	Annually	820
Sediment	128	Annually	23,000
Foodstuffs	19	Annually	16,750
Groundwater	215	Quarterly/semi-annually/annually	162,130
National Pollutant Discharge Elimination System (NPDES) outfalls	11	Weekly	2,680
Surface water base flow	13	Quarterly/semi-annually/annually	4,420
Surface water storm runoff	129	Following rains	37,450
Neutron radiation	47	Quarterly	190
Gamma radiation	98	Quarterly	390
Environmental remediation soil/rock investigation sampling	987	Annually	244,260
Subsurface vapor monitoring	85	Monthly/quarterly/annually	121,040
Totals	**1,866**		**644,720**

Note: Not all the data counted in the table above are reported in this document. Totals include duplicate samples but do not include additional samples and results from the extensive quality assurance/quality control program, which are normally 10% to 20% more but can be over 60% more, depending on the media.

[a] Sampling frequency is location dependant, when more than one frequency is listed.

[b] Does not include particulate (in air) measurements made by four tapered element oscillating microbalance instruments that calculate particulate concentrations every half hour.

Environmental Protection Programs

The US Department of Energy (DOE) has established a series of orders directing each DOE site to implement sound stewardship practices that are protective of natural and cultural resources. These orders require the implementation of an Environmental Management System (EMS), a Site Sustainability Plan, Radiation Protection of the Public, and Radioactive Waste Management.

As part of its commitment to protect the environment and improve its environmental performance, LANL continued the implementation of its EMS pursuant to DOE Order 450.1A and the international standard from the International Organization for Standardization (ISO), ISO 14001:2004. The EMS is a continuous cycle of planning, implementing, evaluating, and improving processes and actions undertaken to achieve environmental missions and goals. In 2011 there was one routine surveillance external audit (in March) and two internal assessments of the LANL EMS program. A three-year cycle recertification external audit was held early in 2012 with no major findings and a determination to extend LANL's 14001:2004 certification.

Directorates at LANL annually identify the environmental impacts associated with their work scope, prioritize these risks for significance, and develop an Environmental Action Plan to manage or prevent those risks. Combined, all of the above activities composed the LANL EMS and supported the Laboratory in meeting several milestones during fiscal year (FY) 2011 (October 2010 to September 2011) and calendar year 2011. LANL identified six high-level objectives to support our goal of establishing excellence in environmental stewardship during FY11. These objectives and our FY11 accomplishments associated with them are presented in Table ES-2. The Laboratory maintained a high level of environmental compliance performance in FY11, completed a major environmental remediation project at Technical Area 21 (TA-21), performed multiple public involvement events, and maintained a fully compliant EMS.

Table ES-2
FY11 Environmental Objectives and Accomplishments

Objective	Example Accomplishments
Improve environmental and safety performance through improved integration and communication at the work level	LANL managers performed frequent management observation and verification (MOV) walkarounds in employee workspaces. Managers documented the results in LANL's new MOV Module to share information with others in the organization.
Reduce cost and increase efficiency and operating capacity through systematic implementation of pollution prevention	The Clean Fill Management database was established so that generators and users can efficiently transfer clean fill without costs related to disposal or procurement.
Reduce cost and increase efficiency and operating capacity through energy conservation and reductions in fuel, electricity, and water consumption	As reported in LANL's Strategic Sustainability Performance Plan (SSPP), LANL reduced its energy intensity by 12.9% since FY03 and its fleet petroleum usage by 6.7% since FY10.
Enhance workplace environment, safety, and security through implementation of Laboratory-wide cleanout activities to disposition unneeded equipment, materials, chemicals, and waste	In FY11, LANL disposed of over 3,500 kilograms of unwanted chemicals during cleanouts.
Ensure operational capacity through implementation of the NPDES Outfall Reduction Program by 2012	The US Environmental Protection Agency (EPA), which issues permits for industrial and sanitary wastewater discharges, approved the removal of four more outfalls from the Laboratory's permit. Only 11 outfalls remain.
Reduce long-term impacts, increase operational capacity, and ensure Laboratory sustainability through an integrated approach to site-wide planning and development	The Sanitary Effluent Reclamation Facility (SERF) treats effluent from LANL's sanitary wastewater plant to be used in various cooling towers at LANL. The effluent is cleaned to higher standards than even drinking water, and less groundwater needs to be pumped to provide water for the cooling towers. Less wastewater is generated because it can be reused in the cooling towers.

The Pollution Prevention 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.

The DOE required its subcontractors to publish Site Sustainability Plans as part of meeting the requirements set forth in its SSPP. The Laboratory published an FY12 Site Sustainability Plan, and Table ES-3 shows the Laboratory's performance status toward meeting the sustainability goals.

Table ES-3
Sustainability Performance Status

DOE/NNSA* Goal	Performance Status	Planned Actions & Contribution
28% Scope 1 and 2 greenhouse gas (GHG) reduction by FY20 from an FY08 baseline	Due to increased computing, LANL has increased GHG emissions by 3%.	LANL will pursue Renewable Energy Certificate (REC) purchases and explore renewable energy power purchase agreements.
30% energy intensity reduction by FY15 from an FY03 baseline	Due to efforts in footprint reduction and energy conservation, LANL has reduced energy intensity by 15% (12.9% without the REC off-set).	LANL will continue to pursue High Performance Sustainable Building implementation; lighting retrofits; heating, ventilation, and air conditioning recommissioning; building setback scheduling; outreach; and footprint reduction efforts.
Individual buildings or processes metering for 90% of electricity (by October 1, 2012); for 90% of steam, natural gas, and chilled water (by October 1, 2015) where life cycle cost effective. The site may also report on potable water and chilled water as applicable.	LANL has installed electric meters to account for 91% electricity at the building level.	LANL estimates a 25% completion rate for steam and a 5% completion rate for gas by the end of FY12. LANL will focus on installing DOE-funded thermal meters in FY12 and needs to identify the meter installations necessary to meet the SSPP goals.
Cool roofs, unless uneconomical, for roof replacements unless project already has Critical Decision (CD)-2 approval. New roofs must have thermal resistance of at least R-30.	All new roofs meet cool roof requirements. In FY 2011, LANL replaced 53,027 square feet of roof space meeting the cool roof requirements.	LANL standards currently implement cool roof requirements, and all new roofs currently meet this standard.
7.5% of annual electricity consumption from renewable sources by FY13 and thereafter (5% FY10–FY12)	LANL exceeded the 5% renewable energy goal. LANL purchased 45,571 RECs in FY11. The new annual request represents a 25% increase over previously contracted levels.	The landfill photovoltaic (PV) array will produce approximately 2,200 megawatt-hour (MWh) per year, and the Abiquiu low flow turbine will produce approximately 7,000 MWh per year (18,400 MWh with double credit for on-site production). The Laboratory used approximately 421,000 MWh in FY10, and the estimated percentage for federal on-site renewable energy is 4.4% once the PV is operational. LANL will support NNSA to renegotiate the Los Alamos County Electric Coordination Agreement to support further third party development of long-term renewable and carbon neutral energy on-site generation.
10% annual increase in fleet alternative fuel consumption by FY15 relative to an FY05 baseline	LANL has increased alternative fuel consumption by 82%, using FY05 as a baseline.	LANL will continue to purchase and use alternative fuel for security force vehicles. In addition, LANL has purchased B5 biodiesel blend for use in equipment and plans to increase the percentage of biodiesel within the blend over time.

*NNSA = National Nuclear Security Administration.

The Laboratory met all DOE public and biota dose limits, as low as reasonably achievable (ALARA) assessments, and clearance of real and personal property requirements during 2011.

