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Los Alamos
NATIONAL LABORATORY

2024 ASER

Annual Site Environmental Report

Los Alamos NATIONAL LABORATORY

Governing Policy for the 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.

Los Alamos National Laboratory 2024 Annual Site Environmental Report
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September 2025
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Los Alamos National Laboratory

2024 Annual Site Environmental Report

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Abstract

Los Alamos National Laboratory (Laboratory) annual site environmental reports are prepared each year by the Laboratory's environmental organizations as required by U.S. Department of Energy Order 231.1B, Administrative Change 1, Environment, Safety, and Health Reporting, and Order 458.1, Administrative Change 4, Radiation Protection of the Public and the Environment.

The chapters in this report discuss

- our compliance with environmental laws, regulations, and orders (Chapter 2, Compliance Summary);
- how we manage the Laboratory's environmental performance and assure the quality of data from analysis of environmental samples (Chapter 3, Environmental Programs and Analytical Data Quality);
- how we monitor for air emissions of radioactive materials and for weather conditions (Chapter 4, Air Quality);
- how we monitor for effects of Laboratory operations on groundwater quality (Chapter 5, Groundwater Protection);
- how we monitor the levels of chemicals and radionuclides in storm water runoff and sediment (Chapter 6, Watershed Quality);
- how we monitor for the levels and effects of chemicals and radionuclides in plants, animals, soil, and vegetation (Chapter 7, Ecosystem Health); and finally,
- what radioactive dose or risk from chemical exposure that members of the public could experience as a result of Laboratory operations (Chapter 8, Public Dose and Risk Assessment).

This report follows plain language guidelines as required for federal agencies by the Plain Language Act of 2010. More information about plain language can be found at http://www.plainlanguage.gov. We have substantially reduced the use of acronyms and abbreviations and are using active voice.

We hope you find this report useful. If you have questions or suggestions about improving this report, or if you want copies of the Supplemental Tables or the Annual Site Environmental Report Summary, please contact us at ASER@lanl.gov. You may also contact Environmental Communication & Public Involvement at envoutreach@lanl.gov or call (505) 667-3792.

Executive Summary

Laboratory employees who make transuranic waste shipping happen commemorated the 25th anniversary of LANL's first shipment to the Waste Isolation Pilot Plant.

Los Alamos National Laboratory (LANL or Laboratory) is in Los Alamos County in north-central New Mexico, about 60 miles north-northeast of Albuquerque and 25 miles northwest of Santa Fe. The Laboratory's mission is to solve national security challenges through scientific excellence. Environmental stewardship and compliance are core values of operations at the Laboratory. Part of that commitment includes reporting on the Laboratory's environmental performance.

This site environmental report

- characterizes the Laboratory's environmental performance, 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;
- highlights significant programs and efforts; and
- describes property clearance activities in accordance with U.S. Department of Energy (DOE) Order 458.1.

The Laboratory's Governing Policy on 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 the public. We reduce our environmental risk through legacy cleanup, pollution prevention, and long-term sustainability programs.

LANL has changed since its founding in 1943. Undoubtedly, the future will continue to bring significant changes to the Laboratory mission and operations. Regardless of these changes, we are committed to operating the site sustainably.

Environmental stewardship requires an active management system to provide environmental policy, planning, implementation, corrective actions, and management review. The Laboratory' Environmental Management System has been certified to the International Organization for Standardization's 14001 standard for environmental management system since April 2006.

The chapters in this report discuss a range of topics:

- our compliance with environmental laws, regulations, and orders (Chapter 2, Compliance Summary);
- how we manage the Laboratory's environmental performance and assure the quality of data from analysis of environmental samples (Chapter 3, Environmental Programs and Analytical Data Quality);
- how we monitor for air emissions of radioactive materials and for weather conditions (Chapter 4, Air Quality);
- how we monitor for and mitigate the effects of Laboratory operations on groundwater quality (Chapter 5, Groundwater Protection);
- how we monitor levels of chemicals and radionuclides in storm water runoff and sediment (Chapter 6, Watershed Quality);
- how we monitor for the levels and effects of chemicals and radionuclides in plants, animals, soil, and vegetation (Chapter 7, Ecosystem Health); and finally,
- what radioactive dose or risk from chemical exposure that members of the public could experience because of Laboratory operations (Chapter 8, Public Dose and Risk Assessment).

2024 Environmental Performance Summary

Our environmental performance can be summarized as follows (refer to Chapters 2 and 3).

- The site operated under 18 different types of environmental permits and legal orders (Chapter 2, Table 2-21).
- For the legacy waste cleanup project, we received eight certificates of completion with controls and two certificates of completion without controls for corrective action sites.
- Mixed wastes managed under the Laboratory's Site Treatment Plan decreased by approximately 15 cubic meters for mixed low-level waste and decreased by approximately 18 cubic meters for mixed transuranic waste.
- Under the Hazardous Waste Facility Permit, the management and operating contractor for the Laboratory (Triad National Security, LLC [Triad]) reported four instances of release within a permitted waste unit in fiscal year 2024, and the legacy waste cleanup contractor reported two releases at a permitted unit. The New Mexico Environment Department issued no findings during the 2024 annual compliance inspection for the Laboratory's Hazardous Waste Facility Permit.
- The site was fully compliant with its Clean Air Act Title V Operating Permit emission limits.
- We discharged approximately 88 million gallons of liquid effluents from outfalls. Three of the 738 outfall samples collected exceeded a permit limit in the outfall permit (Chapter 2, Table 2-6).
- In 2024, Triad was responsible for 40 stormwater pollution prevention plans and performed 1,288 inspections.
- In fiscal year 2024, we reported to the New Mexico Environment Department 11 instances of a constituent detected in groundwater at a location where the constituent had

not been previously detected above a standard or screening level (Chapter 2, Table 2-13). These detections occurred in six wells.

- Two areas of the regional aquifer at the Laboratory continued to have groundwater contaminants that are of sufficient concentration and extent to warrant actions such as interim measures, further characterization, and potential remediation under the 2016 Compliance Order on Consent: RDX (hexahydro-1,3,5-trinitro-1,3,5-triazine) contamination in the vicinity of Technical Area 16 and chromium contamination beneath Sandia and Mortandad canyons (Chapter 5).
- We completed four biological assessments and prepared six floodplain or wetland assessments.
- One environmental occurrence was reported under DOE Order 232.2, Occurrence Reporting and Processing of Operations Information, related to a sample at Outfall 03A181 in Technical Area 55 that exceeded the total residual chlorine permit limit (Chapter 2, Table 2-18). The suspected cause was that the cooling tower had been blowing down for several hours and had caused an imbalance between the chlorine in the water and the amount of the dechlorination chemical.
- The Laboratory had three inspections or audits conducted in 2024 by regulating agencies or external auditors (Chapter 2, Table 2-19).
- We made 13 reports of unplanned liquid releases to the New Mexico Environment Department (Chapter 2, Table 2-20).
- Radiological doses to the public from Laboratory operations were less than 1 millirem per year, and health risks were indistinguishable from zero.

2024 Environmental Program Highlights

During 2024, programs that comprise the Laboratory’s Environmental Management System reported the following new initiatives or highlights.

- Triad subject matter experts reviewed 445 management and operating contractor projects and 16 legacy waste cleanup projects in the Permits and Requirements Identification tool. They also reviewed 770 projects in the Excavation/Fill/Soil Disturbance permitting tool.
- The Laboratory managed 50 miles of trails, including 36 miles with public access; thinned 167 acres of forest; actively monitored forest health on approximately 200 acres; and protected 4,611 acres of core habitat for federally listed threatened or endangered species.

2024 Environmental Monitoring Highlights

During 2024, we completed the following.

- The Laboratory operated 43 environmental air-monitoring stations and conducted stack monitoring at 13 buildings or structures (Chapter 4, Table 4-6) to measure levels of airborne radiological materials. During 2024, the radioactive emissions from all Laboratory sources amounted to approximately 1 percent of the regulatory limit, and concentrations of airborne radioactive material measured in ambient air samples were below the applicable concentration levels for environmental compliance.

- The average temperature measured in Los Alamos during 2024 was 2.4°F above the 1991–2020 average. Monthly average temperatures in 2024 were above the 1991–2020 averages for 10 of the 12 months. Total precipitation during 2024 was 0.37 inches above the 1991–2020 average. Snowfall was 9.5 inches above the 1991–2020 average.
- In March 2023, at the direction of the New Mexico Environment Department, we suspended injection of treated groundwater as part of the chromium plume interim measure due to questions about the configuration of injection wells. This action effectively shut down the chromium interim measure treatment system. A review team of 15 subject matter experts sponsored by DOE and supported by the New Mexico Environment Department was convened in March 2024 to evaluate several technical questions regarding the chromium interim measures and characterization. The interim measure treatment system was reinstated in September 2024.
- Most 2024 stormwater and base flow results fell within the concentration ranges observed from 2011 to 2023. Notable exceptions include elevated iron concentrations in parts of the Mortandad Canyon and Pajarito Canyon watersheds. Sediment exceedances were limited and included manganese, Aroclor-1254, and several PFAS chemicals. The 2024 stormwater, base flow, and sediment data confirm that stormwater runoff in Laboratory canyons generally deposits sediment with concentrations of LANL-related substances that are equal to or lower than those observed in previous years.
- In 2024, we collected terrestrial soil and vegetation as part of our soil, foodstuffs, and biota monitoring program. Previous biota dose assessments have shown that biota doses at the Laboratory are far below the DOE limits. This 2024 assessment confirms the previous assessments and shows that there are no expected harmful effects to the health of biota populations from Laboratory radioactive materials.

Changes and Corrections

You are looking at the first published version of the Los Alamos National Laboratory 2024 Annual Site Environmental Report, released in September 2025.

We will update this page with a description of all revisions of this report.

Revision History of This Report

Description	Release Date	Reason for Update
2024 ASER, Revision 1	September 2025	First published version

In the following section, we report on any revisions we made to previous LANL annual site environmental reports and any newly discovered errors in previous annual site environmental reports during the past year.

Revisions to Previous Reports and Reported Errors

Document	Latest Release Date	Reason for Update or Description of Error
2021 ASER, Revision 2 (LA-UR-22-29103)	September 2022 (Note: It has been several years since publication; therefore, we are not planning to republish this document with the corrections listed here.)	We discovered errors in the Dioxin and Furan Results in Soil section in Chapter 7 of the 2021 Annual Site Environmental Report, which we are reporting here. Specifically, • there were four furan compounds (not three) from the soil sample collected at Technical Area 63 that exceeded only the no-effect ecological screening level. • One dioxin compound (not two) from the soil sample collected from North Mesa exceeded the no-effect ecological screening level. • One furan (not dioxin) compound in the soil samples collected from Technical Area 21 exceeded the no-effect ecological screening level. • A total of 3.5 percent (not 2.6 percent) of the congeners exceeded the ecological screening levels.

Changes and Corrections

<table>
<tr><th>Document</th><th>Latest Release Date</th><th>Reason for Update or Description of Error</th></tr>
<tr><td>2023 ASER, Revision 2 (LA-UR-24-28629)</td><td>April 2025 (Note: These changes are incorporated in the current version of the 2023 LANL ASER available at https://doi.org/10.2172/2447436.)</td><td>• We removed links to the LANL Environmental Reports website and added text that advises readers to contact ASER@lanl.gov for copies of the Supplemental Tables.
• We updated page 7-38 to reflect results in a corrected laboratory data package. We removed the following sentences:
“Higher levels of radium-226 activity were detected in fish samples collected from Abiquiu Reservoir when compared with fish from Cochiti Reservoir (Generalized Linear Model, $p < 0.05$). There was also a significant interaction of radium-226 activity between year and reservoir, with Abiquiu Reservoir increasing at a faster rate (Generalized Linear Model, $p < 0.05$). However, a high percentage of non-detects (79 percent) could be affecting these results.”
• We added the following sentence:
“However, there was a high percentage of non-detects in both Abiquiu and Cochiti reservoirs and therefore, the increasing trend could be an artifact of the low percentage of detections.”</td></tr>
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Chapter 1: Overview

Site Mission and Background

Los Alamos National Laboratory (LANL or Laboratory) began as Project Y of the Manhattan Project during World War II. A small group of scientists and military personnel came to northern New Mexico in March 1943 to design and build the world's first atomic bombs. By 1945, more than 3,000 civilian and military personnel were working in Los Alamos. Currently, the Laboratory is a federally funded research and development center aligned with the priorities of the U.S. Department of Energy's (DOE's) National Nuclear Security Administration and key national strategy guidance documents. The Laboratory's vital roles include enhancing U.S. national security through the military application of nuclear energy; maintaining and enhancing the safety, reliability, and effectiveness of the U.S. nuclear weapons stockpile—including the ability to design, produce, and test—to meet national security requirements; promoting international nuclear safety and nonproliferation; reducing global danger from weapons of mass destruction; and supporting U.S. leadership in science and technology. Figure 1-1 presents a timeline of the site's responsible federal agencies and operating contractors since 1943.

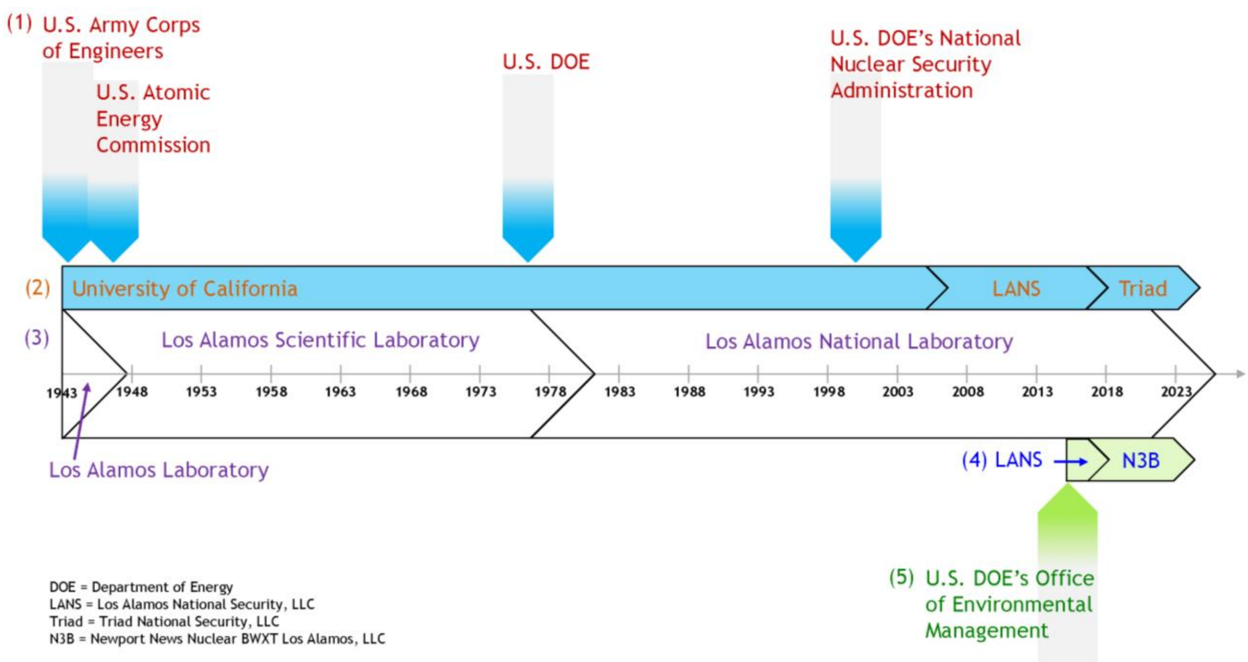

Figure 1-1. Timeline that shows (1) the federal organization responsible for site operations, (2) the management and operating contractor, (3) the Laboratory's name, (4) the legacy waste cleanup contractor, and (5) the federal organization responsible for cleanup at the Laboratory.

Currently, both the National Nuclear Security Administration and DOE's Office of Environmental Management maintain field offices in Los Alamos, New Mexico. This document is a consolidated site environmental report that fulfills the annual reporting requirements of the National Nuclear Security Administration and DOE's Office of Environmental Management under DOE Orders 231.1B Chg 1, Environment, Safety, and Health Reporting; and 458.1 Chg 3, Radiation Protection of the Public and the Environment.

In this document, “we” refers to the people who work at the site, including employees of DOE and contractor organizations.

Environmental Setting

Location

Los Alamos National Laboratory is located in Los Alamos and Santa Fe counties (Figure 1-2). It sits on the Pajarito Plateau, a series of mesas separated by east-west-trending canyons. The Sierra de los Valles range of the Jemez Mountains is directly west of the site, and White Rock Canyon—through which the Rio Grande flows—is east. The mesas are composed mostly of Bandelier Tuff, a type of soft rock formed from hardened volcanic ash. Mesa tops range in elevation from about 7,800 feet on the western side to 6,200 feet on the eastern side of the plateau.

The site comprises about 40 square miles. It includes areas with active operations and additional DOE properties, such as a proposed land transfer tract in Rendija Canyon (labeled “DOE” in Figure 1-2). The land that surrounds the site is largely undeveloped. Large tracts of land north, west, and south of the site are controlled by the Santa Fe National Forest, the U.S. Bureau of Land Management, Bandelier National Monument, and Los Alamos County. The town of Los Alamos borders the Laboratory to the north. The Pueblo de San Ildefonso and the community of White Rock border the site to the east. Santa Clara Pueblo is north of the site but does not share a border (Figure 1-2).

Climate

Los Alamos County has a semiarid climate, meaning that more water is lost from soil and plants through evaporation and transpiration than is received as annual precipitation. Annual temperatures and amounts of precipitation vary across the county because of the complex topography and 5,000-foot change in elevation.

Four distinct seasons occur in Los Alamos County. Winter is generally mild with occasional snowstorms. Spring is the windiest season. Summer is the rainy season, with frequent afternoon thunderstorms. Fall is typically dry, cool, and calm.

On average, winter temperatures range from 30 degrees Fahrenheit (°F) to 50°F during the day and from 15°F to 25°F at night. The Sangre de Cristo Mountains to the east of the Rio Grande act as a barrier to wintertime arctic air masses, making the occurrence of subzero temperatures rare. On average, summer temperatures range from 70°F to 88°F during the day and from 50°F to 59°F at night.

The rainy season begins in early July and ends in early September. Afternoon thunderstorms produce short, heavy downpours and an abundance of lightning. Local lightning density is estimated at 15 strikes per square mile per year.

Average annual precipitation (including both rain and the water equivalent of snow, hail, and any other frozen precipitation) is about 17 inches. Average annual snowfall is about 43 inches.

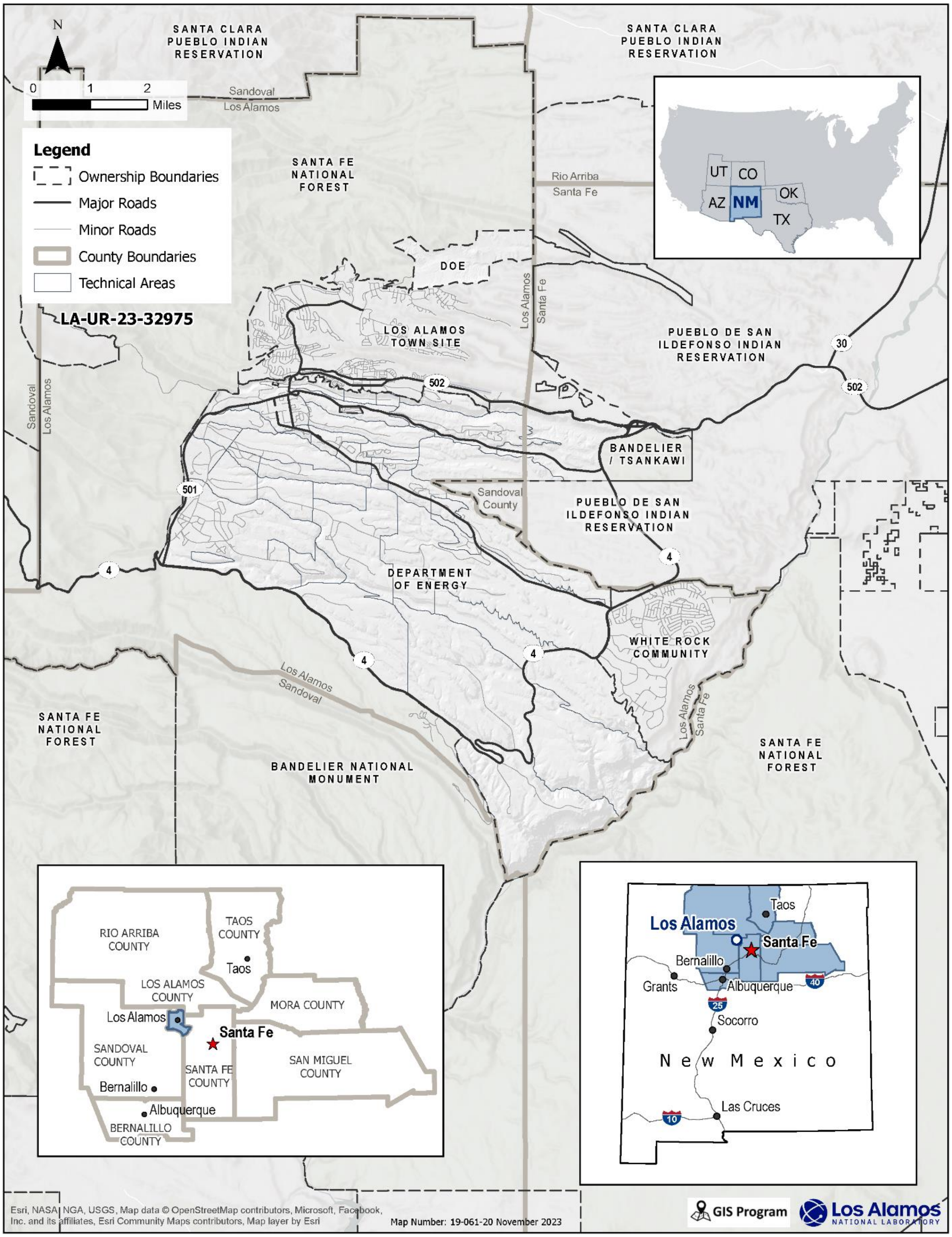

Figure 1-2. Regional location of the Los Alamos National Laboratory site.

Hydrology

The watersheds on the site drain to the Rio Grande. Sources of surface water in these watersheds include snowmelt, stormwater runoff, and springs. Some springs on the edge of the Jemez Mountains supply water year-round to western sections of some canyons; however, surface water does not flow year-round across the site. The regional aquifer is the only groundwater in the area with enough water to serve as a municipal water supply.

Vegetation

The major types of vegetation on the Pajarito Plateau are

- juniper woodlands with scattered piñon (Pinus edulis) trees growing between 5,300 and 7,500 feet in elevation, covering large portions of the mesa tops and south-facing canyon slopes at lower elevations;
- ponderosa pine (Pinus ponderosa) woodlands on the western portion of the plateau between 6,200 and 8,700 feet in elevation;
- mixed conifer woodlands and forests between 6,200 and 9,900 feet in elevation that overlap the ponderosa pine community both in the deeper canyons and on north-facing canyon slopes and extend onto the slopes of the Jemez Mountains;
- grasslands at all elevations that range from blue grama grass near the Rio Grande to montane grasses above 8,100 feet;
- shrublands at all elevations but especially associated with areas severely burned by wildfire (Hansen et al. 2018); and
- local wetlands and riparian areas.

Frequent drought conditions throughout New Mexico since 1998 have resulted in the loss of many forest and woodland trees. Between 2002 and 2005, more than 90 percent of the mature piñon trees in the Los Alamos area died from water stress and bark beetle infestation (Breshears et al. 2005). Many mature ponderosa pine and other conifer trees in the area have also died. This mortality of forest trees is projected to continue into the 2050s due to ongoing water stress associated with increasing temperatures (Williams et al. 2013).

Cultural Resources

Documented human activity on the Pajarito Plateau extends from the Paleoindian Period, 9500 to 5500 BCE (before common era), through the Historic Period (seventeenth century to present). From 600 to 1600 CE (common era), Ancestral Pueblo peoples inhabited the area occupied by the Laboratory. Archaeological sites associated with Ancestral Pueblo and historic period occupations are federally protected cultural resources. In addition, the Laboratory itself is associated with historic events. Some Laboratory buildings and structures are part of the Manhattan Project National Historical Park.

Local Communities

The estimated 2020 population within a 50-mile radius of the LANL site was 369,786 people (U.S. Census Bureau 2022). We calculated this value by summing the population in all census block groups that intersect or lie within a 50-mile radius of the Laboratory. New Mexico's estimated 2024 population was 2,130,256 people (U.S. Census Bureau 2025). Figure 1-3 presents municipalities and tribal properties within 50 miles of the site.

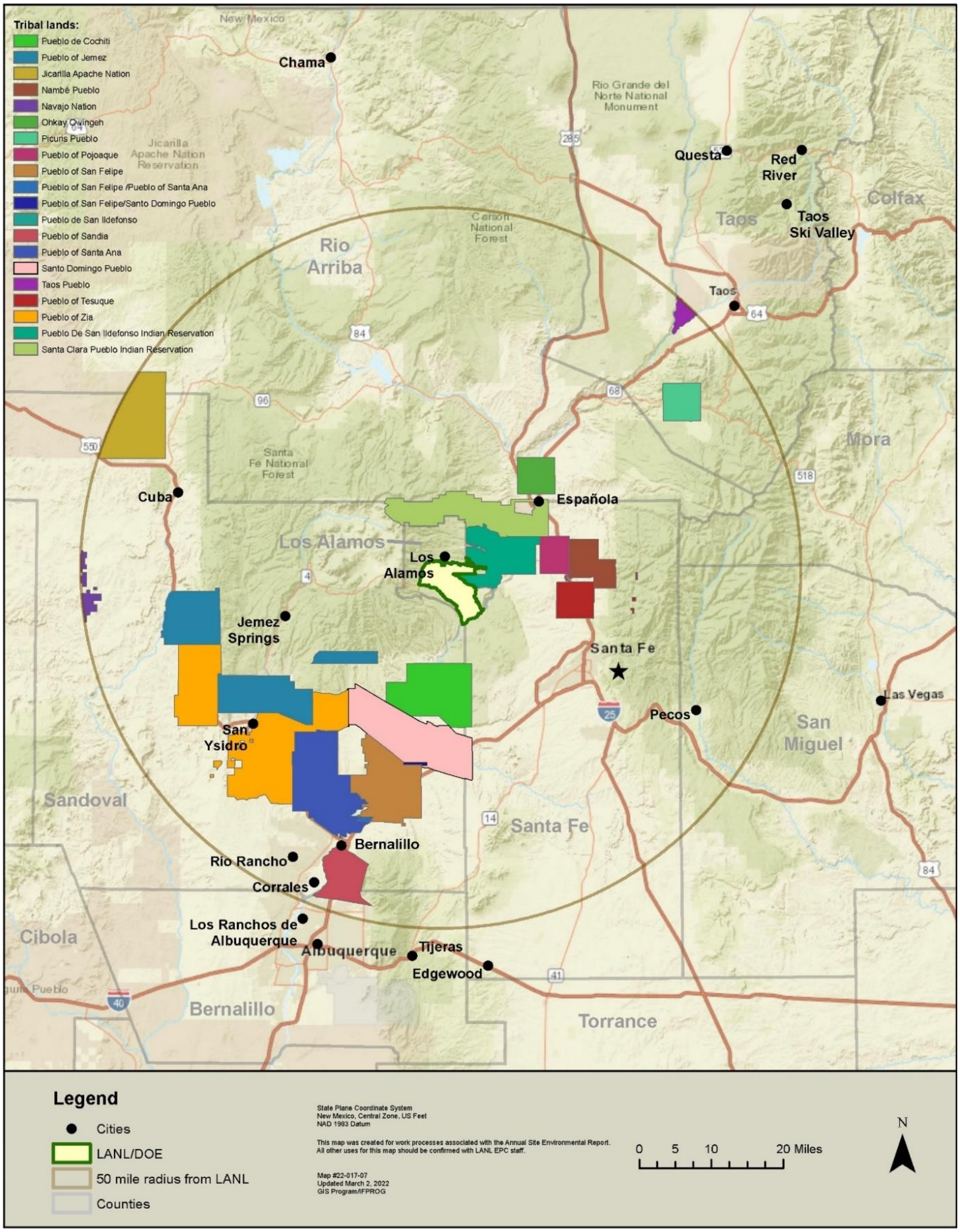

Figure 1-3. Municipalities and tribal properties within a 50-mile radius of the LANL site.

Laboratory Activities and Facilities

The site is divided into 49 technical areas that contain buildings, experimental areas, support facilities, roads, and utility rights-of-way (refer to Figure 1-4 and Appendix C: for more details). Developed areas account for less than half of the total land area, and many portions of the site act as buffer areas for security, safety, and possible future expansion. The Laboratory manages about 897 buildings, trailers, and transportable buildings that contain 8.2 million square feet under roof (LANL 2022). Triad National Security, LLC (the management and operating contractor for the Laboratory [Triad]) also leases office space in Santa Fe, New Mexico.

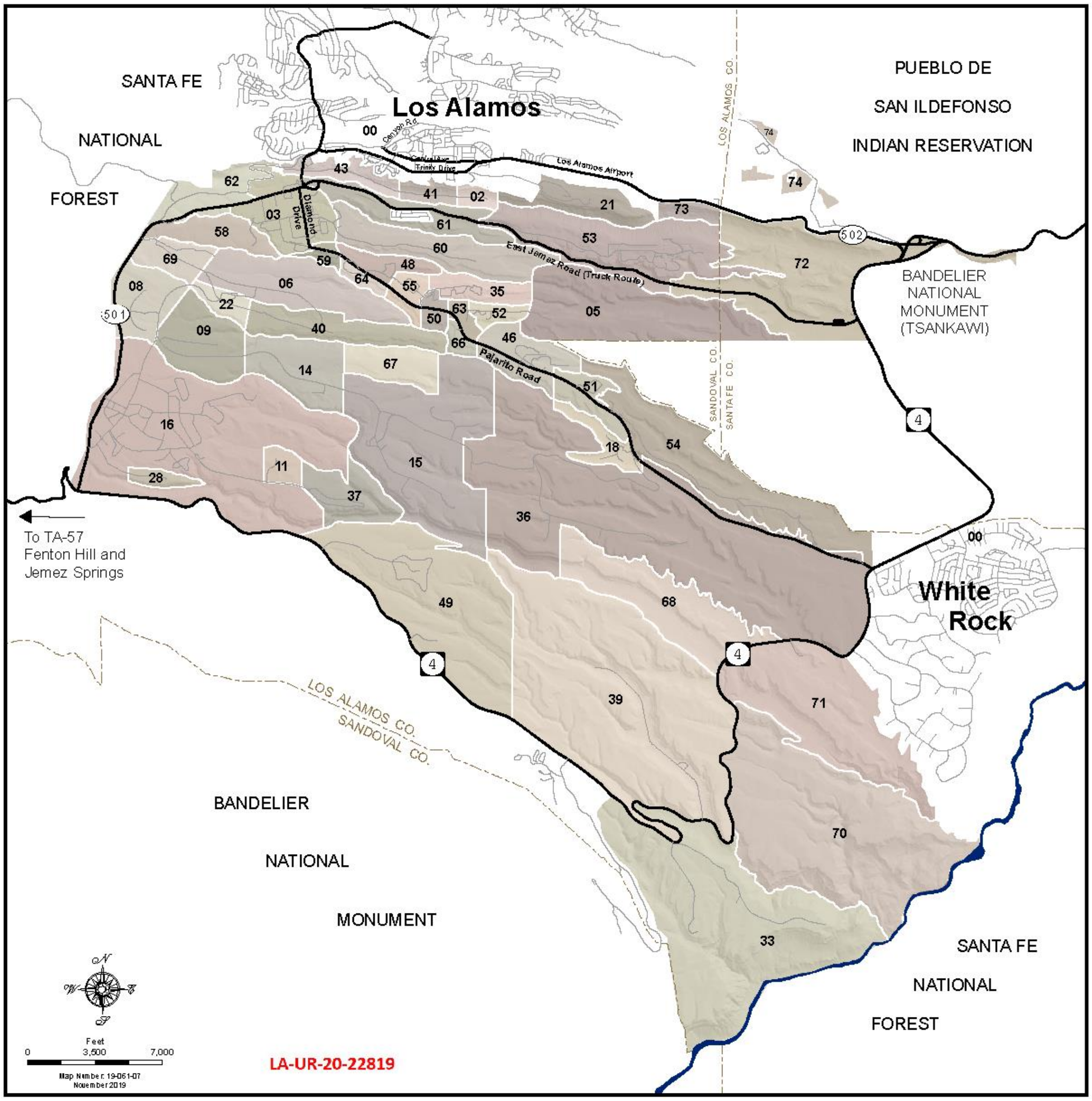

Figure 1-4. Locations of the numbered technical areas at the Los Alamos National Laboratory site.

At the end of 2024, 16,392 people were employed by Triad, and an additional 4,910 people were employed by Triad contractors. N3B and its contractors employed 731 people. The affiliated workforce includes regular workers, temporary workers, and students.

In May 2008, the DOE's National Nuclear Security Administration issued a site-wide environmental impact statement for continued operation of the Laboratory (DOE 2008). In 2022, the National Nuclear Security Administration announced that it was preparing a new site-wide environmental impact statement for LANL. The draft was released in January 2025 (DOE 2025); it describes the environmental impacts of both continuing Laboratory operations and legacy waste remediation.

Recent Environmental Impacts on Site Operations

Several major wildfires have affected the site in recent decades. The Cerro Grande Fire in 2000 and the Las Conchas Fire in 2011 triggered multiday closures of the Laboratory and evacuations of the Los Alamos townsite. Both fires damaged forests on the slopes of the Jemez Mountains west of the Laboratory and were followed by flash floods that caused extensive soil erosion and some infrastructure damage. The Cerro Pelado Fire in 2022 occurred close to the site but did not burn Laboratory property or trigger a closure.

A 1,000-year rainfall event in September 2013 resulted in flooding and damage to infrastructure, and a "bomb cyclone" storm in March 2019 caused flooding and windfall of hundreds of trees, which resulted in power outages and road closures.

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Chapter 2: Compliance Summary

This chapter provides a summary of the site's compliance with state and federal environmental regulations and permits as well as U.S. Department of Energy (DOE) environmental and radiation protection orders. Two reference tables are provided at the end of this chapter: one summarizes the site's operating permits, and the other lists the LANL facilities in the U.S. Environmental Protection Agency Enforcement and Compliance History Online database.

Radiation Protection

DOE Order 458.1 Chg 4, Radiation Protection of the Public and the Environment

DOE Order 458.1 directs DOE sites to keep radiological doses to the public and the environment as low as reasonably achievable and to monitor for routine and nonroutine releases of radioactive materials. The order requires sites to

- ensure that the radiological dose to the public from site activities does not exceed 100 millirem in any given year;
- comply with the Order's dose limits for wildlife and plants;
- notify the public about any radiation doses that result from operations;
- ensure that the dose from items or real estate scheduled for release to the public (for example, surplus equipment, waste shipped for disposal off site, or land parcels transferred to new owners) does not exceed 1 millirem per year above background for moveable items or 25 millirem per year above background for real estate; and
- ensure that the radiological dose to the public due to airborne releases or resuspension of dust does not exceed 10 millirem (exclusively due to the airborne pathway) to a designated maximally exposed individual or alternatively as determined by an air-monitoring station.

Estimated Maximum Potential Radiological Dose to the Public

During 2024, the estimated maximum radiological dose to a member of the public from site operations was less than 1 millirem, and radiation doses to wildlife and plants were below the annual DOE dose limits. Details of the site's annual radiological dose estimates for wildlife and plants are presented in Chapter 7, and estimates for the public are presented in Chapter 8.

Establishment and Use of Authorized Limits

Screening action levels for radionuclides in soils are calculated as part of the corrective action process. DOE can determine whether a set of screening action levels may be used as preapproved authorized limits for unrestricted release of property being considered for conveyance and transfer to other entities. These preapproved authorized limits for radionuclides in soils are evaluated every year to determine if an update is needed—for example, if screening action levels change because of revised exposure models. No updates were needed in 2024. The established limits are found in DOE-STD-1241-2023, Implementing Release and Clearance, for volumetric contamination and surface contamination limits.

Property Released from the Laboratory

Real Estate

We did not convey or transfer any land parcels during 2024.

Recycled Metals

During 2024, we recycled 1,379 tons of metal. Metals that have been exposed to ionizing radiation during site operations (potentially activated metals) are evaluated for levels of radioactivity before being released for recycling. About 134 tons of potentially activated metal was recycled in 2024 from the Los Alamos Neutron Science Center's accelerator operations. Releases from the Los Alamos Neutron Science Center were evaluated using the protocol in the Multi-Agency Radiation Survey and Assessment for Materials and Equipment manual and were independently reviewed by DOE. Releases from the remainder of the site met the criteria for unrestricted radiological release under Title 10 Code of Federal Regulations, Part 835, Occupational Radiation Protection; and DOE Order 458.1, Radiation Protection of the Public and the Environment. Metal items approved for release are sent to a metal recycler in Albuquerque, New Mexico, where they are processed and sold as scrap.

Portable Property

We survey smaller personal property items (for example, tools and furniture) from radiologically controlled areas as needed. These items typically remain on site. Once approved for release, their use is unrestricted. The policies and procedures for releasing these items comply with Title 10 Code of Federal Regulations, Part 835, Occupational Radiation Protection.

N3B surveyed and released property throughout 2024 as part of ongoing environmental remediation, waste packaging, and shipping operations. This effort included releasing 4 mixed low-level waste shipments, 75 low-level waste shipments, and 18 transuranic waste shipments for offsite disposal.

Waste Management Summary

This section discusses the management of wastes at the site. Table 2-1 summarizes the types and disposal methods of wastes that were either shipped off site or had an onsite final disposition in 2024.

Table 2-1. Waste Disposal Methods and 2024 Disposal Amounts[a]

Waste Type	Method for Disposal	2024 Disposal Amount
Solid Transuranic Waste and Solid Mixed Transuranic Waste	This waste was shipped off site to the Waste Isolation Pilot Plant in Carlsbad, New Mexico, when the waste met the plant's waste acceptance criteria. Some waste is being stored at the LANL site while an acceptable disposal pathway is being identified.	332.9 cubic meters
Solid Low-Level Radioactive Waste	This waste was sent off site to the following licensed treatment, storage, and disposal facilities: Nevada National Security Site, operated by DOE; and commercial facilities operated by Energy Solutions; Perma-Fix; Diversified Scientific Services, Inc.; Clean Harbors; and Waste Control Specialists.	6,070 cubic meters
Liquid Radioactive Waste	This waste was treated on site at the Radioactive Liquid Waste Treatment Facility in Technical Area 50. The treated water was either evaporated or discharged at permitted Outfall 051. Some additional liquid radioactive waste was sent to offsite disposal facilities.	1,307,036 liters
Hazardous Waste	This waste was shipped off site for treatment and disposal to the licensed treatment, storage, and disposal facilities of Veolia North America and U.S. Ecology.	74,158 kilograms
Solid Mixed Low-Level Waste	This waste was shipped off site to the following licensed treatment, storage, and disposal facilities: Energy Solutions; Perma-Fix; Diversified Scientific Services, Inc.; and Waste Control Specialists.	570.3 cubic meters
Sanitary Solid Waste	This waste (examples include office and cafeteria trash) was taken to the Los Alamos County Eco Station for transfer to municipal landfills. Los Alamos County operates this transfer station and is responsible for obtaining all related permits for these activities. The total weight of this waste was provided by the Los Alamos County Eco Station.	1,925.5 tons
PCB Wastes[b]	Waste that contained polychlorinated biphenyls (PCBs), including transformers and objects contaminated with at least 50 parts per million PCBs, was sent to Veolia North America or Sunbelt Solomon, U.S. Environmental Protection Agency–authorized treatment and disposal facilities.	2,366.3 kilograms
Asbestos Waste[c]	Waste that contained asbestos was deposited at Veolia or Waste Management-Colorado Springs Landfill, waste disposal sites operated in accordance with Title 40, Part 61, Section 154 of the Code of Federal Regulations.	98.8 cubic meters

[a] We used LANL's Waste Compliance and Tracking System database for totals of gross weights and volumes of waste shipped off site. We did not include some categories of waste, such as nonhazardous waste, universal waste, and non-asbestos New Mexico special waste.
[b] This total includes waste that contained only PCBs. If a waste with PCBs also contains hazardous or low-level waste, it was included in the non-PCB waste category.
[c] This total includes waste that contained only asbestos. If a waste with asbestos also contains hazardous or low-level waste, it was included in the non-asbestos waste category.

What are the types of radioactive waste?

Transuranic Waste – Waste that has an activity of alpha-emitting transuranic radionuclides with half-lives of 20 years or more (such as plutonium, cesium, and strontium) that is greater than 100 nanocuries per gram of waste.

Mixed Transuranic Waste – Transuranic waste along with at least one component defined as hazardous waste under the Resource Conservation and Recovery Act.

High-Level Waste – Transuranic waste, highly radioactive waste that results from the reprocessing of spent nuclear fuel, or tailings from the milling of uranium or thorium ore.

Low-Level Waste – Waste that contains added radioactivity but does not contain high-level waste or any waste defined as hazardous under the Resource Conservation and Recovery Act.

Mixed Low-Level Waste – Low-level waste along with at least one waste defined as hazardous under the Resource Conservation and Recovery Act.

How do we measure waste?

Solid Waste – We report amounts of solid waste either by gross weight (for example, kilograms or tons) or by gross volume (for example, cubic meters). Solid wastes may be reported by volume because it is not practical to weigh the containers that contain the waste. Instead, we note the volume of a container and measure how full it is.

Liquid Waste – We report the amounts of liquid wastes by volume (for example, liters or gallons).

We frequently (but not always) use metric measurements to report the amounts of wastes. The following list shows the conversions of metric measurements to Imperial measurements and an example of how large or heavy one unit is.

1 cubic meter = 1.31 cubic yards: ~ 8 large moving boxes
1 liter = 0.26 gallons: ~ a little more than a quart of milk
1 ton = 2,000 pounds: ~ 2 grand pianos
1 kilogram = 2.2 pounds: ~ 1 head of cabbage

Radioactive Wastes

DOE Order 435.1 Chg 2, Radioactive Waste Management

Site operations that use nuclear materials generate four types of radioactive wastes: low-level radioactive waste (also called low-level waste), mixed low-level waste, transuranic waste, and mixed transuranic waste. Radioactive waste must meet onsite storage requirements as well as requirements for transportation to and disposal at the final facility. All aspects of radioactive waste generation, storage, and disposal are regulated by DOE Order 435.1 Chg 2, Radioactive Waste Management; and DOE Manual 435.1-1, Radioactive Waste Management Manual.

Onsite Low-Level Radioactive Waste Disposal

Material Disposal Area G at Technical Area 54 (Area G) is the only active waste disposal facility at the site. The current capacity to dispose of low-level waste at Area G is very limited; waste is accepted for disposal only under special circumstances and with prior authorization. One 20-cubic-yard roll-off bin of low-level waste was disposed of in Area G in 2024.

Planning for the closure of Area G has been underway since 1992. We are working with the New Mexico Environment Department Hazardous Waste Bureau to develop and implement corrective measures for the Solid Waste Management Units at Area G. We discuss environmental monitoring at Area G in other chapters in this report. Table 2-2 provides the 2024 status of the DOE low-level waste disposal facility management process for Area G.

Table 2-2. DOE Low-Level Waste Disposal Facility Management Status for Area G

Management Process Phase	Status
Performance Assessment/ Composite Analysis	Revision 4 was approved in 2009 (LANL 2008). A determination of adequacy was published in April 2021.
Closure Plan	Plan was issued in 2009 (LANL 2009).
Performance Assessment/ Composite Analysis Maintenance Program	Revised Plan was issued in 2021 (Neptune 2021a). Updated analyses and modeling of erosion, cliff retreat, and infiltration were completed during 2020 (Neptune 2021b, Neptune 2021c).
Disposal Authorization Statement	Revision 2 was issued November 15, 2018. This revision identifies the DOE Environmental Management Field Office in Los Alamos as the responsible field office.

Hazardous Wastes

Resource Conservation and Recovery Act

The Resource Conservation and Recovery Act regulates "covered hazardous wastes" from generation to disposal. Covered hazardous wastes include all solid wastes that are listed as hazardous by the U.S. Environmental Protection Agency (listed wastes); ignitable, corrosive, reactive, or toxic wastes (characteristic wastes); or batteries, pesticides, lamp bulbs, aerosol cans, or wastes that contain mercury (universal wastes).

Mixed radioactive waste (also called mixed waste) is radioactive waste that is mixed with a covered hazardous waste. Under the Resource Conservation and Recovery Act, facilities that treat, store, or dispose of hazardous wastes—including mixed radioactive wastes—must obtain a permit from their regulatory agency.

LANL's Hazardous Waste Facility Permit

Permit Name	Los Alamos National Laboratory Hazardous Waste Facility Permit
Permit Number	NM 0890010515
Permit Issuer	New Mexico Environment Department
Permittee(s)	Department of Energy through its field offices, the National Nuclear Security Administration Los Alamos Field Office and the DOE-Environmental Management Los Alamos Field Office; Triad National Security, LLC (Triad); and Newport News Nuclear BWXT Los Alamos (N3B)
Permit Expiration Date	December 30, 2020
Permit Status	Administratively continued
Permit Regulator	New Mexico Environment Department Hazardous Waste Bureau
Permit Purpose	Authorize and regulate the storage and treatment of hazardous waste at Los Alamos National Laboratory

The Hazardous Waste Facility Permit

- provides requirements for storage and sometimes treatment of hazardous waste at 28 separate hazardous waste management locations at the site;
- provides requirements for sampling, reporting, inspection, training, waste minimization, preparedness and prevention, and emergency and contingency planning; and
- requires the Laboratory to post specific information for public review in an electronic information repository (electronic public reading rooms).

In 2020, we submitted a permit renewal application to the New Mexico Environment Department to renew LANL's Hazardous Waste Facility Permit. The New Mexico Environment Department issued two Administratively Incomplete Determinations for the permit renewal application, and we provided responses with additional information and supporting documents. The New Mexico Environment Department issued direction to proceed with submitting a revised permit renewal application in July 2025.

Permit Modifications

The Hazardous Waste Facility Permit may be modified with approval from the New Mexico Environment Department. Modifications may be minor (Class 1 and Class 2) or major (Class 3). Notifications of proposed Class 2 and Class 3 permit modifications are published in a newspaper of general circulation with a request for public comment and are mailed to members of the public who sign up for a LANL facility mailing list maintained by the New Mexico Environment Department.

We submitted requests for four Class 1 permit modifications in 2024:

- Class 1 – Replacement of curbing at Technical Area 54, Area G, Pad 6, Dome 153
- Class 1 with Prior Approval – Changes to figures and text to add a storage container for nonhazardous waste storage at Technical Area 54, Area G, Pad 9
- Class 1 with Prior Approval – Addition of two storage containers at Technical Area 54, Area G, Pad 10, and removal of two structures from Technical Area 54, Area G, Pads 10 and 11
- Class 1 – Removal of two structures from Technical Area 63

The New Mexico Environment Department approved all permit modification requests.

Reports and Other Activities

Triad and N3B sent coordinated notifications of demolition activity to the New Mexico Environment Department for the quarters beginning in January, April, July, and October of 2024. Waste minimization reporting, responses to requests for information from the New Mexico Environment Department, and annual electronic public reading room training were also coordinated between Triad and N3B.

A Class 1 permit modification was submitted and approved to extend the schedule in the "Amended Closure Plan Open Burning Treatment Unit Technical Area 16-399 Burn Tray." We submitted the "Los Alamos National Laboratory Closure Certification Report for Open Burning

Treatment Unit Technical Area 16-399 Burn Tray, Revision 1," to the New Mexico Environment Department. They approved this report and found that the site meets the clean closure standards outlined in the closure plan.

During January through December 2024, we submitted four quarterly soil vapor monitoring reports for the Technical Area 63 Transuranic Waste Facility. The results indicate that vapor concentrations at the site do not exceed the soil gas screening levels established by the Hazardous Waste Facility Permit. We also submitted a 15-day notification of detection of a new constituent in June 2024. Analytical results from vapor monitoring well 2 (structure 63-2010) indicated the presence of ethanol for the first time since vapor sampling began.

During 2024, no emergency permits were applied for or obtained.

Inspections, Noncompliances, and Notices of Violation

We provide the following notices and reports to the New Mexico Environment Department:

- advance written notice of any changes to any permitted location or activity that could result in a noncompliance with the permit;
- verbal and written reports of the discovery of any noncompliance that could endanger human health or the environment; and
- an annual noncompliance report that includes releases and permit noncompliances that do not threaten human health or the environment.

The following releases and incidents of noncompliance for the period of October 1, 2023, through September 30, 2024, did not pose a potential threat to human health or the environment and were included in the fiscal year 2024 noncompliance report.

- Triad reported four instances of release within a permitted waste unit.
  - Approximately 300 milliliters of hydraulic fluid spilled during a hydraulic fluid change for a scissor lift located on a permitted outdoor pad.
  - Approximately 10 gallons of water was released into a permitted unit when a safety shower was unintentionally activated in an adjacent room.
  - Approximately 3 liters of water was discovered on the floor of a permitted unit. During the night, a valve in a room above the unit was not completely closed, and water dripped through the ceiling down into the unit.
  - Approximately 40 milliliters of gear oil spilled onto concrete under a trailer during repair of conveyor belt equipment.
- N3B reported two releases at a permitted unit.
  - An "Industrial Package 1" bag that contained corrugated metal pipe tore during size-reduction operations, releasing approximately 2 gallons of liquid (presumed to be precipitation) along with a small amount of solid debris.
  - An estimated 0.5 gallon of herbicide was spilled onto an asphalt surface.

Neither instance resulted in the release of hazardous material or waste from the site. No issues of noncompliance were identified for either incident.

Triad reported 24 instances of possible noncompliance with the permit, and N3B reported 2 instances of possible noncompliance with the permit. Both Triad and N3B took corrective actions for all reported instances of possible noncompliance.

The New Mexico Environment Department conducted its annual compliance inspection for the Laboratory's Hazardous Waste Facility Permit on September 23–25, 2024. The New Mexico Environment Department conducted a closeout on November 6, 2024, and issued no findings for the inspection.

Settlement Agreement and Stipulated Final Order

In 2016, the DOE National Nuclear Security Administration, Los Alamos National Security, LLC (the previous management and operating contractor for the Laboratory), and the State of New Mexico signed a Settlement Agreement for resolution of penalties associated with a 2014 contamination event at the Waste Isolation Pilot Plant in Carlsbad, New Mexico. The settlement agreement included five supplemental environmental projects that the National Nuclear Security Administration and the Laboratory implemented. The following supplemental environmental project activities remained for 2024:

- Road Improvement Project – Improve routes at the Laboratory used for the transportation of transuranic waste to the Waste Isolation Pilot Plant; construction to realign the intersection of State Road 4 and East Jemez Road was completed in 2024.

Facility Groundwater Monitoring Program

The Hazardous Waste Facility Permit requires us to monitor groundwater potentially affected by regulated hazardous waste units. The groundwater monitoring conducted under the 2016 Compliance Order on Consent, as modified (Consent Order), fulfills these groundwater monitoring requirements. The Interim Facility-Wide Groundwater Monitoring Plan, which is updated annually, guides Consent Order groundwater monitoring.

Groundwater monitoring activities and results are discussed in Chapter 5. The Consent Order is discussed in the next section.

The Compliance Order on Consent for Legacy Waste Cleanup

The Consent Order (most recently modified in 2024; available at https://www.env.nm.gov/hazardous-waste/lanl) is a settlement agreement between the New Mexico Environment Department and the DOE that addresses cleanup of legacy wastes.

We evaluate both Solid Waste Management Units and Areas of Concern for corrective actions under the Consent Order. Solid Waste Management Units are areas where solid wastes were directly placed or spilled. Examples of these units include septic tanks, firing sites, landfills, sumps, and areas that received liquid effluents from outfalls. Areas of Concern are areas that could have received a hazardous waste or hazardous constituent through soil movement or downstream flow of liquids. Examples include canyon bottoms downstream from historical outfalls. Collectively, these areas are called corrective action sites.