Laboratory operations generate four types of radioactive wastes: low-level waste (LLW), mixed low-level waste (MLLW), transuranic (TRU) waste, and mixed TRU waste. (Waste definitions are provided in Appendix E, the glossary). MLLW is LLW that also contains a hazardous (Resource Conservation and Recovery Act [RCRA]-regulated) component, and mixed TRU waste is TRU waste with a hazardous component. Only LLW is disposed of at LANL; all other radioactive wastes are shipped off site for final treatment, if required, and disposal. All aspects of radioactive waste generation, storage, and disposal are regulated by DOE Order 435.1 and DOE Manual 435.1. The hazardous component of MLLW and mixed TRU wastes is also regulated under RCRA and the LANL Hazardous Waste Facility Permit. During FY11, eight Laboratory Facility Operation Directorates were approved to generate, treat, or dispose of radioactive waste. During FY11, 272 internal inspections were conducted at LANL generation, storage, treatment, and disposal facilities. Six findings were identified; corrective actions were implemented and closed out. The DOE Los Alamos Site Office participates as an observer of internal inspections to ensure continued compliance.

Compliance with State and Federal Regulations

The EPA and the New Mexico Environment Department (NMED) regulate Laboratory operations under various environmental statutes (e.g., Clean Air Act, Clean Water Act, etc.) through operating permits, construction approvals, and the Compliance Order on Consent (Consent Order). These permits are designed by the regulatory agencies to allow Laboratory operations to be conducted while ensuring that the public, air, land, soils, water, and biota are protected. The Laboratory's compliance performance is an assessment of our protection of the environment. Table ES-4 presents a summary of the Laboratory's status in regard to environmental statutes and regulations for 2011.

The federal and state laws regulate management of hazardous wastes based on a combination of the facility's status, the quantities of waste generated, and the types of waste management conducted by the facility. Certain operations require a hazardous waste facility permit, often called a RCRA permit. The LANL hazardous waste facility permit was initially granted in 1989 for storage and treatment operations and was renewed in 2010. All of the permits or approvals the Laboratory operates under are listed in Table ES-4.

- The Consent Order governs the Laboratory's environmental remediation. It specifies actions that the Laboratory must complete to characterize and remediate sites.
- In 2011, LANL installed one monitoring well in the perched/intermediate aquifer and five monitoring wells (with six screens) in the regional aquifer.

Compliance Order on Consent

The March 2005 Consent Order among DOE and its Operations and Management Contractor and NMED is the principal regulatory driver for LANL's environmental remediation programs. The Consent Order contains requirements for investigation and cleanup of solid waste management units (SWMUs) and areas of concern (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 2011. In 2011, the Laboratory submitted 177 deliverables (plans and reports) required by the Consent Order on time to NMED (see Chapter 9). The Laboratory performed significant groundwater compliance work in 2011 pursuant to the Consent Order. These activities included groundwater monitoring, groundwater investigations, and installation of monitoring wells in support of various groundwater investigations and corrective measures evaluations (CMEs).

The status of Consent Order investigations and remediations is presented in Figure ES-2. For those aggregate areas presented as complete, all investigation activities have been completed, and no additional field sampling campaigns, investigation reports, or corrective measures activities are anticipated. Aggregate areas listed as in progress include sites or areas where field sampling campaigns or corrective measure activities are currently being conducted, or investigation reports are being prepared or finalized. Aggregate areas listed as pending include sites or areas where work plan preparation and field sampling campaigns have not yet started.

Site-specific storm water control measures that reflect best industry practice, considering their technological availability, economic achievability, and practicability, are required for each of the 405 permitted sites to minimize or eliminate discharges of pollutants. These controls are referred to as Best Management Practices.

The local storm water drainage around sites (called Site Monitoring Areas) has been hydrologically analyzed, and sampling locations have been identified to most effectively sample runoff from sites.

Table ES-4

Environmental Permits or Approvals under which the Laboratory Operated during 2011

Category	Approved Activity	Issue Date	Expiration Date	Administering Agency
RCRA Permit	Hazardous Waste Facility Permit: Permitted hazardous waste storage units: TA-3, TA-50, TA-54, and TA-55	November 1989, renewed November 2010	December 2020	NMED
	40 Code of Federal Regulations 265 Standards: Interim Status hazardous waste storage and treatment facilities: TA-14, TA-16, TA-36, TA-39, and TA-54. Permit applications to be submitted to NMED.	Post-1980 hazardous waste units; Post-1991 mixed waste units	Inclusion in Hazardous Waste Facility Permit or closure	NMED
Consent Order	Legacy and contaminated waste site investigations, corrective actions, and monitoring; revised to establish new notification and reporting requirements for groundwater monitoring data	March 1, 2005; revised April 20, 2012	September 20, 2015	NMED
CWA[a]/NPDES	Outfall permit for the discharge of industrial and sanitary liquid effluents	August 1, 2007	July 31, 2012	EPA
	MSGP[b] for the discharge of storm water from industrial activities	September 29, 2008	September 29, 2013	EPA
	NPDES Individual Permit for storm water discharges from SWMUs and AOCs	November 1, 2010	October 31, 2015	EPA
	Construction General Permits (17) for the discharge of storm water from construction activities	June 30, 2008	July 31, 2011 (proposed extension until January 31, 2012)	EPA
CWA Sections 404/401	COE[c] Nationwide Permits (five)	Not applicable	Not applicable	COE/NMED
Groundwater Discharge Permit , TA-46 SWWS[d] Plant	Discharge to groundwater	July 20, 1992 Renewed January 7, 1998 Renewal application submitted on July 2, 2010	January 7, 2003[e]	NMED
Groundwater Discharge Plan, TA-50, Radioactive Liquid Waste Treatment Facility	Discharge to groundwater	Submitted August 20, 1996	Approval pending	NMED
Groundwater Discharge Plan, Domestic Septic Tank/Leachfield Systems	Discharge to groundwater	Submitted April 27, 2006 Application resubmitted on June 25, 2010	Approval pending	NMED

Table ES-4 (continued)

Category	Approved Activity	Issue Date	Expiration Date	Administering Agency
Air Quality Operating Permit (20.2.70 NMAC[f])	LANL air emissions Renewal 1	August 7, 2009	August 7, 2014	NMED
Air Quality Construction Permits (20.2.72 NMAC)	Portable rock crusher	June 16, 1999	None	NMED
	Retired and removed from operating permit	June 15, 2006		
	Permit number will remain active to track exempt sources at LANL			
	TA-3 Power Plant	September 27, 2000	None	NMED
	Permit revision	November 26, 2003		
	Permit modification 1, Revision 1	July 30, 2004		
	Permit modification 1, Revision 2	March 5, 2009		
	1600-kW generator at TA-33	October 10, 2002	None	NMED
	Permit revision	May 28, 2008	None	NMED
	Two 20-kW generators and one 225-kW generator at TA-33	August 8, 2007	None	NMED
	Asphalt Plant at TA-60	October 29, 2002	None	NMED
	Permit revision	September 12, 2006	None	NMED
	Data disintegrator	October 22, 2003	None	NMED
	Chemistry and Metallurgy Research Replacement, Radiological Laboratory, Utility, Office Building	September 16, 2005	None	NMED
Air Quality (NESHAP[g])	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

[a] CWA = Clean Water Act.

[b] MSGP = Multi-Sector General Permit.

[c] COE = US Army Corps of Engineers.

[d] SWWS = Sanitary Wastewater System (Plant).

[e] Permit was administratively continued through 2011.

[f] NMAC = New Mexico Administrative Code.