As of October 1, 2024, there were 1,405 corrective action sites listed in Appendix A of the Consent Order. During fiscal year 2024, eight sites received certificates of completion with controls, two sites received a certificate of completion without controls, and no sites were changed to a deferred status. Therefore, at the end of fiscal year 2024, 93 corrective action sites had certificates of completion with controls, 301 had certificates of completion without controls, and 148 sites were deferred until they were no longer associated with active operations. The remaining 863 Solid Waste Management Units and Areas of Concern had investigations or corrective actions (or both) either in progress or pending.

The Consent Order also addresses remediation of groundwater. Groundwater remediation activities are discussed in detail in Chapter 5.

During fiscal year 2024, we submitted the following documents to the New Mexico Environment Department Hazardous Waste Bureau as part of the Consent Order deliverables:

- eight periodic monitoring reports for eight groundwater monitoring groups;
- one periodic monitoring report for vapor sampling activities at Material Disposal Area L;
- four drilling work plans for four regional aquifer monitoring wells;
- three progress reports for three aggregate areas;
- two investigation reports for two aggregate areas;
- one annual update on the Interim Facility-Wide Groundwater Monitoring Plan;
- one annual update for the Los Alamos/Pueblo Canyon Watershed Sediment Transport Mitigation Project;
- one report on the Sandia Canyon Wetland Performance;
- one revised investigation work plan and four revised investigation reports; and
- two annual, long-term monitoring and maintenance reports for the corrective measures implementation.

Mixed Wastes

Federal Facility Compliance Act/Site Treatment Plan

The Federal Facility Compliance Act requires federal facilities that generate or store mixed radioactive and hazardous wastes to submit a site treatment plan that includes a schedule for developing capacities and technologies to treat all mixed waste. Along with the site treatment plan, we submit a site treatment plan annual update to the New Mexico Environment Department. We report the amounts of mixed low-level waste and mixed transuranic waste that are stored at the LANL site under the provisions of the plan and the amounts shipped to approved treatment, storage, and disposal facilities. The site treatment plan annual update must be submitted to the New Mexico Environment Department no later than March 31 of each year and contain data from the previous fiscal year (October 1 through September 30).

The 2024 Site Treatment Plan Annual Update reported that the amount of mixed low-level waste covered under the site treatment plan decreased from 170.4 cubic meters to 155.2 cubic meters. This change was due to offsite shipments of 25.0 cubic meters, administrative adjustments of 7.2 cubic meters, and the addition of 2.7 cubic meters of new waste. The amount of mixed transuranic waste covered under the site treatment plan decreased from 1,138.3 cubic meters to

1,120.2 cubic meters. This adjustment was due to a shipment of 97.0 cubic meters to the Waste Isolation Pilot Plant, administrative adjustments of −38.7 cubic meters, and 117.5 cubic meters of new waste.

Volumes of mixed waste that were managed under the site treatment plan during fiscal year 2024 are provided in Table 2-3. These waste volumes may be adjusted slightly through reconciliation during the New Mexico Environment Department review of the site treatment plan update. Approved site treatment plan updates are available at http://www.env.nm.gov/hazardous-waste/lanl-ffco-stp/.

Table 2-3. Approximate Volumes of Mixed Waste Stored and Shipped Off Site for Treatment and/or Disposal under the Site Treatment Plan during Fiscal Year 2024

Contractor	Volume of Mixed Wastes Stored at the LANL Site under the Site Treatment Plan	Volume of Mixed Wastes Shipped Off Site under the Site Treatment Plan
Mixed Low-Level Waste		
Triad	0.738 cubic meters	1.873 cubic meters
N3B	154.488 cubic meters	23.156 cubic meters
Mixed Transuranic Waste		
Triad	141.580 cubic meters	12.480 cubic meters
N3B	978.596 cubic meters	84.510 cubic meters

Other Wastes

Toxic Substances Control Act

The Toxic Substances Control Act addresses the production, import, use, and disposal of specific chemicals, including PCBs. We conducted 21 Toxic Substances Control Act reviews for regulated chemicals imported or exported by the Laboratory’s Property Management group Customs Office in 2024. These shipments were all properly categorized, and the chemical compound samples were sent to collaborative researchers in other countries.

Air Quality and Protection

Clean Air Act

Title V Operating Permit

Permit Name	Los Alamos National Laboratory Title V Operating Permit
Permit Number	P100-R2M5
Permit Issuer	New Mexico Environment Department Air Quality Bureau
Permittee(s)	Department of Energy, National Nuclear Security Administration and Triad National Security, LLC
Permit Expiration Date	Expired February 2020 (renewal application submitted February 2019 and resubmitted February 2024)
Permit Status	Operations continue under the current permit under the provisions of Title 20, Chapter 2, Part 70, Section 400 of the New Mexico Administrative Code until a renewed permit is issued
Permit Regulator	New Mexico Environment Department Air Quality Bureau
Permit Purpose	Authorize and regulate emissions of specified air pollutants at Los Alamos National Laboratory

Under the Clean Air Act, the LANL site is regulated as a source of air pollutants. The Laboratory's Clean Air Act Title V Operating Permit requires us to keep air emissions of regulated pollutants below permit limits. In 2019, we submitted a five-year Title V permit renewal application, and in 2024, we resubmitted the application. The current Title V Operating Permit expired on February 27, 2020. The Laboratory continues to operate under its existing Title V Operating Permit in accordance with the provisions of Title 20, Chapter 2, Part 70, Section 400 of the New Mexico Administrative Code until a renewed permit is issued.

We annually certify our compliance with the conditions of our Title V Operating Permit and report any deviations to the New Mexico Environment Department. A deviation occurs when a permit condition is not met. In 2024, there were no deviations to report.

Table 2-4 summarizes the site's air emissions data.

Table 2-4. Emissions of Regulated Air Pollutants Reported to the New Mexico Environment Department in 2024

Emission Unit	Pollutants (tons)					
	Nitrous Oxides	Carbon Monoxide	Volatile Organic Compounds	Particulate Matter	Sulfur Oxides	Hazardous Air Pollutants
Asphalt plant	0.06	0.60	0.17	0.19	0.02	0.03
Technical Area 3 power plant (3 boilers)	9.14	6.30	0.87	1.20	0.10	0.29
Technical Area 3 power plant (combustion turbine)	12.32	15.01	0.32	0.99	0.87	0.19
Research and development chemical use	NA[a]	NA	8.16	NA	NA	5.65
Degreaser	NA	NA	0.04	NA	NA	0.04
Data disintegrator	NA	NA	NA	0.27	NA	NA
Stationary standby generators[b]	2.15	0.48	0.09	0.09	0.07	0.001
Miscellaneous small boilers	15.28	12.89	0.90	1.20	0.09	0.30
Permitted generators (11 units)	1.49	1.19	0.15	0.07	0.04	0.004
TOTAL	40.44	36.47	10.66	4.01	1.19	6.51
Permit limits (tons/year)	245	225	200	120	150	120

[a] NA = Not applicable.
[b] These generators are no longer listed as sources in the Laboratory's Title V permit; however, they are included in this table for comparison with previous annual site environmental reports.

The emissions in 2024 were significantly lower than the permit limits; for example, nitrogen oxide emissions were approximately 17 percent of the permit limit, carbon monoxide emissions were 16 percent of the permit limit, and particulate matter emissions were 3 percent of the permit limit.

Figure 2-1 shows a five-year history of pollutant emissions at the site.

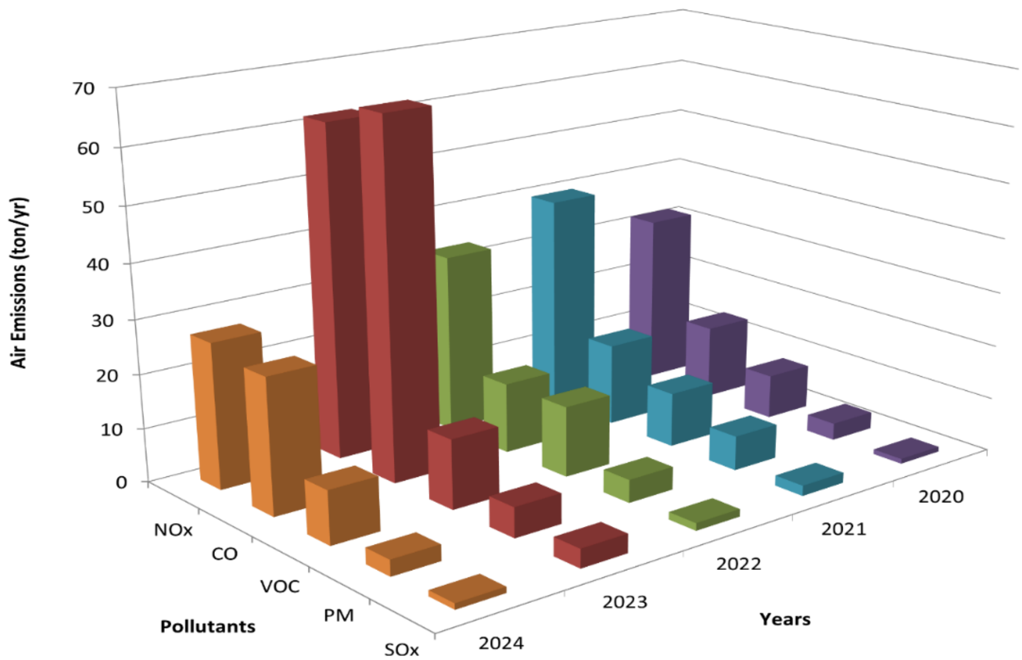

Figure 2-1. Criteria pollutant emissions from the LANL site during 2020 through 2024. These totals do not include small boilers or standby generators. NOx = nitrous oxides, CO = carbon monoxide, VOC = volatile organic compounds, PM = particulate matter, and SOx = sulfur oxides.

Management of Refrigerants and Halons under Title VI – Stratospheric Ozone Protection and the American Innovation and Manufacturing Act

Title VI of the Clean Air Act regulates substances that harm the ozone layer, including halons, chlorofluorocarbons, hydrochlorofluorocarbons, and certain non-ozone-depleting chemicals such as hydrofluorocarbons. These substances are commonly used as refrigerants, solvents, propellants, and foam-blowing agents. We are actively replacing refrigeration equipment that relies on ozone-depleting chemicals with systems that use more eco-friendly refrigerants identified by the U.S. Environmental Protection Agency's Significant New Alternatives Program. In 2024, no refrigerant was sent off site for disposal.

Regulation of Airborne Radionuclide Emissions under the Radionuclide National Emission Standards for Hazardous Air Pollutants

Emissions of airborne radionuclides are regulated under the Radionuclide National Emission Standards for Hazardous Air Pollutants, which sets a dose limit of 10 millirem per year to any member of the public for air emissions. The estimated maximum dose of air emissions to a member of the public in 2024 was 0.78 millirem, less than 5 percent of the limit allowed by the Clean Air Act regulations (refer to Chapter 8).

Asbestos Notifications

The Asbestos National Emission Standards for Hazardous Air Pollutants require us to provide advance notice to the New Mexico Environment Department Air Quality Bureau for large renovation jobs that involve asbestos and for all demolition projects. In 2024, Triad completed nine large renovation and demolition projects. Advance notification to the New Mexico

Environment Department was submitted for each of these projects. All asbestos waste was properly packaged and disposed of at approved landfills.

New Mexico Air Quality Control Act

New Source Reviews

The State of New Mexico requires new or modified sources of air emissions to be evaluated to determine if they

- are exempted under the New Mexico Administrative Code ("Exemption Notice"),
- produce insufficient emissions to require a construction permit ("No Permit Required determination"),
- require a notice of intent to construct ("Notice of Intent"), or
- require a construction permit.

In 2024, we submitted one initial Notice of Intent, one Notice of Intent revision request, four Exemption Notices, one construction permit revision, and three No Permit Required requests to the New Mexico Environment Department Air Quality Bureau. Descriptions of the submissions follow:

- We submitted a request to revise the existing permit for the Technical Area 3 Power Plant to allow boiler TA-3-22-2 to continue operation as a backup along with boiler TA-3-22-3 when the start-up of the two auxiliary boilers (TA-3-22-4 and TA-3-22-5) begins. With this revision, boiler TA-3-22-2 would not be required to be decommissioned within 6 months of the start-up of the auxiliary boilers; boiler TA-3-22-2 would share the emission limits listed in the permit for boiler TA-3-22-3.
- We submitted a Notice of Intent to replace two existing Title V permitted boilers with two equivalent replacement low-nitrous-oxide boilers. The boilers are hot water boilers for Technical Area 53 Building 365 heating systems.
- We added two gas-fired heaters at Technical Area 53 Building 365 for personal use of heating buildings or water. The units met the requirements for an exemption notice.
- We submitted an administrative revision for 20 small boilers and heaters. The units will be added to our small boiler pool, and emissions from these units will be included in our emissions reporting for small boilers.
- We requested coverage for a PVA Delta 6 selective coating/dispensing system. This project upgrades and modernizes the process for applying conformal epoxy coating to electronic printed circuit boards designed for use in space.
- We added a Model C35 D6 60 HP Cummins stand-by diesel generator set as an exempt source for Technical Area 3 Building 1076. It will be used during periods of unavoidable loss of commercial utility power.

The active construction permits issued to us under the New Mexico Air Quality Control Act are listed in Summary of Permits and Compliance Orders later in this chapter.

Surface Water Quality and Protection

Clean Water Act

Outfall Permit

Permit Name	Los Alamos National Laboratory National Pollutant Discharge Elimination System Industrial and Sanitary Point-Source Outfall Permit
Permit Number	NM0028355
Permit Issuer	U.S. Environmental Protection Agency
Permittee(s)	U.S. Department of Energy, Triad National Security, LLC
Permit Expiration Date	October 31, 2028
Permit Status	Currently in effect
Permit Regulator(s)	U.S. Environmental Protection Agency and New Mexico Environment Department Surface Water Quality Bureau
Permit Purpose	Authorize and regulate liquid effluent discharges to the environment from the site's industrial and sanitary outfalls

The primary goal of the Clean Water Act is to restore and maintain the chemical, physical, and biological integrity of the nation's waters. The act requires National Pollutant Discharge Elimination System permits for several types of effluent and stormwater discharges. The permits contain chemical, physical, and biological criteria and management practices that we must meet when discharging water. The U.S. Environmental Protection Agency, Region 6, provides and enforces the Laboratory's Clean Water Act permits. The New Mexico Environment Department certifies the permits as protective of waters of the state and performs some compliance inspections and monitoring on behalf of the U.S. Environmental Protection Agency.

The Laboratory's current Outfall Permit includes 1 sanitary and 10 industrial outfalls that can potentially discharge into five canyons (Table 2-5).

Table 2-5. Volume of Effluent Discharged from Permitted Outfalls in 2024

Outfall No.	Building No.	Description	Canyon Receiving Discharge	2024 Discharge (gallons)
03A048	53-963/978	Los Alamos Neutron Science Center cooling tower	Los Alamos	10,186,600
051	50-1	Technical Area 50 Radioactive Liquid Waste Treatment Facility	Mortandad	99,610
03A022[a]	3-2238	Sigma emergency cooling system	Mortandad	174,240
03A160	3-5-124	National High Magnetic Field Laboratory cooling tower	Mortandad	0
03A181	55-6	Plutonium Facility cooling tower	Mortandad	1,586,530
13S	46-347	Sanitary wastewater system plant	Cañada del Buey	0
001	3-22	Power plant (includes treated effluent from sanitary wastewater system plant)	Sandia	64,245,000

Outfall No.	Building No.	Description	Canyon Receiving Discharge	2024 Discharge (gallons)
03A027	3-2327	Strategic Computing Complex cooling tower	Sandia	0
03A113	53-293/952	Los Alamos Neutron Science Center cooling tower	Sandia	159,340
03A199	3-1837	Laboratory Data Communications Center	Sandia	11,570,300
05A055	16-1508	High Explosives Wastewater Treatment Facility	Water	0
2024 Total:				88,021,620

[a] This outfall's designation was changed back to 03A022 from 04A022 in the September 2023 permit renewal to reflect cooling water, emergency cooling water, and roof drain and stormwater discharges to the outfall (cooling tower blowdown was diverted to the sanitary wastewater system plant).

We sample liquid effluents discharged from the outfalls to the environment as specified in the permit, and we report the results to the U.S. Environmental Protection Agency and the New Mexico Environment Department every month in an electronic Discharge Monitoring Report. Any engineering or flow changes that would affect quality or quantity of the effluents are reported to the U.S. Environmental Protection Agency and the New Mexico Environment Department in a Notice of Planned Change.

In 2024, we collected 738 samples from Outfalls 001, 03A048, 03A113, 03A181, 03A199, 03A022, and 051. We exceeded a permit limit three times (refer to Table 2-6). We addressed each exceedance immediately by correcting the cause or ceasing the discharge until corrective actions could be implemented. Outfalls 03A160, 13S, 03A027, and 05A055 did not discharge in 2024.

Table 2-6. Exceedances at National Pollutant Discharge Elimination System–Permitted Industrial and Sanitary Outfalls in 2024

Outfall No.	Parameter	Date	Permit Limit	Result	Unit	Corrective Action
03A181	Total residual chlorine daily max	4/2/24	0.011	0.19	mg/L	Corrected ratio of chlorinated potable water to chlorine scavenger chemical
03A022	PCBs monthly average	5/15/24	0.054	0.00064	µg/L	Cleaned and painted the cooling water sump that discharges to the outfall
03A022	PCBs daily max	5/15/24	0.054	0.00064	µg/L	Cleaned and painted the cooling water sump that discharges to the outfall

Note: mg/L = milligrams per liter; µg/L = micrograms per liter; cfu/100 mL = colony-forming units per 100 milliliters

Construction General Permit

Permit Name	National Pollutant Discharge Elimination System General Permit for Discharges of Storm Water from Construction Sites
Permit Number	Not applicable
Permit Issuer	U.S. Environmental Protection Agency
Permittee(s)	Nationwide permit covers all eligible construction activities
Permit Expiration Date	February 16, 2027
Permit Status	Currently in effect
Permit Regulator(s)	U.S. Environmental Protection Agency
Permit Purpose	Authorize and regulate discharges of stormwater from construction sites or common plans of development covering more than 1 acre

To comply with the Construction General Permit, we develop stormwater pollution prevention plans for construction sites that cover more than 1 acre and for construction projects smaller than 1 acre that are part of a common plan of development. A stormwater pollution prevention plan describes the project activities, site conditions, best management practices for sediment and erosion control, and permanent control measures to reduce pollutants in stormwater discharges. We inspect stormwater controls during construction and identify any needed corrective actions. We notify the U.S. Environmental Protection Agency when construction is complete.

In 2024, Triad was responsible for 40 stormwater pollution prevention plans and performed 1,288 inspections.

During 2024, N3B operated nine projects that were covered under the Construction General Permit. These projects were inspected and operated in accordance with permit requirements.

Multi-Sector General Permit

Permit Name	National Pollutant Discharge Elimination System Multi-Sector General Permit for Storm Water Discharges Associated with Industrial Activities
Permit Tracking Number(s)	NMR050011 (N3B), NMR050012 (N3B), and NRM050013 (Triad)
Permit Issuer	U.S. Environmental Protection Agency
Permittee(s)	General permit covers all eligible industrial activities in jurisdictions regulated by the U.S Environmental Protection Agency
Permit Expiration Date	February 28, 2026
Permit Status	Currently in effect
Permit Regulator(s)	U.S. Environmental Protection Agency
Permit Purpose	Authorize and regulate discharges of stormwater and specific types of non-stormwater associated with industrial activities and facilities

Industrial facilities, materials, and activities covered under the Multi-Sector General Permit at the Laboratory include timber products, metal fabrication, vehicle and equipment maintenance, hazardous waste treatment and storage, recycling activities, warehousing activities, and asphalt manufacturing.

The Multi-Sector General Permit directs permittees to minimize releases of pollutants and to meet the permit's restrictions regarding quantities, rates, and concentrations of chemical, physical, biological, and other constituents in discharged waters. Requirements include minimizing exposure of industrial materials to stormwater, good housekeeping practices, installation and maintenance of control measures, spill prevention and response, and training.

Under the Multi-Sector General Permit, we are required to monitor stormwater at our facilities with permitted materials and activities. We monitor for the types of water quality parameters listed in Table 2-7.

Table 2-7. Multi-Sector General Permit Stormwater Monitoring Requirements

Parameter	Monitoring Schedule
Quarterly Indicator Parameters; Total Suspended Solids, Chemical Oxygen Demand, and pH	Quarterly for the duration of the permit
Semi-Annual Indicator Parameters; Polycyclic Aromatic Hydrocarbons	Twice annually in years 1 and 4 of the permit
Benchmark Parameters	Quarterly in years 1 and 4 of the permit unless an event occurs that triggers corrective action; if a triggering event occurs, the parameter is monitored quarterly until results indicate a return-to-baseline status
Effluent Limitations Guideline Parameters	Annually for the duration of the permit
Impaired Waters Parameters	Annually in years 1 and 4 of the permit; if a parameter is detected, it is monitored annually until the parameter is not detected

The permit requires corrective actions called "Additional Implementation Measures" when specified levels of benchmark parameters are exceeded. There are three levels of Additional Implementation Measures that have increasingly robust stormwater controls. Benchmarks are not permit limits, and a benchmark exceedance does not constitute a Permit violation.

All types of exceedances require evaluation of potential sources and either follow-up action or documentation of why no action is required.

Responsibilities for Multi-Sector General Permit compliance at the Laboratory are identified by Permit Tracking Number and Operator in Table 2-8.

Table 2-8. Multi-Sector General Permit Tracking Numbers by Operator and Covered Industrial Activity

Permit Tracking No.	Industrial Materials, Activities or Facilities Covered	Responsible Operator	Operator Role
NMR050011	Technical Area 54 Maintenance Facility West	N3B	Environmental Management Legacy Cleanup
NMR050012	Technical Area 54 Areas G and L waste transfer, storage, and disposal activities	N3B	Environmental Management Legacy Cleanup

Permit Tracking No.	Industrial Materials, Activities or Facilities Covered	Responsible Operator	Operator Role
NMR050013	Timber products, metal fabrication, vehicle and equipment maintenance, recycling activities, warehousing activities, and asphalt manufacturing	Triad National Security, LLC	National Nuclear Security Administration Management and Operations

We report annual compliance activities separately for each operator.

Management and Operating Contractor (Triad) Compliance Summary

Nine facilities operated by Triad are covered under the Multi-Sector General Permit. In 2024, we completed the following tasks as part of the Multi-Sector General Permit compliance for Triad:

- 90 inspections of stormwater controls
- 1 annual inspection at each of 38 sites that had “no exposure” status
- Collection of 136 samples
- 461 inspections of ISCO automated sampler equipment
- 77 inspections of single-stage samplers at substantially identical discharge points (discharge points that discharge stormwater from the same source and with the same control measures and amount of stormwater runoff per unit area)
- 35 visual inspections at 12 monitored discharge points
- 41 visual inspections at 10 substantially identical discharge points, and
- 103 corrective actions, as follows:
  - 12 control measures maintained, repaired, or replaced
  - 56 corrective actions to remedy control measures inadequate to meet nonnumeric effluent limitation guidelines
  - 34 corrective actions to address unauthorized releases (spills) or discharges
  - 1 action to establish additional implementation measures in response to benchmark exceedances

All corrective actions associated with exceedances in 2024 have been completed.

By meeting permit-defined criteria, we were able to discontinue monitoring as summarized in Table 2-9. Monitoring was discontinued for the remainder of the permit coverage period because the listed impaired-water parameter was not detected in stormwater discharge in Permit year 4.

Table 2-9. 2024 Parameters with Discontinued Monitoring for the Remainder of Permit Coverage at Specified Discharge Points

Parameter Type	Parameter	Discharge Points
Impaired Waters	Adjusted Gross Alpha	031
Impaired Waters	Total Aroclors	022
Impaired Waters	Total Aroclors	026
Impaired Waters	Total Aroclors	029

Parameter Type	Parameter	Discharge Points
Impaired Waters	Total Aroclors	031
Impaired Waters	Total Aroclors	032
Impaired Waters	Total Aroclors	042
Impaired Waters	Total Aroclors	075
Impaired Waters	Total Aroclors	076
Impaired Waters	Total Aroclors	084
Impaired Waters	Total Aroclors	085

Table 2-10 summarizes Triad's 2024 exceedances of benchmark parameters and the associated Additional Implementation Measure level applied as a corrective action.

Table 2-10. 2024 Exceedances of the Management and Operating Contractor's National Pollutant Discharge Elimination System Multi-Sector General Permit Benchmark Values and the Applied Additional Implementation Measure Level

Discharge Point	Exceeded Benchmark Parameter[a]	Applied Additional Implementation Measure Level[b]	Last Sample Date
022	Aluminum, total recoverable	Level 3	02/02/2024

[a] An exceedance of a benchmark value means that the reported average concentration of the identified parameter in four (or fewer) representative quarterly stormwater samples exceeded an industry-sector-specific benchmark value specified in the Multi-Sector General Permit. Benchmark values are not permit limits.

[b] As quarterly monitoring continues, additional implementation measure levels could advance to the next level or return to baseline. This table reflects the additional implementation measure level at the end of calendar year 2024.

Legacy Cleanup Contractor (N3B) Compliance Summary

Two Laboratory facilities (Technical Area 54 Areas G and L and Maintenance Facility West) subject to N3B control are permitted under the 2021 Multi-Sector General Permit. We completed the following tasks during 2024 as part of Multi-Sector General Permit compliance for N3B:

- Performed four routine facility inspections at each Multi-Sector General Permit–covered facility
- Performed 143 quarterly visual inspections of stormwater discharges from monitored outfalls and substantially identical discharge points
- Collected annual impaired waters monitoring samples from all six monitored outfalls (five at Technical Area 54 Areas G and L and one at Maintenance Facility West)
- Collected 18 quarterly benchmark samples from five monitored outfalls at Technical Area 54 Areas G and L
- Completed seven corrective actions to address needed maintenance or in response to stormwater exceedances of benchmark values or a New Mexico surface water quality standard
- Initiated two corrective actions to maintain, repair, or replace existing stormwater control measures
- Initiated five corrective actions in response to benchmark exceedances.

Because 2024 was Permit year 4, all parameters applicable to each outfall were included in monitoring; no parameters were discontinued based on prior sample results.

Table 2-11 summarizes exceedances of benchmark values in stormwater samples collected in 2024 from N3B-operated facilities and the associated Additional Implementation Measure level applied in response to each exceedance.

Table 2-11. 2024 Exceedances of N3B's National Pollutant Discharge Elimination System Multi-Sector General Permit Benchmark Values[a] and the Applied Additional Implementation Measure Level

Discharge Point	Exceeded Benchmark Parameter[a]	Applied Additional Implementation Measure Level[b]	Last Sample Date
051	Cadmium	Level 1	10/18/2024
051	Lead	Level 1	10/18/2024
072	Chemical Oxygen Demand	Level 3	10/18/2024

[a] An exceedance of a benchmark value means that the concentration of the identified parameter in a quarterly stormwater sample exceeded a benchmark value for that parameter specific to the type of industrial activity at the facility. Benchmark values are not permit limits.

[b] As quarterly monitoring continues, additional implementation measure levels could advance to the next level or return to baseline. This table reflects the additional implementation measure level at the end of calendar year 2024.

Storm Water Individual Permit

Permit Name	Individual Permit Authorization to Discharge under the National Pollutant Discharge Elimination System
Permit Number	NM0030759
Permit Issuer	Issued by U.S. Environmental Protection Agency and certified by the New Mexico Environment Department
Permittee(s)	Newport News Nuclear BWXT-Los Alamos, LLC (N3B) and U.S. Department of Energy
Permit Expiration Date	July 31, 2027
Permit Status	Currently in effect
Permit Regulator(s)	U.S. Environmental Protection Agency
Permit Purpose	Authorize and regulate discharges of stormwater from specified Solid Waste Management Units and Areas of Concern at Los Alamos National Laboratory

The Storm Water Individual Permit authorizes discharges of stormwater from certain Solid Waste Management Units and Areas of Concern. The objective is to prevent stormwater runoff from transporting pollutants of concern from these areas to surface waters. Pollutants of concern that potentially occur include metals, organic chemicals, high explosives, and radionuclides. The U.S. Environmental Protection Agency first issued the permit in 2010 and reissued it in 2022; it currently covers 397 Solid Waste Management Units and Areas of Concern.

The Storm Water Individual Permit contains technology-based requirements for stormwater controls. These requirements reflect best industry practices considering their availability, economic achievability, and practicability. Examples of controls include retention berms and coir logs. We inspect these controls routinely and maintain them as needed.

The Laboratory has grouped the 397 Solid Waste Management Units and Areas of Concern into 239 small subwatersheds called site monitoring areas. We identified pollutants of concern for each site monitoring area. The Permit identifies criteria for target action levels for the pollutants. We sample stormwater runoff at specific locations within each of the site monitoring areas.

Our process for addressing Solid Waste Management Units and Areas of Concern under the Permit involves five steps:

- installing and maintaining baseline stormwater controls,
- sampling stormwater runoff in the site monitoring areas to determine if and at what levels pollutants are present,
- reporting results to the U.S. Environmental Protection Agency and the New Mexico Environment Department,
- implementing corrective action if the results exceed a target action level, and
- placing Solid Waste Management Units and Areas of Concern into long-term stewardship or initiating a deletion request when corrective actions are complete.

If the sampling results exceed target action levels for monitored pollutants, we implement corrective action measures. These measures include

- installing additional stormwater controls called enhanced controls;
- eliminating the potential for pollutants to be exposed to stormwater; or
- installing basins that will retain the volume of stormwater that a 3-year, 24-hour storm event would produce.

In most cases, we continue stormwater sampling after implementing corrective actions. Additionally, there are multiple site monitoring areas where we have not collected sufficient stormwater samples to evaluate compliance with target action levels because of a lack of local rainfall. These locations remain under active monitoring.

If we install all control measures and the results of sampling confirm that all pollutants of concern for a site monitoring area are below the target action levels, we certify to the U.S. Environmental Protection Agency that the corrective actions are complete for the Solid Waste Management Units and Areas of Concern in that site monitoring area.

If we install all stormwater control measures but cannot demonstrate that all results are below target action levels (for example, if natural background concentrations at the site are above the target action levels), we may request that the U.S. Environmental Protection Agency place a site in alternative compliance. In this case, we complete the corrective action under an individual site compliance schedule determined by the U.S. Environmental Protection Agency.

2024 Accomplishments

In 2024, we completed the following tasks to comply with the requirements of the Storm Water Individual Permit:

- Published the 2023 update to the site discharge pollution prevention plan, which identifies pollutant sources, describes control measures, and defines monitoring at all permitted sites
- Published the 2023 Annual Sampling Implementation Plan, which presents the compliance status and monitoring plan for each site monitoring area
- Completed 635 inspections of stormwater controls at 239 site monitoring areas
- Completed 1,949 sampling equipment inspections
- Conducted stormwater monitoring at 193 site monitoring areas
- Collected 57 stormwater samples at 32 site monitoring areas
- Certified 48 controls at 14 site monitoring areas
- Installed one additional control measure at one site monitoring area
- Installed 22 controls to replace existing control measures at 12 site monitoring areas
- Held an annual Individual Permit public meeting on February 28, 2024
- Submitted site deletion requests for five site monitoring areas: CDV-SMA-6.02, LA-SMA-1.1, R-SMA-2.3, S-SMA-4.1, and W-SMA-9.05

Table 2-12 summarizes the exceedance of target action levels for stormwater samples collected in 2024.

Table 2-12. 2024 Exceedances of the National Pollutant Discharge Elimination System Storm Water Individual Permit Target Action Levels (µg/L)

Site Monitoring Area (SMA)	Sample Date	Parameter	Result	Maximum or Average Target Action Level[a]
2M-SMA-1.43	5/11/2024	Copper	26.9	4.35
2M-SMA-1.43	5/11/2024	Total PCB	0.00324	0.00064
2M-SMA-1.43	5/16/2024	Copper	4.78	4.35
2M-SMA-2.2	6/9/2024	Total PCB	0.212	0.00064
A-SMA-3	8/26/2024	Copper	6.94	5.29
CDV-SMA-2	9/5/2024	Aluminum	4,480	1,241
CDV-SMA-2.3	9/5/2024	Total PCB	0.133	0.014
CDV-SMA-2.42	9/5/2024	Total PCB	0.22	0.00064
LA-SMA-3.1	5/15/2024	Benzo(a)pyrene	0.729	0.18
LA-SMA-3.1	5/15/2024	Chrysene	1.01	0.18
LA-SMA-3.1	5/15/2024	Benzo(k)fluoranthene	0.534	0.18
LA-SMA-3.1	5/15/2024	Benzo(b)fluoranthene	1.5	0.18
LA-SMA-3.1	5/15/2024	Indeno(1,2,3-cd)pyrene	0.827	0.18
LA-SMA-3.1	5/15/2024	Benzo(a)anthracene	0.414	0.18
LA-SMA-3.1	6/21/2024	Benzo(a)pyrene	0.298	0.18
LA-SMA-3.1	6/21/2024	Chrysene	0.43	0.18
LA-SMA-3.1	6/21/2024	Benzo(k)fluoranthene	0.199	0.18
LA-SMA-3.1	6/21/2024	Benzo(b)fluoranthene	0.673	0.18

Site Monitoring Area (SMA)	Sample Date	Parameter	Result	Maximum or Average Target Action Level[a]
LA-SMA-3.1	6/21/2024	Indeno(1,2,3-cd)pyrene	0.364	0.18
M-SMA-7.9	5/16/2024	Copper	13.3	4.25
M-SMA-7.9	5/16/2024	Zinc	53.7	52.7
M-SMA-10.3	5/11/2024	Aluminum	1,460	643
M-SMA-10.3	5/16/2024	Aluminum	9,410	643
PJ-SMA-3.05	5/11/2024	Total PCB	1.41	0.014
PJ-SMA-5	9/5/2024	Copper	292	4.35
PJ-SMA-9.2	10/18/2024	Copper	5.65	4.35
S-SMA-3.61	8/1/2024	Bis(2-ethylhexyl)phthalate	29.2	22
S-SMA-3.61	8/1/2024	Total PCB	0.0219	0.00064
S-SMA-3.62	6/9/2024	Aluminum	3,370	1,077
S-SMA-3.62	6/9/2024	Total PCB	0.211	0.00064
S-SMA-3.62	6/9/2024	Copper	9.59	6.07
S-SMA-3.62	7/1/2024	Aluminum	4,940	1,077
T-SMA-1	7/17/2024	Total PCB	0.0662	0.014
T-SMA-1	7/18/2024	Total PCB	0.12	0.014
W-SMA-1	6/9/2024	Total PCB	0.00283	0.00064
W-SMA-1	6/20/2024	Total PCB	0.000643	0.00064
W-SMA-8	9/5/2024	Copper	27	6.69

Note: µg/L = micrograms per liter

[a] The maximum target action level is the target for individual maximum values recorded at a site; the average target action level is the target for the geometric mean of applicable monitoring results at a site. Target action levels are benchmarks, not permit limits.

For more information on surface water quality monitoring results, refer to Chapter 6.

Aboveground Storage Tank Program

The staff of the Aboveground Storage Tank Program manage compliance with New Mexico storage tank regulations and with U.S. Environmental Protection Agency storage tank requirements. The federal regulations require spill prevention, control, and countermeasure plans for facilities with aboveground storage tank systems and regulated oil-filled equipment. We manage 9 aboveground storage tank systems and 18 spill prevention, control, and countermeasure plans.

The New Mexico Environment Department Petroleum Storage Tank Bureau conducted four onsite inspections in 2024. Closure and removal of Aboveground Storage Tank 55-560 was completed in 2024, and the closure report was submitted to the Petroleum Storage Tank Bureau on April 30, 2024. The Petroleum Storage Tank Bureau closure report was received on September 4, 2024.

In 2024, we updated one spill prevention, control, and countermeasure plan. Staff conducted all annual and periodic inspections of the facilities as required.

Clean Water Act Section 404/401 Permits

Section 404 of the Clean Water Act requires that we receive verification from the U.S. Army Corps of Engineers that our proposed projects within certain watercourses comply with Clean Water Act nationwide permit conditions.

Section 401 of the Clean Water Act requires projects to get certification from states that the Section 404 permits issued by the U.S. Army Corps of Engineers comply with state water quality standards. The New Mexico Environment Department Surface Water Quality Bureau reviews the Section 404/401 permit applications and issues separate Section 401 certification letters that may include additional requirements.

Section 404/401 verifications and certifications issued or active at the site in 2024 are listed in Summary of Permits and Compliance Orders later in this chapter. Triad successfully completed final reporting for four permits and compliance orders in 2024.

We continue to protect the LANL site's watercourses using best practices consistent with the Clean Water Act. We use the New Mexico Environment Department's hydrology protocol and the U.S. Environmental Protection Agency's streamflow assessment methodology to assess the dominant flow regimes within our watercourses and determine when consultation with the U.S. Army Corps of Engineers is appropriate.

Municipal Separate Storm Sewer System Permit

The U.S. Environmental Protection Agency determined in 2019 that Los Alamos National Laboratory, Los Alamos County, and the New Mexico Department of Transportation are subject to Municipal Separate Storm Sewer System coverage for stormwater discharges from the Los Alamos Urban Area and confirmed that designation in 2024. The U. S. Environmental Protection Agency had previously announced plans to issue a single Municipal Separate Storm Sewer System permit applicable to all permittees statewide in New Mexico.

Energy Independence & Security Act: Stormwater Management Practices

Section 438 of the Energy Independence and Security Act of 2007 has requirements for managing stormwater runoff for development projects financed with federal funds. Any federally funded project larger than 5,000 square feet that alters the flow of water over the surface of the ground must use low-impact development practices to maintain the water temperatures, flow rates, flow volumes, and flow durations that were present before development. Examples of such practices include vegetated swales, infiltration basins, permeable pavement, vegetated strips, rain barrels, and cisterns. The goal is to manage runoff through infiltration, evapotranspiration, or harvest and reuse.

We comply with Section 438 by identifying eligible projects through the Integrated Project Review tool (refer to Project Review in Chapter 3). Environmental Protection and Compliance Division staff work with internal and subcontractor design and construction personnel to manage a project's stormwater runoff. Section 438 guidance is also published in the LANL Engineering Standards Manual. As part of Section 438 compliance, project designs incorporate vegetated swales, detention and infiltration basins, and revegetation to manage stormwater discharge.

Groundwater Quality and Protection

Safe Drinking Water Act

The Los Alamos County Department of Public Utilities supplies water for Los Alamos and White Rock townsites, the Laboratory, and Bandelier National Monument. The county is responsible for ensuring that drinking water complies with state and federal drinking water standards and for implementing the Lead and Copper Rule regulations. Triad staff operate the potable water distribution system for the Laboratory.

The Los Alamos County Department of Public Utilities issues an annual drinking water quality report, as required by the Safe Drinking Water Act. The 2024 report is available at Los Alamos Department of Public Utilities 2024 Annual Drinking Water Quality Report. For 2024, the drinking water quality for Los Alamos met all U.S. Environmental Protection Agency regulations.

New Mexico Water Quality Act: Groundwater Quality Standards

In fiscal year 2024, we reported to the New Mexico Environment Department 11 instances of a contaminant detected in groundwater at a location where the contaminant had not been previously detected above a standard or screening level (Table 2-13). Refer to Chapter 5 for more information on standards, screening levels, and groundwater monitoring results.

Table 2-13. 2024 Locations with First-Time Groundwater Quality Standard or Screening Level Exceedances

Parameter Name	Location (well or spring)	Groundwater Zone	Sample Date	Result	Standard or Screening Level Value	Units
New Mexico Groundwater Standard Exceedance						
Tetrachloroethene	R-40 S1	Intermediate	2/13/2024	6.62	5	µg/L
Chromium	LAOI-3.2a	Intermediate	9/5/2024	195	50	µg/L
Iron	LAOI-3.2a	Intermediate	9/05/2024	2270	1000	µg/L
Manganese	LAOI-3.2a	Intermediate	9/05/2024	222	200	µg/L
Nickel	LAOI-3.2a	Intermediate	9/05/2024	1220	200	µg/L
Chloride	18-MW-18	Alluvial	9/19/2024	414	250	mg/L
New Mexico Environment Department Tap Water Screening Level Exceedance						
Dibenz(a,h)anthracene	R-53 S1	Regional Aquifer	2/15/2024	0.0675	0.0343	µg/L
Benzo(a)anthracene	R-26 S1	Intermediate	3/04/2024	0.351	0.12	µg/L
Dibenz(a,h)anthracene	R-26 S1	Intermediate	3/04/2024	0.162	0.0343	ng/L
Dibenz(a,h)anthracene	R-9	Regional Aquifer	10/09/2024	0.110	0.0343	µg/L

Note: µg/L = micrograms per liter; mg/L = milligrams per liter

New Mexico Water Quality Act: Groundwater Discharge Regulations

Under the New Mexico Water Quality Act, the New Mexico Water Quality Control Commission sets regulations for liquid discharges onto or below ground surfaces to protect groundwater. For some discharges, facilities must submit a discharge plan and obtain a permit. In 2024, we had five discharge permits.

Technical Area 46 Sanitary Wastewater System Plant Discharge Permit DP-857

Discharge Permit DP-857 applies to combined effluent discharges from the Technical Area 46 Sanitary Wastewater System plant, the Sanitary Effluent Reclamation Facility, the Power Plant boiler, and the Strategic Computing Complex cooling system. The permit requires quarterly, semi-annual, or annual sampling of the following effluent sources and locations where effluents are stored or discharged:

- treated water from the Sanitary Wastewater System plant;
- effluent from National Pollutant Discharge Elimination System Outfalls 001, 03A027, and 13S;
- water in the Sigma Mesa Evaporation Basins; and
- groundwater from monitoring wells located in Sandia Canyon.

On September 25, 2024, the New Mexico Environment Department issued a renewal for Discharge Permit DP-857 to the National Nuclear Security Administration and Triad National Security, LLC. New conditions of the permit included monitoring of water reused for lawn irrigation, testing for per-and polyfluoroalkyl substances (PFAS), expanded flow meter inspection, and creation of a treatment facility closure plan.

Beginning in 2023 and continuing in 2024, samples collected from National Pollutant Discharge Elimination System Outfall 001 exceeded the tap water screening level for BHC[beta-], a pesticide. Source tracing showed that an interaction of a corrosion inhibitor (benzotriazole) and disinfectant (bromine) in water from the Strategic Computing Complex cooling systems is leading to false positive detections of BHC[beta-] in outfall sample results.

In 2024, two samples collected from the Sanitary Wastewater System and three samples from National Pollutant Discharge Elimination System Outfall 001 exceeded the tap water screening level for bromodichloromethane, a disinfection byproduct. Due to past bromodichloromethane exceedances, we had already committed to quarterly sampling of groundwater in Sandia Canyon for bromodichloromethane. The downgradient well SCI-1, which samples perched intermediate groundwater in Sandia Canyon, was monitored quarterly for bromodichloromethane in 2024, but the compound was not detected. Routine sampling for bromodichloromethane at National Pollutant Discharge Elimination System Outfall 001 and monitoring well SCI-1 is included in the renewed 2024 DP-857 permit.

Domestic Septic Tank Disposal Systems Discharge Permit DP-1589

Discharge Permit DP-1589 applies to discharges from septic tank disposal systems. These six active septic tank disposal systems (a combined septic tank and leach field) are in remote areas of the site that do not have access to the sanitary wastewater collection system. The permit requires routine septic tank sampling, septic tank water-tightness testing, annual pumping and septic tank inspection, and inspection of the leach field disposal system.

We conduct annual sampling of water from active septic tank disposal systems. In 2024, there were no detectable water quality exceedances in any of the active septic tanks.

Technical Area 50 Radioactive Liquid Waste Treatment Facility Discharge Permit DP-1132

Discharge Permit DP-1132 requires us to conduct operational, monitoring, and closure actions at the Radioactive Liquid Waste Treatment Facility. Examples of these actions are

- monthly and quarterly sampling of treated effluent;
- quarterly and annual sampling of groundwater at seven monitoring wells;
- operating a soil moisture monitoring system beneath the Technical Area 52 Solar Evaporative Tank System; and
- stabilizing seven units that have ceased operation at the Radioactive Liquid Waste Treatment Facility.

In 2024, one treated effluent sample result for aldrin exceeded the applicable groundwater screening level. In accordance with the permit, a subsequent sample was collected from the next discharge from the Radioactive Liquid Waste Treatment Facility. Aldrin was not detected in this sample. No other exceedances were detected in 2024, and no external compliance inspections were conducted in 2024. Groundwater monitoring well samples met groundwater quality standards and screening levels except for detections of nitrate, perchlorate, chromium, and 1,4-dioxane at well MCOI-6 and aldrin at well R-14. We present more information about well sampling results in Chapter 5.

Land Application of Treated Groundwater Discharge Permit DP-1793

Discharge Permit DP-1793 regulates the discharge of treated groundwater by land application (spraying treated groundwater onto the surface of the ground). We use land application of treated groundwater to dispose of water from activities such as well-pumping tests, aquifer tests, and well rehabilitation. Under the permit, individual work plans must be submitted for each land application project, and the groundwater must be treated so that constituent concentrations are less than 90 percent of their New Mexico groundwater standard level before discharge. We post work plans to the Electronic Public Reading Room for a 30-day public comment period. Each work plan addresses how the groundwater will be treated before it is land applied.

DP-1793 expired in 2020. We submitted a renewal application in January 2020. We continue to operate under the original DP-1793 permit until the New Mexico Environment Department Ground Water Quality Bureau issues a final renewal permit.

Injection of Treated Groundwater into Class V Underground Injection Control Wells Discharge Permit DP-1835

Discharge Permit DP-1835 applies to the injection of treated groundwater into six Class V injection wells in Mortandad Canyon as part of interim measures for mitigating a chromium plume in the regional aquifer under the site. We submitted a renewal application on June 4, 2021. We continue to operate under the existing Discharge Permit DP-1835 until the New Mexico Environment Department Ground Water Quality Bureau issues a final renewal permit.

In 2023, the New Mexico Environment Department directed N3B and DOE Environmental Management to cease all injections authorized under DP-1835. Injections ceased on March 31, 2023. A review and discussion of interim measures to address the chromium plume, including restarting injections, continued throughout 2024. The New Mexico Environment Department allowed a partial restart of injections in late 2024. Refer to Chapter 5 for more information on the chromium plume and the interim mitigation measures.

Other Environmental Statutes and Orders

National Environmental Policy Act

The National Environmental Policy Act requires federal agencies to consider the environmental impacts of proposed activities, operations, and projects. The DOE has analyzed the impacts of LANL operations and activities in Site-Wide Environmental Impact Statements, with the most recent final statement published in 2008 (DOE 2008). On August 19, 2022, DOE/NNSA published a Notice of Intent to prepare a new Site-Wide Environmental Impact Statement for LANL for ongoing and new activities at the site through the next 10 to 15 years. The draft Site-Wide Environmental Impact Statement was in production throughout 2024.

We review proposed projects to determine if the associated impacts were analyzed as part of the most recent final Site-Wide Environmental Impact Statement or in other existing National Environmental Policy Act documents. Projects or activities not covered under existing documents could require new or additional analyses. In 2024, staff reviewed approximately 1,350 proposed projects. One project that received additional National Environmental Policy Act analyses was the following:

- Environmental Assessment for the Los Alamos National Laboratory Electrical Power Capacity Upgrade Project: The purpose of the project is to upgrade the Laboratory's electrical power capacity by constructing and operating a new 115-kilovolt power transmission line and by improving the site's existing electrical infrastructure. The proposed new transmission line would cross public lands managed by the U.S. Department of Interior Bureau of Land Management and the U.S. Department of Agriculture Santa Fe National Forest. The final Environmental Assessment was transmitted to DOE, the Forest Service, and the Bureau of Land Management on August 13, 2024. Ongoing work for the potential effects of the project to cultural resources was conducted through 2024.

Three projects were categorically excluded from further DOE National Environmental Policy Act review in 2024:

- Categorical Exclusion for Domestic Atmospheric Radiation Measurement Campaign - Coast-Urban-Rural Atmospheric Gradient Experiment AMF1 ARM Field Campaign (CX- 270715)
- Categorical Exclusion for Bandelier Ponderosa Water Line Project (CX-31569)
- Categorical Exclusion for San Ildefonso Services Fiber Optic Cable Installation and Los Alamos County Waterline Replacement Project (CX-270735)

National Historic Preservation Act

Section 110 of the National Historic Preservation Act of 1966, as amended, requires federal agencies to identify and manage their historic properties (archaeological sites and historical facilities), and Section 106 directs federal agencies to consider the effects of their activities on historic properties and to implement a mitigation plan for any adverse effects. We operate under a Section 106 alternative Programmatic Agreement that streamlines the Section 106 compliance process. LANL's Cultural Resources Management Plan (LANL 2017) describes the process for complying with cultural resources laws and regulations and its strategy for managing historic properties.

Both the management and operating contractor (Triad) and the legacy waste cleanup contractor (N3B) support compliance with the National Historic Preservation Act and other cultural resources laws and regulations. In 2024, N3B archaeologists monitored and supported the following projects to avoid archaeological sites:

- New chromium monitoring wells (R-77 and R-80) in Technical Area 5
- Tree thinning for wildland fire mitigation in Technical Area 54
- Aggregate area soil sampling in Technical Areas 9, 15, 40, and 69

In fiscal year 2024, Triad archaeologists conducted or supported compliance activities that resulted in the avoidance and protection of more than 530 archaeological sites. The following items are examples of projects we supported in 2024:

- Conducted cultural resources surveys or verified previous survey results for 34 projects
- Supported N3B sampling, characterization, and remediation of Solid Waste Management Units in Technical Areas 8, 15, 33, and 36
- Continued support of wildland fire thinning projects in Technical Area 39, Technical Area 72, and Rendija Canyon and fire-road and fire-break maintenance Laboratory wide
- Supported the re-establishment of I/J Firing Site
- Supported cultural resources compliance for the following major construction projects:
  - Dual-Axis Radiographic Hydrodynamic Test Facility Complex Vessel Repair Facility
  - Flight Instrumentation Test Laboratory Facility
  - Bandelier National Monument Utility Upgrades
  - Technical Area 51 Sprung Warehouse Structures
  - Weapons Engineering Tritium Facility Security Fence
  - Electrical Power Capacity Upgrade Project
  - ProtoSTAR Office Facility

In fiscal year 2024, Triad historical facilities staff supported compliance activities that included the following:

- Performed inspections and research on the historical use of buildings using the National Security Research Center, publicly released documents, and historical photographs for six projects
- Continued support of the Technical Area 3 Building 39 window replacement
- Continued support of the proposed Consolidated Waste Facility
- Continued eligibility evaluations of two Manhattan Project–era facilities for listing in the National Register of Historic Places
- Supported repairs to the Front Gate Guard Tower, Technical Area 73 Building 15

- Supported the pit infill project in Technical Area 60 Building 17
- Evaluated a 1950s wigwag-style security road barrier for a high-explosives area in Technical Area 15
- Participated in surveillance and maintenance evaluations of historic properties, including the 17 buildings and structures that are either included in the Manhattan Project National Historical Park or that are eligible for the Park (refer to Chapter 3).

Artifacts excavated from the site are curated at the Museum of Indian Arts and Culture in Santa Fe, New Mexico. We conduct inspections to ensure that artifacts are curated in compliance with Title 36 Code of Federal Regulations, Part 79, Curation of Federally Owned and Administered Archaeological Collections. During 2024, we made several visits to the museum, including transferring the collections from the Vigil *y* Montoya Homestead excavation to the museum for curation. The curation agreement between the DOE and the museum was updated and signed in 2023 and is effective through September 2028.

The DOE National Nuclear Security Administration continues to consult with the Accord Pueblos (Pueblo de San Ildefonso, Santa Clara Pueblo, Pueblo of Jemez, and Pueblo de Cochiti) and other Tribes and Pueblos with cultural ties to the Pajarito Plateau regarding the identification and preservation of traditional cultural properties, human remains, and sacred objects. This collaboration is conducted in compliance with the National Historic Preservation Act and the Native American Graves Protection and Repatriation Act.

For more information on the Cultural Resources Management, refer to Chapter 3.

Endangered Species Act

The Endangered Species Act requires federal agencies to protect federally listed threatened or endangered species and their habitats. These requirements are implemented through the LANL Habitat Management Plan (Thompson et al. 2022).

The site contains habitat for three federally listed species: the southwestern willow flycatcher (*Empidonax traillii extimus*), the Jemez Mountains salamander (*Plethodon neomexicanus*), and the Mexican spotted owl (*Strix occidentalis lucida*). Two other federally listed species occur near the LANL site: the New Mexico meadow jumping mouse (*Zapus hudsonius luteus*) and the western distinct population segment of the yellow-billed cuckoo (*Coccyzus americanus*). The southwestern willow flycatcher, yellow-billed cuckoo, and New Mexico meadow jumping mouse have not been observed on the site.

In addition, several federal species of concern and state-listed species potentially occur on the site (Berryhill et al. 2020, BISON-M 2023).

Table 2-14 identifies federal- and state-listed species that occur or potentially occur, along with species that have been identified as having conservation concerns but do not currently have a protected status.

Table 2-14. Threatened, Endangered, and State-Listed Sensitive Species that Occur or Have the Potential to Occur at the LANL Site

Common Name	Scientific Name	Protected Status[a]	Potential to Occur[b]
Southwestern willow flycatcher	*Empidonax traillii extimus*	E, NME, S1	Moderate
Mexican spotted owl	*Strix occidentalis lucida*	T, NMS	High
Yellow-billed cuckoo (western distinct population segment)	*Coccyzus americanus*	T, NMS	Low
New Mexico meadow jumping mouse	*Zapus hudsonius luteus*	E, NME, S1	Low
Bald eagle	*Haliaeetus leucocepahlus*	NMT, S1	High
Common black hawk	*Buteogallus anthracinus*	NMT, S1	Low
Broad-billed hummingbird	*Cynanthus latirostris magicus*	NMT, S1	Low
Violet-crowned hummingbird	*Amazilia violiceps*	NMT, S1	Low
Jemez Mountains salamander	*Plethodon neomexicanus*	E, NME	High
Peregrine falcon	*Falco peregrinus*	NMT	High
Northern goshawk	*Accipiter gentiles*		High
Loggerhead shrike	*Lanius ludovicianus*		High
Gray vireo	*Vireo vicinior*	NMT	High
Spotted bat	*Euderma maculatum*	NMT	High
Townsend's pale big-eared bat	*Corynorhinus townsendii pallescens*		High
Wood lily	*Lilium philadelphicum var. andinum*	NME	High
Greater yellow lady's slipper	*Cypripedium calceolus var. pubescens*	NME	Moderate
Springer's blazing star	*Mentzelia springeri*	FSS	Moderate
Monarch butterfly	*Danaus plexippus*	See Note[c]	High
Pinyon jay	*Gymnorhinus cyanocephalus*	See Note[d]	High
Western bumble bee	*Bombus occidentalis*	See Note[d]	Moderate

[a] E = Federal Endangered; T = Federal Threatened; NME = New Mexico Endangered; NMT = New Mexico Threatened; NMS = New Mexico Sensitive Taxa (informal); S1 = Heritage New Mexico: Critically Imperiled in New Mexico; FSS = Forest Service Sensitive Species.
[b] Low = No known habitat exists at the site. Moderate = Habitat exists, though the species has not been recorded recently. High = Habitat exists, and the species occurs at the LANL site.
[c] Proposed to be listed as threatened under the Endangered Species Act.
[d] Under review for federal protection under the Endangered Species Act.

We conduct the following activities as part of our compliance with the Endangered Species Act:

- Survey for the Mexican spotted owl, southwestern willow flycatcher, yellow-billed cuckoo, and Jemez Mountains salamander. Results of these surveys are discussed in Chapter 7.
- Inform and educate the workforce on compliance requirements for biological resources protection, including restrictions on the timing and location of work activities to protect federally listed species.
- Review proposed projects to determine if they have the potential to affect federally listed species or their habitats. In 2024, Triad biologists reviewed 770 excavation permits, 445

project profiles in the permits and requirements identification system, 73 minor siting proposals, and 11 stormwater pollution prevention plans. N3B subject matter experts reviewed 30 excavation permits and 5 project profiles in the project planning and regulatory review system.

If a project has the potential to impact threatened or endangered species, biologists work with project personnel to avoid the impacts or prepare a biological assessment for consultation with the U.S. Fish and Wildlife Service. In 2024, we completed the following biological assessments:

- "Biological Assessment for a Multi-Use Path along Los Alamos Canyon on Federally Listed Threatened and Endangered Species at Los Alamos National Laboratory" (LA-CP-24-20606)
- "Biological Assessment for the Potential Effects from TA-41 Access and Maintenance Los Alamos Canyon, Los Alamos National Laboratory" (LA-CP-24-20509)
- "Biological Assessment for the Technical Area 53 Light Manufacturing Lab at Los Alamos National Laboratory" (LA-CP-24-20415)
- "Biological Assessment of the Potential Effects of TA-61 Asphalt Millings Staging Area at Los Alamos National Laboratory" (LA-CP-24-20549)

We did not find any projects out of compliance with endangered species protection requirements in 2024.

Migratory Bird Treaty Act and Executive Order 13186

Under the Migratory Bird Treaty Act, it is unlawful "by any means or manner to pursue, hunt, take, capture [or] kill" any migratory birds except as permitted by regulations issued by the U.S. Fish and Wildlife Service. We conduct the following activities as part of our compliance with the Migratory Bird Treaty Act and Executive Order 13186:

- Review projects for potential impacts to migratory birds and provide specific guidance on how to avoid impacts to migratory birds, their eggs, and their nestlings
- Conduct long-term monitoring projects to monitor avian populations over time (further discussed in Chapter 7)
- Provide briefings and other information to help the workforce avoid impacts to migratory birds from vegetation removal projects and other potential harms, such as open pipes and bollards
- Conduct field visits when birds are reported in facilities, equipment, or project areas

In 2024, we did not find any projects that were out of compliance with migratory bird protection requirements.

Executive Order 11988, Floodplain Management, and Executive Order 11990, Protection of Wetlands

We comply with these Executive Orders by preparing assessments for projects in floodplains or wetlands. In 2024, Triad and N3B personnel prepared floodplain or wetland assessments for the following projects:

- Installation of a replacement natural gas line from Technical Area 8 to Technical Area 22 (Triad)
- Installation of an expedited vehicle inspection lane in Technical Area 72 (Triad)
- Installation of wood poles to mount traffic sensors along East Jemez Road at Technical Area 72 and the junction of East Jemez Road and New Mexico State Road 4 (Triad)
- Mitigation of wildfire fuels in Technical Area 72 (Triad)
- Chromium remediation in Sandia and Mortandad canyons (N3B)
- Regional groundwater monitoring well SIMR-3 and access road improvements on Pueblo de San Ildefonso property (N3B)

No violations of the DOE floodplain or wetland environmental review requirements were recorded.

Executive Order 13751, Safeguarding the Nation from the Impacts of Invasive Species

We have a mobile device application that allows staff to record the locations of invasive plant species. We address larger, well-established populations of species such as Siberian elm (*Ulmus pumila*), Russian olive (*Elaeagnus angustifolia*), and saltcedar (*Tamarix ramosissima*) by removing them in conjunction with construction or forest management projects. Other invasive species that occur at the LANL site include the Eurasian collared dove (*Streptopelia decaocto*), European starling (*Sturnus vulgaris*), feral cattle (*Bos tauraus*), and several species of thistle (*Cirsium spp*). We finalized an invasive plant species management plan in 2022 (LANL 2022). In 2024, we removed invasive tree species from multiple sites and removed common teasel (*Dipsacus fullonum L.*), an invasive forb that crowds out native plants and spreads quickly, from a singular known location on site.

Federal Insecticide, Fungicide, and Rodenticide Act; New Mexico Pesticide Control Act; and National Pollutant Discharge Elimination System Pesticide General Permit

Two laws and one nationwide Clean Water Act permit regulate how we use and report on the use of pesticides (chemicals that destroy plant, fungal, or animal pests). The Federal Insecticide, Fungicide, and Rodenticide Act regulates the distribution, sale, and use of pesticides. The New Mexico Pesticide Control Act regulates licensing and certification of pesticide workers, recordkeeping, equipment inspection, application of pesticides, and storage and disposal of pesticides. The National Pollutant Discharge Elimination System Pesticide General Permit requires annual reporting of pesticide use to the U.S. Environmental Protection Agency.

Table 2-15 presents the amounts of pesticides used in 2024.

Table 2-15. Pesticides Used on the LANL Site in 2024

Type	Name	Amount
Herbicide	Velossa	43.51 gallons
Herbicide	Ranger Pro Herbicide	27.04 gallons
Insecticide	Maxforce Complete Brand Granular Insect Bait	0.56 pounds
Insecticide	PT Wasp Freeze II and Hornet Insecticide	0.0016 gallon
Insecticide	Apivar Bee Mite Strips	0.13 pounds

Type	Name	Amount
Insecticide	Formic Pro Bee Mite Strips	1.42 pounds
Insecticide	Summit B.T.I. Briquets	1 briquette
Insecticide	Tempo Ultra WP	0.06 pounds mixed with 2 gallons water
Water Treatment	Kurita Formula R-630	4,025 gallons
Water Treatment	Kurita Formula C-358A	3,870 gallons
Water Treatment	Bromine tablets	10,073 pounds

DOE Order 231.1B, Environment, Safety, and Health Reporting

DOE Order 231.1B, Environment, Safety, and Health Reporting, requires the timely collection and reporting of information on environmental issues that could adversely affect the health and safety of the public and the environment at DOE sites. This 2024 Los Alamos National Laboratory Annual Site Environmental Report fulfills DOE Order 231.1B requirements to publish an annual site environmental report. The intent of this report is to

- characterize site environmental management performance, including effluent releases, environmental monitoring, types and quantities of radioactive materials emitted, and radiological doses to the public;
- summarize environmental occurrences and responses reported during the calendar year;
- confirm compliance with environmental standards and requirements;
- highlight significant programs and efforts, including environmental performance indicators, performance measures programs, or both; and
- summarize property clearance activities.

We began environmental monitoring in 1945 and published the first comprehensive environmental monitoring report in 1970.

Emergency Planning and Community Right-to-Know Act

The Emergency Planning and Community Right-to-Know Act requires emergency plans for more than 360 hazardous substances if they are present at a facility in amounts above specified thresholds. We are required to notify state and local officials and the community under this Act about the following items:

- changes that might affect the local emergency plan;
- if the Laboratory’s emergency planning coordinator changes;
- leaks, spills, and other releases of listed chemicals into the environment if these releases exceed specified quantities;
- the annual inventory of the quantities and locations of hazardous chemicals above specified thresholds present at the facility; and
- total annual releases to the environment of listed chemicals that exceed specified thresholds.

Table 2-16 lists the community and emergency planning reporting in 2024.

Table 2-16. Status of Emergency Planning and Community Right-to-Know Act Reporting

Act Section	Description of Reporting	Status (Yes/No/ Not Required)
Sections 302–303	Planning notification	Not required
Section 304	Extremely hazardous substance or hazardous substance release notification	Not required
Sections 311–312	Material safety data sheet and hazardous chemical inventory	Yes
Sections 313	Toxics release inventory reporting	Yes

For Section 313 reporting, the only chemical that met the criteria for reporting in 2024 was lead. The largest source of reportable lead was from offsite waste transfers. Table 2-17 summarizes the reported releases in 2024. No compliance violations are associated with this use or release of lead or mercury.

Table 2-17. Summary of 2024 Total Annual Releases under Emergency Planning and Community Right-to-Know Act, Section 313

Reported Release	Lead (pounds)
Air emissions	3.19
Water discharges	0.19
Onsite land disposal (firing range)	936.4
Offsite waste transfers	13.394

DOE Order 232.2A, Occurrence Reporting and Processing of Operations Information

DOE Order 232.2A, Occurrence Reporting and Processing of Operations Information, requires reporting of abnormal events or conditions that occur during facility operations. An "occurrence" is one or more events or conditions that could adversely affect workers, the public, property, the environment, or the DOE mission. In 2024, Triad had one reportable environmental occurrence, as described in Table 2-18.

Table 2-18. 2024 Environmental Occurrences

Title	Description and Comments	Status
Total Residual Chlorine Exceedance	On April 2, 2024, a sample at Outfall 03A181 in Technical Area 55 exceeded the total residual chlorine permit limit. The suspected cause was that the cooling tower had been blowing down for several hours and had caused an imbalance between the chlorine in the water and the amount of the dechlorination chemical. Technical Area 55 Operations and the Environmental Compliance Programs Permitting and Compliance team took follow-up samples after the exceedance with a result of 0.0 milligrams per liter total residual chlorine. There was no further impact to personnel health, safety, the facility, or the environment.	Final Report published April 15, 2024

Inspections and Audits

Table 2-19 lists the environmental inspections conducted by regulating agencies and external auditors during 2024.

Table 2-19. Environmental Inspections and Audits Conducted during 2024

Date	Purpose	Performing Entity
October 28–31, 2024	Environmental Management System Surveillance Audits, covering clauses of the International Standards Organization 14001:2015 standard	NSF International
May 21–23, 2024	Carlsbad Field Office Annual Recertification	Environmental Protection Agency, Carlsbad Field Office
September 23–25, 2024	Annual Audit and Resource Conservation and Recovery Act Permit Site Inspections	New Mexico Environment Department Hazardous Waste Bureau

Unplanned Releases

Air Releases

In 2024, there were no unplanned air releases.

Liquid Releases

As required by New Mexico Water Quality Control Commission regulations, Triad reported 13 unplanned liquid releases in 2024 (Table 2-20). Corrective actions have been completed for all liquid releases except the drill fluid releases. A corrective action plan has been approved for remediation of these releases by the New Mexico Environment Department, with a proposed cleanup start date of May 2025. We reported the releases and corrective actions to the New Mexico Environment Department Ground Water Quality Bureau, Surface Water Quality Bureau, and Hazardous Waste Bureau within required deadlines.

Table 2-20. 2024 Unplanned Reportable Liquid Releases

Material Released	Number of Releases	Approximate Total Release (gallons)
Sanitary Wastewater	2	220
Potable Water	4	124,000
Drill Fluid	5	28,320
Untreated High-Explosives Wastewater Influent	1	10
Treated Effluent from the Radioactive Liquid Waste Treatment Facility	1	1,100

Site Risk Indices

In 2015, we began tracking indices of risk regarding temperature, precipitation, wind, indicator species, and stormwater flow at the LANL site to identify when actions are necessary to protect facilities and operations. Following are the results of indices that were available in 2024. We have also included climatological data in Meteorological Monitoring in Chapter 4.

Temperature

Figure 4-9 in Chapter 4 presents a graph of long-term trends in annual average temperatures. The temperatures between 1960 and 2000 had no trend. The years 2001–2010 were approximately 1°F warmer than the previous 40 years, and the years 2011–2020 were approximately 2.5°F warmer than the 1960–2000 average. Of the last 10 years, 9 had an annual average temperature of 50°F or greater. When average temperatures are broken down into summer and winter minimums and maximums, the summer maximum, minimum, and average temperatures demonstrate an increase of approximately 5°F (Figure 2-2).

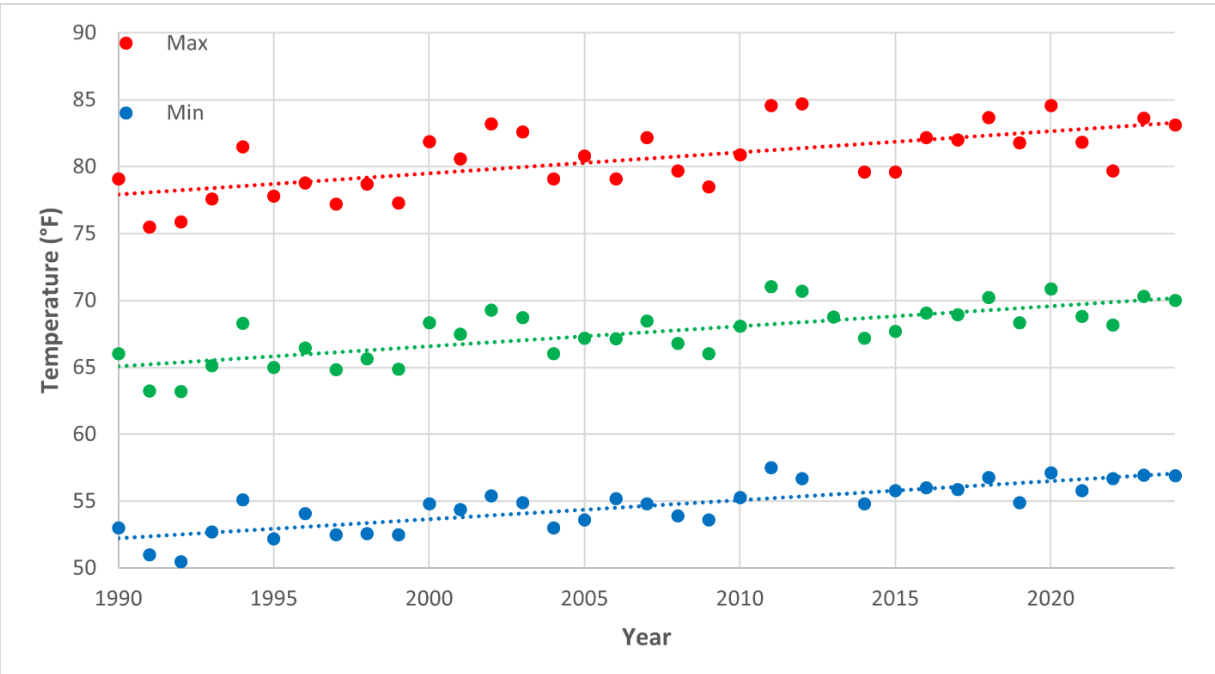

Figure 2-2. Average summer (June, July, August) Los Alamos temperatures. The dashed lines represent the trend line for maximum, minimum, and average summer temperatures, indicating that summer temperatures have been continuously increasing since 1990.

We can also assess changes in temperature by changes in the number of cooling and heating degree-days. We use the number of cooling and heating degree-days to estimate the annual power usage needed to heat or cool buildings. A cooling degree-day represents a 1-degree increase in the average daily temperature above 65°F. As an example, if the average daily temperature was 80°F, that day would represent 15 cooling degree-days. We calculate heating degree-days in the same way from the number of degrees an average daily temperature is below 65°F. Cooling degree-days have been increasing by approximately 10 degree-days per year since 1990, whereas heating degree-days have been decreasing by approximately 30 degree-days per year. Thus, less energy has been needed to heat buildings, and more energy has been needed to cool them.

Wind Speed

The annual average wind speed measured at Technical Area 6 increased approximately 20 percent from 1994 to 2014 (Figure 2-3). Since 2015, the annual average wind speed has remained around 2.9 meters per second. Although not presented here, the monthly average wind speed during the spring months (windiest months) has increased approximately 1 meter per second. There is no trend in the annual peak gusts recorded at Technical Area 6 since 1990 (Kelly et al. 2015).

Winds are produced by low- and high-pressure weather systems that move across New Mexico. Near the ground's surface, wind speeds are also influenced by the type of vegetation present (for example, forests versus grasslands). Our current hypothesis is that the extensive loss of trees in the local area caused by wildfires, drought, and bark beetle infestations led to a decrease in the amount of wind resistance provided by trees, allowing wind speeds near the surface to increase.

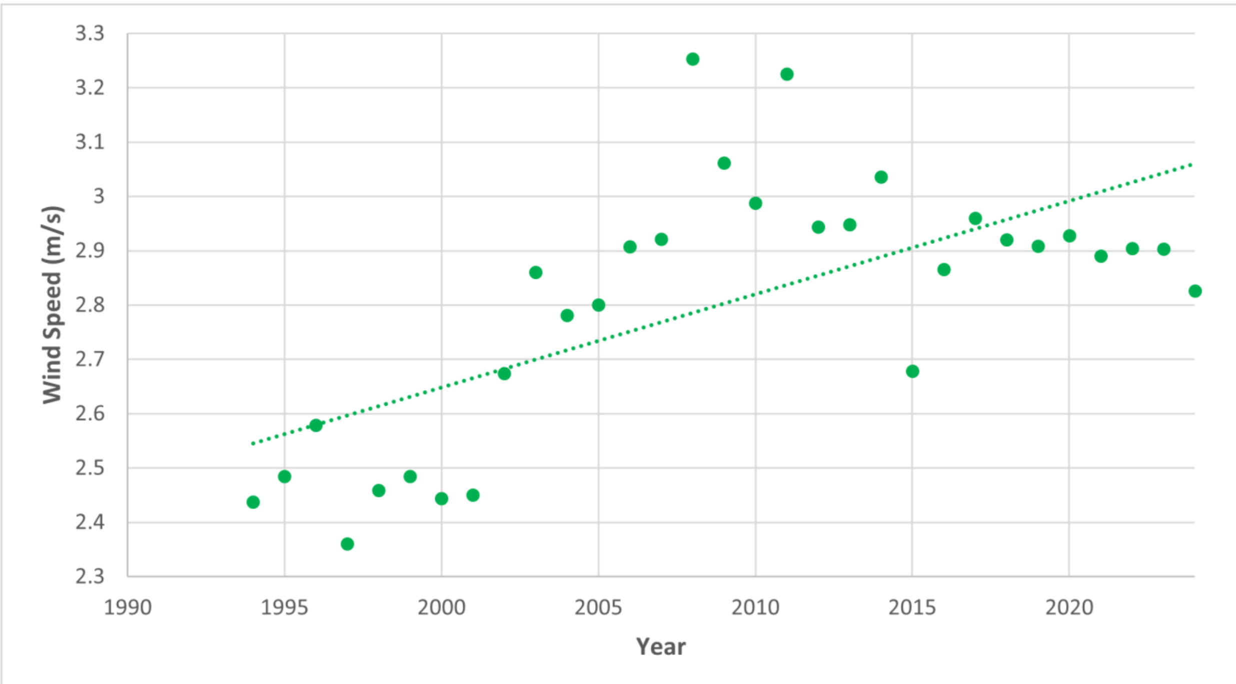

Figure 2-3. Technical Area 6 annual average wind speed at 12 meters above the ground. The dashed line represents the trend line for wind speed, indicating that the annual average wind speed has been increasing since 1994.

Annual Red Flag Warnings

The National Weather Service issues Red Flag Warnings when critical weather conditions could result in extreme fire behavior. If the following weather conditions occur simultaneously for 3 or more hours, a Red Flag Warning may be issued.

- Sustained winds at or above 20 miles per hour
- Relative humidity less than 15 percent
- Above-average temperatures

In 2012, the National Weather Service began recording the number of Red Flag Warnings per year for the Los Alamos area (Figure 2-4). The number of Red Flag Warnings in 2023 was significantly fewer than the anomalously high number in 2022, but since 2012, we have seen no trend. We restrict some operations, including explosives testing, on days with Red Flag Warnings.

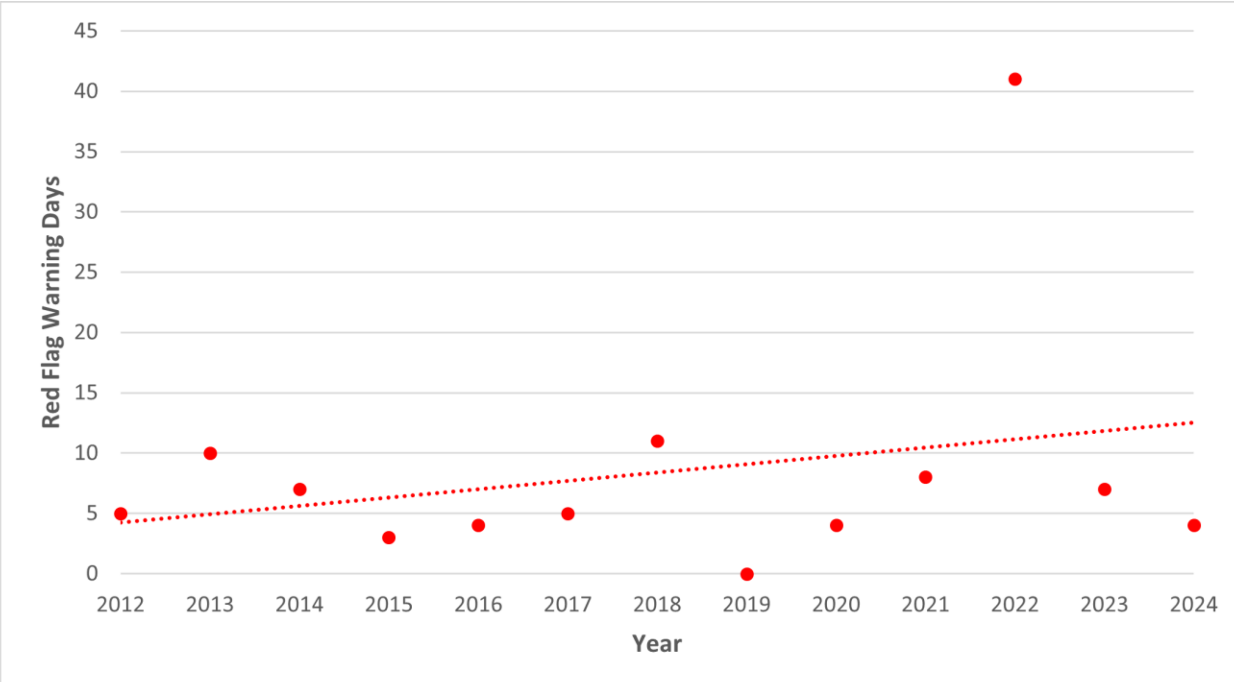

Figure 2-4. Number of National Weather Service Red Flag Warning days for Zone 120 (Los Alamos).

Precipitation

We analyzed the annual average precipitation (refer to Figure 4-11 in Chapter 4) and the number of days per year with heavy rain events (Figure 2-5). From 1924 through 2010, the annual average precipitation was 18 inches, with a standard deviation of 4.4 inches. A long-term drought began in 1998, with annual precipitation under 15 inches between 2000 and 2003 and again in 2011, 2012, 2019, 2020, 2021, and 2023. Annual precipitation values were as low as 10 inches in 2003 and 2012. The frequency of heavy rain events, defined as precipitation greater than 0.5 inches in 1 day, does not demonstrate a significant long-term trend since 1950. Although not presented here, no trend exists in the heaviest events (precipitation greater than 0.75 inches or greater than 1.0 inch per day) in the past 50 years. Annual average snowfall (Figure 2-6) demonstrates a decrease in the long-term trend since 1950. Since the drought began in 1998, the 30-year average snowfall has dropped from 59 to 43 inches.

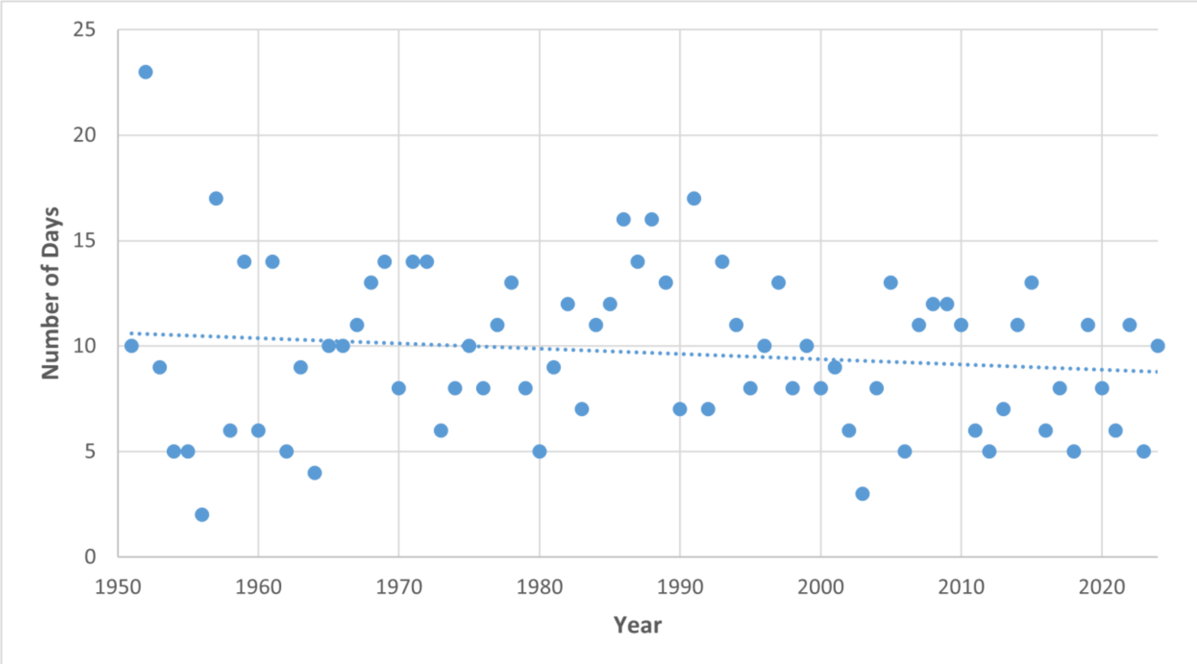

Figure 2-5. Number of days per year with precipitation >0.5 inches. The dashed line represents the trend line for days with precipitation >0.5 inches. The slight decreasing trend since 1950 is not statistically significant.

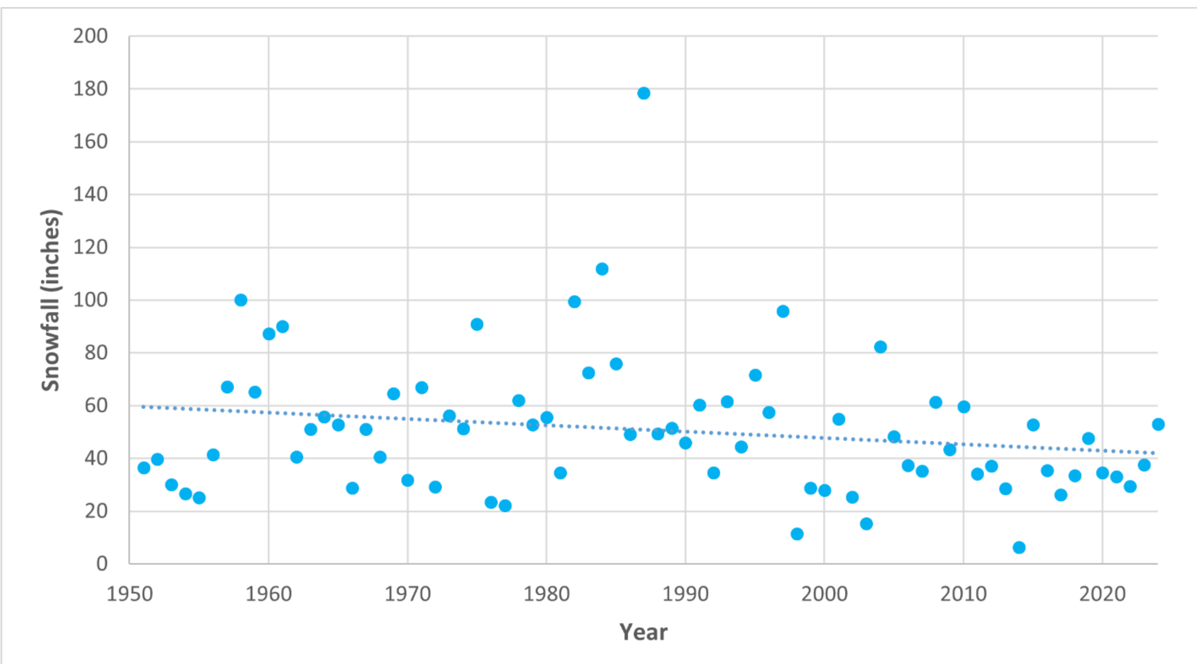

Figure 2-6. Annual average Los Alamos snowfall. The dashed line represents the trend line for snowfall, indicating a decrease in annual snowfall.

Summary

Average temperatures in Los Alamos have increased over the past 25 years. The annual average temperatures for the Southwest are predicted to rise (USGCRP 2023) and the temperatures measured at Los Alamos are consistent with these predictions. Increases in cooling degree-days and reductions in heating degree-days will produce increased summer air-conditioning costs and reduced winter heating costs.

Although the predictions of precipitation changes have less confidence than temperature predictions, decreasing precipitation during winter and spring is predicted in the Southwest (USGCRP 2023). Our data are consistent with these predictions, particularly over the past 25 years, with below-average precipitation and snowfall in many years. The data do not show a trend for heavy precipitation events in Los Alamos.

Increasing wildland fires in the southwest are also predicted (USGCRP 2023). Three major wildland fires have impacted the LANL site in the past 25 years: the 2000 Cerro Grande Fire, the 2011 Las Conchas Fire, and the 2022 Cerro Pelado Fire. Precursors to these fires included warm, dry years and local bark beetle infestations (LANL 2012). The Los Alamos data are consistent with the predictions of increasing wildland fires. The annual average wind speed has been increasing. Temperature, precipitation, wildland fire, and wind speed changes may affect planning, operations, and emergency response.

Summary of Permits and Compliance Orders

Table 2-21 presents the environmental permits and administrative compliance orders for 2024.

Table 2-21. Environmental Permits and Legal Orders for 2024 Operations

Permitted Activity	Issue & Revision Dates	Expiration Date
Los Alamos National Laboratory Hazardous Waste Facility Permit (link)		
A permit that regulates management of hazardous wastes issued by the New Mexico Environment Department	Renewed November 2010	December 2020 (administratively continued until new permit is effective)
Administrative Compliance Order No. HWB-14-20 Settlement Agreement and Stipulated Final Order (link)		
Settlement issued in 2014 for violations of the Hazardous Waste Act and the Laboratory's Hazardous Waste Facility Permit; as part of the settlement, DOE has funded a series of Supplemental Environmental Projects	Settlement Agreement and Stipulated Final Order finalized in January 2016	None
Compliance Order on Consent for Legacy Waste Cleanup (link)		
An order that regulates the investigation, corrective actions, and monitoring for Solid Waste Management Units and Areas of Concern at the LANL site issued by the New Mexico Environment Department	Issued March 2005; replaced by 2016 Compliance Order on Consent in 2016; modified 2017; modified 2024	None

Permitted Activity	Issue & Revision Dates	Expiration Date
Federal Facilities Compliance Order for Mixed Wastes (link)		
An order that requires us to submit an annual update to its Site Treatment Plan for mixed hazardous and radiological wastes (mixed waste) issued by the New Mexico Environment Department	Issued October 1995; amended May 1997	None
Clean Air Act, Title V Operating Permit		
A permit that regulates air emissions from LANL site operations issued by the New Mexico Environment Department	Issued August 2009; reissued October 2018	February 27, 2020 (administratively continued until new permit is effective)
New Mexico Air Quality Control Act Construction Permits (permits issued by the New Mexico Environment Department that regulate construction or modification of air emissions sources)		
Technical Area 3 power plant Permit modification 2 (NSR 2195-B-M3)	Issued September 2000; reissued November 2011; major modification July 2018; administrative revision August 2023	None
Asphalt plant at Technical Area 60 Permit revision 1 (GCP3-2195-G-R1)	Issued October 29, 2002; reissued September 12, 2006; reissued December 2, 2021	None
1600-kilowatt generator at Technical Area 33 Permit revision 4 (NSR 2195-F R4)	Issued October 10, 2002; reissued December 12, 2013	None
Two 20-kilowatt generators and one 225-kilowatt generator at Technical Area 33 (NSR 2195-P)	Issued August 8, 2007	None
Data disintegrator (NSR 2195-H R1)	Issued October 22, 2003; revised June 14, 2006	None
Chemistry and Metallurgy Research Replacement facility, Radiological Laboratory/Utility/Office Building Permit revision 2 (NSR 2195-N R2)	Issued September 16, 2005; reissued September 25, 2012	None
LANL exemption notifications - rock crusher removed (NSR 2195)	Issued June 16, 1999	None
Technical Area 35, Building 213, beryllium machining (NSR 632)	Issued December 26, 1985; revised April 2023	None
Technical Area 3, Building 141, beryllium technology facility (NSR 634 M2)	Issued March 19, 1986; revised October 30, 1998	None
Technical Area 55 beryllium machining (NSR 1081 M1R6)	Issued July 1, 1994; revised May 12, 2006	None
National Pollutant Discharge Elimination System Authorization to Discharge (from Outfalls) under the National Pollutant Discharge Elimination System (Outfall Permit; Permit No. NM0028355; link)		
A permit that authorizes us to discharge industrial and sanitary liquid effluents through outfalls, issued by the U.S. Environmental Protection Agency	Issued September 28, 2023; effective December 15, 2023	October 31, 2028

Permitted Activity	Issue & Revision Dates	Expiration Date
National Pollutant Discharge Elimination System General Permit for Discharges of Storm Water from Construction Sites (Construction General Permit; link)		
A general permit (not LANL-specific) that authorizes the discharge of pollutants during construction activities, issued by the U.S. Environmental Protection Agency	Effective February 16, 2022	February 16, 2027
National Pollutant Discharge Elimination System Multi-Sector General Permit for Storm Water Discharges associated with Industrial Activity (Multi-Sector General Permit; link)		
A general permit (not LANL-specific) that authorizes facilities with specific industrial activities to discharge stormwater and some non-storm-water runoff, issued by the U.S. Environmental Protection Agency	Effective September 29, 2021	February 28, 2026
National Pollutant Discharge Elimination System Authorization to Discharge (from Solid Waste Management Units and Areas of Concern) under the National Pollutant Discharge Elimination System (Storm Water Individual Permit; Permit No. NM0030759; link)		
A permit that authorizes discharges of stormwater from 405 Solid Waste Management Units and Areas of Concern, issued by the U.S. Environmental Protection Agency.	Issued August 1, 2022	July 31, 2027
Clean Water Act Section 404/401 Permits (authorizations for work within water courses under a Section 404 nationwide permit, issued by the U.S. Army Corps of Engineers, with Section 401 certification from the State of New Mexico)		
Water Canyon Storm Drain Reconstruction Project	Annual monitoring and reporting required through 2023	January 3, 2026
Mortandad Wetland Enhancement	Annual monitoring and reporting required through 2022	January 3, 2026 A certificate of completion was accepted by the U.S. Army Corps of Engineers
Technical Area 72 Firing Site Stormwater Control	Annual monitoring and reporting required through 2023	January 3, 2026 A certificate of completion was accepted by the U.S. Army Corps of Engineers
Technical Area 8 and 16 Gas Line Replacement Project involving soil-disturbing activities in Cañon de Valle headwaters under Regional General Permit 16-01. Placing channel fill near channel; expires 3 months from project initiation	Reporting start and finish of channel disturbances; certificate of completion due upon completion of project	January 3, 2026
National Pollutant Discharge Elimination System Municipal Separate Sewer Storm System Permit for Storm Water Discharges		
A permit that will authorize LANL to discharge stormwater from its sewer storm system	Initial permit application has not yet been prepared	To be determined

Permitted Activity	Issue & Revision Dates	Expiration Date
Groundwater Discharge Permit DP-857		
A permit that authorizes discharges to groundwater from the Sanitary Wastewater System plant, the Sanitary Effluent Reclamation Facility, and use of the Sigma Mesa Evaporation Basins, issued by the New Mexico Environment Department	Renewed September 25, 2024	September 1, 2029
Groundwater Discharge Permit DP-1589		
A permit that authorizes discharges to groundwater from septic tank/disposal systems, issued by the New Mexico Environment Department	Renewed May 17, 2023	May 16, 2028
Groundwater Discharge Permit DP-1793		
A permit that authorizes discharges to groundwater from land application of treated groundwater, issued by the New Mexico Environment Department	Issued July 27, 2015	December 16, 2021 Permit reapplication submitted June 17, 2021; issuance of renewed permit is pending
Groundwater Discharge Permit DP-1835		
A permit that authorizes discharges to groundwater from injection of treated groundwater into six Class V underground injection control wells, issued by the New Mexico Environment Department	Issued August 31, 2016	July 22, 2021; permit reapplication submitted January 20, 2021; issuance of renewed permit is pending
Groundwater Discharge Permit DP-1132		
A permit that authorizes discharges to groundwater from the Radioactive Liquid Waste Treatment Facility, issued by the New Mexico Environment Department	Issued May 5, 2022	May 4, 2027
National Pollutant Discharge Elimination System Pesticide General Permit (link)		
A general permit that authorizes the discharge of pesticides that have potential to enter waters of the United States, issued by the U.S. Environmental Protection Agency	Issued October 31, 2011; reissued October 31, 2016	October 31, 2026

Facilities Included in the Enforcement and Compliance History Online Database

Table 2-22 lists Laboratory facilities in the Enforcement and Compliance History Online database that the U.S. Environmental Protection Agency maintains at https://echo.epa.gov/. This database lists environmental violations in the program areas regulated by the U.S. Environmental Protection Agency, such as water quality under the Clean Water Act or air quality under the Clean Air Act. The first two facilities in the table had compliance-monitoring activities recorded within the last 5 years. We excluded individual projects listed as facilities that were covered under only a construction stormwater or multi-sector general permit and had no activity within the past 5 years.

Table 2-22. Los Alamos National Laboratory Facilities Included in the Enforcement and Compliance History Online Database

Facility Name	Facility Address	Facility Registry	Program Area(s) Considered
Los Alamos National Laboratory	Bikini Atoll Road, SM-30, West Jemez Rd.	110010571880	Clean Air Act, Clean Water Act, Resource Conservation and Recovery Act, Air Emissions Inventory, Toxics Releases Inventory
Los Alamos Nat'l Lab Industrial	528 35th Street	110064642445	Clean Water Act
Los Alamos National Laboratory	P.O. Box 1663	110064871107	Clean Water Act
Los Alamos National Laboratory	Los Alamos National Laboratory	110070003747	Clean Water Act
Los Alamos National Laboratory	3747 West Jemez Road	110071159515	Clean Air Act
TA-54 CMP Retrieval	1200 Trinity Drive, Suite 150	110070235529	Clean Water Act
Los Alamos National Laboratory	1.5 mi SE of Los Alamos, NM	110071871801	Clean Air Act
U.S. DOE Los Alamos National Laboratory	528 35th St	110038096716	Clean Air Act

Quality Assurance

Waste Management

Triad's programs for waste management, including quality assurance, are described in the institutional policy P409, *LANL Waste Management*, and flow-down documents. N3B's programs for waste management, including quality assurance, are described in procedure N3B-P409-0, "N3B Waste Management," and flow-down documents.

Air Quality and Protection

Air quality compliance activities are performed in accordance with the procedures and processes described in EPC-CP-QAP-001, "Environmental Compliance Programs Quality Assurance Plan"; EPC-CP-QAP-901, "EPC-CP Quality Procedure to Supplement ADESH-0007, Document Control"; and a series of program implementation plans:

- EPC-CP-PIP-0101, "Rad-NESHAP Compliance Program"
- EPC-CP-PIP-0340, "Title V Operating Permit Program"
- EPC-CP-PIP-0301, "Greenhouse Gas Monitoring and Emissions Reporting"
- EPC-CP-PIP-0310, "Air Quality Refrigerants"
- EPC-CP-PIP-0320, "Emergency Planning and Community Right-to Know Act (EPCRA) Section 313 Reporting"
- EPC-CP-PIP-0330, "Air Quality Regulatory Review and Permitting"
- EPC-CP-PIP-0370, "Asbestos NESHAP Compliance"
- EPC-CP-PIP-0380, "Beryllium NESHAP Compliance"

More than 20 detailed quality procedures flow down from these program implementation plans. Air Quality Compliance team personnel conduct semi-annual, internal inspections of all permitted sources using detailed checklists to ensure that all permit requirements are being met. Additionally, the New Mexico Environment Department Air Quality Bureau conducts periodic external inspections of LANL's compliance with its Title V Operating Permit.

We use analytical data to generate various compliance monitoring reports and deliverables that we submit to regulatory agencies as required by the permit. Each report goes through a quality peer review before submittal to ensure that the data are correct, representative, and meet the established data quality objectives. We maintain all reports submitted to regulatory agencies as quality records in accordance with the permit and ESHQ-AP-006, "Records Management Procedure."

Refrigerant program personnel also conduct internal semi-annual audits to account for refrigerant used in service, maintenance, repair, and disposal activities on refrigeration equipment, thereby assuring compliance with the no-venting prohibition under federal regulations.

Members of the Radioactive Air Emissions Management team conduct stack sampling and monitoring activities, sampler inspections, flow measurements, and data analyses to meet regulatory requirements. The team conducts all activities in accordance with applicable procedures and with peer review. Representatives of the U.S. Environmental Protection Agency, Region 6, periodically visit the site to evaluate operations. Analytical data calculations and compliance reports for the Radioactive Air Emissions Management Team are subject to reviews like those described for the Air Quality Control program.

Surface Water Quality and Protection

Triad performs surface water compliance activities in accordance with the procedures and processes described in

- EPC-CP-QAP-001, "EPC-CP Quality Assurance Plan";

- EPC-CP-QP-0901, "EPC-CP Quality Procedure to Supplement ESHQSS-AP-007, ESHQSS Document Control Procedure"; and
- EPC-CP-PIP-1201, "NPDES Industrial Point Source Permit Self-Monitoring."

These documents ensure that compliance activities are planned, performed, and documented using approved procedures; data quality objectives; monthly, quarterly, or yearly sampling plans; and integrated work processes.

In 2024, we used the following procedures to collect samples, prepare discharge monitoring reports, develop Water Quality Standards, cover the Section 404 permit, and prepare reapplication surveys:

- EPC-CP-PIP-1201, "NPDES Industrial Point Source Permit Self-Monitoring"
- EPC-CP-TP-1202, "Sampling at NPDES Point-Source Outfalls"
- EPC-CP-QP-1204, "Performing NPDES Re-Application Surveys"
- EPC-CP-TP-1205, "Calibration/Standardization of Instruments for Field Analysis"
- EPC-CP-QP-1203, "Preparing Discharge Monitoring Reports for the NPDES IPSP Self-Monitoring Program"
- EPC-CP-PIP-1301, "404/401 Dredge and Fill Permit Program"
- EPC-CP-PIP-1001, "Water Quality Control Commission (WQCC) Program Implementation Plan"

We collect surface water compliance samples and analyze the associated data using established data quality objectives that define the appropriate type of data to collect. We also establish guidelines for the acceptance and use of the analytical data to make decisions regarding compliance at each outfall. These data quality objectives are developed in accordance with U.S. Environmental Protection Agency QA/G-4, Guidance for the Data Quality Objectives Process.

In 2024, the following procedures were used to collect samples and prepare reports for the Triad Construction General Permit and the Multi-Sector General Permit programs:

National Pollutant Discharge Elimination System Construction General Permit

- EPC-CP-PIP-2001, "NPDES Construction General Permit Program Implementation Plan"
- EPC-CP-QP-2002, "Performing CGP[1] Stormwater Inspections"
- EPC-CP-TP-2003, "CGP Rain Gage Operation and Maintenance"

National Pollutant Discharge Elimination System Multi-Sector General Permit

- EPC-CP-PIP-2101, "NPDES Multi-Sector General Permit"
- EPC-CP-TP-2102, "Installing, Setting Up, and Operating ISCO Samplers"
- EPC-CP-TP-2103, "Inspecting ISCO Stormwater Runoff Samplers and Retrieving Samples"

[1] CGP = Construction General Permit

- EPC-CP-QP-2104, "Installing, Inspecting, and Maintaining MSGP[2] Single Stage Samplers"
- EPC-CP-QP-2105, "MSGP Stormwater Visual Assessments"
- EPC-CP-QP-2106, "Processing MSGP Stormwater Samples"
- EPC-CP-QP-2107, "Preparing Discharge Monitoring Reports for the NPDES Multi-Sector General Permit"
- EPC-CP-QP-2108, "MSGP Routine Facility Inspections"
- EPC-CP-QP-2109, "MSGP Corrective Actions"
- EPC-CP-QP-2110, "MSGP Storm Water Pollution Prevention Plan Preparation and Maintenance"

In 2023, N3B used the following procedures to collect samples and prepare reports for the surface water monitoring under the Storm Water Individual Permit, Multi-Sector General Permit, and environmental surveillance programs.

- N3B-AP-ER-5008, "Verifying and Certifying Individual Permit Corrective Action Measures"
- N3B-DI-ER-4010, "Desk Instruction for Managing Electronic Precipitation Data for Storm Water Projects"
- N3B-DI-ER-4011, "Desk Instruction for Managing Electronic Stage and Discharge Data from Stream Gauge Stations"
- N3B-SOP-ER-3002, "Spring and Surface Water Sampling"
- N3B-SOP-ER-4001, "Processing Surface Water Samples"
- N3B-SOP-ER-4003, "Operation and Maintenance of Gauge Stations for Storm Water Projects"
- N3B-SOP-ER-4004, "Installing, Setting Up, and Operating Automated Storm Water Samplers"
- N3B-SOP-ER-5002, "Inspection, Installation, and Maintenance of Non-Engineered NPDES Individual Permit Storm Water Control Measures"
- N3B-SOP-ER-5004, "Inspecting Automated Storm Water Samplers and Retrieving Samples"
- N3B-SOP-ER-5006, "Determining and Evaluating Drainage Area Boundaries"
- N3B-GDE-ER-5013, "Inspection Guidance for Environmental Programs Watershed, Retention, and No Exposure Controls"
- N3B-GDE-ER-5011, "Hydrology for Individual Permit Corrective Actions and Control Measures – Design Guide"
- N3B-GDE-ER-5015, "Stormwater Best Management Practices Manual"
- N3B-SOP-ER-5016, "Multi-Sector General Permit Storm Water Corrective Actions"
- N3B-QP-RGC-003, "Land Application of Drill Cuttings"

[2] MSGP = Multi-Sector General Permit

- N3B-AP-RGC-0002, "Minor Spill Response Reporting Procedure"
- N3B-PLN-RGC-0001, "Sediment Management Decision Tree Guidance"
- N3B-PLN-RGC-0003, "Un-permitted Discharge Reporting"
- N3B-QP-RGC-0002, "Land Application of Groundwater"
- N3B-EPC-CP-QP-064, "MSGP Stormwater Visual Assessments"
- N3B-AOP-TRU-3003, "Material Release or Spill"
- N3B-SOP-RP-0005, "Radiological Emergency Response"

Groundwater Quality and Protection

Triad's Ground Water Quality and Protection program operates in accordance with EPC-CP-QAP-001, "EPC-CP[3] Quality Assurance Plan." Discharges to treatment facilities that are part of this program are conducted in accordance with P409-3, *Waste Acceptance Criteria for Onsite Wastewater Treatment Facilities*.

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[3] EPC-CP = Environmental Protection and Compliance-Compliance Programs

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Chapter 3: Environmental Programs and Analytical Data Quality

This chapter describes the programs that the Los Alamos National Laboratory (LANL or Laboratory) site uses to comply with environmental laws and regulations and to reduce the risk of operations adversely affecting the public and environment. All environmental programs contribute to and are part of our environmental management system.

We first discuss institution-wide processes and programs that improve our environmental performance. Next, we discuss dedicated core programs for compliance with specific environmental laws. Finally, we discuss how we ensure that our sampling results meet U.S. Department of Energy (DOE) standards for data quality.

This chapter includes information from both the management and operating contractor, Triad National Security, LLC (Triad), and the legacy waste cleanup contractor, Newport News Nuclear BWXT-Los Alamos (N3B).

Institutional Processes and Programs

Environmental Management System

An environmental management system is a method of managing environmental compliance, pollution prevention, and performance with a goal of continual improvement. The DOE requires contractors who operate its sites to maintain a system that conforms to the International Organization for Standardization's 14001 Standard, which provides best practices for environmental management systems. The International Organization for Standardization is independent and nongovernmental. It brings together experts to develop voluntary international standards that describe the best practices for conducting a range of activities.

Certification of Triad's Environmental Management System to the International Organization for Standardization's 14001 Standard

The Laboratory has maintained independent third-party certification for an environmental management system under the 14001 Standard since April 2006. In June 2023, the most recent recertification audit renewed LANL's International Organization for Standardization certification through September 2026.