[g] NESHAP = National Emission Standards for Hazardous Air Pollutants.

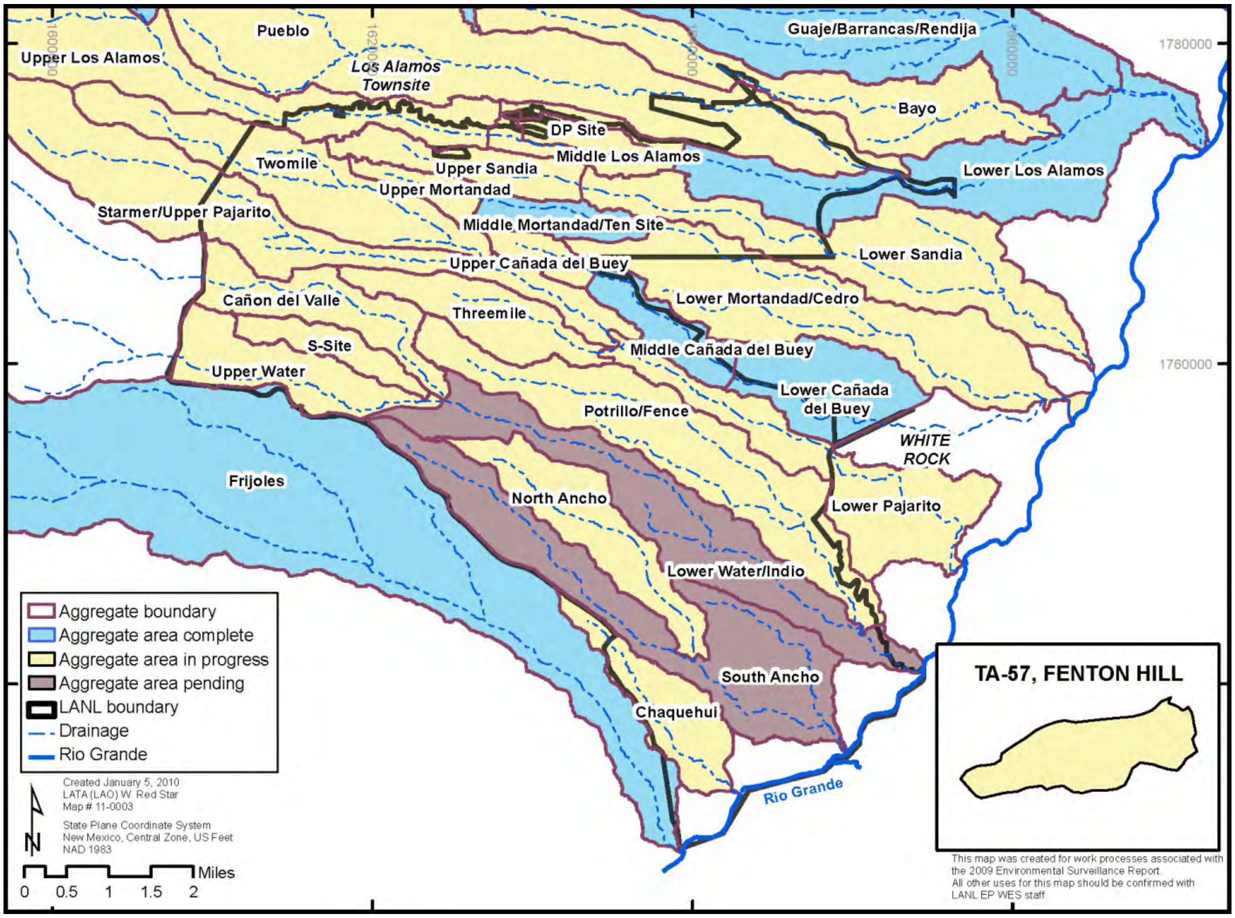

Figure ES-2 Aggregate areas as defined for the Consent Order and their status. Status is shown as aggregate area activities complete, activities in progress, or activities pending.

Unplanned Releases

There were no unplanned airborne releases and no unplanned releases of radioactive liquids from LANL in 2011. There were 20 releases of non-radioactive liquids, most of which were potable water, hydraulic fluid, or domestic wastewater. Other liquids included reuse water, steam condensate, sanitary wastewater, and fire-suppression water. LANL reported all liquid releases to NMED. In 2011, the Laboratory was in the process of administratively closing all releases for 2011 with the NMED and the DOE Oversight Bureau and anticipates these unplanned release investigations will be closed out after final inspections.

Radiological Dose Assessment

Humans, plants, and animals potentially receive radiation doses from various Laboratory operations (Table ES-5). 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. The effective dose equivalent, or “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 millirem (mrem), is a measure of the overall dose to an individual, whether from external radiation or contact with radioactive material. Federal government standards limit the dose that the public may receive from Laboratory operations.

- During 2011, the Laboratory contributions to the airborne pathway dose at an average Los Alamos and White Rock residence were less than 0.1 mrem.

Table ES-5
LANL Radiological Doses for Calendar Year 2011

Pathway	Dose to Maximally Exposed Individual (mrem/yr)	Percent of DOE 100-mrem/yr Limit	Estimated Population Dose (person-rem)	Population within 80 km	Estimated Background Radiation Population Dose (person-rem)
Air	3.53[a]	3.5	0.58	n/a[b]	n/a
Water	< 0.1	< 0.1	0	n/a	n/a
Other pathways (foodstuffs, soils, etc.)	< 0.1	< 0.1	0	n/a	n/a
All pathways	0.9[c]	0.9	0.58	~343,000	~268,000[d]

[a] Rad-NESHAP (NESHAP for Emissions of Radionuclides Other than Radon from DOE Facilities) for the maximally exposed individual (MEI) dose determined at 278 DP Road.

[b] n/a = Not applicable. Pathway-specific populations are not specified, and pathway-specific background doses have not been determined, as allowed by DOE guidance.

[c] All-pathways MEI dose at the boundary of the Pueblo de San Ildefonso sacred area north of Area G.

[d] Based on 270 mrem/yr from inhalation of radon and its decay products, 70 mrem/yr from cosmic radiation, 100 mrem/yr from terrestrial radiation, 29 mrem/yr from potassium-40, 300 mrem/yr from medical and dental uses of radiation, and 13 mrem/yr from man-made products (see Chapter 3, Section B.4).

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. Most collected water, soil, and biota samples from the many locations at LANL in 2011 were well below all applicable screening levels.

As a result of the Las Conchas Fire, suspended sediment in storm water was above screening levels at some locations. The highest concentrations consisted of natural uranium and global fallout in ephemeral storm water. Detailed analysis using RESRAD-Biota includes consideration of maximum and mean concentrations; natural radioactive material, global fallout, and material from LANL; terrestrial, riparian, and aquatic habitats; and bioaccumulation factors. These considerations and analyses conclude that biota doses were below the DOE limits.

Radiological Air Emissions

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) gaseous air activation products (radioactive elements created by the Los Alamos Neutron Science Center [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.

Measurements of LANL stack emissions during 2011 totaled approximately 328 curies (Ci) (compared with nearly 300 Ci in 2010). Of this total, tritium emissions contributed approximately 101 Ci (compared with 87 Ci in 2010), and air activation products from LANSCE stacks contributed nearly 228 Ci (compared with nearly 211 Ci in 2010). LANSCE diffuse emissions of air activation products contributed another 15 Ci of gaseous mixed air activation products. Combined airborne emissions of particulate materials such as plutonium, uranium, americium, and thorium were less than 0.000025 Ci. Emissions of particulate matter plus vaporous activation products were about 0.012 Ci, which is slightly lower than recent years.

Non-Radiological Air Emissions and Air Quality

LANL demonstrated full compliance with all Clean Air Act monitoring and reporting requirements. Emissions of criteria pollutants (nitrogen oxides, sulfur oxides, carbon monoxide, particulate matter, VOCs, and hazardous air pollutants) were similar to the previous five years. 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 VOC and hazardous air pollutant emissions

The Laboratory analyzed air filter samples from 38 sites for beryllium, aluminum, and calcium. These sites are located near potential beryllium sources at LANL and in nearby communities. All concentrations measured this year were at or below 2% of the NESHAP standard of 10 nanograms per cubic meter (ng/m^3) and were similar to those of recent years. Past studies closely correlated beryllium concentrations with aluminum concentrations, which indicates that all measurements of beryllium are from naturally occurring beryllium in resuspended dust. Aluminum and calcium are used to evaluate elevated uranium measurements, and no unusual concentrations were measured.

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. The results of all 2011 studies on groundwater are presented in Chapter 5.

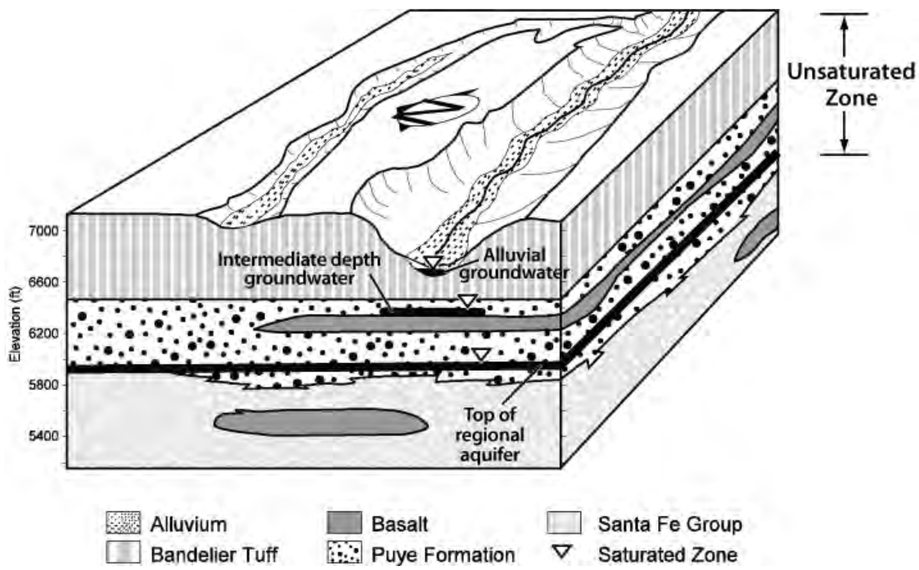

Figure ES-3 Three modes of groundwater occurrence

Most of the groundwater monitoring conducted during 2011 was carried out according to the Interim Facility-Wide Groundwater Monitoring Plans (LANL 2010, 2011b, 2011c) approved by NMED under the Consent Order. The LANL Environmental Programs Directorate collected groundwater samples from wells and springs within or adjacent to the Laboratory and from the nearby Pueblo de San Ildefonso.

The Laboratory has changed groundwater quality through liquid effluent disposal, with the greatest impact on alluvial groundwater. Laboratory contaminants have also affected the intermediate perched zones and the regional aquifer. The 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, and impacts on the regional aquifer are reduced.

In 2011, LANL sampled 215 groundwater wells, well screens, and springs in 813 separate sampling events. The samples collected were analyzed for about 206,026 separate results. If results for field parameters (for example, temperature or pH) and field quality control blanks are excluded, the samples were analyzed for 151,197 results. Table ES-6 summarizes ground water analytes detected above screening levels in portions of the groundwater system.

Table ES-6
Groundwater Analytes with Results above Screening Levels in 2011
(Omitting Field Parameters, Field Quality Control Blanks, and Data Analyzed In-House)

Suite or Analyte	No. of Results	Screening Level	Units	Screening Level Type
General Inorganic Chemistry	**31**			
Chloride	1	250	mg/L[a]	NM groundwater standard
Perchlorate	30	4	µg/L[b]	Consent Order
High Explosives	**24**			
RDX[c]	24	6.11	µg/L	EPA regional screening level for tap water
Metals	**113**			
Aluminum	3	5,000	µg/L	NM groundwater standard
Arsenic (dissolved and total)	9	10	µg/L	EPA MCL[d]
Barium	10	1,000	µg/L	NM groundwater standard
Boron	4	750	µg/L	NM groundwater standard
Chromium (dissolved)	26	50	µg/L	NM groundwater standard
Iron	21	1,000	µg/L	NM groundwater standard
Lead (total)	4	15	µg/L	EPA drinking water system action level
Manganese	34	200	µg/L	NM groundwater standard
Nickel	2	200	µg/L	NM groundwater standard
Radioactivity	**16**			
Gross Alpha	3	15	pCi/L[e]	EPA MCL
Gross Beta	1	50	pCi/L	EPA drinking water screening level
Strontium-90	3	8	pCi/L	EPA MCL
Uranium	5	30	µg/L	NM groundwater standard
Uranium-234	4	4	pCi/L	DOE 4-mrem DCG[f]
Semivolatile Organic Compounds	**17**			
Benzo(a)pyrene	2	0.2	µg/L	EPA MCL
Benzo(b)fluoranthene	1	0.29	µg/L	EPA regional screening level for tap water
Bis(2-ethylhexyl)phthalate	1	6	µg/L	EPA MCL
Dibenz(a,h)anthracene	3	0.029	µg/L	EPA regional screening level for tap water
Dioxane[1,4-]	8	6.7	µg/L	EPA regional screening level for tap water
Indeno(1,2,3-cd)pyrene	2	0.29	µg/L	EPA regional screening level for tap water
Volatile Organic Compounds	**10**			
Acrolein	1	0.042	µg/L	EPA regional screening level for tap water
Dichloroethene[1,1-]	4	5	µg/L	NM groundwater standard
Tetrachloroethene	1	5	µg/L	EPA MCL
Trichloroethane[1,1,1-]	4	60	µg/L	NM groundwater standard

[a] mg/L = milligrams per liter.
[b] µg/L = micrograms per liter.
[c] RDX = Hexahydro-1,3,5-trinitro-1,3,5-triazine.
[d] MCL = Maximum contaminant level.
[e] pCi/L = Picocuries per liter.
[f] DCG = DOE derived concentration guide.

It is important to note that, in many cases, the given screening level may not apply to a particular groundwater sample. For example, some of the screening levels (the EPA maximum concentration levels and EPA Regional Screening Levels for Tap Water) apply specifically to drinking water and not to a sample result from a non-drinking water source. Moreover, for a particular sampling event, multiple measurements made for an analyte may be included in the total. The multiple measurements could include both filtered and unfiltered sample results, multiple analytical laboratory analyses (e.g., made on diluted samples to improve analytical accuracy), and results from field duplicate samples. The monitoring results are described in detail in the following sections.

- Permitted outfalls have been reduced from over 100 in 2000 to only 15 in 2011.
- LANL's outfall reduction efforts are still underway. Watershed-scale approaches to control sediment are being implemented to reduce sediment transport.