Triad, the Laboratory's management and operating contractor, currently manages the certified environmental management system. When the legacy waste cleanup contract was separated from the management and operating contract in 2018, each contracting organization took responsibility for its own environmental management system. N3B, the legacy waste cleanup contractor, has an environmental management system that aligns with the International Standard for Organizations 14001 Standard. This environmental management system is integrated with other N3B procedures and controls to manage environmental performance and compliance. N3B is working toward having its conformance with the 14001 Standard confirmed by an external organization.

Environmental Management System Program Activities

The Deputy Laboratory Director for Operations chairs Triad's Environmental Senior Management Steering Committee. This committee sets institutional objectives for environmental performance. The three institutional objectives for LANL's environmental performance are

- clean the past,[4]
- control the present, and
- create a sustainable future.

Within these three objectives, Triad's Environmental Senior Management Steering Committee identifies goals and targets (desired actions). Managers and teams from each Laboratory directorate update environmental action plans based on their work activities and institutional goals and targets. In 2024, Triad tracked 234 actions in 14 environmental action plans.

Triad staff also annually update a list of the environmental aspects that could be associated with its activities. In the language of the 14001 Standard, an environmental aspect is an ". . . element of an organization's activities or products or services that interacts or can interact with the environment." Table 3-1 lists the environmental aspects identified for 2024, along with some example activities.

Table 3-1. Environmental Aspects

Environmental Aspects	Examples of Activities
Air emissions	Air emissions from stacks, vents, ducts, or pipes
Interaction with surface water and storm water	• Effluent discharges from outfalls • Activity within the boundary of a watercourse
Discharge to wastewater systems	• Sinks in laboratories • Wastewater transported to a wastewater facility
Interaction with drinking water supplies or systems or groundwater	• Work that involves groundwater wells • Land application of water
Work within or near floodplains and wetlands	• Structures built in a floodplain or wetland • Activities that disrupt the integrity of a floodplain
Interaction with wildlife and habitat	• Removal of trees or brush • Installation and operation of night lighting
Biological hazards	Medical materials and byproducts
Interaction with soil resources	• Ground-disturbing activities • Sources of diffuse air emissions
Spark- or flame-producing activities	• Off-road vehicle use • Outdoor spark- or flame-producing operations
Cultural and historical resources	• Maintenance or expansion of existing walkways or roads • Ground-disturbing activities
Visual resources	• Construction of access roads, fencing, and utility corridors • After-hours lighting

[4] This goal relates only to the management and operations contractor (Triad) activities. The legacy waste cleanup contractor (N3B) has a separate environmental management system that covers its activities under the Consent Order.

Environmental Aspects	Examples of Activities
Hazardous or radioactive material and waste packaging and transportation	• Transportation of chemicals • Transportation of low-level radiological waste, mixed low-level waste, or transuranic waste
Radioactive waste generation and management	• Operations that use radioactive materials • Cleanup of historical waste disposal areas
Hazardous or mixed-waste generation and management	• Research and development procedures that use hazardous materials • Disposal of unused chemicals
Solid or sanitary waste generation and management	Machining operations wastes (nonhazardous or nonradioactive)
Interaction with contaminated sites	• Construction • Demolition
Chemical (industrial and laboratory) use and storage	• Chemical use in research laboratories • Vehicle operation and maintenance
Radioactive material use and storage	Radioactive material machining or processing
Surplus properties and material management	Managing (storing, using, recycling, reusing, disposing of) surplus property
Resource use and conservation	Applying sustainable design principles; for example, cool roofs or natural lighting
Storage of materials in tanks	Operating or maintaining aboveground tanks
Engineered nanomaterials	Nanotechnology research and development that generates nanoparticles

To keep employees informed of environmental requirements, the online course, Environmental Awareness Training, is required for all workers. This course is for full- and part-time remote, hybrid, and onsite employees, contractors, and subcontractors. Retraining is required every 2 years.

Triad's environmental management system has both external audits and internal assessments every year. We use an issues management system to track all findings and corrective actions from these audits and assessments to closure. In April 2024, the internal assessment found zero nonconformities, four opportunities for improvement, and four noteworthy practices.

DOE annually scores its sites using red, yellow, or green for metrics that evaluate their environmental management systems. In 2024, we scored green on each of the following federal government metrics:

- Activities, products, and services (and their associated environmental aspects) and all newly identified activities, products, and services (and their associated environmental aspects) were evaluated for significance within the past fiscal year.
- Measurable environmental objectives were in place.
- Operational controls were established, implemented, controlled, and maintained in accordance with operating criteria.

- An environmental compliance audit program was in place, and audits were completed according to schedule. Audit findings were documented, and corrective actions were implemented.
- As directed by Executive Order 13834, Efficient Federal Operations, sustainability goals were addressed.

Site Sustainability

The Site Sustainability Plan for the Laboratory was updated for 2024. Key initiatives included

- reducing demand for energy and water and increasing efficiency of use,
- reducing greenhouse gas emissions from buildings,
- improving efficiency and reducing carbon dioxide emissions for the steam plant and combustion gas turbine generator, and
- transitioning the vehicle fleet to non-emitting vehicles.

Over the past 10 years, we have made significant improvements in both energy- and water-use efficiency. However, the site may increase its energy consumption and water use (for cooling) in high-performance computing facilities over the next decade. To support efficiency efforts, we implemented the following actions in 2024.

- Water efficiency initiatives included
  - continued operation of the Sanitary Effluent Reclamation Facility, and
  - investing in new water treatment systems that increase the number of concentration cycles in cooling towers.
- Energy efficiency initiatives included
  - reducing or eliminating emissions from electricity sources,
  - electrifying building heating systems, and
  - further reducing energy use by facilities and vehicles.

Greenhouse Gas Reduction

During fiscal year 2024, we achieved a 39 percent reduction in combined Scope 1 and Scope 2 greenhouse gas emissions compared with fiscal year 2008, primarily by reducing sulfur hexafluoride emissions by almost 50 percent from the previous fiscal year.

Our Scope 3 emissions have increased 5.4 percent compared with fiscal year 2008. Scope 3 emissions result from offsite activities, such as employee commutes, ground and air travel, and electricity transmission losses. Efforts to reduce traffic and parking congestion include newly expanded and improved bus routes both on and off site for employees.

Due to the expanding scope of the Laboratory's mission, energy consumption is projected to rise over the next decade, driven by increased demand from high-performance computing and expanded operations across the site. To address this growing need, we are advancing the Steam Plant Replacement project. This effort includes the installation of a new control system for the combustion gas turbine generator, a new high-pressure gas line, and two high-efficiency natural gas boilers.

Operating Experience

The Laboratory's operating experience and lessons learned program is called LANL OPEX. The purpose of the program is to capture and apply lessons learned and to communicate best practices to prevent or reduce the severity of future undesirable events. LANL OPEX collects and distributes information from across the Laboratory and from other sources, including other DOE sites. The program has an online database in the LANL-wide iLINK tool for the submission, publication, reading, and searching of relevant lessons learned. This information is available for workers to use and share.

The Associate Laboratory Directorate for Environment, Safety, Health, and Quality provides an electronic newsletter to directorate employees every workday called the Morning Update. Since April 2024, topics in the Morning Update have been posted, published, and archived in LANL OPEX.

Environmental topics in the Morning Update posted in LANL OPEX during 2024 include the following:

- Enduring Environmental Stewardship (published in LANL OPEX 7/22/2024)
- Cleaning up Fireworks Debris Safely (published in LANL OPEX 7/22/2024)
- EPA's Safer Choice Labels for Safer, More Sustainable Cleaning (published in LANL OPEX 11/06/2024)

When environmental shares and lessons learned are published, LANL OPEX uploads those documents to the DOE OPEXShare website so they may be downloaded for the benefit of the DOE Complex. The DOE OPEXShare site allows users to post feedback for individual lessons. That feedback is shared with the original submitting organization to show how information was used or if improvements can be made to the submission or the work being performed.

Pollution Prevention

The Pollution Prevention program focuses on reducing waste and pollution from operations and addressing emerging waste-related issues. Program activities include

- preparing an annual Hazardous Waste Minimization Report for the New Mexico Environment Department;
- supporting annual Efficiency Status Reporting to the DOE;
- funding projects by scientists and engineers to minimize the use of hazardous substances;
- partnering with the Utility Resource Management team to enhance efficiency in helium management, an important input to mission-focused research;
- working to expand and improve preferential purchasing (purchasing products that are manufactured using improved practices, safer ingredients, energy-efficiency certifications, or recycled content); and
- recognizing the waste reduction achievements of projects and programs through the annual Patricia E. Gallagher awards and internal and external communications.

In 2024, the Pollution Prevention Program was instrumental in eliminating single-use Styrofoam container use in all onsite cafeterias. The program also began new initiatives in developing

Pollution Prevention Implementation Assessments and investigating opportunities in electronics stewardship.

Site Cleanup and Workplace Stewardship

In some places at the LANL site, materials and equipment have been abandoned after projects ended. We established the Site Cleanup and Workplace Stewardship Program in 2013 to divert as much material as possible from waste streams and to reduce abandoned items. Program staff coordinate with responsible organizations to develop work plans for removing abandoned items, clearing indoor and outdoor spaces, and implementing best housekeeping practices. The Site Cleanup and Workplace Stewardship Program works closely with the Property Management Group, Excess Operations, the Environmental Protection and Compliance Division, and other organizations to improve processes and policy.

In 2024, the Site Cleanup and Workplace Stewardship Program accomplished the following:

- Sent 296,000 pounds of potentially activated metal (100 items) at Technical Area 53 for recycling (requiring 10 truck shipments).
- Removed 77,000 pounds of capacitors (225 units with 2,455 gallons of oil) for recycling (requiring five truck shipments).
- Continued the years-long cleanout at the Technical Area 43 Health Research Laboratory building to support the upcoming closure of this facility. We set up new laboratory spaces for environmental sampling personnel and moved them to other locations. In 2024, we removed all remaining movable items. Large equipment removal required crane crews as well as the facility moving crews.
- Cleaned up and fenced a historic artifact area in Technical Area 60 to preserve artifacts related to the atomic underground testing program and the LANL site's Rack Tower.
- Moved the contents of three portable buildings at Technical Area 35 to new storage locations to support parking lot expansions.
- Conducted cleanout of multiple facilities, including
  - labs for the Nuclear and Radio Chemistry Division (including electronic waste, and capacitors that we packaged for low-level waste disposal);
  - a lab storage area at Technical Area 3; and
  - Technical Area 57 Fenton Hill facilities (including recycling of many lead bricks).
- Conducted outdoor cleanups, including
  - an outdoor storage area at Technical Area 33,
  - a lab storage area at Technical Area 3,
  - Technical Area 72 near the facility training complex,
  - seven metal sheds from multiple locations that we dismantled and recycled, and
  - multiple old and unneeded transportainers that we sent for resale or metal salvage.

We began a program to walk outdoor spaces with the land users where outdoor salvage and cleanup are needed. We provide the land users with a list of items that need to be cleaned up and the necessary contacts for salvage and waste removal. We also provide funding for some local workers to aid in the organization and preparation for salvage removal.

Project Review

All new and modified activities, work, operations, and projects must be reviewed for environmental and other compliance requirements before work may start. Modifications include changes in work scope, location, or design. The Integrated Review Tool is a web-based platform that makes submitting projects for review easier and more consistent (Figure 3-1).

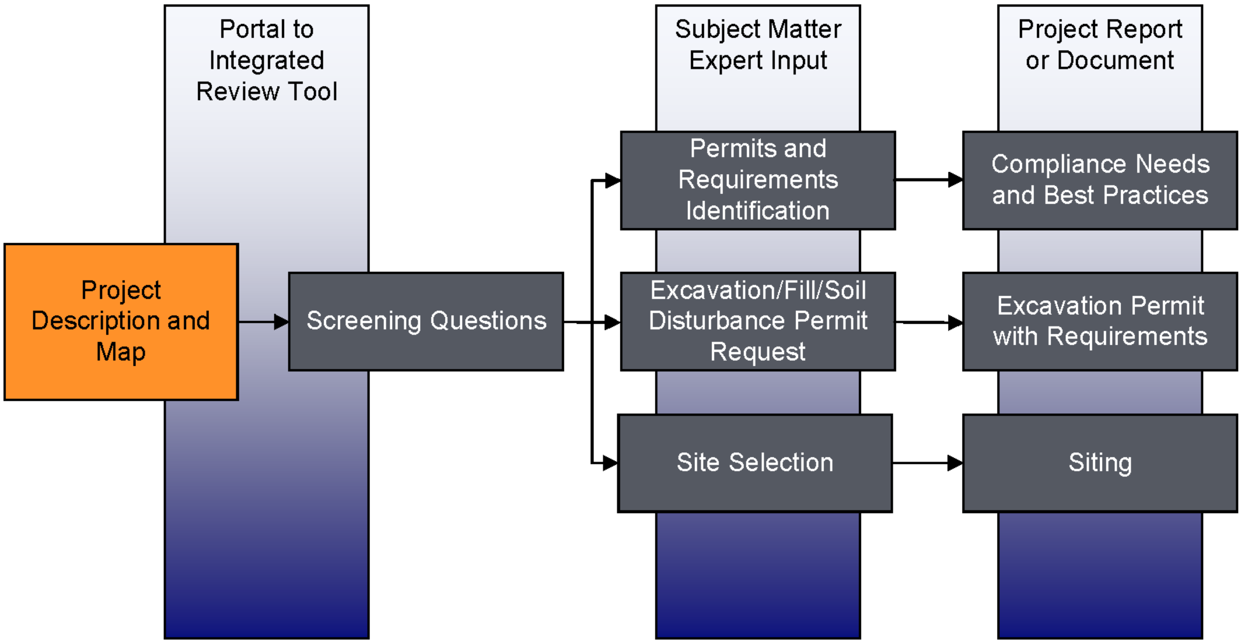

Figure 3-1. Diagram of the Integrated Review Tool process, including inputs and products.

The Environmental and Waste Programs' Project Review Program coordinates subject matter expert reviews and interacts with work owners and planners. Participants include Triad subject matter experts in the following environmental areas: Air Quality, Biological Resources, Consent Order sites (Solid Waste Management Units and Areas of Concern), Cultural Resources, Environmental Health Physics, Storm Water, Manhattan Project National Historical Park, National Environmental Policy Act, Pollution Prevention, Resource Conservation and Recovery Act, Trails Management, Waste and Materials Management, and Water Quality.

N3B project managers use the Integrated Review Tool for some projects and internal N3B procedures for the remaining projects. N3B uses procedures N3B-P351, Project Planning and Regulatory Review, and N3B-P101-17, Excavation/Fill/Soil Disturbance, to identify compliance requirements for new or modified activities. The procedures engage subject matter experts from the following N3B compliance programs: Biological Resources, Cultural Resources, Safety and Industrial Hygiene, National Environmental Policy Act, Resource Conservation and Recovery Act, Waste and Materials Management, and Water Quality.

In 2024, Triad subject matter experts reviewed 445 projects and activities for Permits and Requirements Identification and 770 projects and activities in the Excavation/Fill/Soil Disturbance Permit Request system. Subject matter experts reviewed 16 legacy waste cleanup projects (performed by N3B) for Permits and Requirements Identification.

The Project Review Program continues to support improvements in the Integrated Review Tool. In 2024, we participated in updating the Permits and Requirements Identification module to the Project and Activity Review module. The updated module will integrate Permits and Requirements Identification with New Activity Review.

Community Outreach and Engagement

We are committed to environmental communication and public involvement that includes and is responsive to the communities that surround the LANL site. In Chapter 1, we included descriptions of the communities adjacent to the site.

Staff from the Soil, Foodstuffs, and Biota Program conducted the following outreach events and local environmental monitoring in 2024:

- Presented "Using Aquatic Insects for Water Quality Biomonitoring," and performed a field demonstration to Cochiti Pueblo STEM (science, technology, engineering, and math) Day at Pueblo de Cochiti
- Presented "Using Aquatic Insects for Water Quality Biomonitoring," and performed a field demonstration to San Ildefonso Summer Camp at Pueblo de San Ildefonso
- Collected soil and vegetation samples from Los Alamos, White Rock, Pueblo de San Ildefonso, and other nearby communities (see Chapter 7 for a full list of locations)
- Collected hunter donations such as deer and elk

Staff from the Biological Resources Protection program supported the following outreach events and local environmental monitoring in 2024:

- Presented "All About Birds" and performed a field demonstration for the Cochiti Pueblo STEM Day at Cochiti de Pueblo
- Provided a wildlife presentation and activity to the early education program at the Embudo Valley Library
- Completed bird surveys at the Ute Creek Cattle Ranch, funded as part of a New Mexico Small Business Grant
- Provided a presentation and a lesson on threatened and endangered riparian species at the San Ildefonso Youth Summer Camp

Staff from the Cultural Resources Management program conducted the following outreach activities in 2024 in addition to public tours associated with the Manhattan Project National Historical Park (refer to Manhattan Project National Historical Park later in this chapter):

- Provided presentations to Leadership Los Alamos and the University of Oklahoma
- Conducted science, technology, engineering, and math outreach at Los Alamos Middle School and Science Fest in Los Alamos
- Along with DOE representatives, met with the San Ildefonso Tribal Historic Preservation Officer and Advisory Council regarding legacy collections

- Hosted meetings and visits to ancestral places for the San Ildefonso Tribal Historic Preservation Officer, other Pueblo de San Ildefonso members, and Pueblo youth in the summer STEM program
- Hosted meetings with Jemez Pueblo for information sharing about cultural resource management practices and for a presentation by Vachel Kraklow of Earth and Environmental Sciences Division on her wildfire research in the Jemez Mountains
- Hosted meetings, driving tours, and archaeological site visits for staff from the Anthropology and History programs at Texas A&M University
- Attended the Accord Pueblos technical and environmental meetings

Staff from the Forest Health Program conducted the following outreach events in 2024:

- Hosted San Ildefonso Pueblo Summer Camp
- Provided a presentation on environmental resources to students at Carlos F. Vigil Middle School

Environmental staff help to organize and present at the East Jemez Resources Council meetings twice a year. Invitees to these meetings include Tribal representatives and personnel from state and federal agencies who are interested in the eastern Jemez Mountains. The meetings are open to any interested parties. In 2024, the Council held two hybrid (in-person and virtual) meetings with more than 30 attendees each. The Council also sponsored an in-person training about grass and invasive thistle identification in July 2024.

In fiscal year 2024, Environmental Management Los Alamos[5] engaged with the following communities as part of the Strategic Vision: Pueblo de Cochiti, Pueblo de San Ildefonso, Pueblo of Jemez, Santa Clara Pueblo, and Rio Arriba County.

Staff participated in or hosted public meetings in 2024 regarding modifications to the Consent Order, the annual plan for cleanup activities, progress on cleanup activities, the Storm Water Individual Permit, and the Electrical Power Capacity Upgrade Project Draft Environmental Assessment.

Los Alamos Pueblos Project, Cooperative Agreements, and Grants

Los Alamos Pueblos Project cooperative agreements provide funding to support sampling and monitoring on Pueblo land under Pueblo direction for each of the Accord Pueblos: Pueblo de Cochiti, Pueblo de San Ildefonso, Pueblo of Jemez, and Santa Clara Pueblo. The Pueblos have begun acquiring additional resources to support Los Alamos Pueblos Project goals and objectives. These resources include staffing, equipment, supplies, and contract support.

The Los Alamos Pueblos Project also supports the Santa Fe Indian School, which has continued work on its Community Based Education Model and plans to expand the initiative. All classes at Santa Fe Indian School will include some community-based education content in the next school year.

[5] Environmental Management Los Alamos Office, DOE Environmental Management

Environmental Management Los Alamos supports the University of New Mexico-Taos Hub of Internet-based Vocation and Education through a grant for its efforts to build capacity. This program supports nontraditional students in accessing education and job training, particularly in the fields of science, technology, engineering, and math.

Dedicated Core Programs

Air Quality Programs

Compliance and Permitting

We operate under several air emissions permits issued by the New Mexico Environment Department Air Quality Bureau as well as approvals issued by the U.S. Environmental Protection Agency for construction of new facilities or operations that involve radionuclide emissions. We describe these permits and approvals in more detail in Chapter 2.

Stack Monitoring

As described in Chapters 2 and 4, we monitor emissions of radionuclides from building stacks to determine the potential for stack emissions to adversely affect the public or the environment.

Ambient Air Monitoring

The Laboratory operates a network of ambient air quality monitoring stations to detect other possible radioactive air emissions (refer to Chapter 4). The network includes stations located on site, in adjacent communities, and in regional locations.

Water Quality Programs

We have multiple programs that address the quality of surface water and groundwater. We comply with the following National Pollutant Discharge Elimination System permits:

- the industrial outfall permit
- the individual permit for storm water discharges
- the construction general permit
- the multi-sector general permit
- the pesticide general permit

We also have groundwater discharge permits issued by the New Mexico Environment Department. These permits cover discharges from the sanitary wastewater system plant and the sanitary effluent reuse facility, six septic tank systems, land application of treated groundwater, and injection of treated groundwater into the aquifer through underground injection control wells. All permits are described in more detail in Chapter 2.

We monitor and remediate groundwater (refer to Chapter 5) and conduct environmental surveillance monitoring on surface water base flow, storm water flow, and deposited sediments (refer to Chapter 6). We have also implemented low-impact development projects at Technical Areas 3 and 53 that reduce the amount of storm water runoff from developed areas to improve the quality of the storm water flow.

In 2024, we continued operating the site-wide network of storm water gaging stations to monitor stream flow and collect storm water samples in all major canyons. We also continued operating the early notification system that provides the operators of Santa Fe's Buckman Direct Diversion, which diverts water from the Rio Grande for Santa Fe's drinking water supply, with early notification of storm water flows through Los Alamos Canyon into the Rio Grande.

Cultural Resources Management

Most DOE land in Los Alamos County has been surveyed for cultural resources during the past 25 years. We have identified more than 1,900 archaeological sites, with human occupation at the oldest sites that dates back approximately 10,000 years. About 74 percent of the sites are associated with Ancestral Pueblo peoples that date from 600 to 1600 Common Era (CE). However, these archaeological sites range from Archaic Period (5500 Before Common Era [BCE] to 500 CE) lithic scatters to historical homestead, ranching, and logging sites (1890s to 1940s). We are validating previous surveys across the LANL site because changing environmental conditions can reveal previously unidentified sites or significantly alter known sites.

Buildings and structures from the Manhattan Project and Cold War eras (about 1943 to 1990) are historical built-environment cultural resources. We have evaluated about 44 percent of the Laboratory's nearly 1,000 buildings and structures for eligibility for listing in the National Register of Historic Places.

Current cultural resource management initiatives include

- completing new cultural resource surveys and updating documentation for archaeological sites;
- verifying past survey results (for example, if an existing survey of an area potentially impacted by a proposed project is more than 10 years old, we resurvey the area);
- determining the eligibility of archaeological sites and historical buildings and structures for listing in the National Register of Historic Places; and
- conducting internal and external outreach activities, tours, and educational events for the LANL site workforce, Pueblos, and other stakeholders.

Archaeologists who work for the legacy waste cleanup contractor, N3B, facilitate the cultural resources compliance reviews for legacy waste cleanup projects. N3B archaeologists, the DOE-Environmental Management's Los Alamos Field Office, the DOE-National Nuclear Security Administration's Los Alamos Field Office, and Triad archaeologists meet periodically to discuss cultural resource compliance issues for legacy waste cleanup activities across the site.

In addition to supporting project compliance with cultural resource laws and regulations (described in Chapter 2), Triad cultural resources staff completed the following cultural resources management activities during 2024:

- Monitored DOE preservation districts in Pueblo Canyon and Rendija Canyon
- Monitored seasonal recreational use of trails in Technical Areas 70 and 71
- Assessed the condition and updated photographic records of Nake'muu Pueblo

- Conducted archival photography to document life cycle changes of buildings in Technical Areas 03, 08, 09, 16, 46, and 59
- Continued to integrate historical artifacts into the Bradbury Science Museum's catalog system
- Conducted tours of historical sites for
  - LANL site employees and summer students
  - DOE Field Office staff
  - Triad Board (Business and Investment Committee)
  - National Park Service personnel
  - Weapons Engineering Study Halls participants
  - Environmental Management System auditors
- Gave briefings to Weapons Facility Operations-Maintenance and Site Services employees; staff from the Finance and Controller Divisions; and visitors to the Worker Environment, Safety, and Security Festival booth
- Presented at the Society for American Archaeology annual meeting, the alliance for Historic Landscape Preservation annual meeting, and the Pecos Archaeological Conference

Manhattan Project National Historical Park

The effort by the United States to develop an atomic weapon during World War II, known as the Manhattan Project, took place at several locations across the country. In 2014, Congress established the Manhattan Project National Historical Park to interpret and preserve the remaining structures and landscapes associated with the wartime project. The park consists of units located in Hanford, Washington; Oak Ridge, Tennessee; and Los Alamos, New Mexico. The Los Alamos unit protects the significant buildings and structures of Project Y, the once-secret designation for the scientific and engineering efforts of the Manhattan Project at Los Alamos.

The Manhattan Project National Historical Park program staff conduct interpretative activities that highlight the social and technical history of the Manhattan Project through stories that connect to the people, buildings, and landscapes of pre-war and wartime Los Alamos; make park properties more historically accurate and safer for visitors and maintenance staff; and support a cultural landscape report effort to help planners and decision-makers manage the landscape for interpretive, archaeological, and historical interests. The program completed the following activities in 2024:

- gave tours of Manhattan Project facilities to sponsored guests;
- hosted two tours open to members of the workforce;
- provided public tours to Technical Area 18 twice during the year;
- removed non-period-correct items, made repairs, and encapsulated lead and asbestos with new paint at V-Site Building 0516 in Technical Area 16;
- partnered with the National Park Service's Historic Preservation Training Center to complete preservation work on two Manhattan Project–era guard stations;
- completed an archaeological survey and monitored soil sampling activities at Gun Site in Technical Area 8;

- supported the completion of cleanup work at the Concrete Bowl and a recently discovered Manhattan Project–era firing pad, and
- supported visits by Pueblo representatives for an ethnographic study of the Technical Area 18 landscape, operating through a partnership with the National Park Service and the University of Arizona.

Natural Resources Management

A summary of the LANL site natural resource management activities during 2024 is provided in Table 3-2.

Table 3-2. Natural Resource Management Actions at the Los Alamos National Laboratory Site during 2024

Natural Resources Management Action	Area Treated or Managed	Description
Large-Mammal Monitoring with National Park Service	Not applicable	• We continued to assist National Park Service personnel with a large-mammal monitoring project to assess habitat use. • We tracked radio-collared mountain lions that have territories that overlap the site, documented mountain lion kill locations, and contributed data for the habitat assessment. • We collected a mountain lion blood sample for PFAS analysis; refer to Institutional Monitoring for Radionuclides and Chemicals in Chapter 7.
Trails Management	50 miles total; 36 miles public access; 37 named trails	See https://environment.lanl.gov/resources/trails/. • We installed seven new trailhead kiosks (five in public access areas) and a new 0.5-mile section of the Twomile Mesa Trail to route it around a new facility. • We assessed the condition of six trails.
Forest Thinning and Vegetation Management	167 acres	Refer to Wildland Fire Program in this chapter. • We thinned forests in Rendija Canyon adjacent to a private residential area. • We managed vegetation around firing sites, along evacuation routes, and in utility corridors.
Forest Health Monitoring	~200 acres	Refer to Wildland Fire and Forest Health Programs in Chapter 7.
Endangered Species Habitat Protection	4,611 acres core habitat; 3,218 acres buffer habitat	Area is managed under the LANL Threatened and Endangered Species Habitat Management Plan. Refer to Endangered Species Act in this chapter.
Breeding Bird Surveys and Monitoring	Not applicable	• We established banding stations and a nest box monitoring network. • We conducted point-count surveys. Refer to Biological Resources Management Program in Chapter 7.
Fall Migration Bird Monitoring	Not applicable	We established banding stations. Refer to Biological Resources Management Program in Chapter 7.

Natural Resources Management Action	Area Treated or Managed	Description
Endangered Species Surveys	Not applicable	Refer to Endangered Species Act in this chapter and Biological Resources Management Program in Chapter 7.
Pinyon Jay Monitoring	Not applicable	We used passive acoustic recorders to conduct active surveys. Refer to Biological Resources Management Program in Chapter 7.
Invasive Plant Species Management	< 1 acre	• We removed an invasive teasel plant from Los Alamos Canyon to prevent spread downstream; we mapped the occurrence as part of early detection and response efforts. • We improved processes and established treatment areas to remove 17 invasive Siberian elm and Russian olive trees in five project areas.
Bumble Bee Monitoring	Not applicable	We conducted surveys for the western bumble bee and the Morrison bumble bee, both petitioned to be listed under the Endangered Species Act.
Monarch Butterfly Monitoring and Conservation	< 1 acre	• We conducted surveys for eggs and caterpillars of monarch butterflies. • We established roadside mowing management guidelines. • We targeted planting of native forage plants. The monarch butterfly has been proposed as a threatened species under the Endangered Species Act.

Biological Resources Management Program

The LANL site's approximately 40 square miles encompass multiple plant communities, including riparian areas, piñon-juniper woodlands, ponderosa pine woodlands, and mixed conifer forests. These habitats support biologically diverse ecosystems and several different sensitive or federally protected species.

The goal of the Biological Resources Management Program is to minimize impacts on federally protected and sensitive wildlife and plant species and to ensure that all operations comply with federal and state requirements for biological resources protection. Our work under the Endangered Species Act, the Migratory Bird Treaty Act, and Executive Order 13751, Safeguarding the Nation from the Impacts of Invasive Species, is described in Chapter 2, Compliance Summary.

Each year, we inform and educate the workforce on compliance requirements related to biological resources, including restrictions on the timing and location of operations. We also provide safety briefings on wildlife encounters and assist with mitigating impacts to migratory birds. The program conducts long-term monitoring projects to inform management decisions. Results for 2024 are reported in Chapter 7, Ecosystem Health. Program biologists work with the Forest Health Program and the Soil, Foodstuffs, and Biota Program to mitigate impacts to natural resources and ensure operational compliance.

The following documents provide guidance for protection of biological resources:

- Thompson, B. E., C. D. Hathcock, A. A. Sanchez. (2022). "Threatened and Endangered Species Habitat Management Plan for Los Alamos National Laboratory" (LA-UR-22-20556).

- Gadek, C. G., N. M. Mason, J. E. Stanek. (2024). “Migratory Bird Management Plan for Los Alamos National Laboratory, Revised November 2024” (LA-UR-24-32122).
- Stanek, J. E., S. Lord, A. A. Sanchez. (2024). “Pollinator Protection Plan for Los Alamos National Laboratory, Revised November 2024” (LA-UR-24-321134).
- Stanek, J. E., B. E. Thompson, K. A. Sartor, L. W. Merrill. (2022). “Invasive Plant Species Management Plan for Los Alamos National Laboratory” (LA-UR-22-32639).
- Berryhill, J. T., J. E. Stanek, E. J. Abeyta, C. D. Hathcock. (2020). “Sensitive Species Best Management Practices Source Document, Revision 5” (LA-UR-20-24514).

LANL biologists were authors on the following publications in 2024:

- Stanek, J. E., M. S. Velardi, E. J. Abeyta. (2024). “White Rock Canyon Feral Cattle Removal Plan Management Considerations for the Removal of Feral Cattle in White Rock Canyon” (LA-CP-23-20452).
- Mason, N. M., C. D. Gadek, E. J. Abeyta, J. E. Stanek, G. M. Gaukler. (2024). “2024 Results for Avian Monitoring at the Technical Area 36 Minie Site, Technical Area 39 Point 6, Technical Area 16 Burn Ground, and DARHT at Los Alamos National Laboratory” (LA-UR-24-21036).

Wildland Fire Program

The Wildland Fire Program treats wildland fuels to protect life, property, and other values that are at risk. The goals of the program are to restore and maintain landscapes, develop a fire-adapted community, and ensure sound implementation of wildland fire mitigation. Interagency project planning is critical. We coordinate with federal land management agencies and Los Alamos County on fuel mitigation and forest management projects. We are implementing a 5-year plan to reduce overall wildland fire risk at the LANL site.

The key functions of the Wildland Fire Program are

- preparing site-wide wildland fire hazard risk analyses;
- developing operating plans and procedures and wildland fire and forest prescriptions;
- conducting projects and maintaining wildfire defenses, including forest thinning, fuel and fire breaks, defensible space, and fire roads; and
- publishing daily updates to the Wildland Fire Danger Rating so that fire conditions and fire danger ratings are available to the workforce;

Our program highlights during 2024 included the following:

- Completed a 167-acre forest thinning operation on DOE property in Rendija Canyon to provide defensible space to an adjacent residential area
- Implemented fuels reduction and firebreak treatments surrounding firing site locations
- Started fuels reduction and defensible space treatments at the Technical Area 72 shooting range
- Treated vegetation in utility corridors and implemented fire-resistant paint on wooden power poles

- Completed annual treatments of vegetation along roadside evacuation routes to provide safe evacuation in case of emergency
- Inspected all fire roads and implemented repairs where necessary
- Collaborated with stormwater personnel to preserve a 169-year-old ponderosa pine
- Collaborated with the Trails Program to reroute the Twomile Mesa Trail
- Participated in Four Accord Pueblos firewood distribution, providing more than 200 cords of firewood
- Constructed a new wood yard and equipment storage facility
- Attended public forums for the new LANL site-wide environmental impact statement

Forest Health Program

The objectives of the Forest Health Program are to manage the LANL site's forests, woodlands, and other plant communities for resilience and safety by conducting plant community monitoring (including before and after fuels treatments) and coordinating restoration activities during projects. Staff collaborate with other operational and resource management programs, including the Wildland Fire Program. Results of 2024 forest monitoring activities are provided in Wildland Fire and Forest Health Programs in Chapter 7. Program highlights during 2024 included the following:

- Planned for fuels mitigation and restoration in Los Alamos Canyon, including environmental compliance analysis in the upcoming site-wide environmental impact statement
- Presented "Pinyon Juniper Monitoring at Los Alamos National Laboratory" (LA-UR-24-32247; poster) at the Fourth Southwest Fire Ecology Conference
- Collected field-monitoring data on more than 100 forest inventory plots

Waste Management

Wastes from current operations at the site are managed by Triad's Waste Management and Nuclear Process Infrastructure divisions, whereas legacy waste—defined as wastes generated before 1999—and environmental remediation are managed by the legacy waste cleanup contractor, N3B.

The Enduring Mission Waste Management Plan describes our institutional strategy to manage waste from work for enduring DOE National Nuclear Security Administration missions and Strategic Partnerships Projects. The plan incorporates pollution prevention to significantly reduce the volume and toxicity of waste generated. All waste that has a disposal pathway is shipped off site to government and commercial treatment, storage, and disposal facilities for proper disposal. We operate the Transuranic Waste Facility, where we stage transuranic waste for shipment to the Waste Isolation Pilot Plant in Carlsbad, New Mexico, and we are currently building replacement low-level radioactive and transuranic liquid waste facilities.

Refer to Chapter 2 for more information about waste disposal.

Environmental Remediation

The Legacy Waste Cleanup Program investigates and, where necessary, remediates sites to ensure that chemicals and radionuclides released from past operations do not result in an unacceptable chemical or radiological risk to human health or the environment. We sample soil and other media according to approved work plans to determine if releases have occurred and, if so, whether the nature and extent of contamination is well defined or further sampling is needed. We conduct human health and ecological risk assessments using the results. We remediate sites if the risk assessments indicate potential adverse impacts to human health, the environment, or both. Corrective actions are complete at a site when we have documented to the regulatory authority's satisfaction that the site does not pose an unacceptable risk to humans, plants, or wildlife. Table 3-3 presents a summary of the reports submitted and site investigations conducted in fiscal year 2024 by N3B under the Compliance Order on Consent. (For more information on the Compliance Order on Consent, refer to Chapter 2. Information on groundwater remediation is presented in Chapter 4.)

Table 3-3. Summary of Appendix B Consent Order Milestone Reports Submitted and Site Investigations Conducted in 2024 under the N3B Environmental Remediation Program

Document or Activity Technical Areas Number of Sites Addressed	Sampling and Remediation Activities and Recommendations
Investigation Report for the Twomile Canyon Aggregate Area • Technical Areas 03, 06, 22, 40, 50, and 59 • 61 Consent Order Sites	We completed the investigations presented in the approved Investigation Work Plan for Twomile Canyon Aggregate Area and submitted an investigation report to the New Mexico Environment Department with conclusions and recommendations for 61 sites. We recommended that 43 sites receive a certificate of completion without controls and 15 sites receive a certificate of completion with controls due to an unacceptable risk to human health under the contruction worker or residential risk scenarios. Two sites require additional characterization or remediation, which is scheduled for 2025. We recommended to delay characterization for one site due to its location beneath a building.
Conclusions: We completed investigations at 58 sites, initiated remediations at 2 sites, and recommended that the investigation for 1 site be delayed.	
Investigation Report for Material Disposal Area A at Technical Area 21 • Technical Area 21 • 1 Consent Order Site	We completed the investigations presented in the approved Investigation Work Plan for Material Disposal Area A at Technical Area 21. We investigated the area to evaluate the trends in volatile organic compounds and tritium in pore gas beneath the area over time. We submitted an investigation report to the New Mexico Environment Department in September 2024 that summarized the results of site investigations. The report recommended conducting a corrective measures evaluation at Material Disposal Area A to assess potential future risk and finding a corrective measures alternative for closure of the area.
Conclusion: We completed the investigation at one site.	

Document or Activity Technical Areas Number of Sites Addressed	Sampling and Remediation Activities and Recommendations
Progress Report for the Lower Pajarito Canyon Aggregate Area • Technical Areas 18 and 27 • 31 Consent Order Sites	We began implementing the Investigation Work Plan for Lower Pajarito Canyon Aggregate Area in 2024. We determined that 31 sites require sampling to define the nature and extent of contamination and potential human health and ecological risks. We submitted a progress report to the New Mexico Environment Department in September 2024 that summarized the investigation status for three sites.
Conclusion: We completed investigations at three sites.	
Progress Report for the Starmer/ Upper Pajarito Canyon Aggregate Area • Technical Areas 08, 09, 22, and 40 • 67 Consent Order Sites	We continued implementing the Investigation Work Plan for Starmer/Upper Pajarito Canyon Aggregate Area in 2024. Sixty-seven sites required sampling to define the nature and extent of contamination, potential human health and ecological risks, and need for removal of contaminated soil. We submitted a progress report to the New Mexico Environment Department in September 2024 that summarized the status of site investigations. The progress report summarized the status of investigations for nine sites.
Conclusions: We initiated or completed investigations at 37 sites. We determined that two sites were colocated with active utilities and mission-critical work; therefore, we recommended those for deferred investigation.	

Environmental Health Physics Program

The Environmental Health Physics Program provides technical support for radiation protection of the public and the environment. We use sampling results and radiological assessment models to calculate dose estimates for the public and for plants and animals. We communicate these estimates to regulatory agencies and to the public.

DOE Order 458.1, Radiation Protection of the Public and the Environment, also requires us to oversee releases to the public of real estate and portable property (such as surplus equipment and wastes) that could contain residual radioactivity. Examples include land tracts transferred to other owners and debris from building demolition.

What is health physics?

Health physics is the branch of radiation science that deals with the effects of ionizing radiation on human health.

Our environmental health physicists assist emergency planning and response by providing technical support and dispersion modeling in the case of an accident as well as providing recommendations for protective actions. They also support environmental remediation projects.

Refer to Chapters 2, 7, and 8 for more information.

Soil, Foodstuffs, and Biota Program

The Soil, Foodstuffs, and Biota Program monitors levels of radionuclides, inorganic elements (mostly metals), and organic chemicals (for example, polychlorinated biphenyls [PCBs] and PFAS) in soil, plants, and animals. We routinely sample surface soil; native vegetation; crops and other foodstuffs, including fruits, vegetables, grains, milk, eggs, fish, meat, and honey; small mammals, such as mice; and other animals that have died due to natural causes or accidents, such as roadkill. We collect these samples from the LANL site, the surrounding communities, and regional background locations. The data are used to

- determine if operations are affecting levels of chemicals or radionuclides in the environment,
- monitor for new releases,
- calculate estimates of radiation dose for the public and for biota, and
- conduct risk assessments.

We compare levels of chemicals in our samples with background levels, screening levels, and effects levels, and we examine wildlife population and community characteristics. The program's 2024 activities are described in detail in Chapter 7, Ecosystem Health.

Meteorological Monitoring Program

DOE Order 458.1, Radiation Protection of the Public and the Environment, and DOE Order 151.1D, Comprehensive Emergency Management System, require DOE sites to measure certain weather variables based on radiation-producing operations, the site's topography, and the distances to critical receptors. The Meteorological Monitoring Program maintains a network of eight meteorological towers that measure temperature, wind, humidity, pressure, precipitation, and solar radiation across the site. These data are used for emergency planning in the event of a chemical or radiological release and for regulatory compliance regarding air quality, water quality, and waste management. The data also support monitoring programs for surface water and environmental radiation. Weather data can be accessed at the LANL Weather Machine website (https://weather.lanl.gov). We report on meteorological conditions at the LANL site for 2024 in Chapter 4, Air Quality.

Data Management and Quality Control Process for Analytical Data

In 2024, N3B received and reviewed more than 2 million results from analyses of environmental or waste samples. Triad received and reviewed more than 330,000 results. We manage our environmental data to ensure that the data meet requirements and are suitable for their intended use (for example, monitoring compliance at outfalls). Each contractor has its own sample management office but uses the same data management platform. Individual programs plan and collect their samples in coordination with their sample management office (refer to Figure 3-2). The sample management offices are responsible for sample handling and shipment, analyses, and data review and evaluation. Individual programs produce the final reports. In the following paragraphs, we describe our system for sample and data processing and quality assurance.

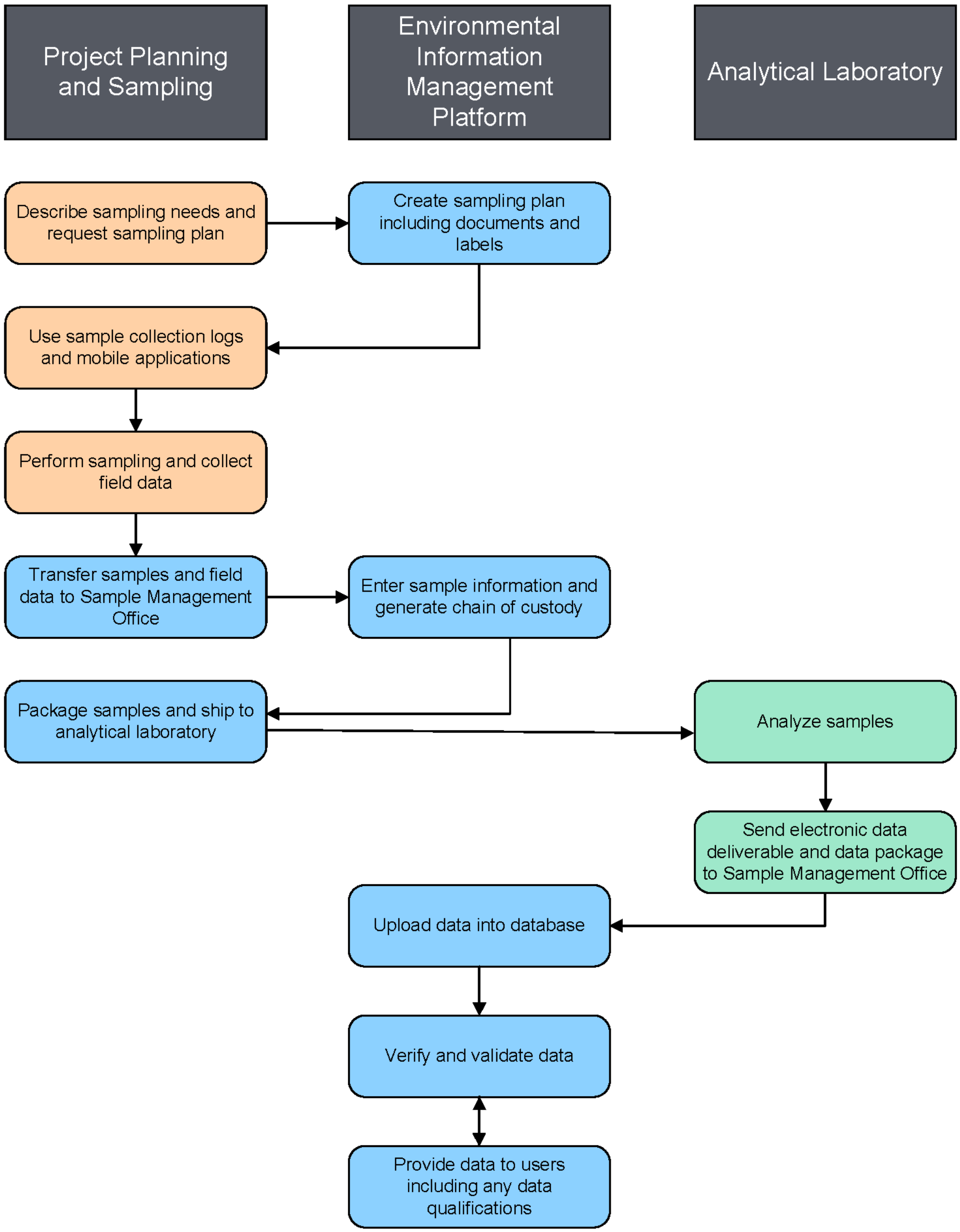

Figure 3-2. Diagram of sample management workflow. Blue shapes show data management steps that directly involve a Sample Management Office. Green shapes show steps that involve the external analytical laboratory. Orange steps are performed by programs responsible for sampling or reporting.

Environmental Information Management Database

To manage sample collection and analytical results, N3B, Triad, and the DOE Oversight Bureau of the New Mexico Environment Department use the same environmental information management database created for the us by Lotus Technologies. The database interfaces with IntellusNM, a fully searchable database available to the public through the IntellusNM website (http://www.intellusnm.com).

The database structure consists of a cloud-based Structured Query Language server database platform with a web-based user interface. The database includes modules for planning sample collection, tracking samples, uploading field data, uploading electronic data deliverables from analytical laboratories, and conducting automated data review. We use the automated data review module in conjunction with manual examinations and full manual validation of selected data to evaluate and maintain data quality.

A Software Change Control Board (which comprises representatives from N3B, Triad, and the New Mexico Environment Department) oversees modifications to the database. This process ensures that changes requested by one organization will not adversely affect the others. We use standardized naming conventions for sampling locations to create a single list of shared location names.

Data Quality Objective Process

N3B and Triad ensure that the data reported from the analytical laboratories are of acceptable quality to fulfill their intended purpose and that data quality is documented so that the data can be evaluated for current and future use. This quality check allows data collected to support defensible decision-making as described in the Guidance on Systematic Planning Using the Data Quality Objectives Process (EPA QA/G-4; EPA 2006).

N3B data quality objectives are set on a project-specific basis. Examples of different types of projects include collection of samples to fulfill a set of permit requirements, to determine waste disposition, or to fulfill a memorandum of understanding or regulated agreement. The project manager determines the project’s specific data quality objectives within the boundaries of contracts for services and standard operating procedures. If a project’s needs exceed contracted services or standard operating procedures, the project manager may initiate revisions to contracts and standard operating procedures.

Sample Collection and Handling

We plan sampling so that data will meet the data quality objectives for each project. Whenever possible, we use methods approved by the U.S. Environmental Protection Agency for sample collection and handling. When federal- or state-approved methods are not available, we use site-specific procedures.

We create a formal sampling plan using the Environmental Information Management database. The system generates sample collection logs and chain-of-custody forms based on the planned samples and analyses. A sample collection log lists the sampling containers and preservatives needed for each analysis requested. The samplers record information in the sample collection log, including the location of sampling (if different from planned), sampling date and time (to establish holding time), any field measurements needed for the project, and other comments as needed. They then place the samples into coolers, with ice if required.

From the time of sampling until delivery to the Sample Management Office, the samples are in direct custody of the samplers. The samplers place tamper-indicating devices—also known as custody seals—on every sample container. At the Sample Management Office, the samplers transfer custody of the samples to the office staff. Sample Management Office staff store samples as required by the analysis method, including in temperature-controlled refrigerators if needed. They wrap glass sample containers in bubble bags to prevent breakage during shipping. They pack samples in coolers with blue ice or bagged ice to ensure proper shipping temperature and place signed chain-of-custody documents inside the coolers. They tape the coolers shut and protect the seals with tamper-indicating devices before shipping them overnight to the designated analytical laboratory.

Both N3B and Triad have implemented an electronic chain of custody that arrives at the analytical laboratory before the official chain of custody. This practice allows the analytical laboratory to prepare to receive the upcoming sample and reduces errors throughout the process. When the samples arrive at the analytical laboratory, laboratory staff verify the integrity of tamper-indicating devices, measure the shipping temperature, and compare the samples with their chain-of-custody forms. If both the cooler and sample tamper-indicating devices are damaged or tampered with, the sample is considered unusable. After the analytical laboratory logs in the samples, laboratory staff analyze the samples.

Selection of Analytical Laboratories

N3B and Triad select analytical laboratories that meet the DOE Consolidated Audit Program Accreditation Program requirements. More information on the DOE Consolidated Audit Program can be found in DOE’s Analytical Services Program later in this chapter. Triad chooses National Environmental Laboratory Accreditation Program–accredited laboratories when a given analysis is not available from a contracted DOE Consolidated Audit Program–accredited laboratory. Along with the DOE Consolidated Audit Program accreditation, N3B selects laboratories that meet requirements in their document, “Scope of Work and Technical Specifications for Off-Site Analytical Laboratory Services” (Exhibit D). N3B developed Exhibit D using the Department of Defense and Department of Energy Quality Systems Manual for Environmental Laboratories.

Beyond meeting the requirements of the DOE Consolidated Audit Program and the scope of work, Triad and N3B choose laboratories for a specific analysis based on their capacity to maintain a project’s continuity of data, their ability to prevent disruptions caused by unforeseen lab closures or instrument failures, and their capacity to deliver a cost-effective service. This approach allows for split sampling and data quality comparison. N3B has contracted with 10 analytical laboratories, 9 of which performed certifiable analyses for N3B in 2024.

Sample Analysis Methods

Analytical laboratories perform sample preparation and analyses using industry-standard methods such as those from

- U.S. Environmental Protection Agency publication SW-846,

- DOE Environmental Measurements Laboratory Procedures Manual HASL 300,
- the Clean Water Act,
- the American Industrial Hygiene Association,
- the Occupational Safety and Health Administration,
- the National Institute of Safety and Health,
- the American Society for Testing and Materials, and
- the American Public Health Association.

In the absence of a standard method, laboratories perform analyses using performance-based methods that meet project-specific data quality objectives.

The choice of a method is determined by program or permit requirements or by the desired detection limit. All analyses of laboratory quality control samples are reported to us. Additionally, we send field quality control samples (blank samples and duplicate samples) periodically for analysis. The frequency of field quality control samples is determined by analytical methods, permits, or site procedures.

Data Review and Evaluation

Laboratories generally return analytical results to us in two formats: as electronic data deliverables and as data packages. An electronic data deliverable is a data file transmitted in a format that can be directly uploaded to database programs. A data package consists of the combined analytical chain of custody, signed sample collection logs, a validation report if available, and the analytical data report. These documents are usually delivered as a portable document format (PDF) file. Some data users also request a hard copy of the data package. For N3B, laboratory data packages and electronic data deliverables adhere to the requirements specified in Exhibit D.

Electronic data deliverables are loaded into holding tables in the Environmental Information Management database. Automated programs in the database verify the data in these files by checking that

- the electronic data deliverable file is formatted correctly, including in the number and types of fields (text/numeric/date-time);
- the analyses reported agree with those we ordered;
- the data were not already reported (to avoid duplicates);
- the sampling date used by the analytical laboratory agrees with the database sampling date (which is important for holding time evaluation); and
- the dates listed by the lab are in logical order, such as sampling before preparation date and preparation before analysis date.