In 2011, the high explosives (HE) compound RDX continued to be detected in the regional aquifer at Pajarito Canyon monitoring well R-18. The RDX concentration was at 19% of the EPA tap water screening level of 6.1 µg/L. RDX was also detected in a new Cañon de Valle regional aquifer well, R-63 (to the south of R-18), at 23% of the screening level. RDX continues to be detected in the upper two regional aquifer screens of R-25 (also near Cañon de Valle) at up to 8% of the screening level. Earlier detection of RDX at higher values in the regional aquifer screens of R-25 was probably because of cross-contamination from shallower well screens that occurred for several months before the sampling system was installed, allowing flow between the screens.

The principal radioactive element detected in the regional aquifer is naturally occurring uranium, found at high concentrations in springs and wells throughout the Rio Grande valley. Other radioactivity in groundwater samples comes from members of the decay chains for naturally occurring uranium-235, uranium-238 (including radium-226 and uranium-234), and thorium-232 (including radium-226). Potassium-40 is also a source of natural radioactivity.

No 2011 activity or concentration value for a radioactivity analyte in a Los Alamos County water supply well exceeded any regulatory standard, including the 4-mrem/yr DOE DCGs applicable to drinking water. The 2011 samples from water supply wells used by the City of Santa Fe and Pueblo de San Ildefonso had background levels of uranium and gross alpha results near or above screening levels, as described in Chapter 5.

No 2011 radioactivity results for intermediate groundwater or regional aquifer wells within or immediately adjacent to LANL were above screening levels.

Watershed Monitoring

Los Alamos National Laboratory monitors the quality of surface water, including storm water, and canyon bottom sediment to evaluate effects associated with transport of legacy contaminants and ongoing Laboratory operations. The Laboratory collects and analyzes samples for a variety of constituents, including radionuclides and inorganic and organic chemicals. The sampling results are compared with various screening criteria to protect human health and the aquatic environment.

Laboratory lands contain all or parts of seven primary watersheds that drain directly into the Rio Grande, each defined by a master canyon. Listed from north to south, the master canyons for these watersheds are Los Alamos, Sandia, Mortandad, Pajarito, Water, Ancho, and Chaquehui Canyons. Each of these watersheds includes tributary canyons of various sizes. Los Alamos, Pajarito, and Water Canyons have their headwaters west of the Laboratory in the eastern Jemez Mountains (the Sierra de los Valles), which burned in the Las Conchas Fire. The remainder of the primary watersheds head on the Pajarito Plateau, in areas not burned by the Las Conchas Fire. Only the Ancho Canyon watershed is entirely located on Laboratory land. The Las Conchas Fire burned areas of Santa Fe National Forest upgradient of Laboratory property resulting in increased sediment and ash transport into Water, Pajarito, and Los Alamos Canyon watersheds in 2011. Following the Cerro Grande Fire in May 2000, ash and sediment transport returned to pre-fire levels in three to five years. A similar return to pre-fire conditions is expected for the Las Conchas Fire.

Sediment and surface water monitoring and assessments at the Laboratory in 2011 occurred following the annual summer monsoon season. Extensive sampling of storm water occurred in Los Alamos and Pueblo Canyons under a plan to monitor the effectiveness of sediment transport mitigation activities. Control and monitoring of storm water discharges associated with SWMUs and AOCs occurred under the Individual

Permit with the EPA. Sampling of storm water at gage stations occurred as part of the Laboratory's environmental surveillance activities.

In 2011, snowmelt runoff only crossed the eastern Laboratory boundary in Pueblo Canyon, estimated at 62 acre-feet (ac-ft), however 29 ac-ft of the runoff was effluent from the Los Alamos County Waste Water Treatment Plant. Continuous runoff was present at that location for 65 days. Total storm water runoff at downstream gages in the canyons leaving the Laboratory is estimated at 154 ac-ft, approximately 87% of this occurring in Los Alamos and Pueblo Canyons and the remaining 13% in Pajarito, Potrillo, Water, and Ancho Canyons above White Rock.

Storm water samples collected in 2011 downgradient of burned areas contained increased concentrations of ash and sediment. These samples contained correspondingly increased concentrations of background and fallout constituents transported with sediment and ash in storm water. In storm water, elevated concentrations of inorganic and organic chemicals and radionuclides were observed, including aluminum, arsenic, barium, copper, cyanide, manganese, selenium, zinc, polychlorinated biphenyls (PCBs), gross alpha, radium-226, radium-228, americium-241, cesium-237, plutonium-238, plutonium-239/240, strontium-90, uranium-234, and uranium-238.

Concentrations of constituents in storm water decrease as sediment and ash are deposited on floodplains and at other LANL-constructed and -maintained flood and sediment control features such as wetlands, detention basins, sediment traps, and weirs. In 2011, the Pueblo Canyon wetlands reduced storm water discharge such that the gage station downstream of the wetland and grade control structure did not measure discharges over 5 cfs. The Los Alamos Canyon low-head weir reduced storm water concentrations for almost all constituents, particularly those elevated because of ash and sediment from Las Conchas burn areas. Sediment and ash were trapped upstream of the Pajarito Canyon flood control structure, reducing sediment transport downstream.

Human health and ecological assessments have been conducted for each of the Canyons Investigation Reports conducted under the Consent Order. The human health risk assessments in those reports have concluded that concentrations of contaminants present in canyons media are within acceptable limits for applicable exposure scenarios. Sediment data presented in this report are used to verify the conceptual model that the scale of storm water related contaminant transport observed in LANL canyons generally results in lower concentrations of contaminants in the new sediment deposits than previously existed in deposits in a given reach. The results of the comparisons of sediment data collected from flood-affected canyons in 2011 verify the conceptual model and support the premise that the risk assessments presented in the Canyons reports represent an upper bound of potential risks in the canyons.

Soil Monitoring

LANL conducts large-scale soil sampling within and around the perimeter of LANL every three years. The most recent comprehensive soil survey that included the analysis of radionuclides, target analyte list (TAL) inorganic elements (mostly metals), PCBs, semivolatile organic compounds (SVOCs), and HE was conducted in 2009. In general, all radionuclides and TAL elements were far below industrial screening levels (ISLs) for on-site soils or far below residential screening levels (RSLs) for perimeter soils. Moreover, no HE was detected above the reporting level of quantification in any soil collected from on-site, perimeter, or regional locations. And only trace amounts of a few PCB Aroclors (Aroclor-1254 and Aroclor-1260) and SVOCs (aniline and fluoranthene) in soil from a few sites were detected; however, all levels were far below either ISLs or RSLs, and no increasing trends were evident. The next planned full-scale institutional soil assessment will occur in 2012.

LANL also annually collects soil samples from two locations on the Pueblo de San Ildefonso land downwind of TA-54, Area G. Radionuclides and metals in the 2011 soil samples were below background or near background and were consistent with levels measured in previous years. To evaluate potential Laboratory impacts from radionuclides and chemicals in surface soil, LANL first compares the analytical results of samples collected from the Laboratory's on-site and perimeter areas with regional statistical reference levels (RSRLs).

The only radionuclide that was detected in higher concentrations than the RSRL was plutonium-238 in the Pueblo de San Ildefonso soil location closest to Area G. The amount of plutonium-238 in soil from the "San Ildefonso" site, however, was far below the RSL and generally did not increase over time (the overall long-term pattern showed normal variability along the RSRL line over time). Other radionuclides associated with Area G operations, like tritium and plutonium-239/240 in the "San Ildefonso" soil sample, were very similar to past years, are not increasing over time, and remain below the RSL.

> ❖ Four elk and two deer killed on the road were collected on or near LANL, and radionuclides in both muscle and bone were either not detected or below the RSRLs.

The Laboratory began using containment vessels for HE testing in 2007 (of which there were three detonations in 2011) at the Dual Axis Radiographic Hydrodynamic Test (DARHT) facility. The Laboratory has conducted facility-specific soil and sediment monitoring on an annual basis at DARHT since 1996. Most radionuclides in soil and sediment collected from within and around the perimeter of the DARHT facility were either not detected or below the statistical reference levels. Tritium, americium-241, and uranium-238 in only one soil sample on the south side were detected above the statistical reference level, but the amounts were far below the ISLs and do not pose an unacceptable dose to any site workers.

Foodstuffs Monitoring

A wide variety of wild and domestic crops, including vegetables, fruits, berries, nuts, and grains, are grown and/or harvested at many locations surrounding the Laboratory. Also, many food products from domestic livestock (e.g., milk, eggs, and meat) and apiaries (honey) are available, and fishing in waters downstream of the Laboratory (e.g., Rio Grande) and hunting (e.g., rabbits, turkey, deer, and elk) on neighboring properties around LANL are a common occurrence. While the many years of data collected to date do not demonstrate LANL impacts above screening levels on these resources, the ingestion of these foods might conceptually constitute an exposure pathway and are subject to monitoring.

The collection of surface soil–/native vegetation–related samples was completed in 2009, and the collection of agriculture-related samples (produce crops, goat milk, chicken eggs, and honey) from the neighboring communities surrounding the Laboratory was accomplished in 2010. This report presents the results of Rio Grande–related samples (fish, crayfish, and benthic macroinvertebrates) downstream of the Laboratory.

Fish have been collected for radionuclide analysis from two general reaches as they relate to the location of LANL since 1984; these locations are upstream of LANL (background) on the Rio Chama/Rio Grande and downstream of LANL on the Rio Grande (Figure ES-4). In 2011, samples were mostly collected during and after the Las Conchas Fire, which burned much of the watershed above and adjacent to LANL on the western side. As a result of the fire, several flooding events occurred from many canyon confluences upstream and downstream of LANL to the Rio Grande during the fish sampling period; this included the Los Alamos Canyon, as evidenced by ash residue at the Los Alamos Canyon/Rio Grande confluence.

All radionuclide concentrations (activities) in both predator and bottom-feeding fish collected on the Rio Grande at all locations downstream of LANL, including Cochiti Reservoir, were either not detected (majority of results) or were similar to RSRLs. These results indicate no effects from the runoff of stormwater and sediments from LANL on radionuclide concentration in fish downstream of LANL.

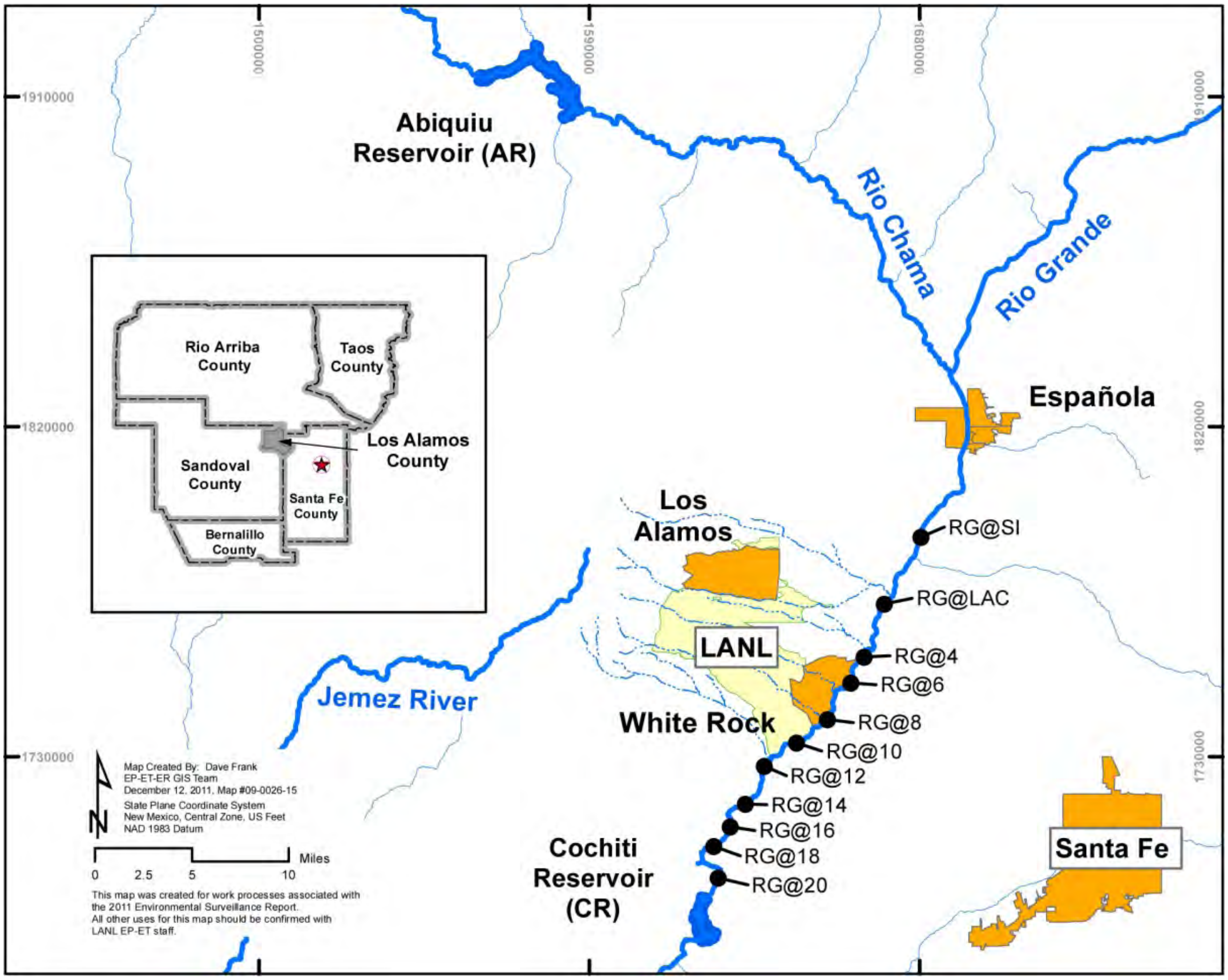

Figure ES-4 Locations of fish collected upstream and downstream of LANL on the Rio Chama and Rio Grande

Bottom-feeding fish were chosen for this example over predator fish because they are the more sensitive of the two fish types—they feed on the bottom where radionuclides readily bind to the sediment.

Most of the 23 TAL elements in the muscle fillet of both predator and bottom-feeding fish collected along the Rio Grande downstream of LANL to Cochiti Reservoir were either not detected or were below the RSRLs (based on 2005–2011 data; n = 50). Although the amounts of mercury in both fish types collected upstream and downstream of LANL were similar to each other, the level of mercury in many fish samples, and primarily in predator fish from Cochiti Reservoir, exceeded the EPA standard level of 0.30 milligrams per kilogram wet. The main sources of mercury into the water systems in New Mexico are natural sources and the burning of fossil fuels.

In general, total PCBs (all congeners combined) in predator and bottom-feeding fish from all locations are lower and in some cases an order of magnitude lower than what were measured in past surveys. Total PCB concentrations in muscle fillet tissue of the bottom feeders are higher than in muscle fillet tissue of the predator fish. The PCB data from 2011, particularly those directly upstream and downstream of LANL, are in agreement with other studies, mainly the following: (1) the placement of stationary semipermeable membrane devices (e.g., artificial fat bags) upstream and downstream of LANL that showed similar PCB concentrations between locations and (2) the collection of sediment samples along the same general reach of waters upstream and downstream of LANL in previous years that showed mean PCB concentrations and homolog patterns generally similar to those of the present data. These results indicate no effects from the runoff of stormwater and sediments from LANL on PCB concentrations in fish downstream of LANL.