Following verification, a Sample Management Office chemist runs an auto-validation program to validate reported data. Automated data review follows the U.S. Environmental Protection Agency's National Functional Guidance documents and the DOE/Department of Defense Consolidated Quality Systems Manual for validation of analytical data. The automated review checks and applies proper validation qualifiers and validation reason codes for the following:

- Holding time
- Temperature of the samples on arrival at analytical laboratory
- Method and field blank contamination
- Field duplicates
- Laboratory control samples and duplicates within limits
- Matrix spike recoveries within limits
- Missing laboratory quality control samples

When examination, verification, and automated data review are completed, data are transferred to production tables in the database.

A chemist also manually validates a subset of the data. We have two methods to select data for manual validation: (1) data are randomly selected across different analytical methods and laboratories, and (2) a new detection of a substance or a data quality question may trigger a manual validation. For N3B, a chemist manually validates a minimum of 10 percent of analytical data. Project personnel determine if a greater frequency of manual validation is required to meet project-specific data quality objectives and will notify the Sample Management Office accordingly. A chemist may perform triggered validation on specific data at the request of the project or the person who prepares the reports.

During manual validation, we review data stored in the Environmental Information Management database tables and the data packages. We evaluate all aspects of data quality, including spectral data. If manual validation results in a change of the data qualifiers, we enter the changes into the Environmental Information Management database. We include a description of the changes and a short explanation of reasons for the changes. All such changes are tracked in the Environmental Information Management database's audit tables.

We evaluate field quality control samples when datasets are prepared for individual programs or data owners. Any detections found in blank samples or large discrepancies in results between duplicate samples are reviewed during automated data review in the Environmental Information Management database. Validation qualifiers and reason codes can be applied to sample data based on the results and agreement of field quality control samples.

The primary purpose of data validation is to summarize the quality and defensibility of analytical data for end users. Guidelines and requirements ensure the necessary level of confidence in data quality and usability for project activities. The entire data validation process includes a description of the reasons for any failure to meet method, procedural, or contractual requirements and an evaluation of the failure's impact on data or a dataset.

All analytical data packages include the automated data review report, the examination or verification report, and if performed, the data validation report. These reports are transferred to records management to meet records retention requirements. Compiled data packages are also uploaded to the IntellusNM website.

Environmental Data Validation Performance Testing

N3B chemists performed extensive testing of the Automated Data Review Data Validation Module of the Environmental Information Management database, including using electronic data deliverables from actual laboratory analyses. They identified specific issues and opportunities for enhancements. N3B personnel coordinated with Triad and the New Mexico Environment Department and worked with Locus Technologies to implement improvements and ensure that validation outputs meet the requirements of the Quality Systems Manual and recommendations in the U.S. Environmental Protection Agency's National Functional Guidelines. During this process, N3B found that radiochemical capabilities were underutilized, so they enhanced the Automated Data Review functionality regarding radioanalytical assessment.

Chemists performed an increased number of full validations to monitor Automated Data Review performance following requested changes in the module. No major issues were identified. Performance enhancements and improvements are ongoing.

Records Retention

Original hard copies of chain-of-custody forms and sample collection logs are stored temporarily at the Sample Management Offices until staff transmit final records to Records Management. The ambient air-monitoring program requires that a hard copy Level IV complete data package remain on site. Records Management packages these records by the end of each fiscal year and transfers them to the LANL Records Center, where they remain on site for 5 years.

We store analytical records in the Environmental Information Management database, and we back up the entire N3B and Triad Environmental Information Management database at least quarterly on N3B or Triad servers. Analytical results are copied daily to the publicly available IntellusNM database (www.intellusnm.com). Complete data packages are uploaded to the Electronic Document and Records Management System to fulfill the long-term record retention requirement. Approximately once per month, complete data packages are copied to IntellusNM.

We withhold some data and analytical packages from public view for up to 90 days from the date of receipt. These packages usually have results from samples collected off site that we share first with other entities, including nearby counties or Native American Tribes.

Quality Assurance

N3B's Sample Data Manager and the Sample Management Office are subject to the N3B Quality Assurance and Transformation Audit and Surveillance program. They are also subject to

- DOE Consolidated Audit Program audits of analytical laboratories used for analysis of environmental samples;
- DOE Consolidated Audit Program audits of treatment, storage, and disposal facilities used for waste disposal;
- Internal audits under the management assessments program;
- Quality assurance and transformation in developing project assessment criteria and issues responses in the N3B integrated Contractor Assurance System;
- Management observations and verifications; and
- Performance tracking by personnel who monitor activities conducted under the scope of this sample and data management plan.

DOE's Analytical Services Program

The DOE's Analytical Services Program provides environmental management services and products to DOE program offices and field sites. The various parts of the Analytical Services Program in which we participate are described here.

DOE Consolidated Audit Program–Accreditation Program for Commercial Analytical Laboratories

The DOE Consolidated Audit Program provides for assessments of commercial analytical laboratories that analyze environmental samples. Use of third-party auditors replaced the traditional DOE Consolidated Audit Program audits beginning in 2018. The DOE Consolidated Audit Program has qualified the following three accrediting bodies to perform these audits:

- Perry Johnson Laboratory Accreditation, Inc.
- The American Association for Laboratory Accreditation
- The American National Standards Institute National Accreditation Board

Analytical laboratories are audited against the International Organization of Standardization's Standard 17025, General Requirements for the Competence of Testing and Calibration Laboratories; the National Environmental Laboratory Accreditation Conference Standard; and the DOE/Department of Defense and Department of Energy Quality Systems Manual (Quality Systems Manual). N3B uses the results from these third-party accreditation assessment reports as part of its oversight for its subcontracted commercial analytical laboratories.

Table 3-4 summarizes the DOE Consolidated Audit Program laboratories currently subcontracted to perform samples analysis for N3B and Triad.

Table 3-4. DOE Consolidated Audit Program-Accreditation Program Audits of Laboratories Contracted by N3B and/or Triad in Fiscal Year 2024

Laboratory	Audit Dates	Accrediting Body	Used in FY24
ARS Aleut Analytical, LLC (Port Allen, LA)	August 16–21, 2024	ANAB[a]	Yes
Cape Fear Analytical, LLC (Wilmington, NC)	January 17–19, 2024	A2LA[b]	Yes
Southwest Research Institute (San Antonio, TX)	January 10–12, 2024	A2LA	Yes
Eurofins TestAmerica (Denver, CO)	September 9–13, 2024	A2LA	Yes
Eurofins TestAmerica (Knoxville, TN)	December 4–5, 2023	ANAB	Yes
Eurofins TestAmerica (Folsom, CA)	February 7–9, 2024	ANAB	Yes
ALS Environmental (Salt Lake City, UT)	September 5–6, 2024	PJLA[c]	Yes
Materials and Chemistry Laboratory, Inc. (Oak Ridge, TN)	June 10–12, 2024	PJLA	Yes
GEL Laboratories, LLC (Charleston, SC)	February 20–21, 2024	A2LA	Yes
Pace Analytical (Mt. Juliet, TN)	August 20–22, 2024	ANAB	Yes

[a] ANAB = American National Standards Institute National Accreditation Board
[b] A2LA = American Association for Laboratory Accreditation
[c] PJLA = Perry Johnson Laboratory Accreditation, Inc.

N3B provided support to the DOE Consolidated Audit Program in various ways throughout fiscal year 2024. Radiochemists from N3B participated in the Analytical Services Program annual training workshop, leading a session on radiological data validation. N3B supported DOE Consolidated Audit Program audits by providing audit observers to GEL Laboratories, LLC; Pace Analytical; Southwest Research Institute; and Eurofins TestAmerica audits. Finally, N3B staff played an active role in the DOE Consolidated Audit Program Data Quality Work Group, participating in conference calls and answering questions and fielding requests about issues that emerged during laboratory audits and general laboratory or data quality questions from around the complex.

The DOE Consolidated Audit Program administrator reports findings from the third-party audits to DOE sites. N3B tracks findings from the analytical laboratories it has under contract. Significant findings from fiscal year 2024 included tracking radiological samples from receipt to disposal and monitoring for potential radiological contamination on received shipments.

Before receiving certificates of accreditation, analytical laboratories are required to submit corrective action reports to the accrediting bodies, who must accept these corrective actions as sufficient before granting accreditation. All N3B subcontracted laboratories received their accreditations in 2024, indicating that the corrective actions were determined to have adequately addressed the identified issues.

DOE Mixed Analyte Performance Evaluation Program

The Mixed Analyte Performance Evaluation Program provides proficiency testing in various environmental matrices, primarily for radionuclide identification and quantification. Results of proficiency testing help assure field managers of the quality and reliability of environmental data used in decision-making. Laboratories are required by the National Laboratory Accreditation Conference Standard and the Quality Systems Manual to participate in proficiency testing in all fields of accreditation, where available.

Although not a mandatory requirement of the Quality Systems Manual, the Mixed Analyte Performance Evaluation Program can serve as a tool to determine a commercial laboratory's radiological analysis capabilities across most environmental matrices. Participation in the Mixed Analyte Performance Program is required for laboratories that perform radiochemical analyses for N3B.

DOE Consolidated Audit Program—Treatment, Storage, and Disposal Facility Audits

Audit reports for treatment, storage, and disposal facilities produced by the DOE Consolidated Audit Program are used by DOE Headquarters managers and DOE Field Office managers in performing their DOE Order 435.1 annual acceptability reviews for commercial sites that dispose of waste from DOE sites. The audits are performed by trained and qualified auditors from the various DOE and contractor (co-permittee) sites within the DOE complex. Table 3-5 provides a summary of the most recent audits performed by the DOE Consolidated Audit Program for the treatment, storage, and disposal facilities subcontracted to accept radioactive waste from N3B.

Table 3-5. Most Recent Audits of Treatment, Storage, and Disposal Facilities Used by N3B under the DOE Consolidated Audit Program

Treatment, Storage, and Disposal Facility	Most Recent Audit Date
Waste Control Specialists, LLC (Andrews County, TX)	May 14–22, 2024
Perma-Fix Northwest, Inc. (Richland, WA)	June 4–13, 2024
Perma-Fix Florida (Gainesville, FL)	September 10–19, 2024
Energy Solutions LLC (Bear Creek Processing Facility, Oak Ridge, TN)	August 19–24, 2024
Energy Solutions (Clive, UT)	April 30–May 3, 2024
Diversified Scientific Services Inc (Oak Ridge, TN)	July 23–August 1, 2024
Alaron Nuclear Services (Oak Ridge, TN)	August 13–14, 2024

Priority I findings identified by the DOE Consolidated Audit Program are reviewed and tracked by the administrator and lead qualified auditors. Priority I findings are considered significant. The most recent audits identified Priority II findings that were not considered of immediate significance to compliance, policy, or performance. The results are as follows: 1 Priority I finding, 61 Priority II findings, and 68 observations. The Priority I findings and associated Priority II findings were closed out during follow-up surveillance audits.

References

EPA 2006: "Guidance on Systematic Planning Using the Data Quality Objectives Process: EPA QA/G-4," U.S. Environmental Protection Agency report EPA/240/B-06/001, Washington, D.C.

Chapter 4: Air Quality

Introduction

We use or generate radioactive materials in some site operations, such as at the Los Alamos Neutron Science Center, and radioactive materials are associated with legacy wastes in some areas at the LANL site. We monitor air quality and radioactive air emissions to protect public health and the environment. Each of our five types of monitoring—ambient (outside) air sampling at public locations, exhaust-stack sampling at site facilities, gamma and neutron direct radiation monitoring near radiation sources and in public locations, particulate matter monitoring, and meteorological monitoring of the local wind and weather conditions—is described in this chapter.

We measure concentrations of airborne radiological materials and calculate radiological doses to humans, plants, and animals. We compare our results with U.S. Department of Energy (DOE) and U.S. Environmental Protection Agency standards. The maximum allowed doses for members of the public are provided in DOE Order 458.1 Chg 5, Radiation Protection of the Public and the Environment, and in National Emission Standards for Hazardous Air Pollutants, Title 40, Part 61 of the Code of Federal Regulations. This chapter reports our monitoring results; estimates of public doses are reported in Chapter 8.

Ambient Air Sampling for Radionuclides

During 2024, we operated 43 environmental air-monitoring stations (Figure 4-1 and Figure 4-2). The air-monitoring stations sample ambient air in a variety of locations to measure airborne radionuclides. We categorize station locations as regional background (away from the Laboratory), perimeter, onsite, or waste site. Waste site locations monitor radionuclides near Area G, the site's low-level radioactive waste disposal area and radioactive waste storage area at Technical Area 54 (Figure 4-2).

The stations operate by continuously pulling ambient air through a filter to capture airborne particulate matter. We change out the filters every 2 weeks and send the used filters to an offsite analytical laboratory for analysis. The analytical methods comply with U.S. Environmental Protection Agency requirements in National Emission Standards for Hazardous Air Pollutants, Title 40, Part 61 of the Code of Federal Regulations, Appendix B, Method 114.

We compare radioactivity levels in the air with the U.S. Environmental Protection Agency's Concentration Levels for Environmental Compliance provided in National Emission Standards for Hazardous Air Pollutants, Title 40, Part 61 of the Code of Federal Regulations, Appendix E, Table 2.

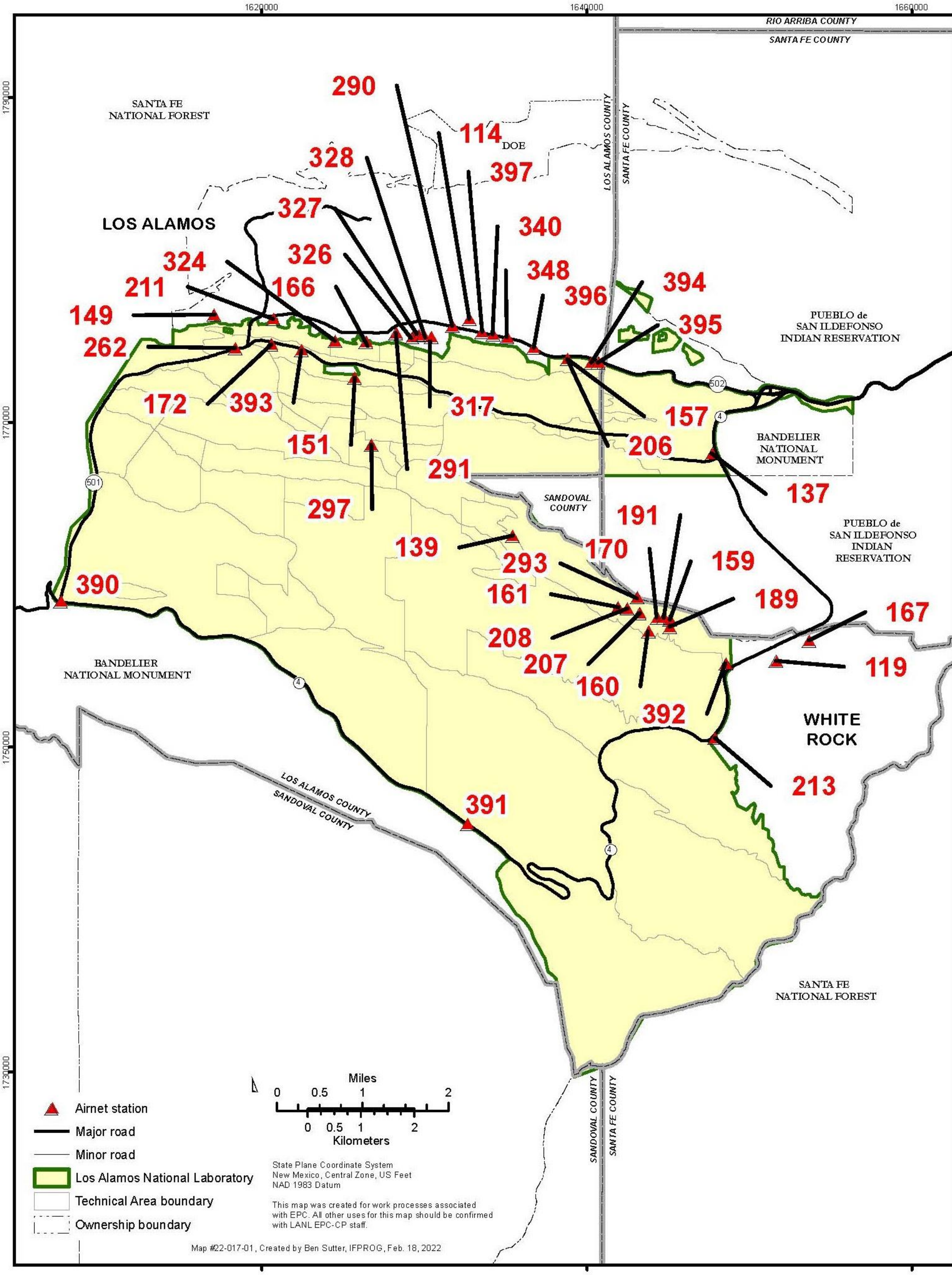

Figure 4-1. Environmental air-monitoring stations at and near the LANL site.

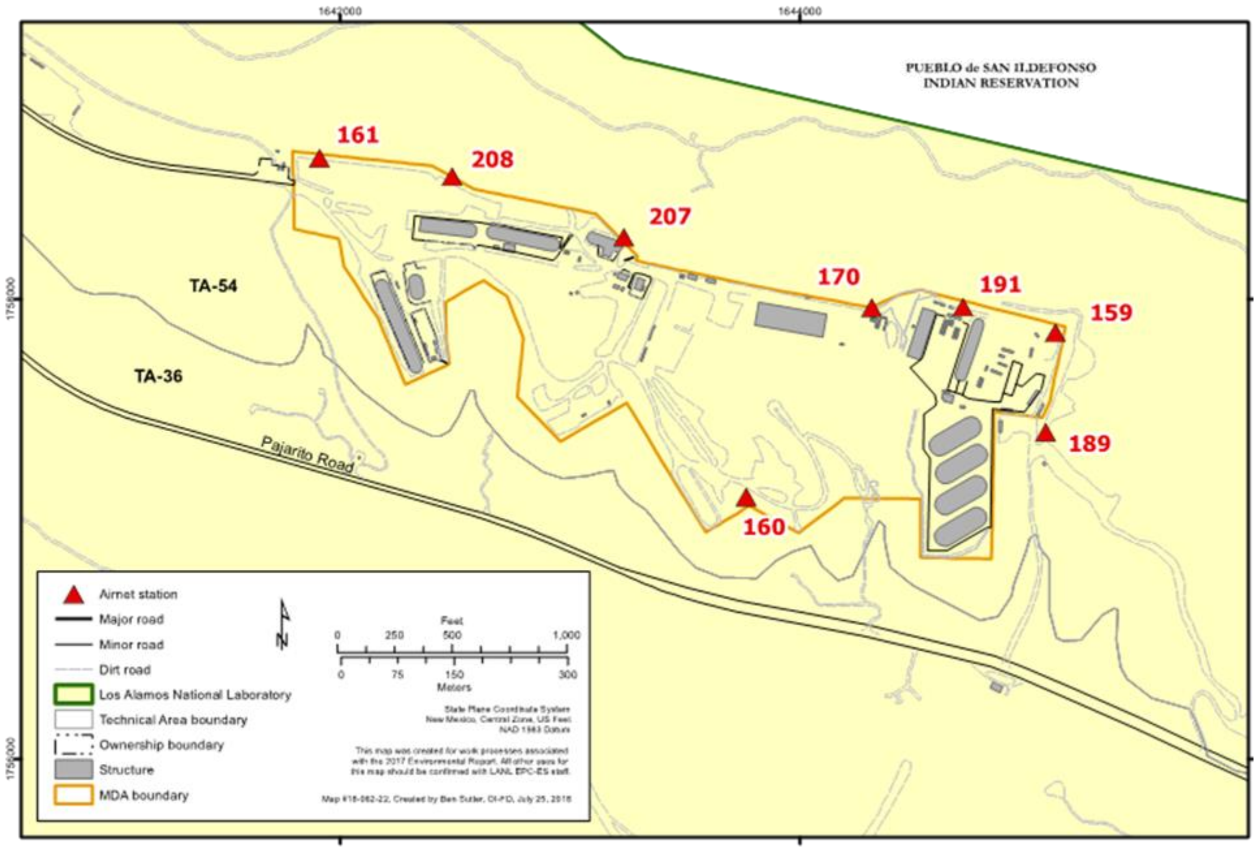

Figure 4-2. Environmental air-monitoring stations at Technical Area 54, Area G. MDA = material disposal area.

Regional Background Levels

The atmosphere contains background concentrations of radioactivity from naturally occurring radionuclides and from airborne radioactive materials produced by global nuclear weapons testing and nuclear accidents. We measure background concentrations using monitoring stations in the communities of El Rancho, Española, and Santa Fe. We report background levels of several radionuclides of interest in Table 4-1.

Table 4-1. Average Background Radionuclide Concentrations in the Regional Atmosphere

Analyte	Units	U.S. Environmental Protection Agency Concentration for Environmental Compliance	Average Regional Background Concentration
Tritium	pCi/m^3	1,500	1 ± 1
Americium-241	aCi/m^3	1,900	1 ± 1
Plutonium-238	aCi/m^3	2,100	0 ± 1
Plutonium-239/240	aCi/m^3	2,000	1 ± 1
Uranium-234	aCi/m^3	7,700	11 ± 7
Uranium-235	aCi/m^3	7,100	0 ± 1
Uranium-238	aCi/m^3	8,300	11 ± 7

Note: pCi/m^3 = picocuries per cubic meter; aCi/m^3 = attocuries per cubic meter.

Perimeter, Onsite, and Waste Site Radionuclides

Tritium

Tritium is present in the environment as the result of past nuclear weapons tests and cosmic-ray interactions with the air (Eisenbud and Gesell 1997). Laboratory operations also produce tritium. Measurements of both water vapor in the air and tritium in that water vapor are used to calculate the amount of tritium in air.

What are cosmic rays?

Cosmic rays are fragments of atoms that rain down upon the Earth from outside the solar system.

During 2024, some individual tritium samples had too small of a liquid aliquot, and as a result, some samples had much larger uncertainties than others. For Table 4-2, we used inverse-variance weighting to calculate the averages because of the extreme variations in uncertainties. (https://en.wikipedia.org/wiki/Inverse-variance_weighting).

All results are far below the U.S. Environmental Protection Agency's concentrations for environmental compliance of 1,500 picocuries per cubic meter.

Table 4-2. Airborne Tritium Concentrations for 2024—Group Summaries

Station Grouping	No. of Stations	Average and uncertainty (pCi/m³)		Maximum Annual Station Concentration (pCi/m³)	U.S. Environmental Protection Agency Concentration for Environmental Compliance (pCi/m³)
Regional	3	1	±2	1	1,500
Perimeter	30	2	±2	2	1,500
Onsite	2	1	±2	1	1,500
Waste site	8	66	322	465	1,500

Note: pCi/m³ = picocuries per cubic meter.

For the waste site, the largest tritium concentration (465 picocuries per cubic meter) was measured at the southern boundary of Area G (station 160; Table 4-3) near the tritium-waste burial shafts. All concentrations at the other stations were less than 24 picocuries per cubic meter. The annual average concentration is well below 1,500 picocuries per cubic meter, which is the U.S. Environmental Protection Agency concentration level for the public.

Americium-241

Table 4-3 summarizes the 2024 sampling data for americium-241. The results are similar to recent years and are less than 2 percent of the americium-241 concentration level for environmental compliance (see Table 4-1).

Table 4-3. Airborne Americium-241 Activities for 2024—Group Summaries

Station Grouping	No. of Stations	Mean ± 2 Standard Deviations (aCi/m³)		Maximum Annual Station Activity (aCi/m³)
Regional	3	1	±2	2
Perimeter	30	1	±2	3
Onsite	2	1	±2	4
Waste site	8	5	±20	30

Note: aCi/m³ = attocuries per cubic meter.

Plutonium

Table 4-4 summarizes the LANL site plutonium-238 and plutonium-239/240 data for 2024.

Table 4-4. Airborne Plutonium-238 and -239/240 Activities for 2024—Group Summaries

Station Grouping	No. of Stations	Group Mean ± 2 Standard Deviations (aCi/m^3)		Maximum Annual Station Activity (aCi/m^3)	
		Plutonium-238	Plutonium-239/240	Plutonium-238	Plutonium-239/240
Regional	3	0 ± 2	−1 ± 2	1	1
Perimeter	30	0 ± 1	4 ± 33	1	89
Onsite	2	1 ± 1	1 ± 2	1	2
Waste site	8	1 ± 3	1 ± 2	4	3

Note: aCi/m^3 = attocuries per cubic meter.

Every year, resuspended dust causes small but detectable concentrations of plutonium-239 in the air near former Technical Area 01 and near Technical Area 21, both perimeter locations. In 2024, the concentrations were highest at Technical Area 21 because Los Alamos County realigned and repaved DP Road. DP Road is located in Technical Area 21, and part of the technical area was conveyed to Los Alamos County in 2011 after remediation of Material Disposal Area B, a Manhattan Project–era waste disposal site. Material Disposal Area B is adjacent to DP Road and was closed in 1948. The largest annual average plutonium-239 concentration in 2024 was 89 attocuries per cubic meter at air-monitoring station #317 on DP Road (Figure 4-1).

The americium-241 concentrations are about 2 percent of the plutonium-239 concentrations, which is consistent with the radioactive materials delivered to the Laboratory from Hanford in the 1940s and consistent with the waste material that was placed in Material Disposal Area B.

The plutonium-239 concentration at air-monitoring station #317 was less than 5 percent of the U.S. Environmental Protection Agency's plutonium-239 concentration level for environmental compliance, which is 2,000 attocuries per cubic meter. The concentrations at other nearby locations were much smaller and were less than 0.5 percent of the compliance concentrations.

Uranium

Table 4-5 summarizes the uranium data for 2024. The concentrations at most perimeter sites were about 10 attocuries per cubic meter, which is similar to previous years. This year, the perimeter average increased to 13 attocuries per cubic meter because of dust resuspended by the road work on DP Road.

Table 4-5. Airborne Uranium-234, -235, and -238 Activities for 2024—Group Summaries

Station Grouping	No. of Stations	Group Mean ± 2 Standard Deviations (aCi/m^3)		
		Uranium-234	Uranium-235	Uranium-238
Regional	3	11 ± 14	1 ± 2	11 ± 13
Perimeter	30	13 ± 27	1 ± 2	13 ± 28
Onsite	2	8 ± 6	1 ± 2	9 ± 6
Waste site	8	8 ± 4	1 ± 1	10 ± 7

Note: aCi/m^3 = attocuries per cubic meter.

The ratios of isotopes in the uranium results indicate that the source is natural uranium. The results are far below the concentration levels for environmental compliance listed in Table 4-1.

Gamma Spectroscopy Measurements

Ambient air samples are analyzed by gamma spectroscopy for the following gamma-ray-producing radionuclides: cobalt-60, cesium-134 and -137, iodine-131, sodium-22, and protactinium-234m. These radionuclides were not detected.

Conclusion

All concentrations of airborne radioactive material measured in ambient air samples were below the applicable concentration levels for environmental compliance.

Exhaust-Stack Sampling for Radionuclides

We use radioactive materials in some operations. The buildings that house those operations may vent radioactive materials to the environment through an exhaust stack or other release point. The stack-monitoring team measures or estimates emissions from these point sources in accordance with the National Emission Standards for Emissions of Radionuclides Other Than Radon from Department of Energy Facilities, Title 40, Part 61, Subpart H of the Code of Federal Regulations. We actively monitor emission points that could cause a public dose greater than 0.1 millirem during a 1-year period by sampling stack emissions.

Emissions from stacks that have the potential to cause less than 0.1 millirem dose per year are estimated as described in the annual *Radioactive Materials Usage Survey for Unmonitored Point Sources* (Fuehne and Lattin 2025). The impacts of non-point sources, such as large-area sources, leaks, and diffuse or fugitive emissions, are measured by the environmental air-monitoring network or calculated as described in Fuehne and Lattin (2025).

Sampling Methodology

Radioactive stack emissions can be one of four types: particulate matter, activated vapors and volatile compounds, tritium, or gaseous mixed activation products. Activated materials are made radioactive by exposure to neutron radiation. This section describes the sampling method for each of these emission types.

We sample emissions of particulate matter using a glass-fiber filter. We pull a continuous sample of air from the stack through a filter that captures small particles. We collect filters weekly and send the spent filters to an offsite analytical laboratory for analysis.

We use charcoal cartridges to sample emissions of activated vapors and volatile compounds generated by operations at the Los Alamos Neutron Science Center at Technical Area 53, the Chemistry and Metallurgy Research Building, and Technical Area 48.

To measure tritium emissions, we use collection devices known as bubblers to determine the total amount of tritium released and whether it is in elemental or oxide form. The bubblers pull a continuous sample of air from the stack, which is then “bubbled” through three sequential vials that contain ethylene glycol. The ethylene glycol collects any tritium oxide that could be part of a water molecule. Then the air is passed through a palladium catalyst that converts the elemental tritium to the oxide form. Following this conversion, we pull the sample through three additional vials that contain ethylene glycol; these vials collect the newly formed tritium oxide.

The stack-monitoring team measures activities of gaseous mixed activation products emitted from the Los Alamos Neutron Science Center using real-time, air-monitoring data. To collect these data, a sample of air from the stack is pulled through an ionization chamber that measures the total amount of radioactivity in the sample.

Data Analysis

Methods

This section discusses the analysis methods used for each type of the Laboratory's emissions. The sampling methods comply with U.S. Environmental Protection Agency requirements in the National Emission Standards for Hazardous Air Pollutants, Title 40, Part 61 of the Code of Federal Regulations, Appendix B, Method 114.

Particulate Matter Emissions

Each week, we collect glass-fiber filters and measure total activity before the filters are shipped to an offsite analytical laboratory, where they are analyzed using spectroscopy to identify radionuclides. We use the spectroscopy data to quantify the radioactivity of particulate matter emissions. We compare the results with the total activity measurements to ensure that all radionuclides are identified.

Vaporous Activation Products

Each week, we collect charcoal cartridges and ship them to an offsite analytical laboratory where they are analyzed using spectroscopy. We use these data to identify and quantify the presence of vaporous material.

Tritium

Each week, we collect tritium bubbler samples and transport them to LANL's Health Physics Analysis Laboratory, where the amount of tritium in each vial is determined by liquid scintillation counting.

Gaseous Mixed Activation Products

We use continuous monitoring for gaseous mixed activation products at the Los Alamos Neutron Science Center. There are two reasons for the use of continuous monitoring. First, standard filter paper and charcoal filters will not collect gaseous emissions. Second, the half-lives of these radionuclides are so short that the activity would decay away before any sample could be analyzed off site. The monitoring system includes a flow-through ionization chamber in series with a gamma spectroscopy system. We record the real-time current measured by this ionization chamber and integrate the total amount of charge collected in the chamber daily. The gamma spectroscopy system analyzes the composition of these gaseous mixed activation products.

Results

Table 4-6 provides detailed emissions data for Laboratory buildings with sampled stacks. Table 4-7 lists the stack emissions of the main activation products. Table 4-8 presents the half-lives of the main radionuclides typically emitted by the Laboratory.

In addition to the stack emissions, 10 curies of carbon-11 and 12 curies of argon-41 were emitted from non-point (diffuse) sources at Technical Area 53 (Fuehne and Lattin 2025).

Table 4-6. Airborne Radioactive Emissions[a] from Buildings with Sampled Stacks in 2024 (all units in curies)

Technical Area and Building Number	Tritium	Americium-241	Plutonium	Uranium	Thorium	Particulate or Vapor Activation Products	Gaseous Mixed Activation Products
TA-03-029		2.3 × 10–6	7.9 × 10–6	4.6 × 10–8	4.8 × 10–8	7.8 × 10–7	
TA-16-205/450	53.6		6.2 × 10–5				
TA-48-001			6.8 × 10–8	7.2 × 10–10	1.7 × 10–8	6.7 × 10–5	
TA-50-001							
TA-50-069		2.5 × 10–9	2.0 × 10–9		1.0 × 10–9		
TA-53-003	1.2					3.5 × 10–7	3.4
TA-53-007	0.9					7.7 × 10–2	39.8
TA-53-0984						5.6 × 10–7	6.5
TA-54-231				3.3 × 10–9			
TA-54-375							
TA-54-412				1.6 × 10–9	1.7 × 10–9		
TA-55-004	34.7		7.8 × 10–8	5.1 × 10–8	8.0 × 10–8		
TA-55-400							
Total	90.5	2.3 × 10–6	7.0 × 10–5	1.0 × 10–7	1.5 × 10–7	7.7 × 10–2	49.7

[a] Values are expressed in scientific notation.

Table 4-7. Main Activation Product Emissions in 2024

Nuclide	Emission (curies)	
	Standard Notation	Scientific Notation
Argon-41	2.4	2.4×10^{0}
Carbon-10	0.074	7.4×10^{-2}
Carbon-11	30	3.0×10^{1}
Nitrogen-13	6.2	6.2×10^{0}
Nitrogen-16	0.15	1.5×10^{-1}
Sodium-24	0.076	7.6×10^{-2}
Oxygen-14	1.3	1.3×10^{0}
Oxygen-15	9.5	9.5×10^{0}

Table 4-8. Radionuclide Half-Lives

Nuclide	Half-Life
Americium-241	433 years
Argon-41	1.8 hours
Carbon-10	19.3 seconds
Carbon-11	20.4 minutes
Nitrogen-13	10.0 minutes
Nitrogen-16	7.1 seconds
Oxygen-14	70.6 seconds

Nuclide	Half-Life
Oxygen-15	122.2 seconds
Plutonium-238	87.7 years
Plutonium-239	24,100 years
Plutonium-240	6,560 years
Plutonium-241	14.3 years
Sodium-24	15.0 hours
Tritium	12.3 years
Uranium-234	245,500 years
Uranium-235	703,800,000 years
Uranium-238	4,468,000,000 years

Conclusions and Trends

Emission-control systems for particulates such as plutonium and uranium continue to work as designed in Laboratory facilities, and particulate emissions remain very low. Emissions of short-lived gases and vapors were similar to last year. The radioactive emissions from all Laboratory sources was approximately 1 percent of the regulatory limit.

Monitoring for Gamma and Neutron Direct Penetrating Radiation

We monitor gamma and neutron radiation levels using the direct penetrating radiation monitoring network (McNaughton 2018) supplemented by the neighborhood environmental watch network. The objectives are to monitor gamma and neutron radiation in the environment as required by DOE Order 458.1.

Dosimeters are devices that measure exposure to ionizing radiation. During 2024, we deployed dosimeters at 73 locations to monitor direct penetrating radiation in the environment. Thermoluminescent dosimeters, which monitor gamma and neutron radiation, are deployed at every environmental air-monitoring station (Figure 4-1 and Figure 4-2). We deployed additional thermoluminescent dosimeters at Technical Areas 53 and 54, where potential Laboratory sources of direct penetrating radiation exist (Figure 4-3 and Figure 4-4). Together, these locations make up the direct penetrating radiation monitoring network. The Radiation Protection Division dosimetry laboratory is accredited by the DOE Laboratory Accreditation Program and provides quality assurance for the dosimeters.

Gamma radiation occurs naturally, typically 100 to 200 millirem per year near Los Alamos, so it is difficult to distinguish the much smaller levels of radiation contributed by site operations. Gamma radiation from operations is identified by higher radiation levels near the source and reduced radiation levels at greater distances.

Neutron doses are measured near known or suspected sources of neutrons, including Technical Areas 53 and 54. At 45 locations, the accuracy of the neutron measurements is enhanced by the addition of acrylic blocks that reflect neutrons into the dosimeter. The neutron background is measured at locations far from Laboratory sources.

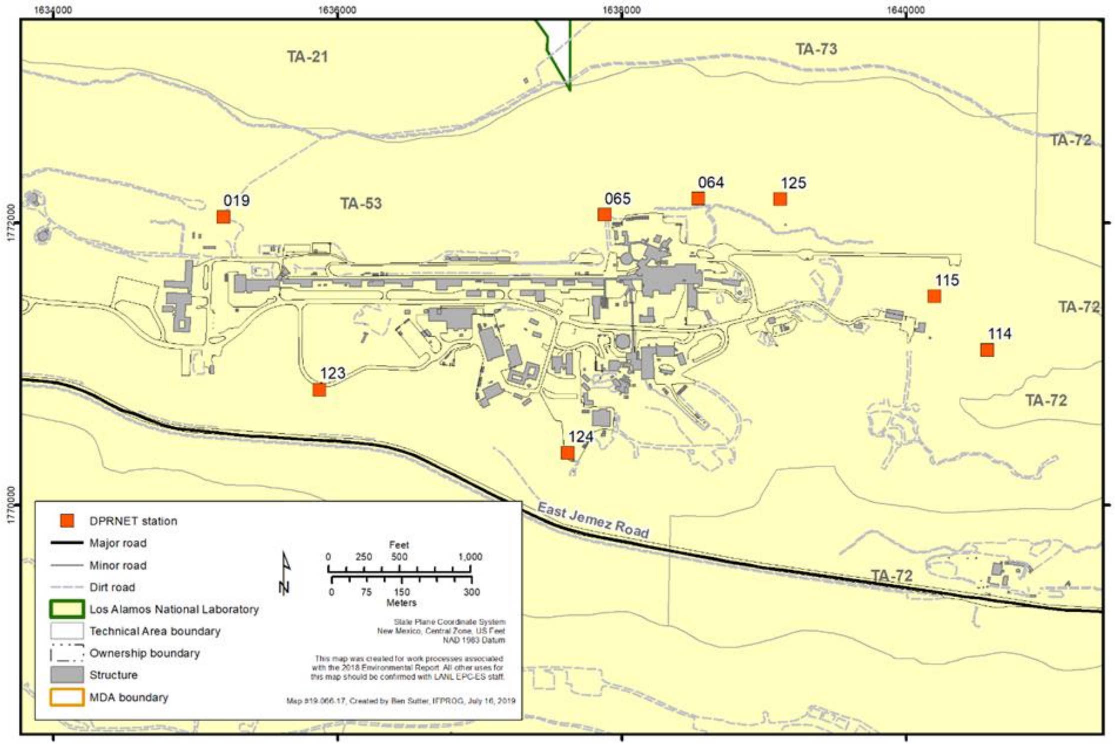

Figure 4-3. Locations of thermoluminescent dosimeters at Technical Area 53 around the Los Alamos Neutron Science Center that are part of the direct penetrating radiation monitoring network (DPRNET).

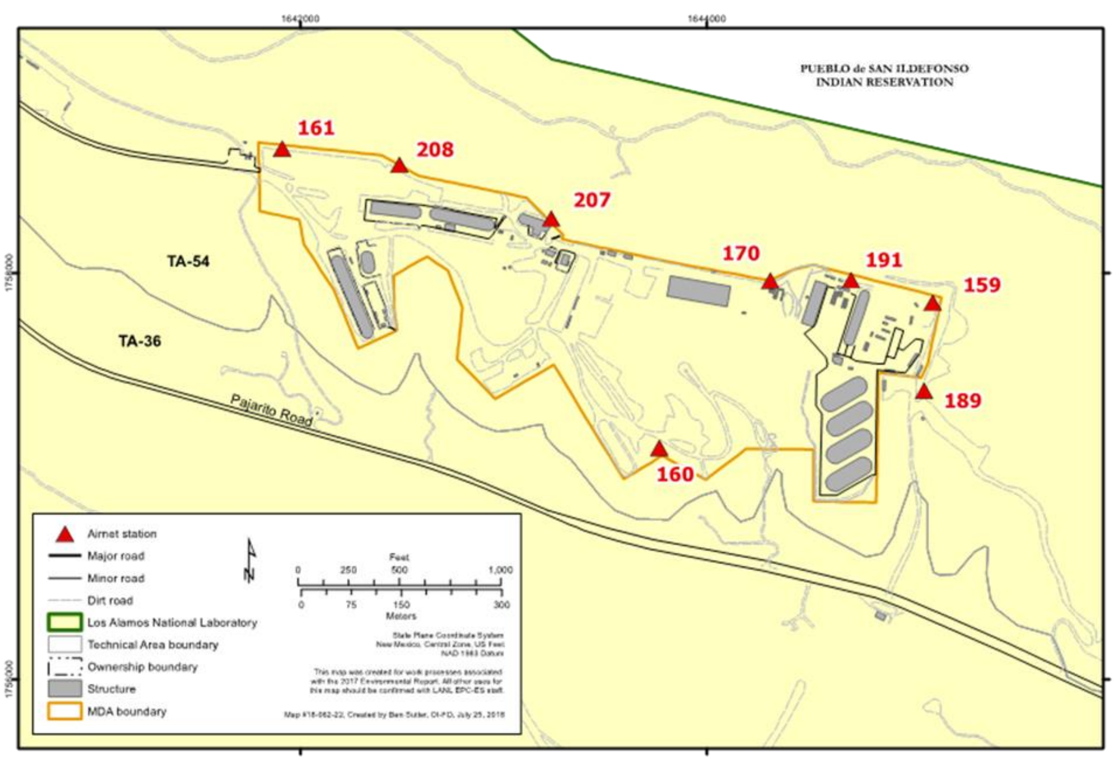

Figure 4-4. Locations of thermoluminescent dosimeters at Technical Area 54, Area G, that are part of the direct penetrating radiation monitoring network (DPRNET).

Results

Table 4-9 summarizes the gamma radiation data for 2024. We compared the results with the values recorded at those stations in previous years. At regional locations, the gamma radiation is natural and, as expected, has not changed. At the perimeter stations, gamma radiation is generally higher than at the regional stations because of increased cosmic radiation at higher altitudes and increased uranium and thorium in the soil. At these stations, the radiation is mostly natural and, as expected, 2024 data are similar to data from previous years. At the Los Alamos Neutron Science Center accelerator facility, the accelerator generates measurable gamma radiation, which varies from year to year.

The average gamma radiation near the fence of the Area G waste site is approximately 150 millirem per year, which is slightly higher than the 125 millirem per year average on the Pajarito Plateau. The extra 25 millirem per year at the fence is mostly from 60-kiloelectronvolt gamma rays, which are almost entirely absorbed within 200 meters by ambient air and are not detectable in either Pajarito Canyon to the south or Cañada del Buey to the north.

Table 4-9. Gamma Radiation for 2024—Group Summaries

Station Grouping	No. of Stations	Group Mean ± 1 Standard Deviation (millirem per year)	
		Previous	2024
Regional	3	110 ± 2	109 ± 9
Perimeter	34	129 ± 11	126 ± 11
Onsite	2	134 ± 15	133 ± 10
Los Alamos Neutron Science Center	5	137 ± 16	135 ± 14
Area G Waste Site	29	149 ± 25	152 ± 48

Table 4-10 summarizes the neutron radiation data. At regional stations, the background radiation measured by these dosimeters is 1 to 2 millirem per year. This estimate is not an accurate measurement of the cosmic-ray neutrons because the dosimeters are designed for the lower-energy neutrons produced by site operations.

After subtracting background, the neutron dose rates at the perimeter and onsite stations were less than 4 millirem per year, similar to previous years. The neutron radiation from the Area G waste site is about 3 millirem per year in Pajarito Canyon to the south and in Cañada del Buey to the north. Details are discussed in Technical Area 54, Area G later in this chapter.

Table 4-10. Neutron Radiation for 2024—Group Summaries

Station Grouping	No. of Stations	Group Mean ± 1 Standard Deviation (millirem per year)	
		Previous	2024
Regional	1	2 ± 1	1 ± 1
Perimeter	10	3 ± 1	4 ± 1
Onsite	1	3 ± 1	2 ± 1
Los Alamos Neutron Science Center	5	5 ± 1	4 ± 1
Area G Waste Site	29	37 ± 29	32 ± 36

In the following sections, we discuss locations with measurable contributions of gamma or neutron radiation from site operations.

Los Alamos Neutron Science Center at Technical Area 53

Figure 4-3 shows the locations of dosimeters at Technical Area 53. Previous studies (McNaughton 2013) discuss the possibility that a member of the public on East Jemez Road south of Technical Area 53 could be exposed to gamma and neutron radiation from the Los Alamos Neutron Science Center. In the following paragraphs, we estimate the maximum gamma and neutron doses that would be received by a hypothetical person who remained on East Jemez Road continuously for 1 year.

During 2024, Dosimeter #115 in Technical Area 53 measured a gamma dose of 150 millirem per year, which is 25 millirem per year above the background of 125 millirem per year. The gamma dose at East Jemez Road is 0.2 percent of the dose measured by Dosimeter #115 (McNaughton 2013). Therefore, the gamma dose from Laboratory operations at East Jemez Road was 0.05 millirem per year near this location.

Dosimeter #124 at Technical Area 53 measured a neutron dose 3 millirem per year above background. The neutron dose at East Jemez Road is 10 percent of this value (McNaughton 2013). Therefore, the neutron dose from Laboratory operations at East Jemez Road was 0.3 millirem per year near this location.

These doses are for continuous occupancy; however, no residences, work locations, or parking areas exist near this location. Adjustments for occupancy are discussed in Chapter 8.

Technical Area 54, Area G

Figure 4-4 shows the locations of the dosimeters at Technical Area 54, Area G. Area G is a controlled-access area, so Area G data do not represent a potential public dose.

Dosimeters #642 through #645 are in Cañada del Buey. After subtracting background, the 2024 annual neutron dose measured by Dosimeter #645 was 3 millirem—the dose that would be received by a person who is at the location of the dosimeter 24 hours per day, 365 days per year. As discussed in Chapter 8, an occupancy factor of 1/20 is applied (National Council on Radiation Protection 2005). Therefore, the dose in Cañada del Buey at the dosimeter is calculated to be 3 millirem multiplied by 1/20, equaling approximately 0.15 millirem per year, which is similar to previous years.

Neighborhood Environmental Watch Network

During 2024, the neighborhood environmental watch network detected gamma-ray emissions that amounted to less than 0.1 millirem. This amount supports the measurements of the ambient air sampling and exhaust stack sampling discussed in this chapter. It also supports the conclusion in Chapter 8 that the radiological dose to the public in 2024 was far below the annual limit of 10 millirem.

Conclusion

Generally, the data are similar to previous years, and emissions of direct penetrating radiation from the LANL site were far below the DOE limits.

Total Particulate Matter Air Quality Monitoring

Particulate matter consists of smoke, dust, and other material that can be inhaled.

The total amount of respirable particulate matter in ambient air is monitored at two locations: near the intersection of New Mexico State Road 4 and Rover Boulevard in White Rock and at the Los Alamos Medical Center in Los Alamos. Data are available at https://airquality.lanl.gov/.

During 2024, the particulate matter concentrations in ambient air remained well below the U.S. Environmental Protection Agency standard of 35 micrograms per cubic meter for particulate matter smaller than 2.5 micrometers. Typical concentrations (greater than 95 percent of the time) were less than 10 micrograms per cubic meter. The highest concentrations occurred during the spring from windblown dust and during the spring and summer from wildfires.

Meteorological Monitoring

We collect weather data to support many activities, including emergency management and response, regulatory compliance, safety analysis, engineering studies, and environmental surveillance programs. The meteorological monitoring program measures wind speed and direction, temperature, atmospheric pressure, relative humidity, dew point, precipitation, and solar and terrestrial radiation, among other atmospheric variables. The meteorological monitoring plan (Dewart and Boggs 2014) provides details of the meteorological monitoring program. Site weather data are available at https://weather.lanl.gov.

Monitoring Network

Eight meteorological towers gather weather data at the LANL site (Figure 4-5). These towers include three new meteorological towers added to the network in 2021 (Towers 16B, 54B, and 63). Seven of the towers are sited on mesa tops (Technical Areas 06, 16, 49, 53, 63, and two towers at Technical Area 54), and one tower is sited at the bottom of Mortandad Canyon (Technical Area 05). An additional precipitation gauge is deployed in the North Community neighborhood of the Los Alamos townsite. The Technical Area 06 tower is the official meteorological measurement station for the Laboratory. For more than 50 years, we have provided daily weather statistics to the National Weather Service.

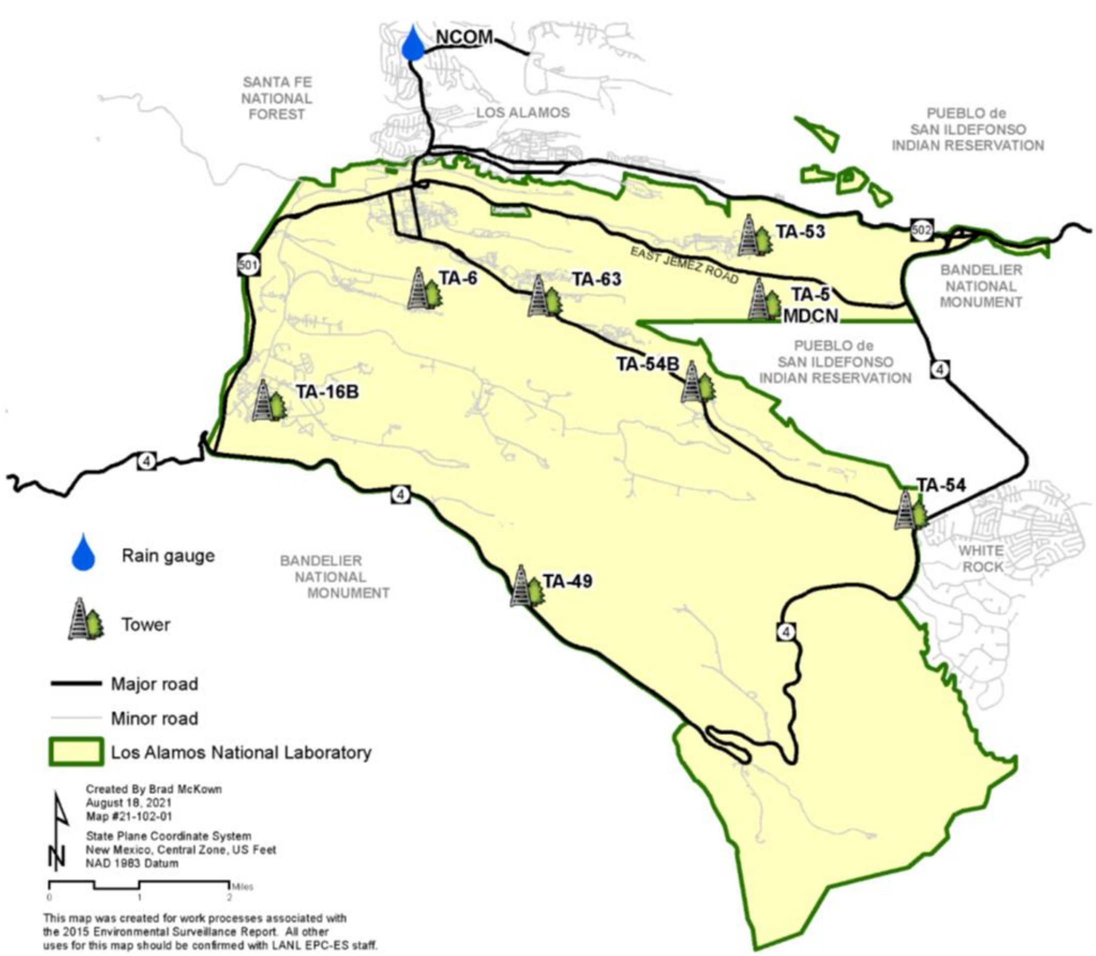

Figure 4-5. Locations of eight site meteorological monitoring towers and an offsite rain gauge.

Sampling Procedures and Data Management

Weather-sensing instruments are located in areas without any obstacles—usually in open fields—to avoid impacts on wind and precipitation measurements. Technical Areas 06, 49, 53, and 54 have open-lattice towers that measure temperature and wind at multiple heights. The multiple levels provide a vertical profile for assessing wind speed and direction at different heights above ground and for determining atmospheric stability conditions. The multiple levels also provide redundant measurements for data quality checks. Boom-mounted temperature sensors on the towers are shielded from solar radiation and aspirated (provided with constant air circulation) to minimize effects from direct sunlight.

Towers 16B, 54B, 63, and Mortandad Canyon are 10-meter tripod towers that measure wind speed, direction, and temperature at the top of the tower. Temperature is measured near ground level (approximately 5 feet high) at all stations except North Community, and humidity is measured at the same level only at the taller towers at Technical Areas 06, 49, 53, and 54. The North Community station measures only precipitation.

Data loggers at the stations collect most measurements every 3 seconds, average the results over 15-minute periods, and transmit the averaged data by network connection or cell phone to a computer workstation. The workstation program automatically edits measurements that fall outside of realistic ranges.

Meteorological Conditions

Los Alamos is temperate and semiarid. The humidity is generally low, and clear skies are present about 75 percent of the time. These conditions lead to high solar heating during the day and strong longwave radiative cooling at night. Winters are generally mild, with occasional winter storms. Spring is the windiest season. Summer is the rainy season, due to the Southwest monsoon, with frequent afternoon thunderstorms. Fall is typically dry and cool, with light wind speeds. Weather statistics are based on analyses of historical meteorological databases (for example, Bruggeman and Waight 2021).

December and January are the coldest months, when 90 percent of minimum temperatures are between 4°F and 31°F. Ninety percent of maximum temperatures, which are usually reached in mid-afternoon, are between 25°F and 55°F. Wintertime arctic air masses that descend into the central United States usually moderate before they reach the southern latitude of Los Alamos and are sometimes blocked by the Sangre de Cristo Mountains, so subzero temperatures are not common. Winds during the winter are relatively light, so extreme wind chills are not common.

June through August are the warmest months, when 90 percent of maximum temperatures are between 67°F and 89°F. During the summer months, 90 percent of minimum temperatures are between 45°F and 61°F.

Average annual precipitation is calculated using 30 years of data measured at the official Laboratory weather station at Technical Area 06. This nationally standardized period is updated every decade. (The averaged results are called the climate normals or climatological normals.) The averaged years for 2024 climatological normals are 1991 through 2020.

The average annual precipitation, which includes rain and the water equivalent from frozen precipitation, is 17.36 inches. The average annual snowfall is 43.4 inches. The greatest winter precipitation events in Los Alamos are caused by storms that approach from the west to southwest. Snowfall amounts are occasionally enhanced from orographic lifting as the storms travel up the high terrain.

Table 4-11 presents temperature and precipitation records for Los Alamos from 1924 through 2024.

Table 4-11. Records Set between 1924 and 2024 for Los Alamos

Measurement	Record	Date or Period
Low temperature	–18°F	January 13, 1963
High temperature	97.5°F	July 11, 2020
Single-day rainfall	3.52 inches	September 13, 2013
Single-day snowfall	39 inches	January 15, 1987
Single-season snowfall	153 inches	1986–1987

Note: °F = degrees Fahrenheit.

The rainy season—when the Southwest monsoon is present—typically begins in early July and ends in mid-September. Afternoon thunderstorms form as moist air from the Gulf of California and the Gulf of America is convectively or orographically lifted by the Jemez Mountains. The thunderstorms yield short, heavy downpours and abundant lightning.

The complex topography of Los Alamos influences local wind patterns. Often a distinct daily cycle of winds occurs. As air close to the ground is heated during the day, it becomes less dense and flows uphill. During the night, as air close to the ground cools, it becomes denser and flows downhill. The daytime breeze that flows up the Rio Grande Valley adds a southerly component to the prevailing westerly winds of the Pajarito Plateau. Nighttime airflow enhances the local westerly winds. Flow in the canyons of the Pajarito Plateau is generally aligned with the canyons; therefore, canyon winds usually flow from the west at night and from the east during the day. Winds on the Pajarito Plateau are usually faster during the day—a result of vertical mixing driven by solar heating.

2024 in Perspective

Figure 4-6 presents a graphical summary of Los Alamos temperatures for 2024, comparing the daily high and low temperatures at Technical Area 06 with the 1991 through 2020 climatological normal values and the record values from 1924 to the present. Table 4-12 presents the overall average temperature in 2024, which was 2.4°F above the 1991 through 2020 average. The total precipitation was 17.72 inches, which was 0.37 inches above the 1991 through 2020 average. Snowfall was 9.5 inches above the 1991 through 2020 average because of unusually heavy snowfall in March and November. The hottest temperature was 92°F on June 6, and the coldest temperature was 3°F on January 9. Monthly average temperatures in 2024 were above the 1991 through 2020 averages for 10 of the 12 months. The average wind speed was 0.1 mph above the 1991 through 2020 average. In 2024, the strongest officially recorded wind gusts at Technical Area 06 occurred on April 16 at 58 miles per hour.

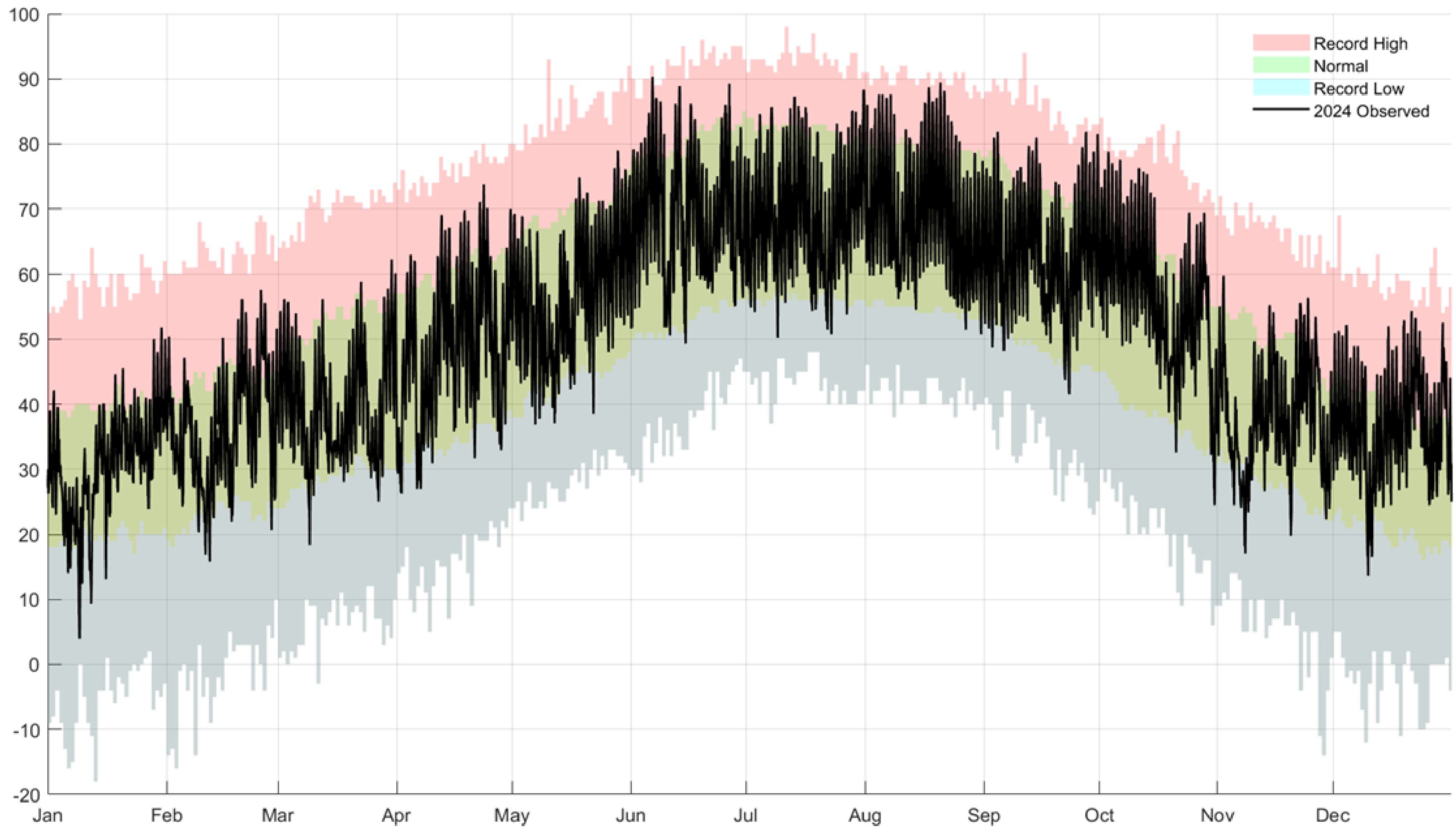

Figure 4-6. Los Alamos daily high and low temperatures in 2024 in degrees Fahrenheit (black line) compared with record (red = record highs; blue = record lows) and normal (green).

Table 4-12. Monthly and Annual Climatological Data for 2024 at Los Alamos

Month	Temperatures (degrees Fahrenheit)[a]								Precipitation (inches)[a]				12-meter[b] Wind (miles per hour)[a]				
	Averages				Extremes						Snowfall				Peak Gusts		
	Daily Maximum	Daily Minimum	Overall	Departure[c]	Highest	Date	Lowest	Date	Total	Departure[c]	Total	Departure[c]	Average Speed	Departure[d]	Speed	From	Date
January	38.8	22.4	30.6	0.9	53	30	3	9	0.41	−0.47	7.3	−2.3	5.4	0.4	52	WNW	14
February	46.2	26.8	36.5	3.0	60	25	15	12	0.78	0.02	5.1	−3.2	6.5	0.5	54	WNW	3
March	50.5	30.1	40.3	−0.5	63	30	17	9	1.75	0.76	17.9	12.4	6.7	0.1	43	SSW	31
April	62.5	36.4	49.5	2.0	77	23	25	2	0.46	−0.47	4.8	1.6	8.1	0.2	58	WNW	16
May	68.9	44.9	56.9	0.4	81	28	36	7	1.66	0.50	0	−0.2	8.3	0.7	49	SW	5
June	82.2	56.6	69.4	2.8	92	6	48	15	2.33	1.17	0	0	6.9	−0.5	45	SSE	19
July	82.8	56.7	69.7	0.6	91	31	49	9	3.33	0.48	0	0	5.8	0	38	WNW	21
August	84.3	57.4	70.8	4.1	91	17	49	31	1.80	−1.40	0	0	5.6	0.1	42	W	24
September	76.5	50.8	63.7	2.7	85	4	41	23	1.81	−0.21	0	0	5.8	0	39	SW	21
October	68.6	45.1	56.9	7.0	81	3	23	31	1.65	0.11	0	−1.6	6.5	0.7	50	SSE	18
November	47.2	28.2	37.7	−0.8	61	2	15	8	1.74	0.80	17.8	13.3	5.6	0.1	50	WNW	27
December	48.3	26.1	37.2	7.2	55	21	12	10	0	−0.92	0	−10.5	4.9	0	40	W	30
Year	63.1	40.1	51.6	2.4	92	Jun 6	3	Jan 9	17.72	0.37	52.9	9.5	6.3	0.1	58	WNW	Apr 16

[a] Data from Technical Area 06, the official Los Alamos weather station.
[b] Wind data measured at 12 meters above the ground.
[c] Departure column indicates positive or negative departure from 1991 to 2020 (30-year) climatological average.
[d] Departure column indicates positive or negative departure from 1993 to 2020 (28-year) climatological average.

Figure 4-7 presents the Los Alamos cumulative precipitation for 2024. Los Alamos had fairly well-distributed precipitation through the year and finished with a slightly above-average annual total despite the complete absence of precipitation in December. The U.S. Drought Monitor (https://droughtmonitor.unl.edu) classified Los Alamos County with “Severe Drought” at the beginning of 2024. Then a full year of average precipitation resulted in an improvement of two categories, ending 2024 as “Abnormally Dry,” the mildest drought category.

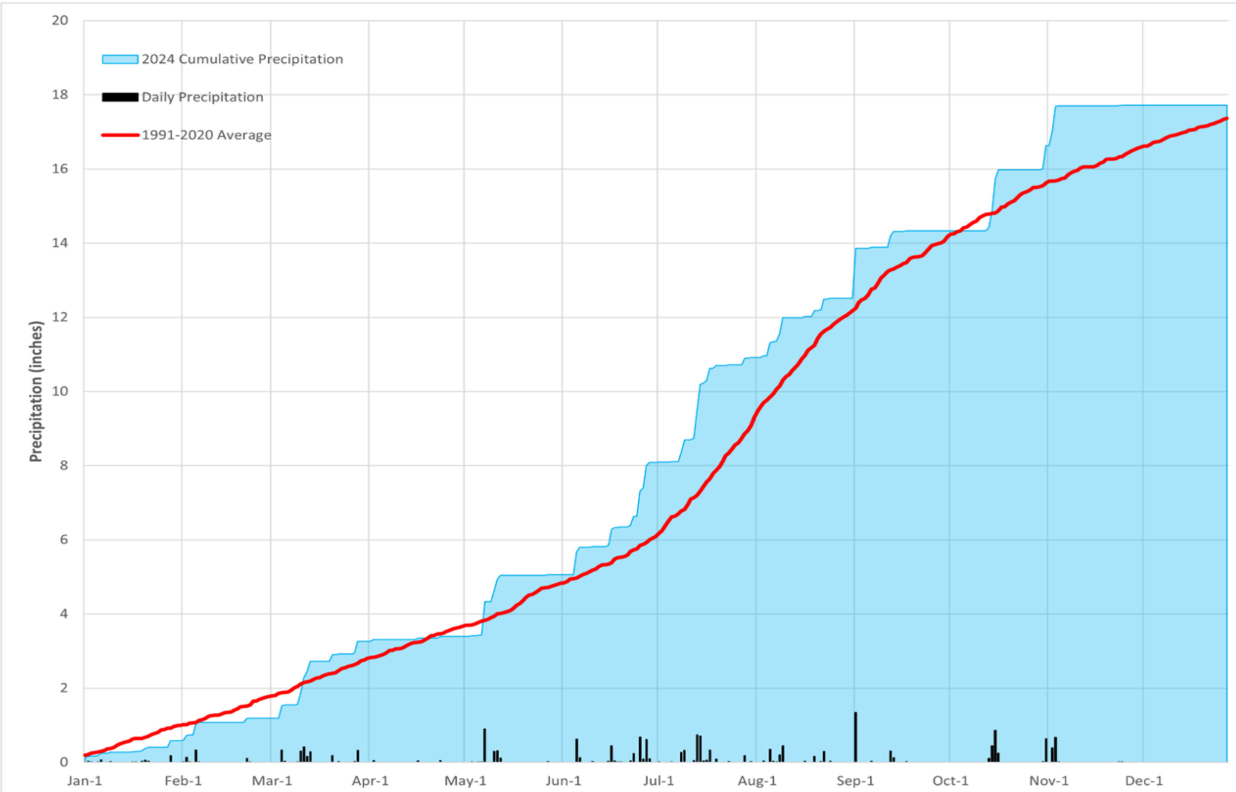

Figure 4-7. Technical Area 06 daily and cumulative precipitation in 2024 versus 30-year average.

At the Laboratory’s weather stations, approximately 50 percent of the annual precipitation falls during the summer monsoon season, which is based on the National Weather Service definition of June 15 to September 30. Typically, more precipitation is measured at locations closer to the Jemez Mountains. The Technical Area 54 tower near White Rock tends to measure the least precipitation because it is farthest from the Jemez Mountains. Although not presented here, more precipitation fell during 2024 at Technical Area 06 and North Community compared with Technical Area 54.

Daytime (sunrise to sunset) winds and nighttime (sunset to sunrise) winds are presented in wind roses in Figure 4-8. The wind roses are based on 15-minute average wind observations for 2024 at four mesa-top stations (Technical Areas 06, 49, 53, and 54). Wind roses depict the percentage of time that wind blows from each of 16 cardinal compass point directions and the distribution of wind speed for each direction. During the day, winds are typically from the south and southwest, whereas at night, winds are usually from the west and northwest. Although not presented in this figure, wind roses from different years are almost identical regarding the distribution of wind directions, indicating that wind patterns are consistent over time.

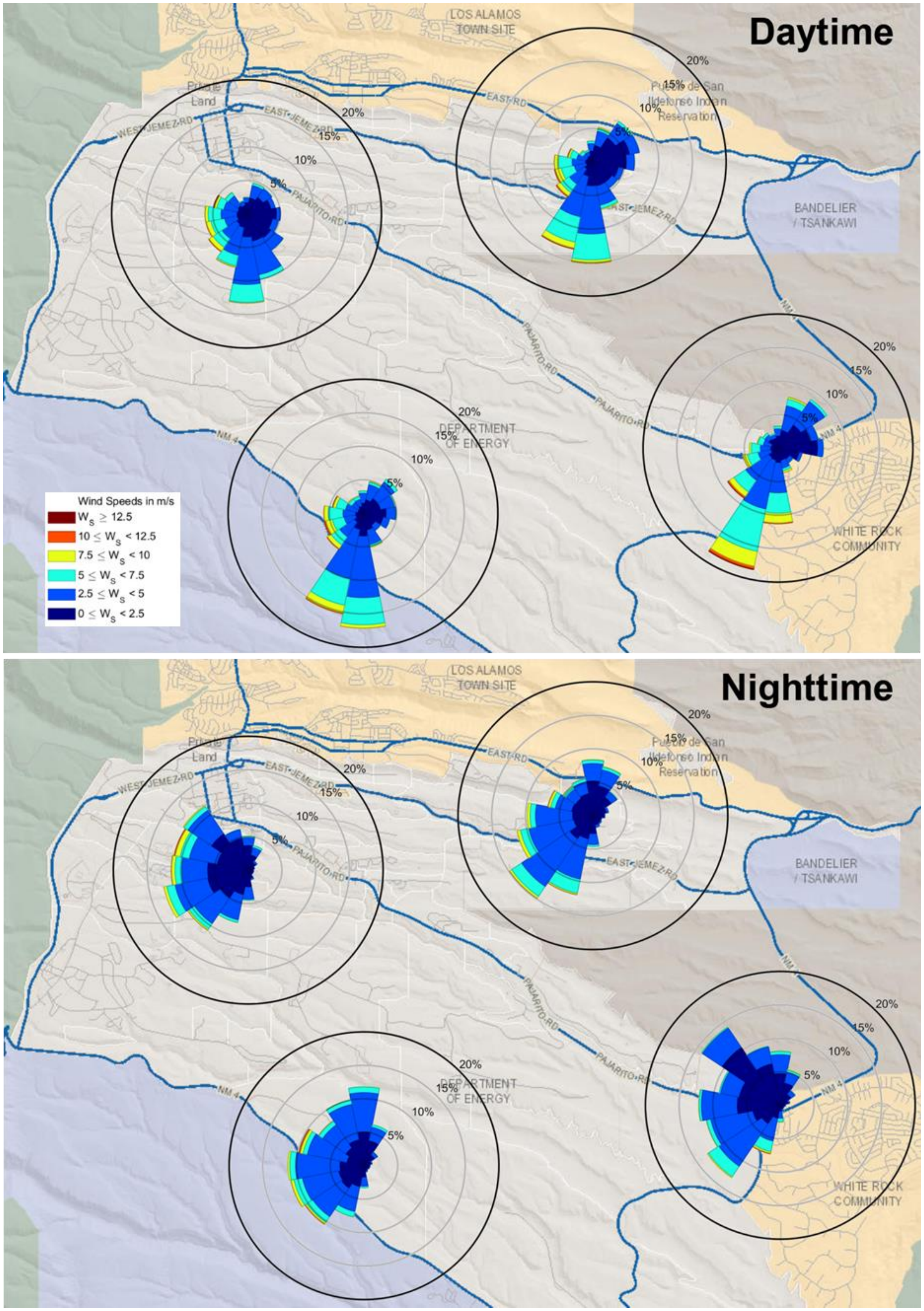

Figure 4-8. Wind roses for 2024 at four mesa-top meteorological towers.

Long-Term Climate Trends

Temperature and precipitation data have been collected in the Los Alamos area since 1910. Figure 4-9 presents the historical record of temperatures at Los Alamos from 1924 through 2024. The annual average temperature is the daily midpoint between the high and low temperatures, averaged for the year. The green lines in Figure 4-9 indicate 1-year averages, and a 5-year running average—presenting longer-term trends—is depicted in black. The warm spell during the past 15 years is more extreme than the warm spell during the early-to-mid 1950s and is longer lived. Although not presented in the figure, five of the hottest summers on record have occurred since 2002, and the highest summertime (June, July, and August) average temperature on record was 71.1°F, recorded during 2011.

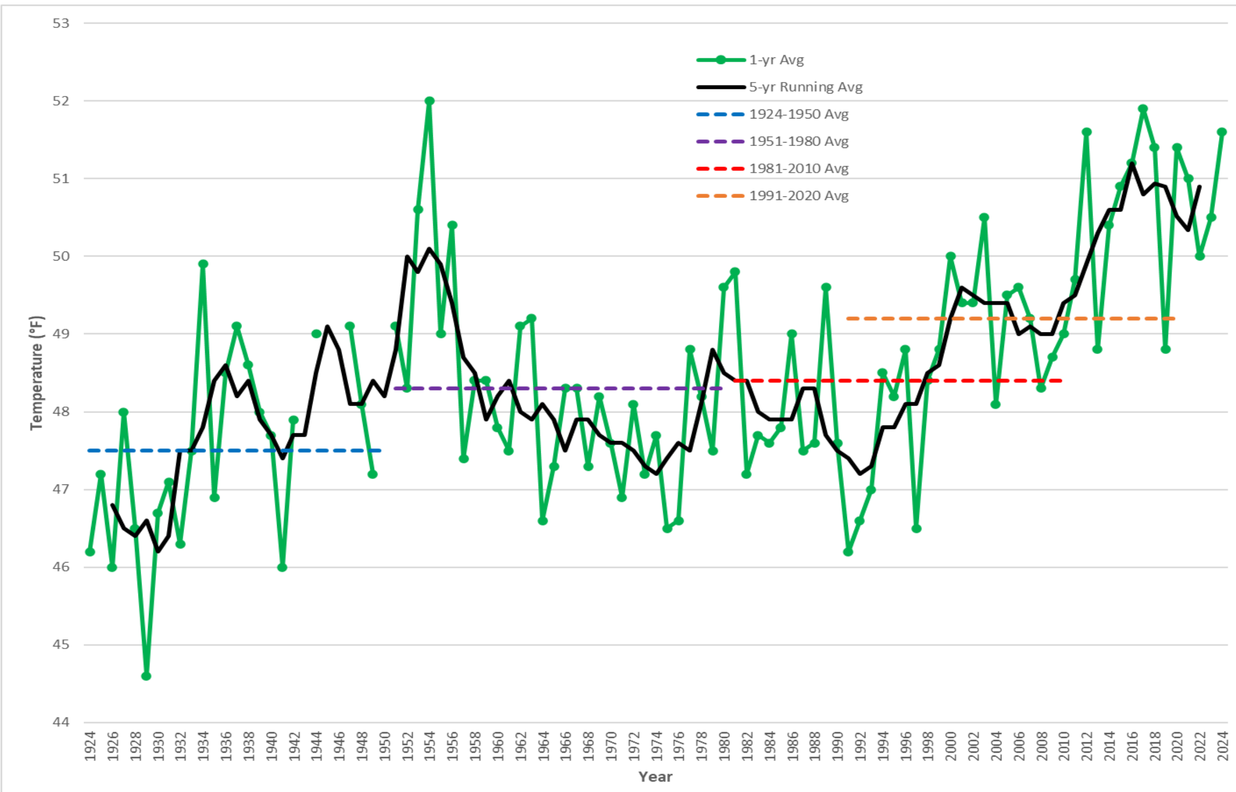

Figure 4-9. Temperature history for Los Alamos; 1-year average shown in green and 5-year running average shown in black. Dashed lines represent long-term averages (25 and 30 years).

The average temperatures per decade, recorded at Technical Area 06, along with two times the standard deviation, are plotted in Figure 4-10, with each annual average temperature from 2020 to 2024. During each decade, 95 percent of the annual average temperatures are within the standard deviation bars. During the decades between 1960 and 2000, the annual average temperatures in Los Alamos varied only slightly from 48°F; however, during the 2001–2010 decade, the annual average temperature increased to above 49°F; this value is statistically significantly higher than previous decades. During the recent 2011–2020 decade, the average temperature increased even more than the previous decade, with annual average temperatures above 50°F. The annual average temperatures during 2021–2024 continue to demonstrate a warming trend for Los Alamos.

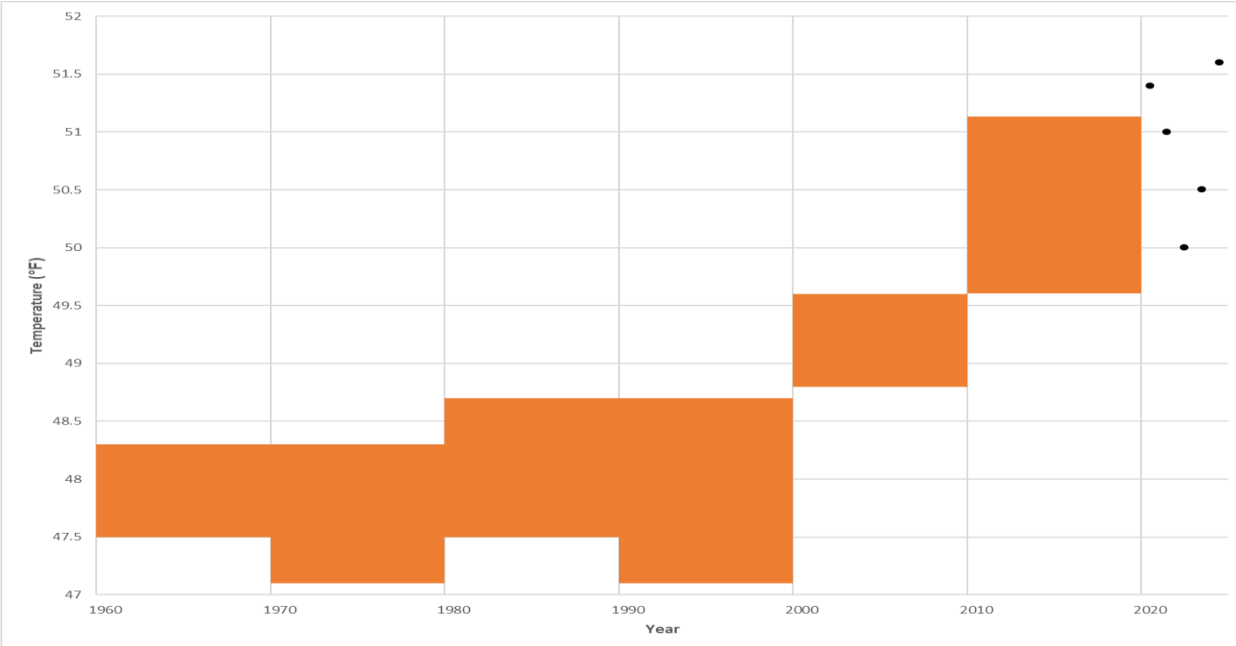

Figure 4-10. Technical Area 06 decadal average temperatures with two times the standard deviation for 1960–2020, and the recent annual average temperatures (black points).

Figure 4-11 presents the historical record of the annual precipitation at Technical Area 06. As with historic temperature profiles, the 5-year running averages and long-term averages (25- or 30-year periods) are both plotted. The 1998–2024 period includes the most recent drought, although near-average precipitation from 2004 to 2010 and a few above-average precipitation years did occur during this period.

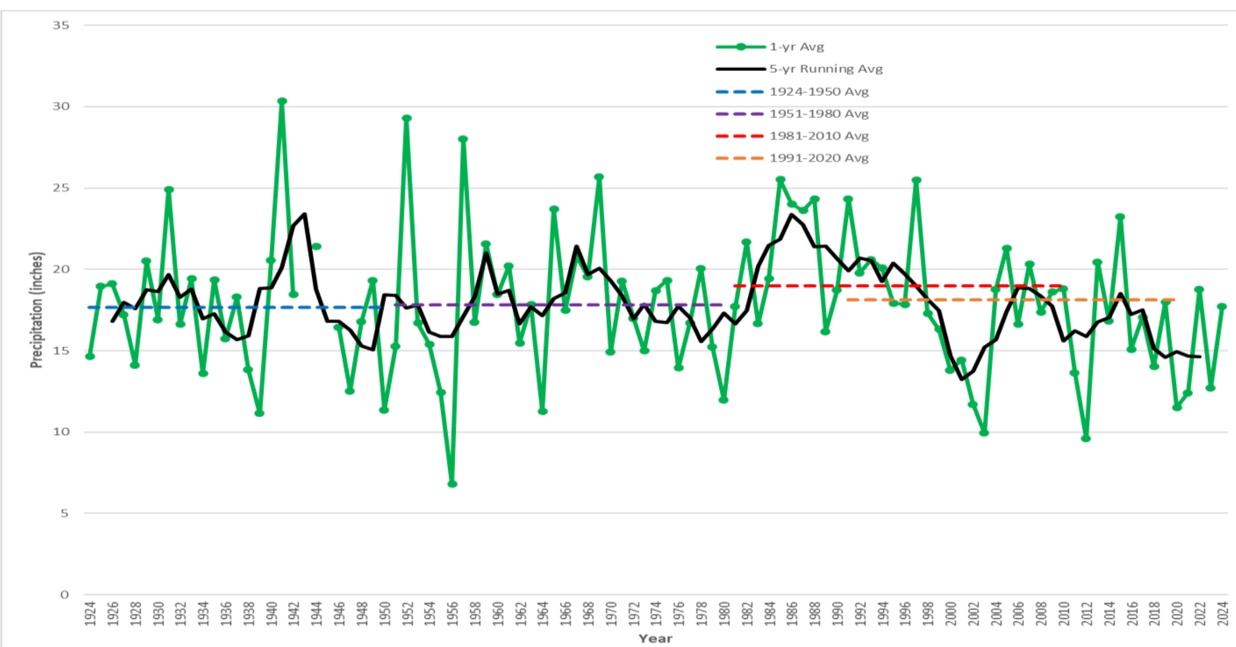

Figure 4-11. Precipitation history for Los Alamos; 1-year annual total shown in green and 5-year running average shown in black. Dashed lines represent long-term averages (25 and 30 years).

Quality Assurance

Air Quality Sampling

The quality assurance program satisfies requirements in the U.S. Environmental Protection Agency's National Emission Standards for Hazardous Air Pollutants, Title 40, Part 61, of the Code of Federal Regulations, Appendix B, Method 114. Project plans and implementing procedures specify the requirements and implementation of sample collection, sample management, chemical analysis, and data management following U.S. Environmental Protection Agency methods for sample handling, chain of custody, analytical chemistry, and statistical analyses of data. We describe the quality assurance plan for ambient air sampling in EPC-CP-PIP-5140, "Radiological Air Sampling Network," and 23 supporting procedures. We describe the stack-sampling quality assurance plan in EPC-CP-PIP-0101, "Rad-NESHAP Compliance Program," and 38 supporting procedures.

Direct Radiation Monitoring

We describe the quality assurance plan for direct penetrating radiation in EPC-ES-TPP-007, "Direct Penetrating Radiation Monitoring Network," and in EPC-ES-TP-002, "Obtaining the Environmental Dose from the Model 8823 Dosimeter." The Radiation Protection Division dosimetry laboratory, which is accredited by the DOE Laboratory Accreditation Program, provides quality assurance for the Model 8823 dosimeter.

Meteorological Monitoring

Meteorologists conduct data-quality reviews using time-series plots of data. They also use daily statistics, such as daily minimum and maximum temperatures, daily total precipitation, and maximum wind gust, to check for quality and out-of-range values.

We follow meteorological instrument and data-logger manufacturers' recommendations, and operating conditions determine how often to calibrate weather-sensing instruments. We calibrate all wind instruments every 6 months and all other sensors annually, except the solar radiation sensors, which we calibrate once every 5 years.

Periodically, we perform internal self-assessments and external audits of the meteorological program (inclusive of the instruments and methods); annually, a qualified subcontractor inspects the tower and the instruments of all meteorological towers and performs maintenance.

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Chapter 5: Groundwater Protection

Introduction

U.S. Department of Energy (DOE) Order 458.1 Chg 4, Radiation Protection of the Public and the Environment, requires operators of DOE facilities to ensure that radionuclides from DOE activities do not cause private or public drinking water systems to exceed the drinking water maximum contaminant levels prescribed in the National Primary Drinking Water Regulations, Title 40, Part 141, of the Code of Federal Regulations. Operators also must document the baseline conditions of groundwater quantity and quality.

In 2016, DOE and the New Mexico Environment Department signed a new Compliance Order on Consent (Consent Order) for legacy waste cleanup at the Los Alamos National Laboratory (LANL or the Laboratory) site that included requirements for groundwater monitoring and remediation. The Consent Order was modified in 2024 (refer to Chapter 2). Under the Consent Order, we submit an Interim Facility-Wide Groundwater Monitoring Plan to the New Mexico Environment Department for approval each year. The plan contains updates to the monitoring locations, the frequency of monitoring, and the specific constituents monitored. We do additional groundwater monitoring to meet the requirements of LANL's hazardous waste facility permit and groundwater discharge permits (refer to Chapter 2). Currently, DOE's legacy waste cleanup contractor for the site, Newport News Nuclear BWXT-Los Alamos, LLC (N3B), implements the groundwater program (N3B 2023, 2024).

Hydrogeologic Setting

The LANL site is located in Northern New Mexico on the Pajarito Plateau, which extends from the Sierra de los Valles range of the Jemez Mountains eastward to the Rio Grande. The top layer of the Pajarito Plateau consists of a type of rock called Bandelier Tuff (Figure 5-1). This tuff formed from volcanic ash and other materials that were ejected from the Jemez Mountains volcanic field between 1.6 and 1.2 million years ago. The tuff layer is more than 1,000 feet thick on the western side of the plateau, and it thins to about 260 feet thick near the Rio Grande.

On the western edge of the Pajarito Plateau, the Bandelier Tuff overlaps an older type of volcanic rock called the Tschicoma Formation (Figure 5-1). Underneath the tuff in the central and eastern parts of the plateau are layers of loose sedimentary materials (sand, gravel, and silt) called the Puye Formation. These sediments washed down from the Tschicoma Formation. Basalt rock from a volcanic center east of the Rio Grande, called the Cerros del Rio basalt flows, extends into the Puye Formation from the east. These geologic formations all sit on top of the very thick sediments of the Santa Fe Group, which extends across the Rio Grande Valley.

Hydrogeologic Terms

Saturated rock and **sediment** are completely wet.

Unsaturated rock and **sediment** have some air in their pore spaces.

Perched groundwater is a zone of saturation of limited thickness that occurs above the regional aquifer.

Alluvial groundwater is a zone of saturation that exists in sands and gravels in the bottoms of canyons.

An **aquifer** is an underground layer of rock or sediment that contains enough accessible water to be of interest to humans.

The **Santa Fe Group** is a geologic formation of sedimentary and volcanic rocks.

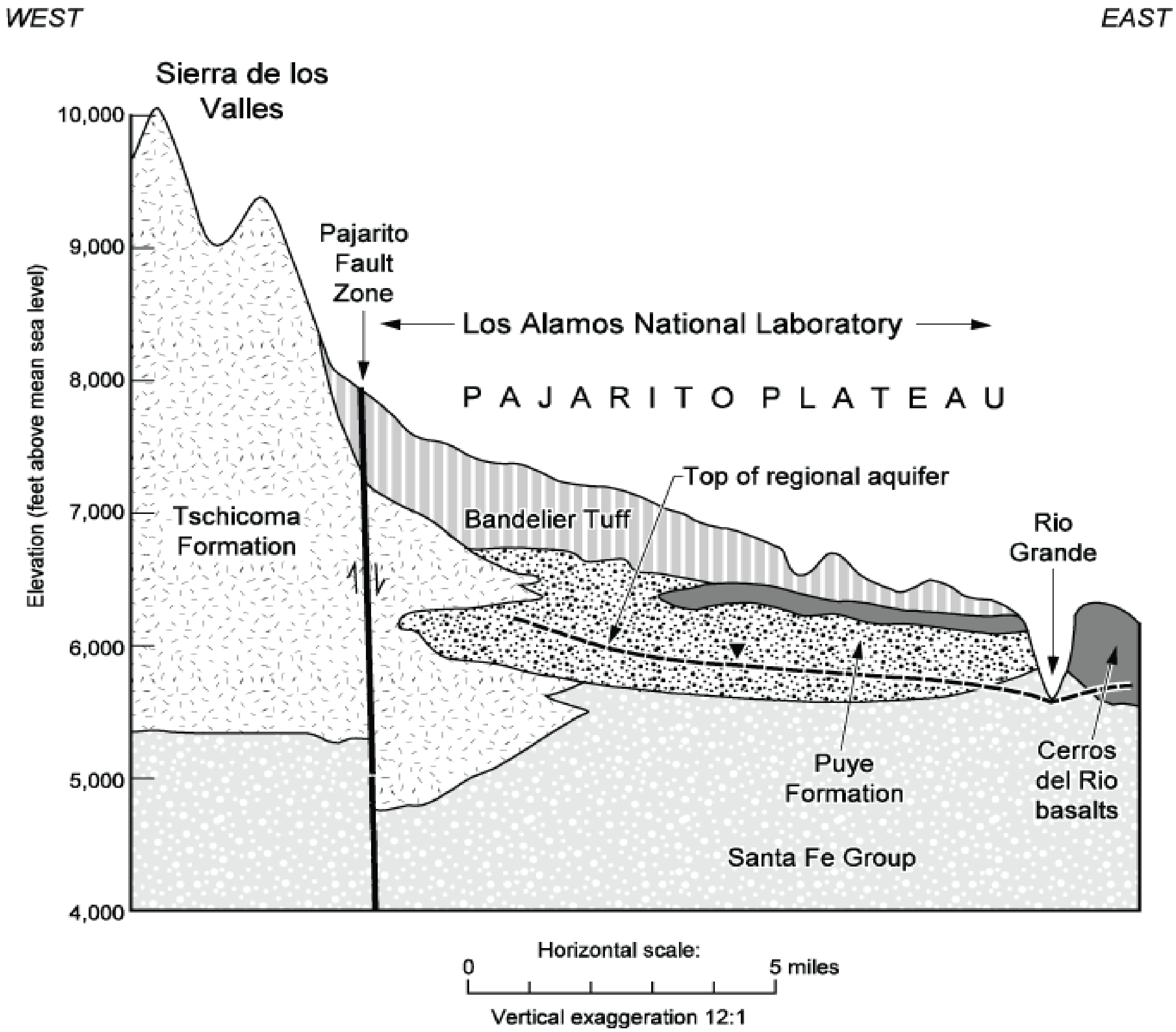

Figure 5-1. This drawing is a generalization of the geologic formations of the Pajarito Plateau, which extends from the Sierra de los Valles range of the Jemez Mountains eastward to the Rio Grande.

The LANL site is located on top of thick layers of rock and sediment that contain limited to no water. Groundwater beneath the Pajarito Plateau is found in three different zones (Figure 5-2):

- **Alluvial groundwater** is found in the sand and gravel at the bottom of some canyons. Surface water flows through this alluvium until it meets less-permeable rock layers, creating shallow pools of groundwater. Most canyons on the plateau have little surface water flow, so they have little to no alluvial groundwater. A few canyons on the western end have saturated alluvium supported by runoff from the Jemez Mountains. Discharges from the Laboratory also supplement surface water in some areas. As the alluvial groundwater flows down a canyon, it gets used by plants or seeps into the underlying rock and sediment.
- **Perched intermediate groundwater** is found within unsaturated geological layers, typically in the lower Bandelier Tuff, the Puye Formation, and the Cerros del Rio basalt

layer. This groundwater is "perched" because it is trapped by less-permeable rock layers, forming isolated pockets at intermediate depths. The depth to perched intermediate groundwater varies from about 120 feet under Pueblo Canyon to 500–750 feet under Mortandad Canyon.

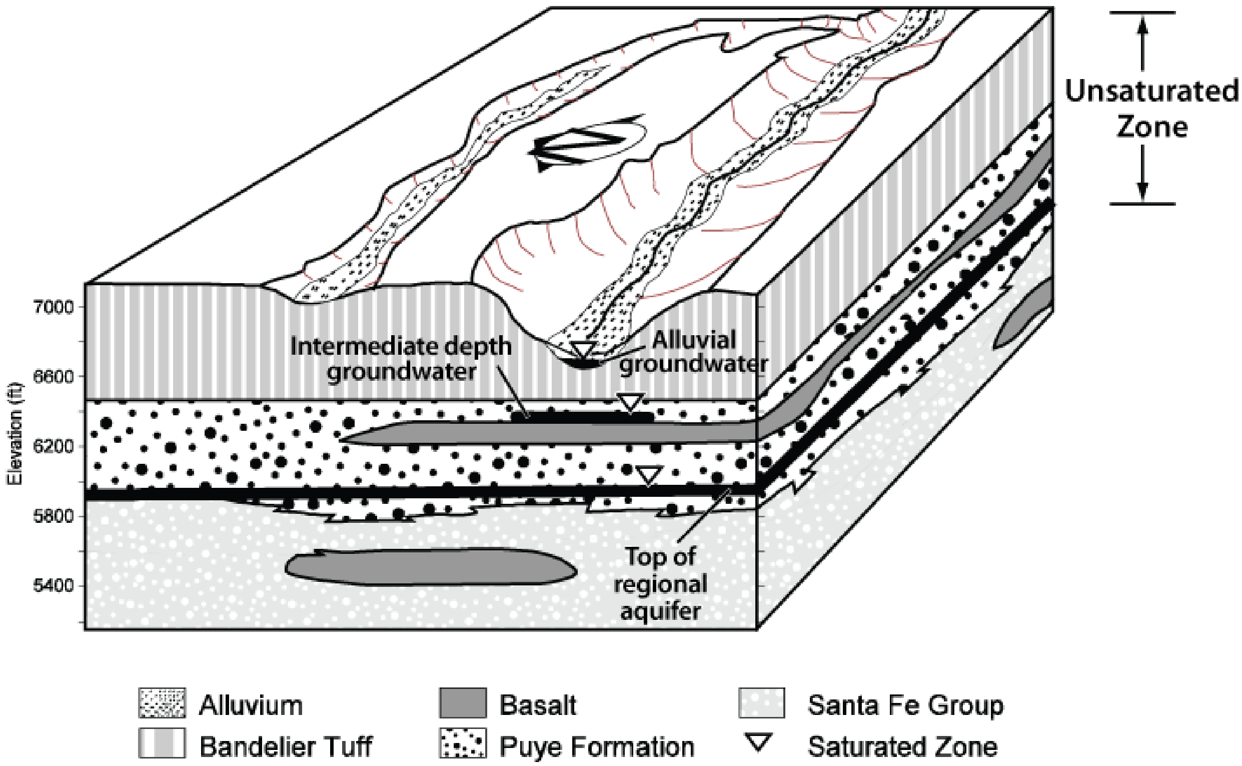

Figure 5-2. The LANL site sits atop a thick zone of mainly unsaturated rock and sediment. Groundwater beneath the Pajarito Plateau occurs in three modes: perched alluvial groundwater in the bottoms of some canyons, small areas of intermediate-depth perched groundwater, and groundwater within the regional aquifer.

- **The regional aquifer** is the main, continuous groundwater system that underlies the plateau. The water table (top of the aquifer) is about 1,200 feet deep on the western edge and 600 feet deep on the eastern edge (Figure 5-3). Studies show that the main source of recharge for the regional aquifer is water that flows from the Sierra de los Valles range of the Jemez Mountains (LANL 2005a). Groundwater in the aquifer generally flows eastward at a rate of about 30 feet per year. The regional aquifer is separated from the shallower alluvial and perched groundwater by thick layers of unsaturated rock and sediment. The shallower groundwater zones are important parts of the hydrologic pathway to the regional aquifer but do not contribute much water for aquifer recharge.

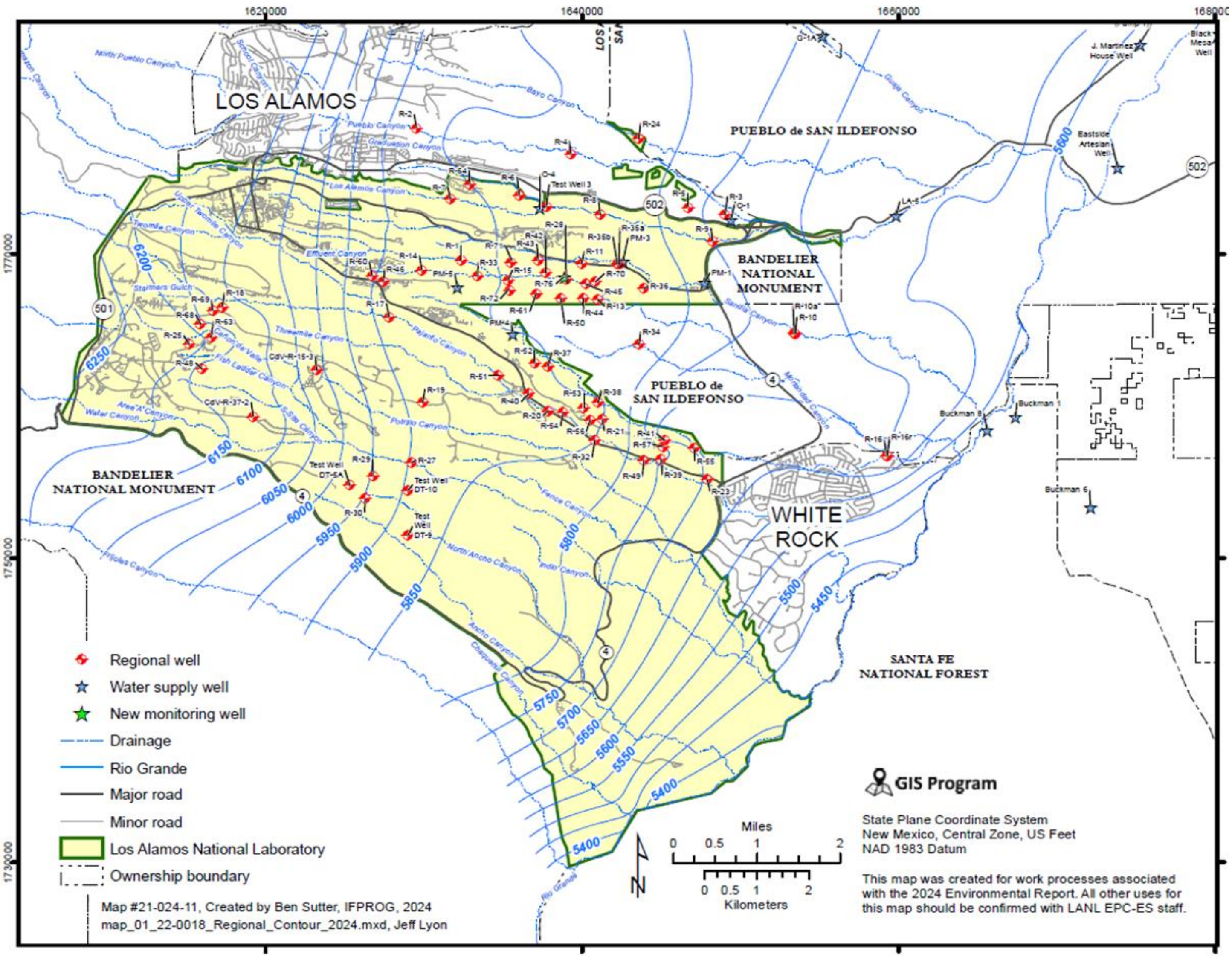

Figure 5-3. This contour map shows the elevation contours of the upper edge surface of the regional aquifer (called the water table) underneath the Laboratory and the regional aquifer wells. Groundwater near the water table generally flows east, with local northeast and southeast flows.

Potential Sources of Contamination

Historical discharges from site operations have potentially affected all three groundwater zones. Figure 5-4 presents locations of historical effluent discharges. Many of the outfalls are currently inactive. Rogers (2001) and Emelity (1996) summarize effluent discharge history at the site.

Drainages that received effluents from site operations in the past include Mortandad Canyon; Pueblo Canyon from its tributary, Acid Canyon; and Los Alamos Canyon from its tributary, DP Canyon. Water Canyon and its tributary, Cañon de Valle, received effluents produced by high-explosives processing and experimentation. Sandia Canyon received discharges of power plant cooling water, other cooling water, and water from the Sanitary Wastewater Systems Plant. Over the years, Los Alamos County has operated several sanitary wastewater treatment plants and currently operates one in Pueblo Canyon.

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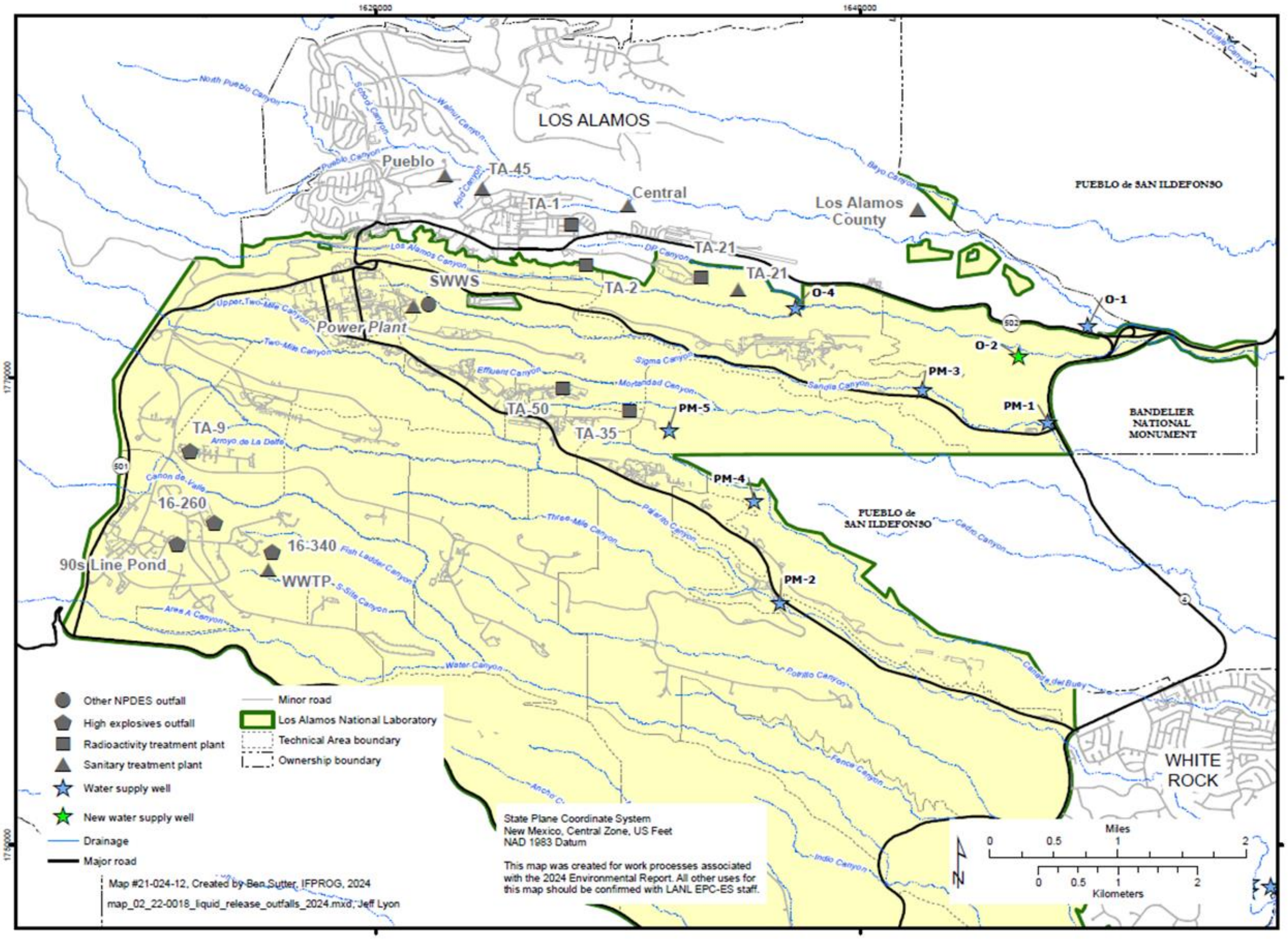

Figure 5-4. This map shows major liquid release outfalls that potentially affected all three groundwater zones. Most of the outfalls shown are currently inactive except for the sanitary wastewater treatment plant in Pueblo Canyon.

Groundwater Standards and Screening Levels

The groundwater standards and screening levels are set by three regulatory agencies: DOE, the U.S. Environmental Protection Agency, and the New Mexico Water Quality Control Commission. Section 9 of the Consent Order describes the role of data screening; exceedance of a screening level indicates a need for further evaluation of risk. We use the standards and screening levels listed in Table 5-1 to evaluate our groundwater monitoring results.