Crayfish (crawfish, crawdads, or mudbugs) (*Orconectes* spp) samples were collected along the Rio Grande within two reaches (upstream and downstream) relative to the location of LANL from August 10 to 15, 2011 (Figure ES-5). These samples were collected after the Las Conchas Fire.

Figure ES-5 Collection of crayfish samples from the Rio Grande

Whole-body crayfish were analyzed for tritium, strontium-90, cesium-137, plutonium-238, plutonium-239/240, uranium-234, uranium-235, and uranium-238. Edible (meat) and nonedible (head, gut, claws, and shell) portions of crayfish were analyzed for 23 TAL elements, and PCBs were analyzed for 209 possible chlorinated congeners.

Most radionuclides in a composite whole-body crayfish sample (n = 7) collected from the Rio Grande directly downstream of the Los Alamos Canyon confluence were either not detected (most results) or were detected below the RSRLs (based on 2009 and 2011). The only radionuclides in a composite whole-body crayfish sample collected downstream of LANL that were detected in higher concentrations than the RSRLs were uranium-234, uranium-238, and strontium-90.

All of the TAL elements in the edible portions of the crayfish collected along the Rio Grande directly downstream of the confluence of Los Alamos Canyon were below or similar to the RSRLs. In general, the total PCBs (picograms per gram wet) in whole-body crayfish from both upstream and downstream reaches were markedly lower than the PCB levels in bottom-feeding fish collected from these same reaches, and only one out of the seven crayfish from the downstream reach was higher than the RSRL. Overall, the mean total PCB concentrations in whole-body crayfish from the downstream reach are similar to those amounts reported in the last survey conducted in 2009 and are below the EPA risk-based screening level for unrestricted fish consumption.

Biota Monitoring

No wide-scale monitoring of vegetation was conducted in 2011. However, sampling in 2009 and in previous years shows that, in general, all concentrations of radionuclides and inorganic constituents in vegetation are very low and indistinguishable from regional background levels.

Virginia's Warbler

As in previous years, results at TA-54, Area G, for all radionuclides, with the exception of tritium, in native overstory vegetation (branches and needles) were either not detected or below the RSRLs. Tritium is detected above RSRLs in vegetation collected on the south side of TA-54, Area G, near tritium waste disposal shafts.

In vegetation around the DARHT facility, concentrations of radionuclides and metals were either not detected or below RSRLs. In the past, uranium-238 was usually the only radionuclide to be detected in overstory vegetation around the DARHT facility (probably as a result of foliar deposition more than by root uptake), but since 2007 the concentrations have generally decreased from all sides of the DARHT perimeter. This general decrease in uranium-238 concentrations with respect to the RSRL was probably because of the change in contaminant mitigation procedures from open-air to closed steel containment.

Populations, composition, and the diversity of birds collected just west of the DARHT facility in 2011 were compared with samples collected in 1999 (pre-operational phase). The purpose of the bird monitoring project is to determine the general ecological stress levels around the vicinity of DARHT that may be associated with facility operations (e.g., noise, disturbance, traffic, etc.). The number of birds, number of bird species, diversity, and evenness (distribution) collected in 2011 are similar to those collected before the start-up of operations at DARHT in 1999. In general, there are a large number of birds and types of birds located in the vicinity of the DARHT complex (see Figure ES-6).

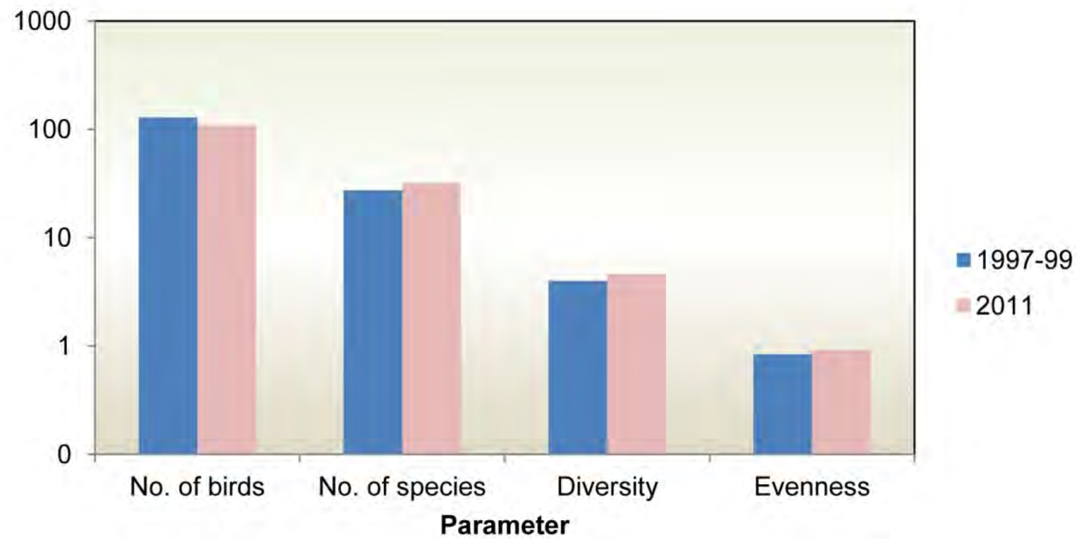

Figure ES-6 Populations, number of species, diversity, and evenness of birds occurring before (1999) and during (2010) operations at DARHT. Note the logarithmic scale on the vertical axis.

In general, special studies are conducted when there is a lack of biological data (populations, composition, and diversity) or data concerning a contaminant(s) that has the potential to impact human health and/or the environment. Ten special studies were conducted in 2011 in support of mitigation action plans, the Biological Resources Management Plan, and the Environmental Surveillance Program. The special studies included "Radionuclide and Chemical Concentrations in Biota Collected from Water/Silt Retention Basins: Los Alamos Canyon Weir and the Pajarito Flood Control Retention Structure," "Winter and Breeding Bird Surveys at LANL," "Los Alamos National Laboratory Fall Avian Migration-Monitoring Report 2010" and the 2011 report, "Small Mammal Sampling at Open-Detonation Firing Sites," "Preliminary Results of Chytrid Fungus Testing of Amphibians at LANL" "Road-Crossing Behavior of Mule Deer in a Wildland-Urban Interface," and "Bat and Small Mammal Use of Burned and Unburned Ponderosa Pine Forest following the Cerro Grande Fire in Los Alamos, New Mexico."

Environmental Remediation Program

Corrective actions proposed and/or conducted at LANL in 2011 follow the requirements of the 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, canyons, 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 drain lines), excavation of media, and confirmatory sampling. These activities define the nature and extent of contamination and determine the potential risks and doses to human health and the environment. The Environmental Programs Directorate developed and/or revised 18 investigation work plans and 27 investigation reports, which were submitted to NMED during 2011.

The Laboratory developed a Phase III investigation work plan for Material Disposal Area (MDA) C, which was approved by NMED. During 2010 and 2011, Phase III investigation activities were conducted to better define the lateral and vertical extent of subsurface volatile organic compound (VOC) and tritium pore-gas contamination at MDA C, to install downgradient regional groundwater monitoring wells, and to characterize background concentrations of inorganic chemicals detected in dacite rocks.