Table 5-1. Application of Standards and Screening Levels to Groundwater Monitoring Data

Constituent Type	Screening Levels	Notes
Water Supply Wells		
Radionuclides	• New Mexico groundwater standards[a] • DOE derived concentration technical standards[b] • U.S. Environmental Protection Agency maximum contaminant levels[c]	This sampling is conducted in addition to the regulatory compliance sampling conducted by the water supply system operator.
Nonradionuclides	• New Mexico groundwater standards • U.S. Environmental Protection Agency maximum contaminant levels	This sampling is conducted in addition to the regulatory compliance sampling conducted by the water supply system operator.
Non-Water-Supply Groundwater Samples		
Radionuclides	• New Mexico groundwater standards • DOE derived concentration technical standards • U.S. Environmental Protection Agency maximum contaminant levels	New Mexico groundwater standards apply to all groundwater. The concentration technical standards (derived from DOE's 4-millirem-per-year drinking water dose limit) and U.S. Environmental Protection Agency's maximum contaminant levels are drinking water standards only and are provided for comparison.
Nonradionuclides	• New Mexico groundwater standards • U.S. Environmental Protection Agency maximum contaminant levels • U.S. Environmental Protection Agency regional screening levels for tap water[d]	A hierarchy of levels apply as screening levels for groundwater under the Consent Order.

[a] New Mexico Water Quality Control Commission groundwater standards from Ground and Surface Water Protection, Title 20, Chapter 6, Part 2 of the New Mexico Administrative Code

[b] DOE-derived concentration technical standards based on the U.S. Environmental Protection Agency's 4-millirem-per-year drinking water dose limit as specified in DOE Order 458.1 Chg 4

[c] U.S. Environmental Protection Agency's maximum contaminant levels from the Code of Federal Regulations Title 40 Parts 141–143

[d] or as specified in the 2016 Compliance Order on Consent revised in 2024.

DOE has authority under the Atomic Energy Act of 1954 to set standards for certain nuclear materials. DOE Order 458.1 Chg 4, Radiation Protection of the Public and the Environment, establishes dose limits for radiation exposure and provides derived concentration technical standards for radionuclide levels in air and water based on those dose limits. For drinking water, DOE calculates derived concentration technical standards based on the U.S. Environmental Protection Agency's 4-millirem-per-year drinking water dose limit. The U.S. Environmental

Protection Agency and the New Mexico Water Quality Control Commission set screening levels and standards for other constituents.

The U.S. Environmental Protection Agency's maximum contaminant levels are the maximum permissible level of a constituent in water delivered to any user of a public water system. The New Mexico Water Quality Control Commission groundwater standards (found in Ground and Surface Water Protection, Title 20, Chapter 6, Part 2 of the New Mexico Administrative Code) apply to all groundwater with a total dissolved solids concentration of 10,000 milligrams per liter or less. The New Mexico standards include numeric criteria for many constituents and a separate list of toxic pollutants.

The Consent Order requires screening and reporting of groundwater data. In general, the required screening levels are the lower of either the New Mexico groundwater quality standard or the federal maximum contaminant level. If neither exists for a given chemical, the New Mexico Environment Department's tap water screening levels—provided in the Risk Assessment Guidance for Site Investigations and Remediation: Volume I, Soil Screening Guidance for Human Health Risk Assessments (Table A-1; New Mexico Environment Department 2022)—are used. If no New Mexico Environment Department tap water screening level is established for a constituent, the U.S. Environmental Protection Agency's regional human health medium-specific screening level for tap water is used, adjusted to a 1×10^{-5} excess risk for carcinogenic contaminants. The U.S. Environmental Protection Agency updates the regional screening levels for tap water periodically; 2023 values were used to prepare this chapter.

The New Mexico Water Quality Control Commission numeric criteria for constituent concentrations apply mostly to filtered water samples; however, the standards for mercury, organic compounds, and nonaqueous-phase liquids apply to unfiltered samples, which represent both the dissolved concentration of the constituent in the water and the concentration associated with suspended sediments in the sample. The U.S. Environmental Protection Agency applies maximum contaminant levels and regional screening levels for tap water to both filtered and unfiltered sample results depending on the constituent.

To better understand and report on radioactivity in groundwater, we compare sample results with screening levels, including DOE's drinking water concentration technical standards (derived from DOE's 4-millirem-per-year dose limit) and the U.S. Environmental Protection Agency's maximum contaminant level drinking water standards. Our only required comparison is with the New Mexico Water Quality Control Commission groundwater standards for combined radium-226 and radium-228.

Beginning in monitoring year 2020, we implemented a site-wide sampling program for the emerging contaminants known as per- and polyfluoroalkyl substances (PFAS). In 2024, PFAS were sampled at all locations. A handful of locations have recorded results above the New Mexico Environment Department groundwater screening levels (refer to section Summary—PFAS Monitoring Results). Starting in 2025, locations with PFAS detections will be sampled annually; locations with no detections will be sampled every other year.

Groundwater Data Interpretation

We report analytical results relative to limits of the method used to analyze the sample (Figure 5-5). The detection limit is the lowest concentration in which the presence of a constituent can be reliably detected even if it cannot be precisely quantified. The practical quantitation limit is the lowest concentration of a constituent that can be accurately measured and is usually about three times the method detection limit. Concentrations between the detection limit and the practical quantitation limit are marked with a "J" qualifier in the analytical report, in the results found on the IntellusNM website, and in this chapter.

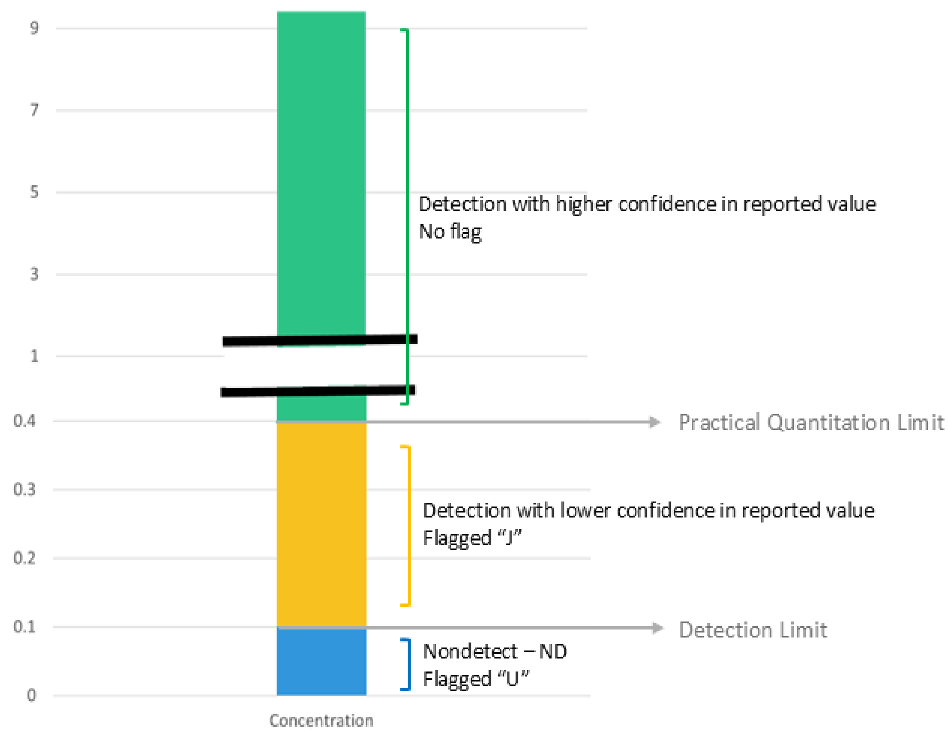

Figure 5-5. This chart shows how analytical results are reported based on the detection limit and the practical quantitation limit of the analytical method. Concentration values are for demonstration purposes only.

A nondetect result means that the analytical laboratory did not detect the constituent in the sample. These results are marked with a "U" qualifier. In the past, we sometimes reported nondetect results as the practical quantitation limit value. Therefore, for older results, the detected but lower confidence results (results between the detection limit and the practical quantitation limit) could have a lower reported value than nondetect results for the same constituent. We report recent groundwater nondetect results as the value of the detection limit.

Neither the detection limit nor the practical quantitation limit apply to radiological measurements. For radiological measurements, the minimum detectable activity is similar to the detection limit. To be considered detected, a radiological measurement must be greater than the minimum detectable activity.

The groundwater monitoring data for 2024 are available from the IntellusNM website at https://www.intellusnm.com.

Groundwater Monitoring Network

We monitor water quality and other characteristics by taking samples from various water sources:

- Wells in alluvial groundwater, perched intermediate groundwater, and the regional aquifer
- Springs that discharge shallow perched intermediate and regional aquifer groundwater
- Streams that maintain perennial base flow

Some wells have multiple water intake points (screens) at different depths.

We collect samples from the following drinking water supply wells (Figure 5-6):

- Los Alamos County water supply wells
- Wells on Pueblo de San Ildefonso lands
- Wells in the Buckman well field operated by the City of Santa Fe

Most of the sampling occurs at monitoring wells and springs. Many wells and springs are assigned to area-specific monitoring groups: Technical Area 54, Technical Area 21, Material Disposal Area AB, Material Disposal Area C, the Chromium Investigation area, or the Technical Area 16-260 outfall (Figure 5-7). Wells and springs that are not included in these monitoring groups are part of the White Rock Canyon monitoring group (Purtymun et al. 1980) or are included in general surveillance monitoring.

We monitor groundwater quality at specific wells for compliance with groundwater discharge permits (refer to Chapter 2, New Mexico Water Quality Act: Groundwater Discharge Regulations). These wells include three alluvial wells, two intermediate wells, and four regional aquifer wells; results are summarized in section Groundwater Discharge Permit Monitoring later in this chapter. We have included monitoring required under LANL's Hazardous Waste Facility Permit in the Interim Facility-Wide Groundwater Monitoring Plan and report those results throughout this chapter.

The following sections present results for Los Alamos County and City of Santa Fe water supply wells, the six area-specific monitoring groups, the White Rock Canyon monitoring group (which includes springs and sampling locations along the Rio Grande), and general surveillance monitoring. We have organized the tables and discussions within each section by groundwater zone, from the deepest (the regional aquifer) to the shallowest (the alluvial groundwater). The accompanying tables and text mainly address constituents with results above screening levels. In a few cases, other constituent results that are below screening levels, such as tritium, are discussed.

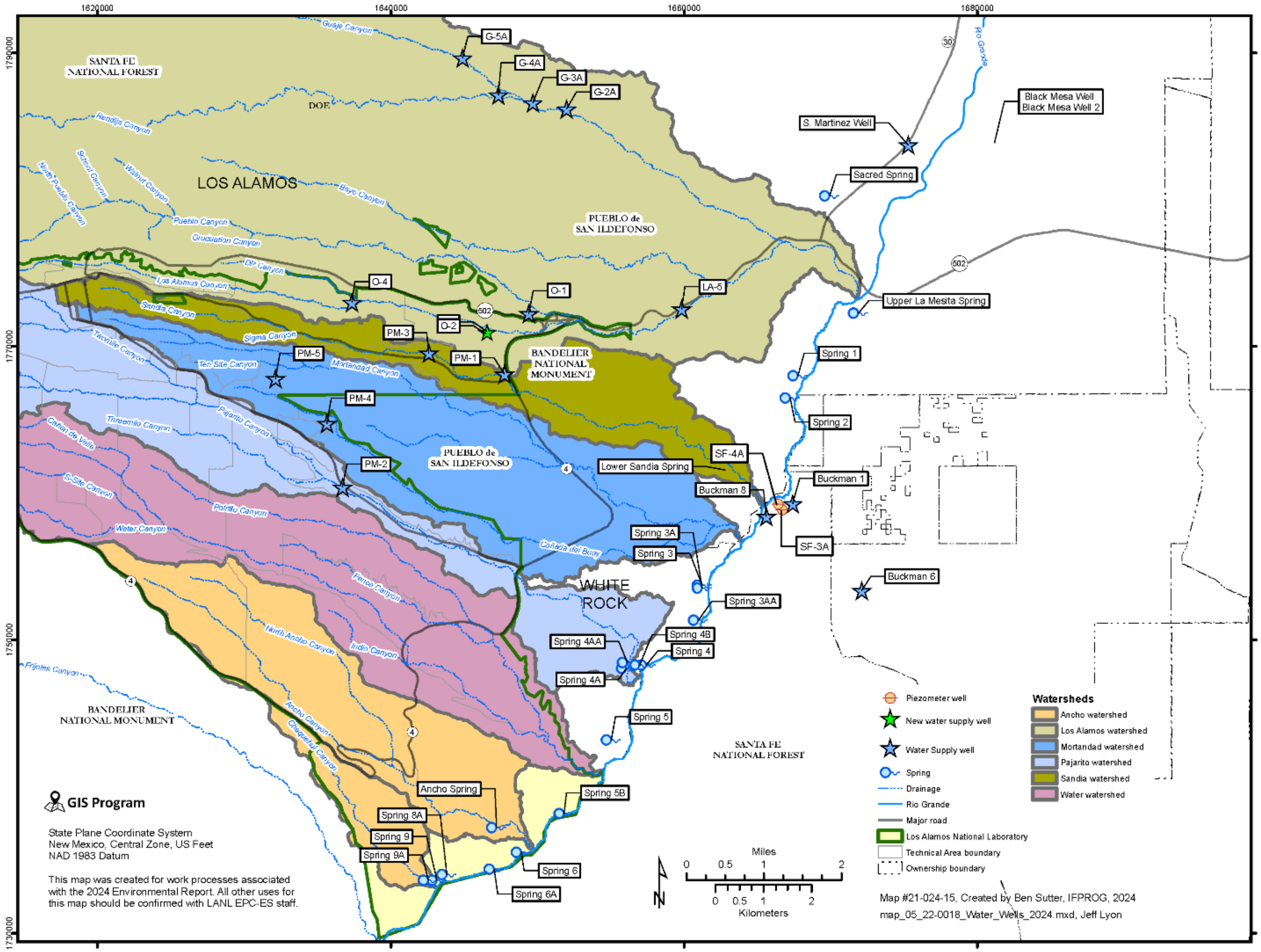

Figure 5-6. This map shows locations of water supply wells, including on Pueblo de San Ildefonso, and springs on the eastern side of the monitored area. Springs along the Rio Grande are sampled to monitor the discharged groundwater as part of the White Rock Canyon monitoring group. The colored areas are watersheds of canyons that cross Laboratory property.

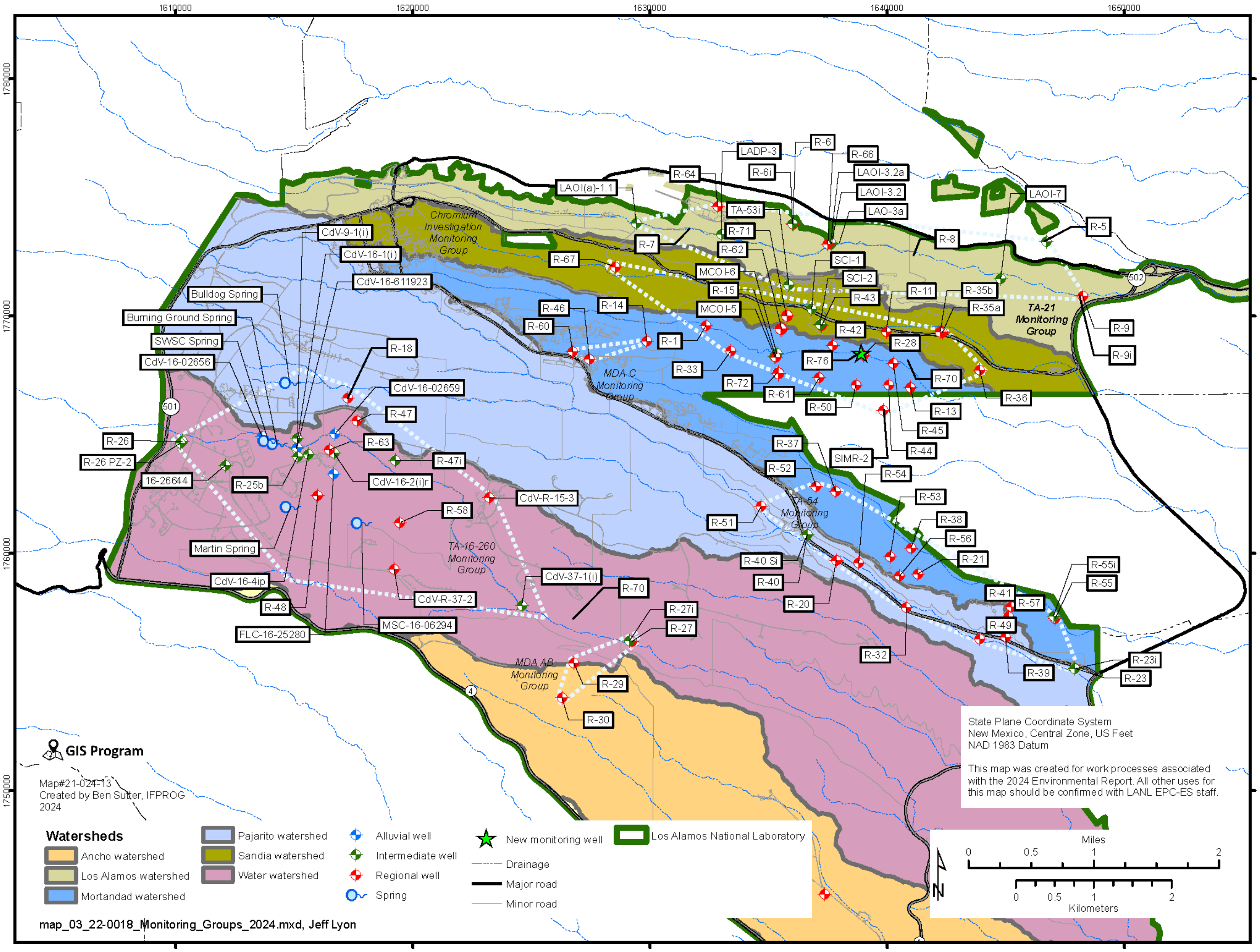

Figure 5-7. This map shows wells and springs that are part of six area-specific monitoring groups: Technical Area 54, Technical Area 21, Material Disposal Area AB, Material Disposal Area C, the Chromium Investigation area, and the Technical Area 16-260 outfall.

Water Supply Well Monitoring

Los Alamos County

We collected samples from 11 Los Alamos County water supply wells (Figure 5-6). This sampling is performed in addition to Los Alamos County's regular monitoring and is specifically tested for contaminants potentially related to site operations. All drinking water produced by the Los Alamos County water supply system meets federal and state drinking water standards as reported in the county's annual drinking water quality report (Los Alamos Department of Public Utilities 2024 Annual Drinking Water Quality Report). In 2024, no water supply wells had detections of site-related constituents above applicable drinking water standards. Los Alamos County well PM-3 was not sampled because it is not currently delivering drinking water.

City of Santa Fe

In 2024, we sampled three water supply wells (Buckman-1, Buckman-6, and Buckman-8) in the City of Santa Fe's Buckman well field. No Laboratory-related constituents were present above standards for these locations. Natural background levels of arsenic were observed at all three wells. Arsenic was present at Buckman-1, Buckman-6, and Buckman-8 at 12.2, 10.3, and 10.2 micrograms per liter, respectively. These natural background values are above the New Mexico Groundwater Standard of 10 micrograms per liter. The City of Santa Fe publishes an annual water quality report that provides additional information (City of Santa Fe Water 2024 Water Quality Report).

Technical Area 21 Monitoring Group

Technical Area 21 is located on a mesa bordered by Los Alamos Canyon on the south and DP Canyon on the north. It was the location of two Laboratory facilities, DP West and DP East, that produced liquid and solid radioactive wastes. Operations at DP West included plutonium processing; at DP East, operations included weapons initiators production and tritium research. From 1952 to 1986, a liquid waste treatment plant discharged effluent that contained radionuclides from the plutonium-processing facility into DP Canyon (refer to Figure 5-4).

Potential sources of groundwater pollutants in the vicinity of Technical Area 21 include Solid Waste Management Unit 21-011(k) (the former liquid waste treatment plant outfall location), Solid Waste Management Unit 02-005 (the former Omega West reactor cooling tower), adsorption beds and disposal shafts at Material Disposal Area T, adsorption beds at Material Disposal Area U, DP West, DP East, waste lines, an underground diesel fuel line, and sumps.

The Technical Area 21 monitoring group includes wells in perched intermediate groundwater and in the regional aquifer. Samples from several wells that monitor perched intermediate groundwater contain tritium that likely originated from the former liquid waste treatment plant, the Omega West Reactor, or both. Tritium concentrations in perched intermediate wells R-6i, LAOI-3.2, LAOI-3.2a, and LAOI-7 in 2024 are generally consistent with concentrations measured in recent years (Figure 5-8; refer to Figure 5-7 for well locations) and have long-term declines over time. The highest tritium concentration among these wells in 2024 was 661 picocuries per liter in R-6i, down from 723 picocuries per liter in 2023. For comparison, the U.S. Environmental Protection Agency maximum contaminant level for tritium in drinking water is 20,000 picocuries per liter.

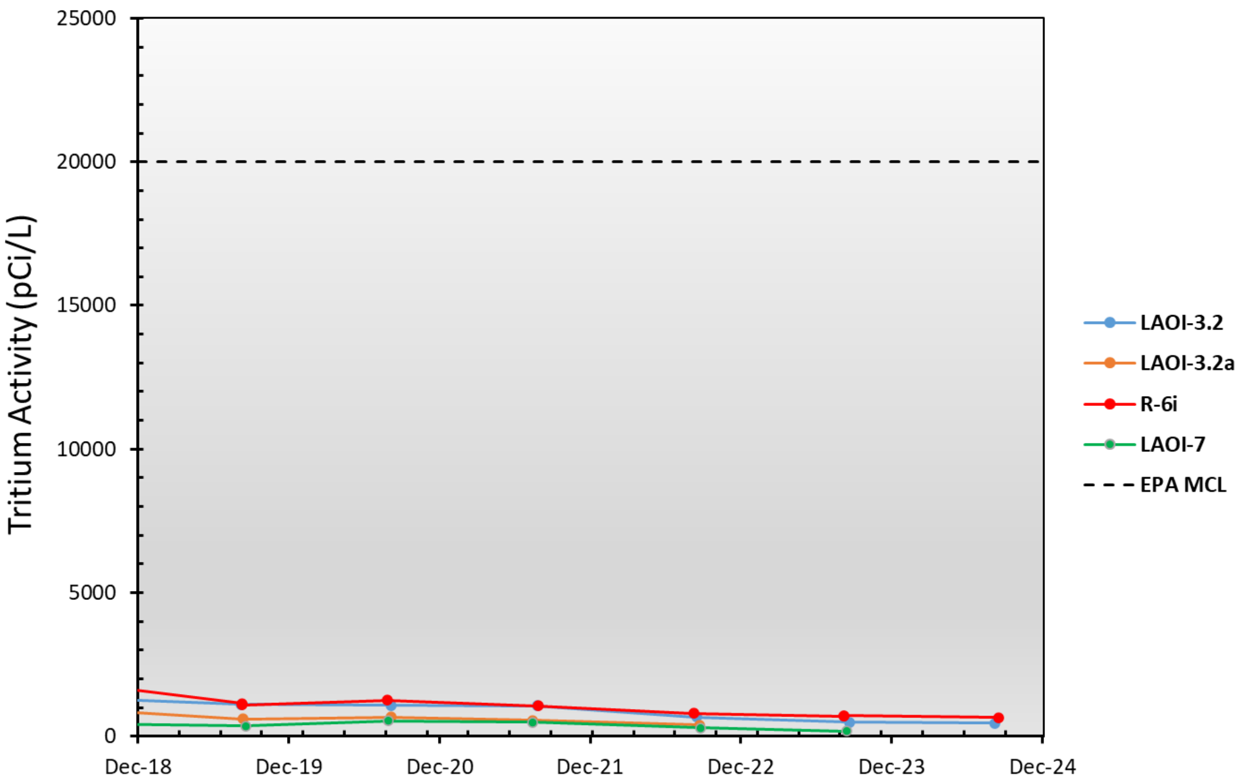

Figure 5-8. Technical Area 21 tritium concentrations in perched intermediate wells show long-term declines over time. EPA MCL = U.S. Environmental Protection Agency maximum contaminant level for tritium in drinking water.

Chromium Investigation Monitoring Group

Chromium is present in the regional aquifer beneath Sandia and Mortandad canyons at levels above the New Mexico Environment Department groundwater standard of 50 micrograms per liter. The area of the regional aquifer where chromium exceeds standards (the chromium plume) is estimated to be approximately 1 mile in length and about a half-mile wide (Figure 5-9 and Figure 5-10).

From 1956 to 1972, we used potassium dichromate as a corrosion inhibitor in the cooling system at the Laboratory's power plant (LANL 1973). Potassium dichromate was present in effluent discharged to Sandia Canyon. These discharges of potassium dichromate are the source of the hexavalent chromium observed in groundwater beneath Sandia and Mortandad Canyons.

We present a conceptual model for the sources and spatial distribution of chemicals and radionuclides in groundwater in this area in the Investigation Report for Sandia Canyon (LANL 2009), the Phase II Investigation Report for Sandia Canyon (LANL 2012), and the Compendium of Technical Reports Conducted Under the Work Plan for Chromium Plume Center Characterization (LANL 2018a). The conceptual model indicates that the chromium originated from releases into Sandia Canyon and then migrated belowground along geologic perching horizons to the regional aquifer beneath Sandia and Mortandad Canyons.

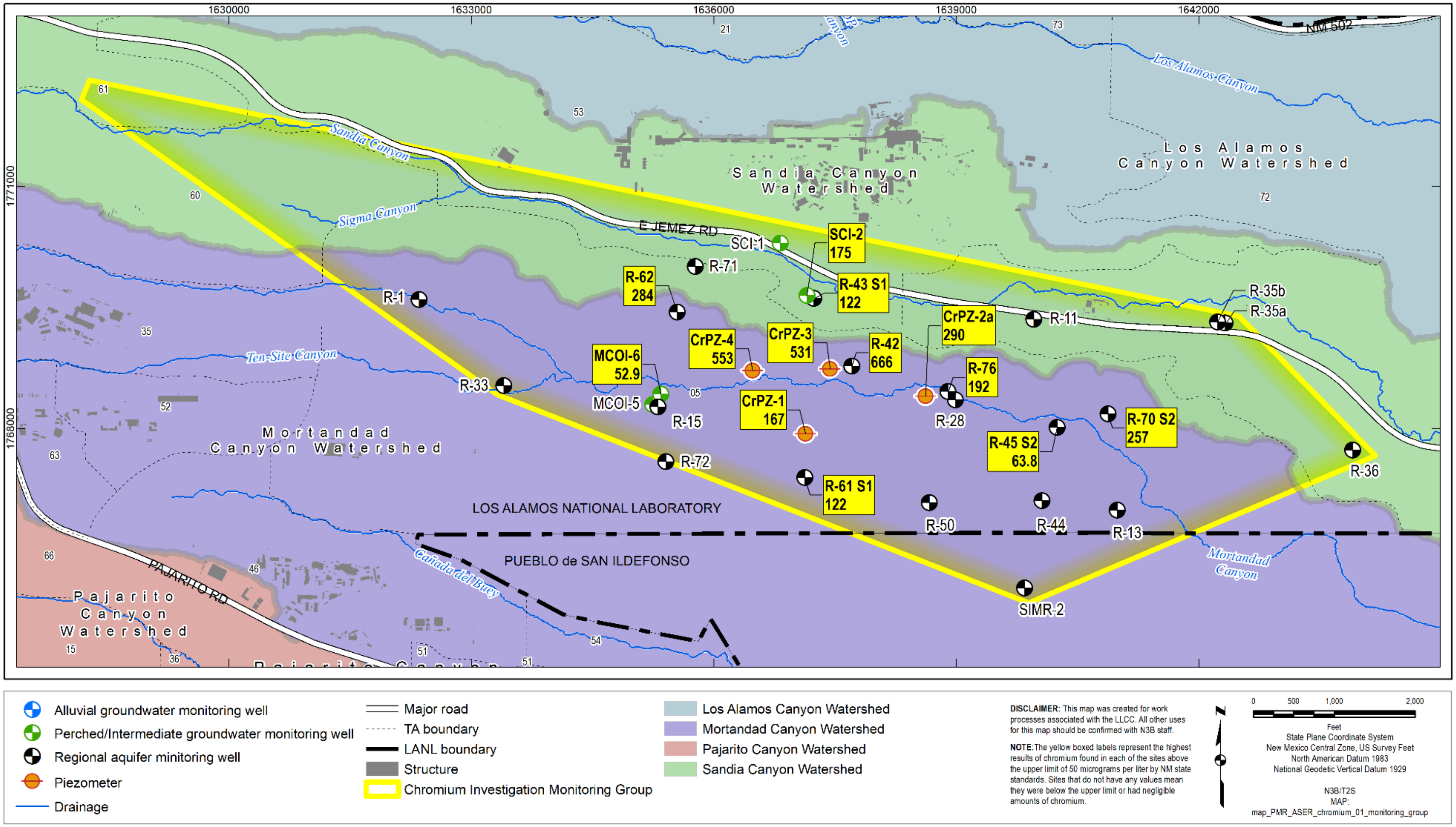

Figure 5-9. Chromium Investigation monitoring group perched intermediate and regional aquifer monitoring wells. The yellow outline encompasses the monitoring group. Wells that exceeded the 50 micrograms per liter New Mexico groundwater standard from chromium in 2024 are labeled with their maximum 2024 chromium level in micrograms per liter.

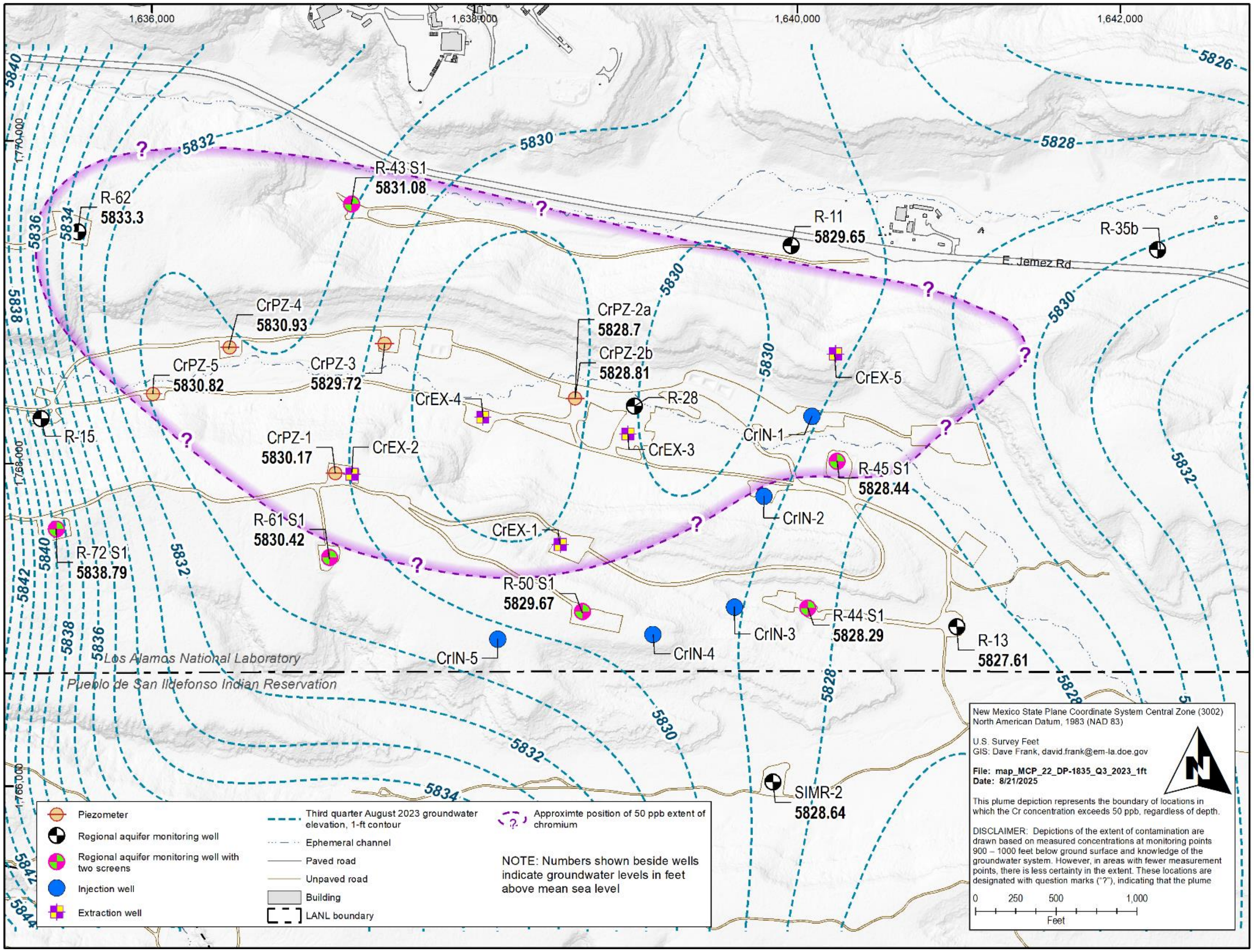

Figure 5-10. The map shows the approximate chromium plume footprint in the regional aquifer and the chromium plume interim measure extraction and injection wells.

Chromium contamination is generally detected within 100 feet of the top of the regional aquifer (LANL 2009, 2012, 2017, 2018b). Some locations (for example, at well R-70) have chromium deeper than 100 feet.

Chromium Monitoring Results and the Chromium Plume Interim Measure

Chromium concentrations exceeded the New Mexico groundwater standard of 50 micrograms per liter in 12 regional aquifer wells and one intermediate well location within the monitoring group in 2024: CrPZ-1, CrPZ-2a, CrPZ-3, CrPZ-4, CrPZ-5, R-42, R-43 screen 1, R-45 screen 2, R-61 screen 1, R-62, R-70 screen 2, new well R-76, and intermediate well SCI-2 (Figure 5-9 and Figure 5-11).

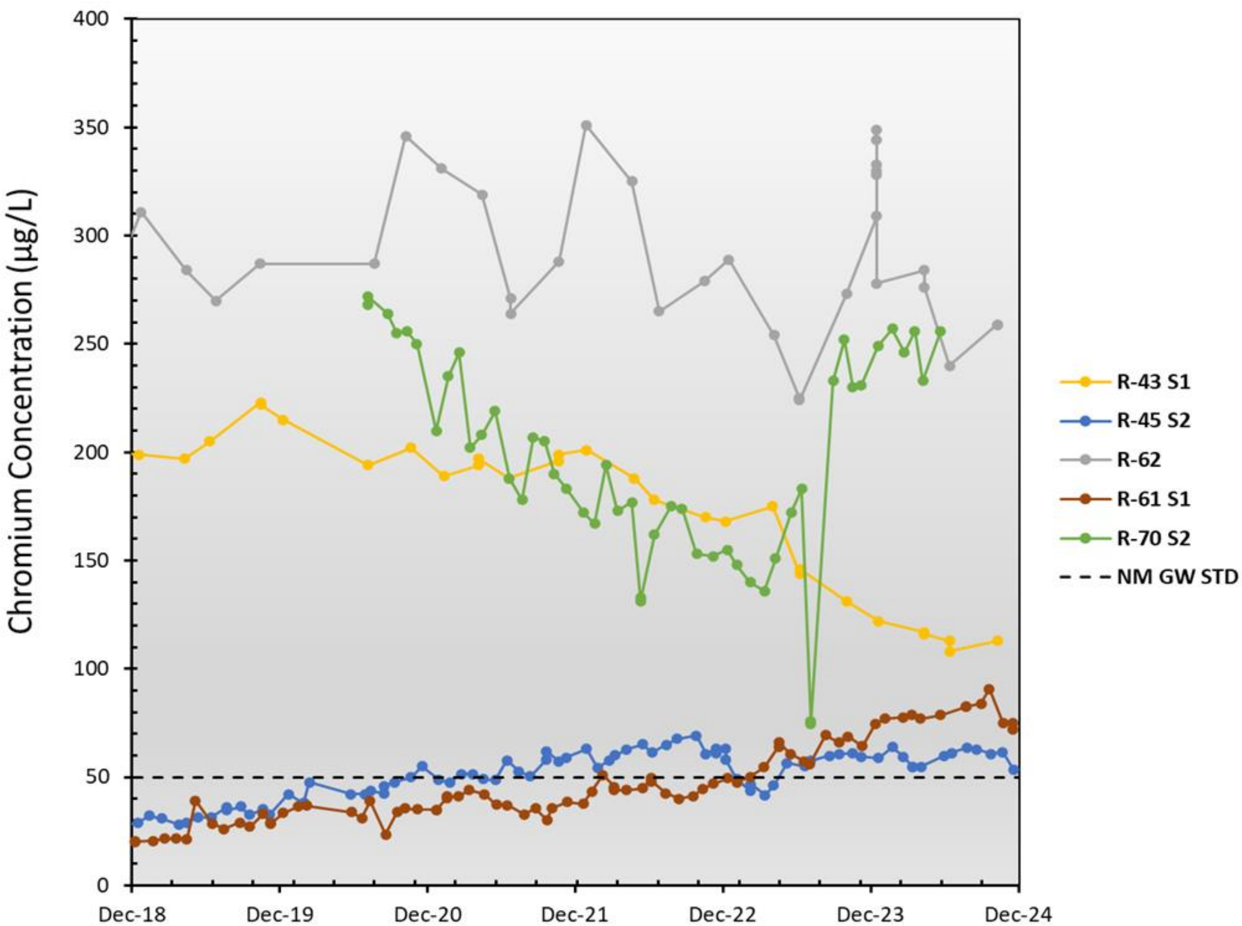

Figure 5-11. Chromium concentration trends for five regional aquifer wells R-43 screen 1, R-45 screen 2, R-62, R-61 screen 1, and R-70 screen 2 have exceeded the New Mexico groundwater standard for chromium of 50 micrograms per liter (µg/L).

For the Chromium Plume Interim Measure, contaminated groundwater is extracted from a group of extraction wells. The extracted water is piped to an aboveground ion exchange treatment system, and following treatment, the treated water is injected back into the regional aquifer through injection wells located in the downgradient portion of the plume. The interim measure primarily targets the area along the boundary between the LANL site and the Pueblo de San Ildefonso on the southeastern downgradient portion of the plume (Figure 5-10). Interim measure operations to maintain the portion of the plume that contains 50 micrograms per liter or more of chromium completely within the site boundary began on a limited scale in 2017 and were expanded starting in 2018. We began operations along the eastern portion of the plume in late 2019. On March 31, 2023, the interim measure system was shut down so that various options for potentially modifying and operating the system could be evaluated. As a result of the evaluation, interim measure operations resumed on September 30, 2024.

Two regional aquifer wells, R-44 and R-50, monitor the effectiveness of the interim measure along the Pueblo de San Ildefonso boundary (Figure 5-12). Wells R-44 and R-50 each have two screens; R-44 screen 2 is approximately 100 feet below the water table at 985.3 to 995.2 feet below the ground surface, and R-50 screen 2 is approximately 100 feet below the water table at 1,185.0 to 1,205.6 feet below the ground surface. Well R-50 screen 2 has maintained chromium concentrations within naturally occurring (background) levels, indicating that chromium contamination at that location does not extend to the depth of that screen. The levels of chromium in R-50 screen 1, which is near the water table, decreased over time in response to the interim measure but increased during the several months when the interim measure was shut down from late March 2023 through late September 2024 (Figure 5-12). Chromium concentrations in R-44 screen 1 and screen 2 remained generally unaffected during this period.

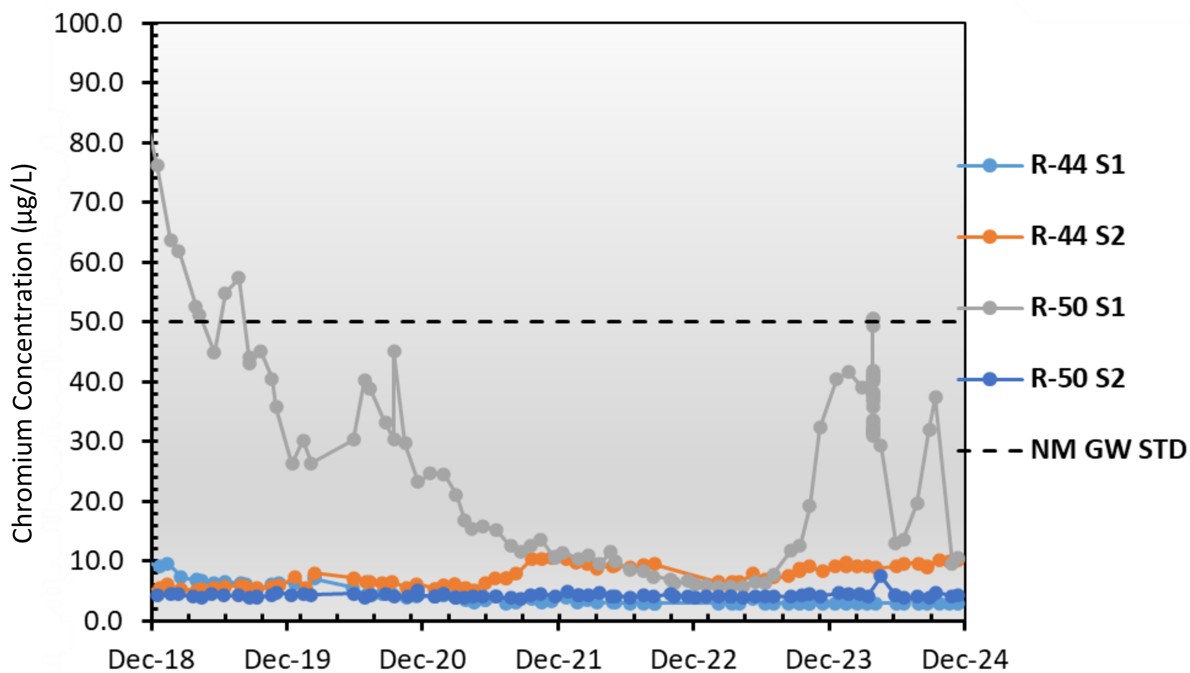

Figure 5-12. The graph shows chromium concentrations in four regional aquifer wells that monitor the effectiveness of the interim measure downgradient of the chromium plume. Wells R-44 screens 1 and 2 and R-5 screens 1 and 2 are in a downward trend below the New Mexico groundwater standard for chromium of 50 micrograms per liter (µg/L).

Five regional monitoring wells (R-11, R-45, R-70, R-35a, and R-35b), five piezometer locations (observation wells where piezometers are used to measure groundwater pressure; CrPZ-1, CrPZ-2a, CrPZ-3, CrPZ-4, and CrPZ-5), and one extraction well (CrEX-5) are located along the eastern portion of the plume (Figure 5-10 and Figure 5-11). Wells R-35a and R-35b have consistently shown chromium concentrations within naturally occurring (background) levels. Chromium concentrations at well R-11 continue to measure below the 50-micrograms-per-liter groundwater standard, with variations in concentrations that might not be related to interim measure operations. The five piezometer locations have chromium concentrations above the New Mexico groundwater standard; Figure 5-10 presents the maximum concentration at each location for 2024.

Well R-45 is located south and west of R-70 and is flanked by injection wells CrIN-1 and CrIN-2 to the north and southwest. This well was first sampled in 2009. Before interim measure operations began in this area, chromium concentrations in well R-45 screen 1 and screen 2 were below 50 micrograms per liter but above background and rising. Since the start of sustained injection in 2018, chromium concentrations at R-45 screen 1 have declined, a trend that continued after injection was expanded to the eastern area of the plume in 2019. An observed increase in chloride and sulfate at R-45 screen 1 indicates that injection water is entering screen 1. Chromium concentrations in R-45 screen 2 have increased above the 50 micrograms per liter groundwater standard. There is no sign of injection water at screen 2. Given the proximity of injection wells CrIN-1 and CrIN-2 to well R-45 and the injection water signature at screen 1, eastern area interim measure operations may have affected the R-45 screen 2 concentrations. Figure 5-13 presents R-11 and R-45 screens 1 and 2 chromium concentration trends.

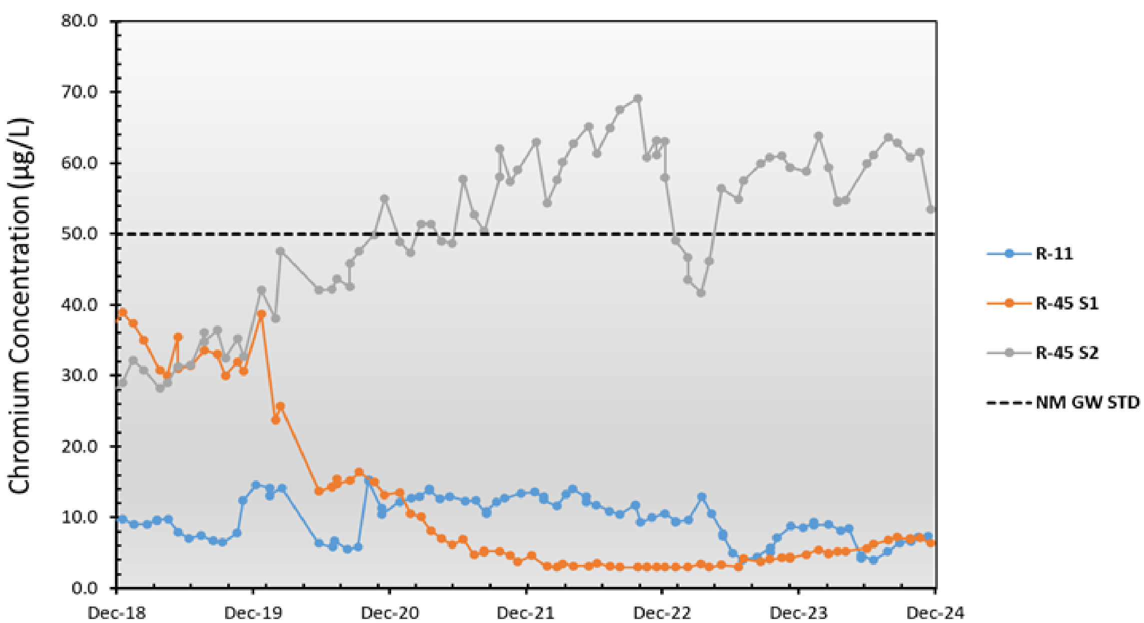

Figure 5-13. This graph shows chromium concentrations of two regional wells along the northeast edge of the plume. These trends reflect chromium concentrations in water that recharges the regional aquifer.

Two wells located along the northwestern upgradient portion of the chromium plume, R-62 and R-43 screen 1, continued to have concentrations of chromium above the standard in 2024 (Figure 5-14). For these locations, we are seeing a trend of declining chromium concentrations.

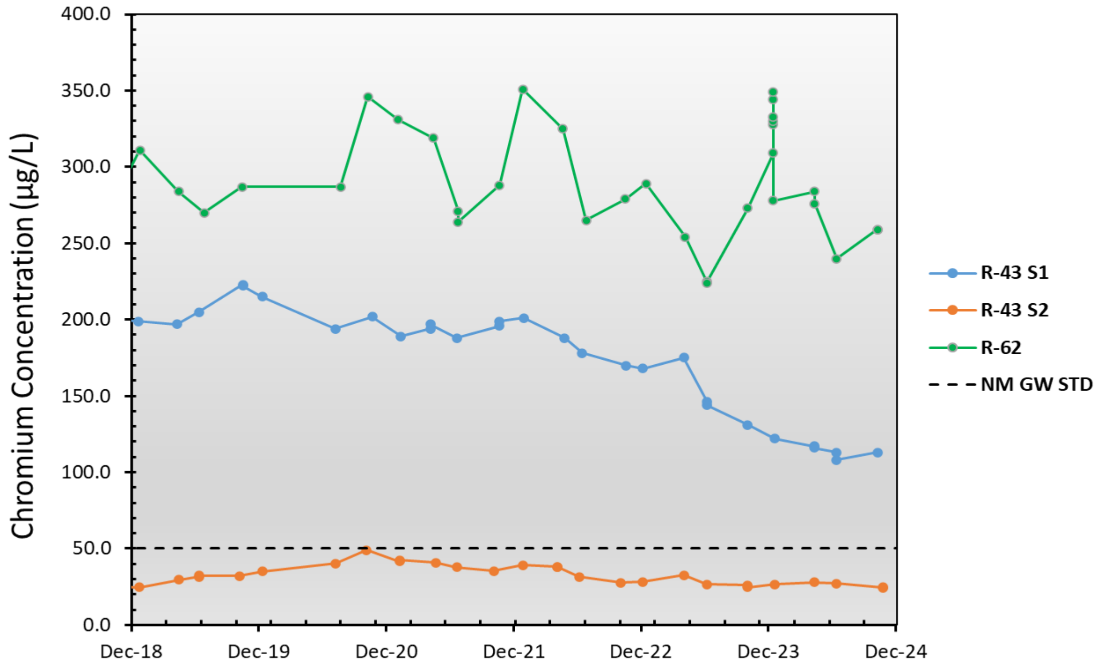

Figure 5-14. This graph shows chromium concentrations of two regional monitoring wells located on the northwestern side of the plume. R-43 screen 1 and R-62 show chromium concentrations above the New Mexico groundwater standard (µg/L).

Two perched intermediate wells reported chromium concentrations above the standard: SCI-2 and MCOI-6. Chromium concentrations continue to decline in SCI-2 and remain steady in MCOI-6 (Figure 5-15).

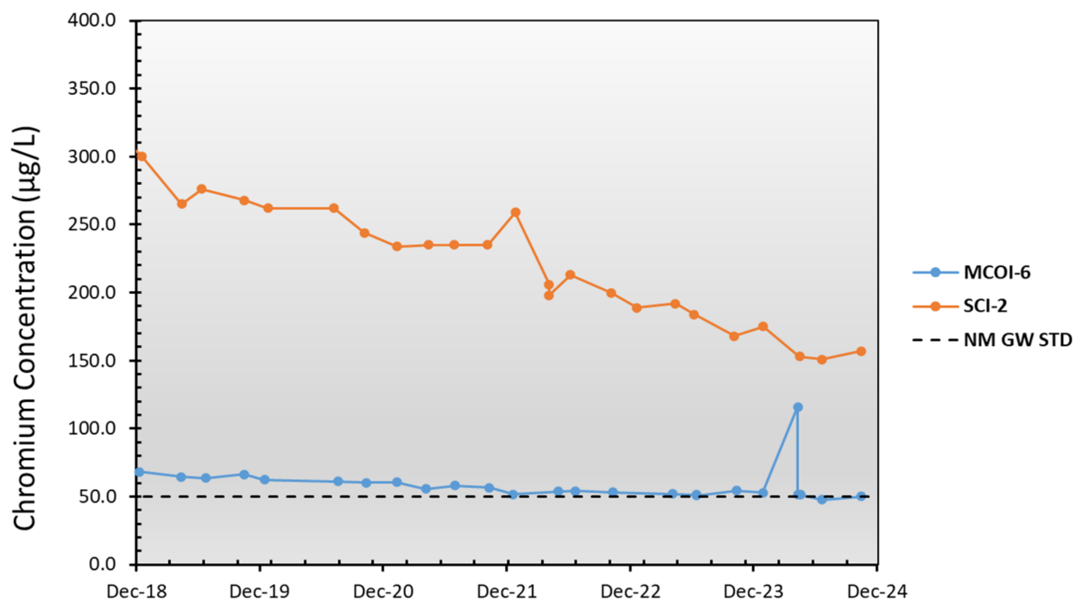

Figure 5-15. This graph shows chromium concentrations for two perched intermediate groundwater monitoring wells in the Chromium Investigation monitoring group that had chromium concentrations that exceeded the New Mexico groundwater standard of 50 micrograms per liter (µg/L).