The DP Site Aggregate Area includes container storage areas, surface disposal areas, PCB container storage areas, septic systems, sumps, drain lines, outfalls, a waste treatment laboratory, a sewage treatment plant, and seepage pits at TA-21. The 2010–2011 investigation activities included collecting 368 surface and subsurface soil and tuff samples from 173 locations to define the extent of contamination. Structures, waste lines, debris, and/or asphalt (approximately 30 cubic yards) were removed.

Subsurface Vapor Monitoring

Subsurface vapor (pore-gas) monitoring is implemented as part of corrective action investigations at LANL. Vapor monitoring is conducted beneath and surrounding several historic MDAs at the Laboratory. The data collected from vapor monitoring wells are used to help characterize the nature and extent of VOCs and tritium in the vadose zone. Analysis of pore gas also assists in evaluating whether VOCs and tritium may be a potential threat to the groundwater.

Periodic monitoring of pore gas was required in 2011 by the Consent Order at MDAs G, H, L, T, and V (Figure ES-7).

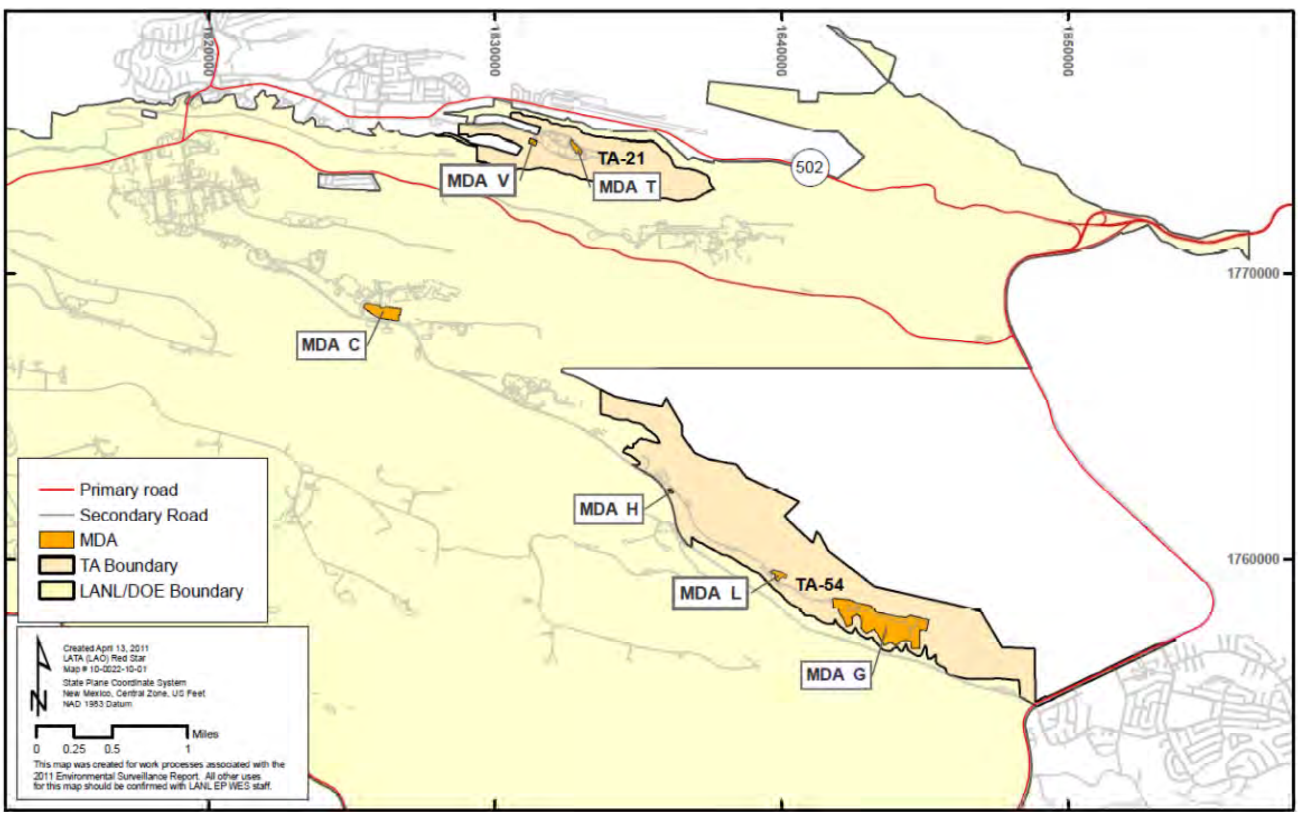

Figure ES-7 Locations of MDAs where subsurface vapor monitoring was performed in 2011

Table ES-7 shows the VOCs at MDAs C and L that exceeded the more realistic Tier II screening values developed in the Phase III investigation report for MDA C and the CME report for MDA L, respectively. No VOCs exceeded the Tier II screening values developed for MDA G during 2011.

Table ES-7
VOCs that Exceeded Tier I and Tier II Screening Values during 2011

Location	VOC	Maximum Pore-Gas Concentration (µg/m³)	Calculated Concentrations in Pore Gas Corresponding to Groundwater Standard (µg/m³)	Tier I Screening Ratio (unitless)
MDA C	Benzene	4,100	1,140	3.6
	Hexanone[2-]	1,500	180	8.3
	Methylene Chloride	3,900	650	6.0
	Trichloroethene*	93,000	2,000	46.5
MDA G	Dichloroethane[1,1-]	24,000	5,750	4.2
	Dichloroethene[1,1-]	25,000	5,500	4.6
	Tetrachloroethene	32,000	3,600	8.9
	Trichloroethane[1,1,1-]	740,000	42,300	17
	Trichloroethene	11,000	2,000	28
MDA L	Benzene	3,300	1,140	2.9
	Butanol [1-]	1,700	1,332	1.3
	Carbon tetrachloride	11,000	5,500	2.0
	Chloroform	120,000	15,000	8.0
	Dichloroethane [1,1-]	71,000	5,750	12.3
	Dichloroethane [1,2-]*	600,000	240	2500
	Dichloroethene [1,1-]*	65,000	5,500	11.8
	Dichloropropane [1,2-]*	280,000	600	467
	Dioxane [1,4-]	11,000	12.2	900
	Methylene chloride*	120,000	650	185
	Tetrachloroethene*	760,000	3,600	211
	Trichloroethane[1,1,1-]*	2,300,000	42,300	54.4
	Trichloroethane[1,1,2-]	1900	170	11.2
	Trichloroethene*	1,500,000	2,000	750
	Trimethylbenzene [1,2,4-]	16,000	3,750	4.3
MDA T	Methylene chloride	2,600	650	4.0
	Trichloroethane[1,1,2-]	210	170	1.2

*Denotes the VOC concentration exceeded the Tier II screening value; analysis performed for MDAs C, G, and L only.

Analytical Laboratory Quality Assurance

Environmental samples collected by the Laboratory are processed and analyzed by commercial independent analytical chemistry laboratories to determine contaminant concentrations in the samples. Each analytical laboratory must follow EPA-approved analysis methods to determine contaminant concentrations and implement a stringent quality assurance/quality control program to ensure the accuracy of the results. All analytical laboratory results undergo validation by a LANL subcontractor. If data validation identifies analytical results that do not meet EPA or LANL requirements, then LANL will perform a follow-up assessment with the analytical laboratory to identify issues and corrective actions. Finally, LANL requires each analytical laboratory to participate in third-party independent review and certification programs as a further quality assurance requirement.

There was no analytical laboratory data quality issues related to the soil, foodstuffs, and biota sampling program during 2011. Detailed discussion of overall analytical laboratory quality performance is presented in Chapter 11. Analytical data completeness for all soil, foodstuffs, and biota sampling programs was 99% in 2011.