As previously mentioned, injection of treated water was suspended on March 30, 2023, at the direction of the New Mexico Environment Department due to questions about the configuration of injection wells. This decision shut down the chromium interim measure treatment system. A rebound in chromium concentration was observed in several monitoring-group wells following the shutdown (refer to Figure 5-11). A review team of 15 subject matter experts sponsored by DOE and supported by the New Mexico Environment Department was convened in March 2024 to evaluate several technical questions regarding the chromium interim measures and characterization. In May 2024, the New Mexico Environment Department sent a letter to DOE allowing the operation of three injection wells (CrIN-3, CrIN-4, and CrIN-5). The interim measure treatment system was reinstated in September 2024. The responses and recommendations of the review team were issued in a report released in December 2024 (Batu et al. 2024).

Other Monitoring Results

Perchlorate contamination is also present in groundwater beneath Mortandad Canyon. The primary source of perchlorate is effluent discharges from the Radioactive Liquid Waste Treatment Facility from 1963 until March 2002. Perchlorate has been detected above the New Mexico Environment Department tap water screening level of 13.8 micrograms per liter in two perched intermediate wells: MCOI-5 and MCOI-6 (Figure 5-16). In perched intermediate well MCOI-6, the perchlorate concentration trends are relatively stable. Well MCOI-5, which is evaluated quarterly for sampling, has not been sampled since 2019 due to insufficient water in the well. Perchlorate concentrations in regional aquifer well R-15 surpassed the 13.8 micrograms per liter screening level in 2024 for the first time. The highest recorded concentration in 2024 in regional aquifer well R-15 was 18.5 micrograms per liter. Regional aquifer well R-61 screen 1 has historically maintained perchlorate concentrations near or slightly above 13.8 micrograms per liter. In 2024, samples collected at piezometer wells CrPZ-1 and CrPZ-4 had concentrations of 26.1 micrograms per liter and 51.4 micrograms per liter, respectively. We continue to monitor perchlorate and, if necessary, will incorporate remedial actions for perchlorate as part of the chromium remediation efforts.

Other constituents detected in the Chromium Investigation monitoring group include 1,4-dioxane and tritium in perched intermediate well MCOI-6 (Figure 5-17 and Figure 5-18). The trend for 1,4-dioxane concentrations at MCOI-6 is increasing. Concentrations of 1,4-dioxane were present in 2024 above the exceedance level of 4.59 micrograms per liter, with the highest level being 33.1 micrograms per liter. Perched intermediate well MCOI-6 has tritium concentrations far below the U.S. Environmental Protection Agency maximum contaminant level for tritium in drinking water of 20,000 picocuries per liter.

Additionally, values for nitrate-nitrite as nitrogen have trended above the U.S. Environmental Protection Agency’s standard of 10 micrograms per liter at perched intermediate wells MCOI-5 and MCOI-6. In 2016, the lowest concentration of nitrate-nitrite as nitrogen for MCOI-5 was 10.0 micrograms per liter. At the end of 2017, MCOI-5 was recorded at 15.0 micrograms per liter. In 2023, MCOI-6’s lowest concentration for nitrate-nitrite as nitrogen was 13.9 micrograms per liter. In 2024, the highest level in samples at MCOI-6 was 16.4 micrograms per liter.

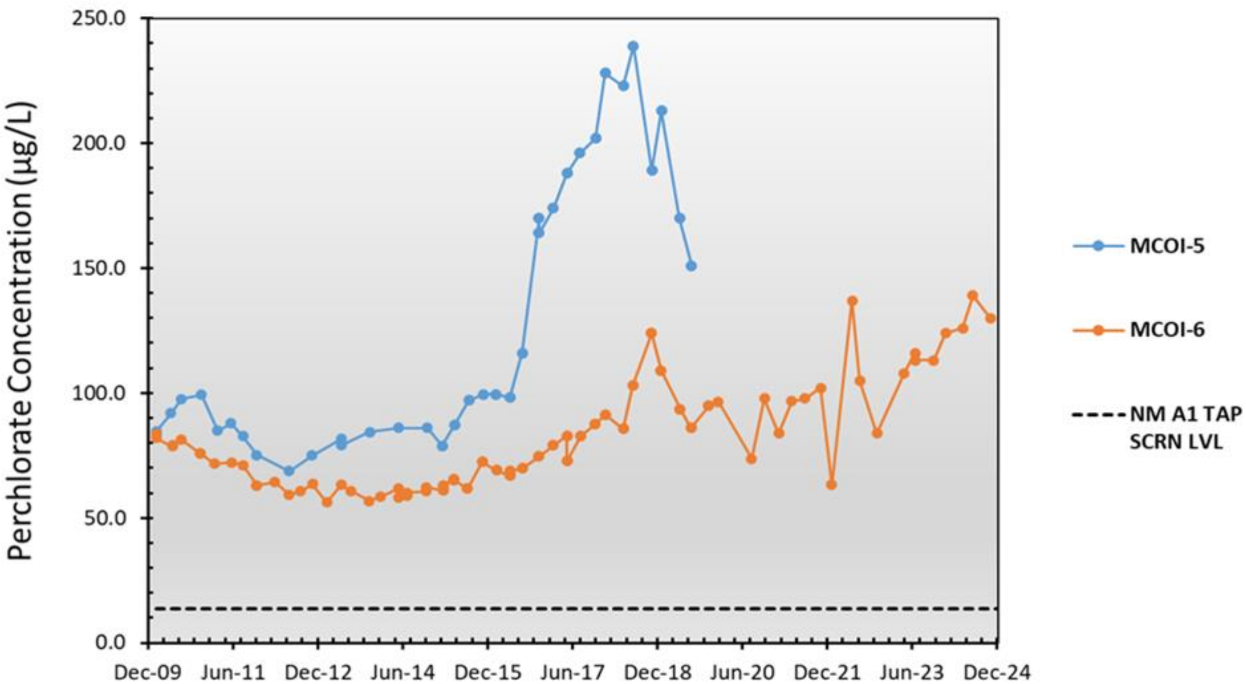

Figure 5-16. The graph shows perchlorate concentrations for two perched intermediate groundwater monitoring wells in the Chromium Investigation monitoring group that had perchlorate detections above the New Mexico tap water screening level of 13.8 micrograms per liter (µg/L). MOI-5 has not been sampled since 2019 due to insufficient water at this location.

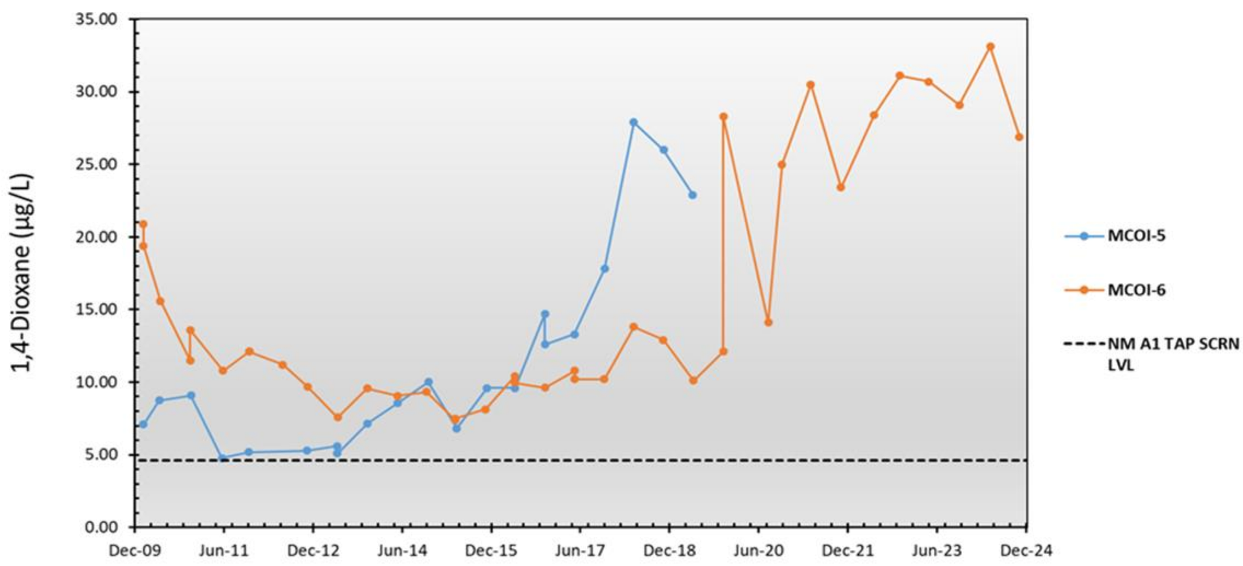

Figure 5-17. The graph shows concentrations of 1,4-dioxane in perched intermediate groundwater monitoring wells in the Chromium Investigation monitoring group. Both locations showed concentrations above the New Mexico Department tap water screening level for 1,4-dioxane of 4.59 micrograms per liter (µg/L).

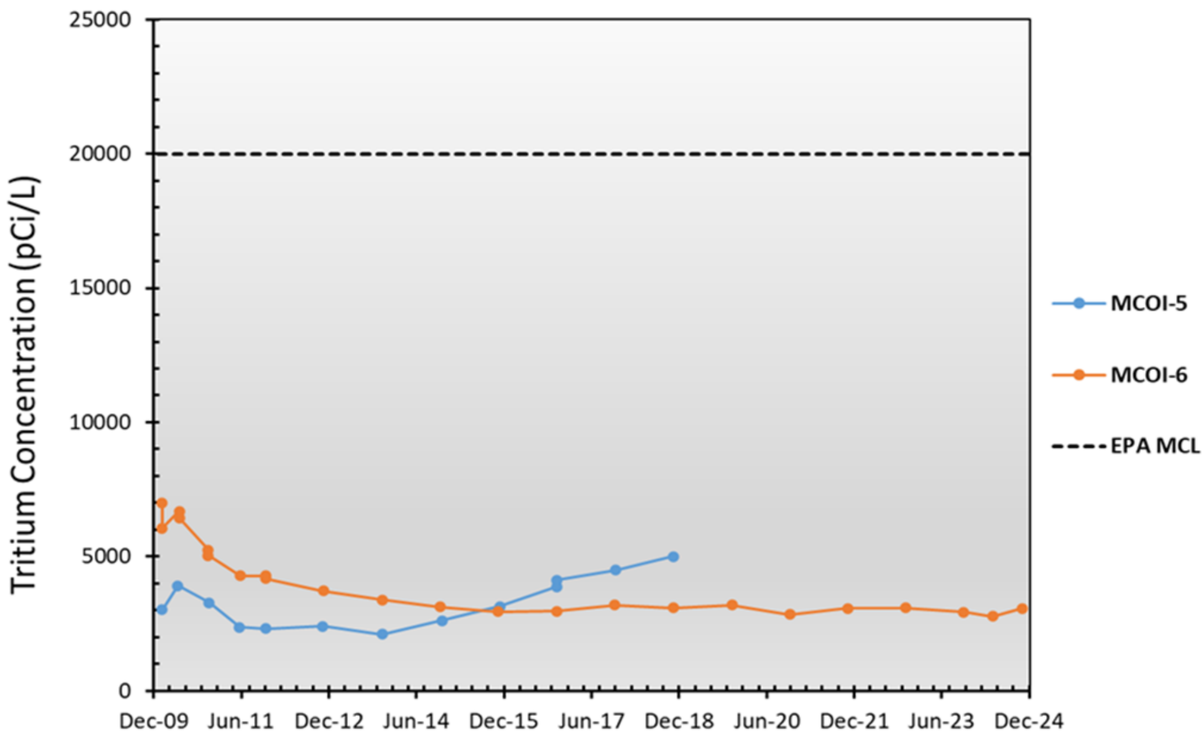

Figure 5-18. The graph shows tritium concentrations in two perched intermediate groundwater monitoring wells in the Chromium Investigation monitoring group. The U.S. Environmental Protection Agency maximum contaminant level for tritium in drinking water is 20,000 picocouries per liter (pCi/L). Both locations are trending well below the screening level; MCOI-5 has not been sampled in recent years due to insufficient water at this location.

Material Disposal Area C Monitoring Group

Material Disposal Area C is in Technical Area 50, at the head of Ten Site Canyon. It is an inactive landfill that received solid low-level radioactive wastes and chemical wastes between 1948 and 1974. Vapor-phase volatile organic compounds and tritium are present in the upper 500 feet of the soil and rock beneath Material Disposal Area C (LANL 2011a). The primary volatile organic compound is trichloroethene. The Material Disposal Area C monitoring group includes nearby regional aquifer monitoring wells (Figure 5-7). A sample from well R-14 S1 tested for aldrin had a result of 0.00668 micrograms per liter, which is above the screening level of 0.00198 micrograms per liter. No perched intermediate groundwater is present beneath Material Disposal Area C.

Technical Area 54 Monitoring Group

Technical Area 54 is in the east-central portion of the Laboratory on Mesita del Buey. The technical area includes material disposal areas; a waste characterization, storage, and transfer facility (Technical Area 54 West); active radioactive waste storage operations at Area G; hazardous- and mixed-waste storage operations at Area L; and administrative and support areas.

At Technical Area 54, we monitor groundwater to support both the monitoring of Solid Waste Management Units and Areas of Concern (particularly Areas G, H, and L) under the Consent Order and the Laboratory’s Hazardous Waste Facility Permit. The Technical Area 54 monitoring group includes perched intermediate and regional wells (Figure 5-7).

Vapor-phase volatile organic compounds were found in the soil and rock beneath Areas G and L. The primary vapor-phase volatile organic compounds at Technical Area 54 are 1,1,1-trichloroethane; trichloroethene; and Freon-113. Tritium is also present (LANL 2005b, 2006, 2007).

We have periodically detected a variety of constituents in samples from the groundwater monitoring network around Technical Area 54, including several volatile organic compounds. In 2024, the chemical 1,4-dioxane was detected at levels above the U.S. Environmental Protection Agency maximum contaminant level of 4.59 micrograms per liter at intermediate well R-37 screen 1, with a concentration of 7.32 micrograms per liter. This event is the fourth detection of 1,4-dioxane above the screening level at R-37 screen 1. Tetrachloroethene was detected at intermediate well R-40 screen 1, with a concentration of 6.62 micrograms per liter, above the New Mexico Groundwater standard of 5 micrograms per liter. Lastly, dibenz(a,h)anthracene was detected at regional well R-53 screen 1 at a concentration of 0.0675 micrograms per liter, above the NMED A1 tap water screening level of 0.0343 micrograms per liter.

Technical Area 16-260 Monitoring Group

The Technical Area 16 Building 260 area includes parts of Water Canyon and Cañon de Valle (a tributary of Water Canyon) in the southwest portion of the LANL site. In the past, the Laboratory released wastewater into both canyons from several high-explosives processing facilities in Technical Areas 16 and 09 (Figure 5-4). The Technical Area 16-260 outfall discharged high-explosives-bearing water from a high-explosives machining facility to Cañon de Valle from 1951 through 1996. These discharges served as a primary source of high-explosives and inorganic element contamination in the area (LANL 1998, 2003, 2011b).

The Technical Area 16-260 monitoring group monitors constituents released from Consolidated Unit 16-021(c)-99, which includes the Technical Area 16-260 outfall and associated Solid Waste Management Units. Current evidence indicates that, over time, the effluent from the Technical Area 16-260 outfall—sometimes mixed with naturally occurring surface water and alluvial groundwater—infiltrated from Cañon de Valle and percolated through unsaturated rock layers to perched intermediate groundwater zones and ultimately into the regional aquifer.

RDX (hexahydro-1,3,5-trinitro-1,3,5-triazine) is the primary groundwater contaminant in this area and the only contaminant that exceeds its screening level in the regional aquifer. The tap water screening level for RDX is 9.66 micrograms per liter. RDX was detected in the regional aquifer in wells R-18, R-63, R-68, and R-69 screens 1 and 2 (Figure 5-19 and Figure 5-20); the highest RDX concentrations in samples from these wells in 2024 were 8.75 micrograms per liter, 2.22 micrograms per liter, 17.2 micrograms per liter, 18.9 micrograms per liter, and 15.9 micrograms per liter, respectively. The concentrations in regional monitoring wells R-63 and R-18 remain below the screening level but are exhibiting stable to increasing trends. Other constituents, including tetrachloroethene, trichloroethene, boron, and barium, are present in all groundwater zones but are well below applicable standards in the regional aquifer.

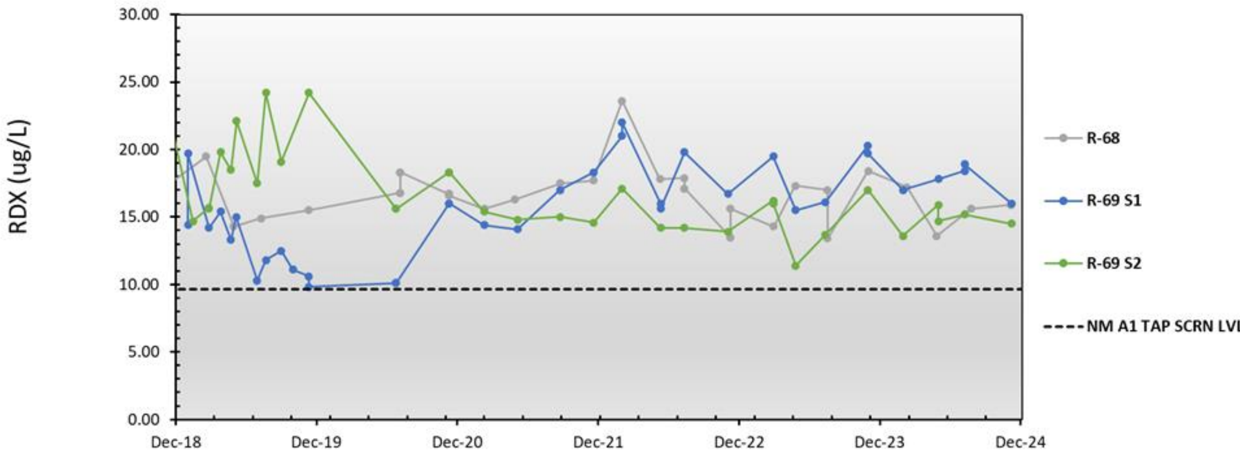

Figure 5-19. The graph shows RDX concentrations in regional aquifer wells R-68 and R-69 screens 1 and 2. The New Mexico groundwater standard for RDX is 9.66 micrograms per liter (µg/L); both locations exhibit results above the standard.

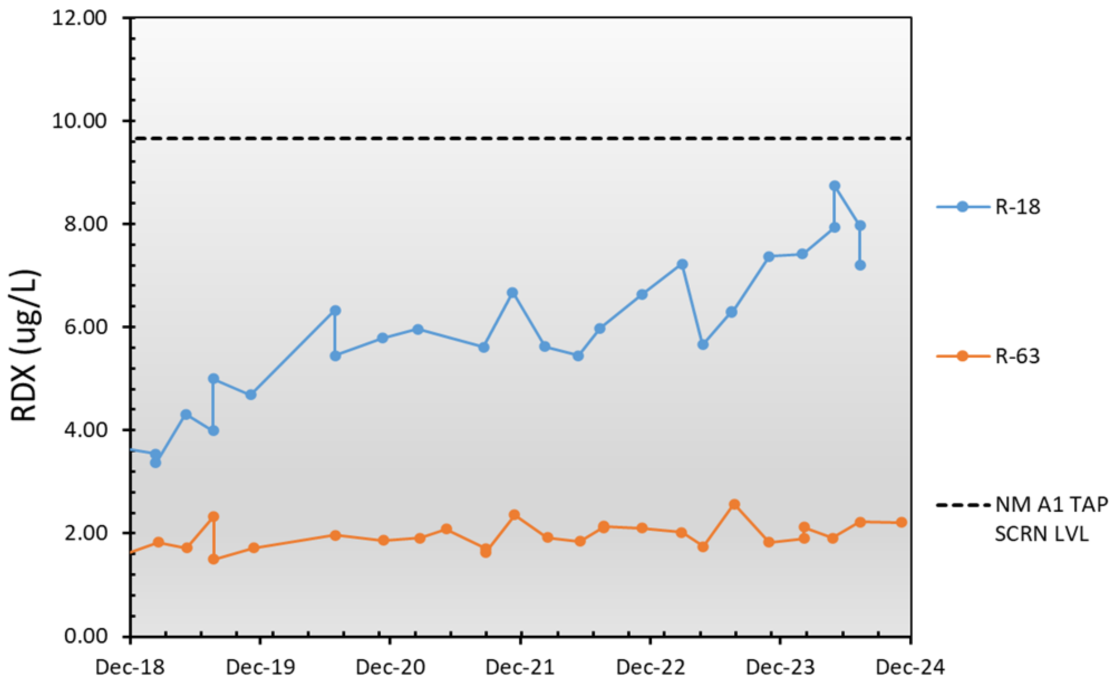

Figure 5-20. The graph shows RDX concentrations in regional aquifer wells R-18 and R-63. The New Mexico groundwater standard for RDX is 9.66 micrograms per liter (µg/L).

Springs, surface water, alluvial groundwater, and perched intermediate groundwater in the area contain explosive compounds, including RDX (hexahydro-1,3,5-trinitro-1,3,5-triazine), HMX (octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine), and TNT (2,4,6-trinitrotoluene). Barium, benzo(a)anthracene, dibenz(a,h)anthracene, methylene chloride, and RDX were also detected above their respective screening levels in some locations in springs, alluvial groundwater, and perched intermediate groundwater. Figure 5-21 presents RDX concentrations in springs, which discharge from shallow perched intermediate groundwater zones. Of the springs sampled, the concentrations of RDX are highest in Martin Spring (Figure 5-7). SWSC Spring, near the former location of the Technical Area 16-260 outfall, does not have consistent flow, so it was not sampled during 2019 through 2024. Burning Grounds Spring has had concentrations of RDX near or above the screening level. RDX was detected above the screening level at Bulldog Spring in a sample collected in September 2021; however, in samples collected thereafter, the concentration of RDX has been below the screening level.

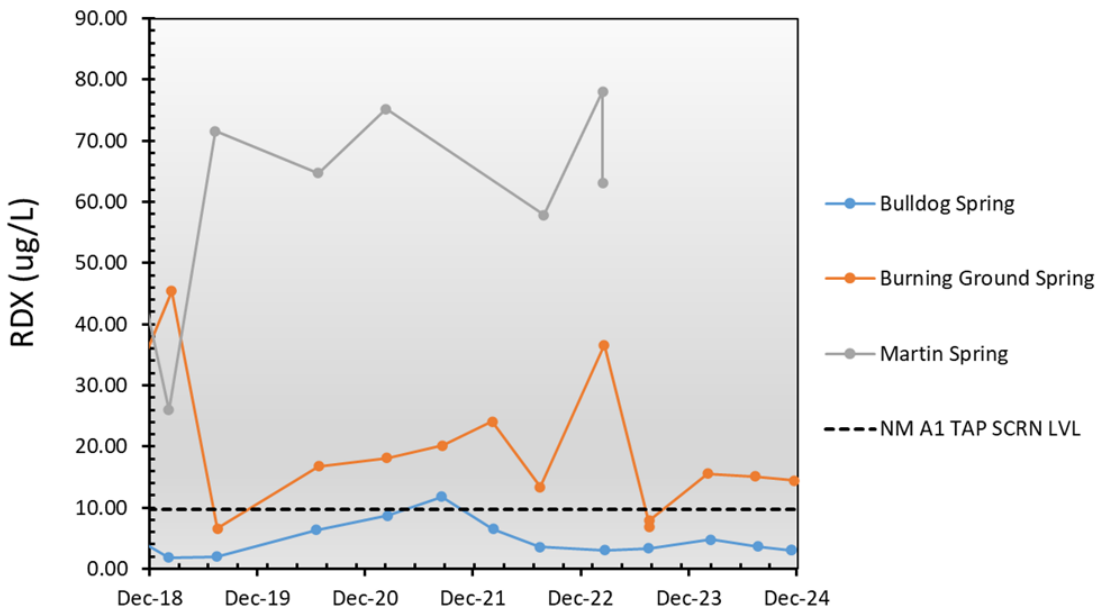

Figure 5-21. The graph shows RDX concentrations in three springs in Technical Area 16. (SWSC Spring has not been sampled since 2017 due to the location being dry.) The New Mexico groundwater standard for RDX is 9.66 micrograms per liter (µg/L). The latest results for Burning Ground Spring and Martin Spring are above the RDX groundwater standard.

Figure 5-22 and Figure 5-23 present RDX concentrations in alluvial wells and perched intermediate wells. RDX concentrations in alluvial monitoring wells have significant variability because of seasonal influences but remain relatively low (Figure 5-22). RDX concentrations in each of the perched intermediate wells have some variability, but over the years, an increasing trend has begun to develop (Figure 5-23). Long-term monitoring of some of these springs and alluvial wells is now included in the annual Interim Facility-Wide Groundwater Monitoring Plan (N3B 2024).

A risk assessment submitted to the New Mexico Environment Department in 2022 concluded that there is no unacceptable risk to human health from RDX in the reasonably foreseeable future (N3B 2022).

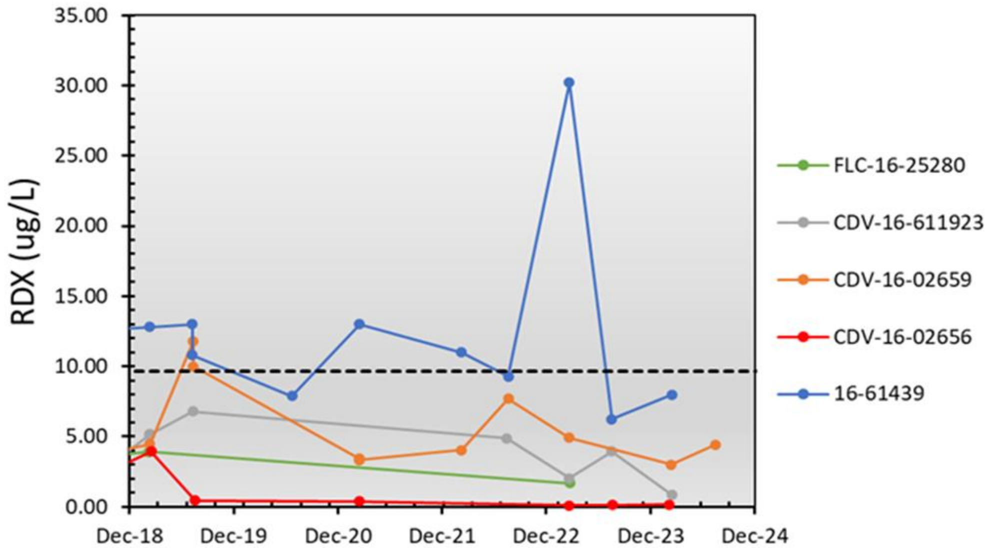

Figure 5-22. The graph shows RDX concentrations in five alluvial groundwater wells in Technical Area 16. The New Mexico groundwater standard for RDX is 9.66 micrograms per liter (µg/L). Locations CdV-16-02659 and 16-61439 have displayed concentrations of RDX above the standard before 2024.

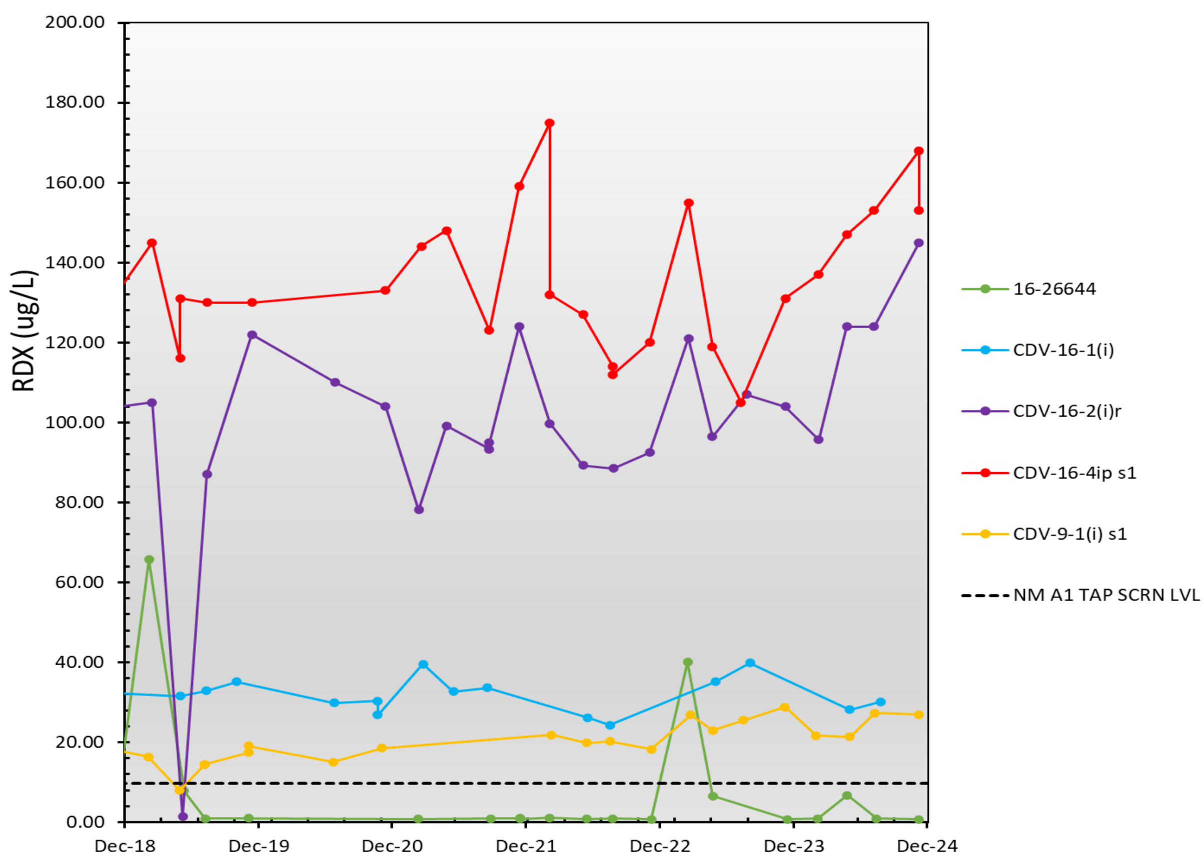

Figure 5-23. The graph shows RDX concentrations in perched intermediate groundwater wells in Technical Area 16. The New Mexico groundwater standard for RDX is 9.66 micrograms per liter (µg/L).

Material Disposal Area AB Monitoring Group

The Material Disposal Area AB monitoring group is in Technical Area 49. Also known as the Frijoles Mesa Site, Technical Area 49 is located on a mesa near the western end of Ancho Canyon. Part of the area drains into Water Canyon. The canyons in the Ancho Canyon watershed are mainly dry, with no known persistent alluvial groundwater zones and no known perched intermediate groundwater.

We used the site of Material Disposal Area AB to test nuclear weapons components from 1959 to 1961 (Purtymun and Stoker 1987, LANL 1988). The testing involved isotopes of uranium and plutonium; lead and beryllium; explosives such as TNT, RDX, and HMX; and barium nitrate. Some of this material remains in shafts on the mesa top. Further information about activities, Solid Waste Management Units, and Areas of Concern at Technical Area 49 can be found in Laboratory reports (LANL 2010a, 2010b).

In 2024, no constituents were found in Material Disposal Area AB monitoring group wells at concentrations above standards or screening levels.

White Rock Canyon Monitoring Group

This monitoring group includes springs and locations with perennial base flow (streams and rivers). The springs that flow along and near the Rio Grande in White Rock Canyon discharge mostly regional aquifer groundwater (Purtymun et al. 1980). A few springs appear to discharge perched intermediate groundwater. Some other springs could discharge a mixture of regional aquifer groundwater, perched intermediate groundwater, and percolation of recent precipitation (Longmire et al. 2007). The White Rock Canyon springs serve as important monitoring points for evaluating the Laboratory's potential to impact the Rio Grande (Figure 5-6).

In 2024, three constituents (iron, aluminum, and manganese) were detected above applicable groundwater standards or screening levels for this monitoring group. We had exceedances at two base flow sampling locations and one spring. Table 5-2 presents the date, location, constituent, sample result, and sample purpose for each recorded exceedance.

Table 5-2. Results that Exceeded Applicable Standards or Screening Levels in Spring and Perennial Base Flow Samples in White Rock Canyon in 2024

Location	Sample Date	Constituent Name	Sample Result (micrograms per liter)	Standard or Screening Level (micrograms per liter)	Sample Purpose
Sacred Spring	10/07/2024	Manganese	363	200	REG[a]
Rio Grande at Frijoles	10/02/2024	Iron	3,270[b]	1,000	REG
Rio Grande at Frijoles	10/02/2024	Aluminum	5,580	5,000	REG
Rio Grande at Otowi Bridge	04/18/2024	Iron	4,300; 1,850	1,000	REG, FD[c]

Location	Sample Date	Constituent Name	Sample Result (micrograms per liter)	Standard or Screening Level (micrograms per liter)	Sample Purpose
Rio Grande at Otowi Bridge	10/07/2024	Iron	2,130; 1,930	1,000	REG, FD
Rio Grande at Otowi Bridge	04/18/2024	Aluminum	7,370	5,000	REG

[a] REG = regular investigative sample
[b] The sample or laboratory duplicate result is <5 times the reporting limit, and the absolute difference between sample and duplicate result exceeds the limits.
[c] FD = field duplicate sample for quality assurance purposes

General Surveillance Monitoring

Wells and springs that are not assigned to one of the six area-specific monitoring groups and are not located in White Rock Canyon are sampled as part of our general surveillance monitoring of groundwater (Figure 5-24). Results, organized by watershed, from our general surveillance monitoring in 2024 are discussed in the following sections.

Los Alamos and Pueblo Canyons

Alluvial wells LAO-3a and LAUZ-1 in Los Alamos Canyon (Figure 5-24) continue to have strontium-90 concentrations above or near the U.S. Environmental Protection Agency's 8 picocuries per liter maximum contaminant level (Figure 5-25). Both locations have a steady declining trend for strontium-90. Alluvial well LAUZ-1 has been sampled only periodically since 2011; it was sampled in 2018, 2019, 2021, and 2022. The concentration of strontium-90 in well LAUZ-1 was 64.5 picocuries per liter in 2011, 18.6 picocuries per liter in 2019, 17.1 picocuries per liter in 2021, and 6.01 picocuries per liter in 2022. The source of the strontium-90 is Solid Waste Management Unit 21-011(k), which was an outfall from industrial waste treatment at Technical Area 21. Strontium-90 is persistent at this location and in several downgradient alluvial wells near the confluence of DP Canyon with Los Alamos Canyon, but it has not been migrating to alluvial locations farther down Los Alamos Canyon (LANL 2004).

At 94.0 nanograms per liter, alluvial well PAO-5n showed PFAS results above the New Mexico Environment Department tap water screening level of 60 nanograms per liter in 2024.

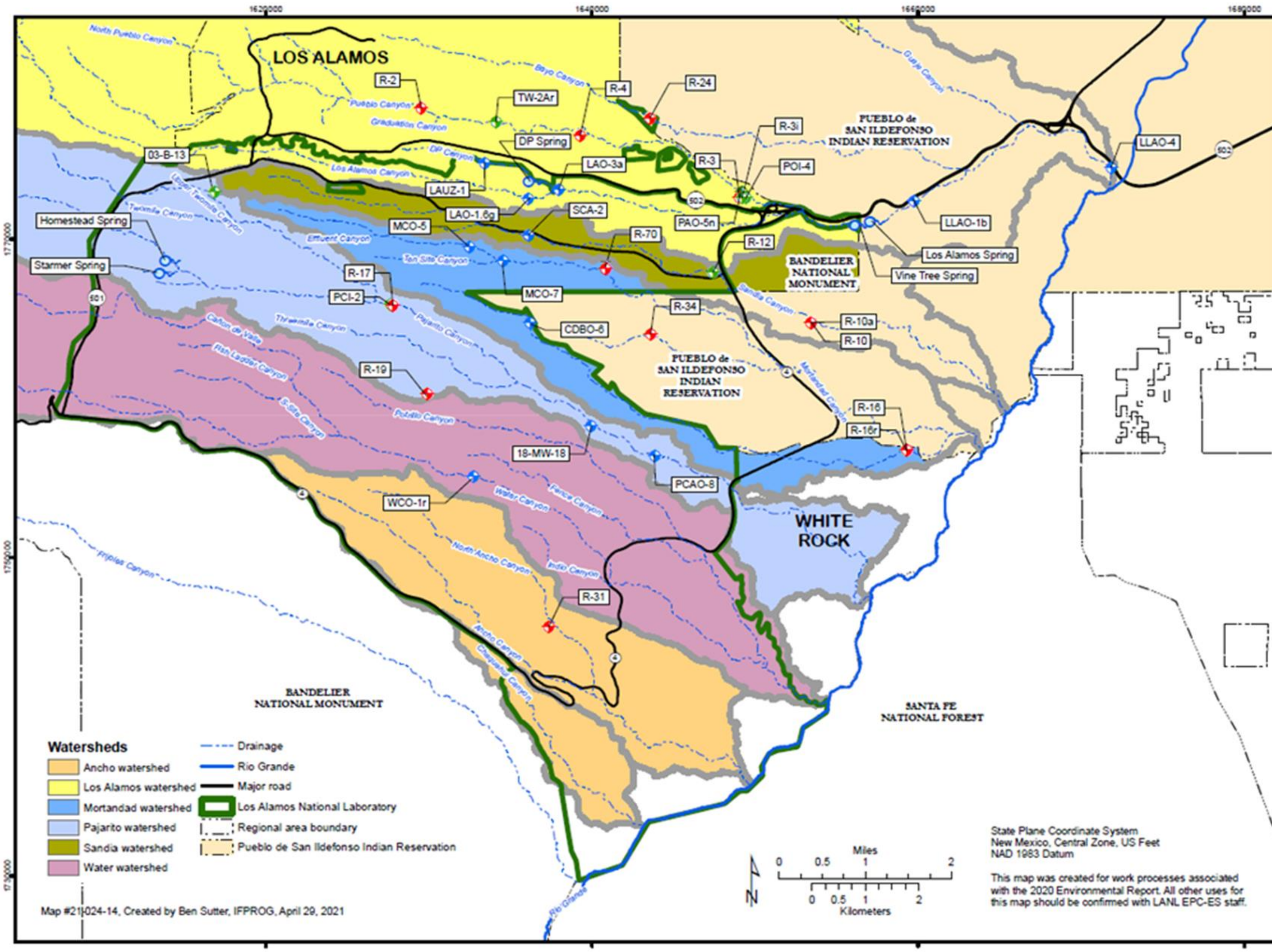

Figure 5-24. This map shows groundwater monitoring wells and springs in the General Surveillance monitoring group at Los Alamos National Laboratory. These wells and springs are not included within one of the six area-specific monitoring groups.

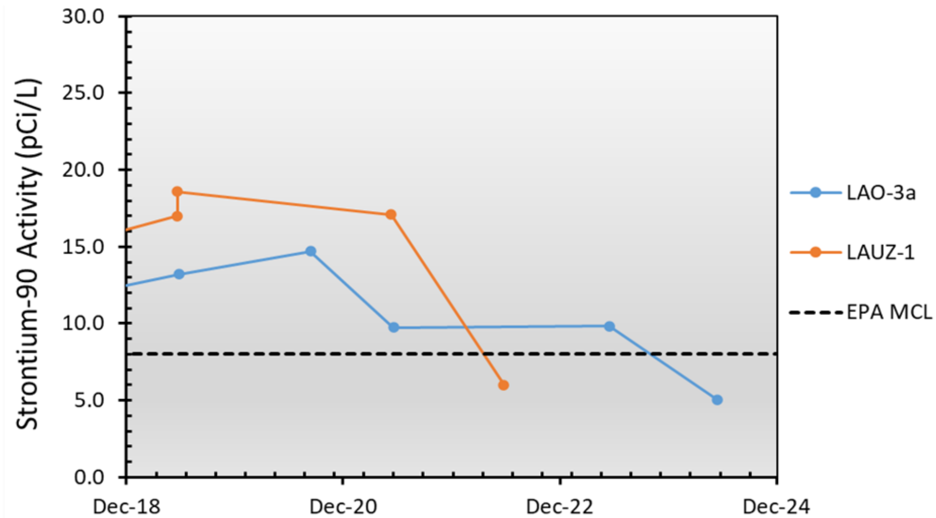

Figure 5-25. This graph shows strontium-90 levels at alluvial monitoring wells LAO-3a and LAUZ-1 in Los Alamos Canyon. The U.S. Environmental Protection Agency maximum contaminant level for strontium-90 in drinking water is 8 picocuries per liter (pCi/L). Both locations show a steady declining trend for strontium-90.

Lower Los Alamos Canyon

Vine Tree Spring on Pueblo de San Ildefonso land (Figure 5-24) discharges perched intermediate groundwater. Sampling at Vine Tree Spring began as a replacement for nearby Basalt Spring, which we had sampled since the 1950s until it dried up around 2010. Vine Tree Spring was not sampled in 2024 because black bears were in the area at the time of sampling. Previously observed perchlorate contamination could be associated with historical Laboratory operations (Figure 5-26). For context, the perchlorate values are below the risk-based screening level of 13.8 micrograms per liter. The screening level for perchlorate is determined according to a hierarchical data-screening process required under the Consent Order.

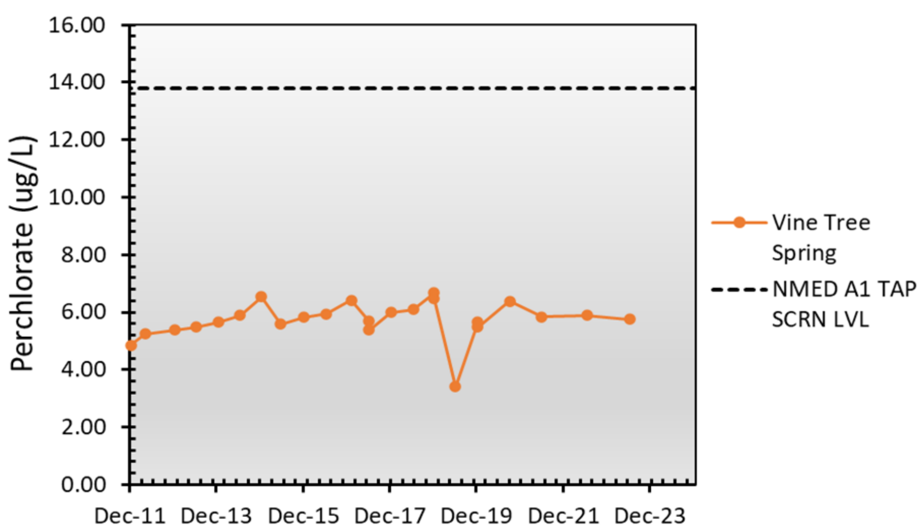

Figure 5-26. The graph shows perchlorate concentrations at Vine Tree Spring in Lower Los Alamos Canyon. The New Mexico risk-based screening level for perchlorate is 13.8 micrograms per liter (µg/L). The spring was not sampled in 2024.

Sandia Canyon

The wells located in Sandia Canyon that are not part of the Chromium Investigation monitoring group include regional aquifer wells R-10 and R-10a and perched intermediate well R-12. Wells R-10 and R-10a are located on Pueblo de San Ildefonso land. In 2024, R-10 and R-10a did not produce any analytical results above their respective screening levels from their tested samples. R-12 was not sampled for the 2024 monitoring year due to well maintenance.

Mortandad Canyon

Several regional aquifer wells in Mortandad Canyon are part of the General Surveillance monitoring group. No constituents in the regional aquifer during 2024 were measured above their respective screening levels for these wells.

As part of the requirements of groundwater discharge permit DP-1132 for the Technical Area 50 Radioactive Liquid Waste Treatment Facility, we collect quarterly and annual samples from seven alluvial, perched intermediate, and regional aquifer wells in Mortandad Canyon to monitor for impacts to groundwater, as discussed in Chapter 2 and later in this chapter.

Historically, we have detected perchlorate in alluvial monitoring wells MCO-4B, MCO-6, and MCO-7 (Figure 7-18). Due to insufficient water, MCO-4B has not been sampled since 2017. Starting in 2018, MCO-6 had results higher than the New Mexico tap water screening level of 13.8 micrograms per liter for perchlorate. In 2024, we were unable to sample MCO-4B, MCO-6, and MCO-7 due to insufficient water available at the time of sampling. Nitrate, fluoride, and total dissolved solids have historically been below applicable standards in these alluvial wells.

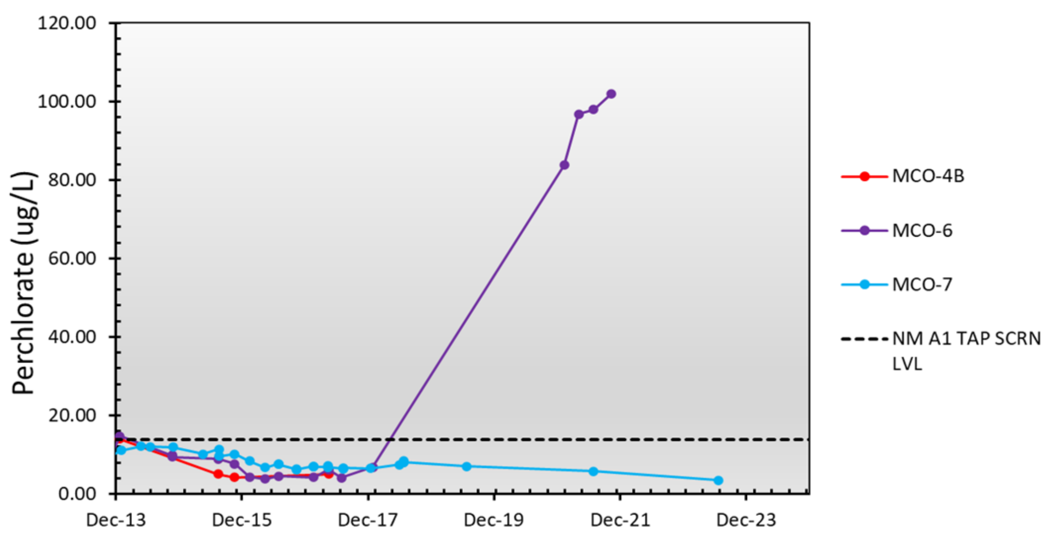

Figure 5-27. This graph shows perchlorate concentrations at General Surveillance monitoring group and groundwater discharge plan monitoring wells MCO-4B, MCO-6, and MCO-7 in Mortandad Canyon alluvial groundwater. The New Mexico tap water screening level for perchlorate is 13.8 micrograms per liter (µg/L). MCO-6 has recently shown results much higher than the New Mexico tap water screening level for perchlorate.

Cañada del Buey

Alluvial well CDBO-6 in Cañada del Buey was dry in 2024 and therefore not sampled.

Pajarito Canyon

The Pajarito Canyon watershed begins in the Sierra de los Valles, west of the Laboratory. Twomile Canyon and Threemile Canyon at the Laboratory are tributaries of Pajarito Canyon. Saturated alluvium is present in portions of Pajarito Canyon—including a reach in lower Pajarito Canyon—but does not extend beyond the site's eastern boundary. In the past, the Laboratory released small amounts of wastewater into tributaries of Pajarito Canyon from several high-explosives-processing sites at Technical Area 09. A nuclear materials experimental facility occupied the floor of Pajarito Canyon at Technical Area 18. Waste management areas at Technical Area 54 occupy the mesa north of the lower part of the canyon.

Solid Waste Management Unit 03-010(a) is the outfall area from a former vacuum repair shop behind a warehouse at Technical Area 03. The outfall area is located on a small tributary to Twomile Canyon. A small zone of shallow perched intermediate groundwater is present, apparently recharged by runoff from adjacent parking lots and building roofs. We sample this perched groundwater at a depth of approximately 21 feet below ground surface at well location 03-B-13. Historically, samples from 03-B-13 have contained 1,1,1-trichloroethane at concentrations below the New Mexico groundwater standard. In 2024, well 03-B-13 contained iron at 3,630 micrograms per liter, above the New Mexico groundwater standard for iron of 1,000 micrograms per liter. Aluminum was detected in 2024 at 6,190 micrograms per liter, above the New Mexico groundwater standard for aluminum of 5,000 micrograms per liter. In 2024, we detected 1,4-dioxane at 1.46 micrograms per liter in 03-B-13, below the 4.59-microgram-per-liter New Mexico groundwater standard. In accordance with the Interim Facility-Wide Groundwater Monitoring Plan (N3B 2023), we did not sample for 1,1,1-trichloroethane at this location in 2024.

Several other alluvial and perched intermediate groundwater and regional aquifer wells in Pajarito Canyon are part of the General Surveillance monitoring group. At alluvial well 18-MW-18, chloride was measured at 414 milligrams per liter, which was above the New Mexico groundwater standard of 250 milligrams per liter.

Water Canyon has only one General Surveillance monitoring group location: alluvial well WCO-1r. In 2024, the well was unable to be sampled due to insufficient water. During the previous sampling event in 2019, iron was detected at 1,560 micrograms per liter, which is above the 1,000 micrograms per liter New Mexico groundwater standard.

Groundwater Discharge Permit Monitoring

We collect samples from wells MCA-RLW-1, MCA-RLW-2, MCOI-6, SCA-3, SCI-1, R-1, R-14 screen 1, R-46, and R-60 to meet monitoring requirements for groundwater discharge permits referenced in Chapter 2 of the ASER. Alluvial wells MCA-RLW-1, MCA-RLW-2, and SCA-3 were dry during the monitoring period in 2024. Constituents identified in the groundwater discharge permits were measured above applicable standards or screening levels in some wells in 2024, as discussed in Chromium Investigation Monitoring Group of this report. Several constituents related to historical operations were detected in perched/intermediate aquifer well MCOI-6; some of these constituents measured above applicable standards or screening levels, as presented in Chromium Investigation Monitoring Group.

Summary—PFAS Monitoring Results

PFAS are manufactured compounds used in various industrial, commercial, and consumer applications. Three PFAS compounds are currently identified as toxic pollutants under Ground and Surface Water Protection, Title 20, Chapter 6, Part 2 of the New Mexico Administrative Code: perfluorohexanesulfonic acid, perfluorooctanoic acid, and perfluorooctanesulfonic acid. Before June 2022, the New Mexico regulatory standard for PFAS in groundwater was 70 nanograms per liter for the combined total concentration of the three PFAS compounds. As of June 2022, the regulatory standards for the PFAS compounds in groundwater are 401 nanograms per liter for perfluorohexanesulfonic acid, 60 nanograms per liter for perfluorooctanoic acid, and 60 nanograms per liter for perfluorooctanesulfonic acid.

During 2020 and 2021, we tested for these three PFAS compounds at all groundwater monitoring locations identified in those years' Interim Facility-Wide Groundwater Monitoring Plans. During 2022 and 2023, we tested for PFAS compounds only at locations where two rounds of PFAS sampling had not been completed or where PFAS compounds had been detected. For 2024, we again tested for PFAS at all groundwater monitoring locations. Table 5-3 provides the 2024 results for these three PFAS compounds in groundwater and perennial base flow. Two results are listed for locations where duplicate samples were taken and both the regular sample and duplicate had detections.

Table 5-3. PFAS Results for 2024 in Groundwater and Perennial Base Flow

Canyon	Location (well, spring, or perennial base flow sampling site)	Water Source	Sample Date	Perfluorooctanesulfonic acid (nanograms per liter)	Perfluorooctanoic acid (nanograms per liter)	Perfluorohexanesulfonic acid (nanograms per liter)	Sample Purpose[a]
Technical Area 21 Monitoring Group							
Los Alamos	LAOI-3.2	Intermediate groundwater	9/04/2024	ND[a]	1.96	ND	REG[b]
Los Alamos	R-9i S1	Intermediate groundwater	9/05/2024	12.4	7.38	17.8	REG
Sandia	TA-53i	Intermediate groundwater	9/24/2024	ND	ND	1.56 J[c] 1.55 J	REG FD[d]
Chromium Investigation Monitoring Group							
Mortandad	R-72 S1	Regional groundwater	5/15/2024	23.8	11.2	1.97	REG
Technical Area 16-260 Monitoring Group							
Water	16-61439 (PRB Alluvial Seep)	Spring	3/14/2024	ND	ND	5.26	REG
Pajarito	Bulldog Spring	Spring	3/13/2024	6.69	4.21	0.846 J	REG
Water	Burning Ground Spring	Spring	3/02/2024	ND	ND	0.959 J	REG

Canyon	Location (well, spring, or perennial base flow sampling site)	Water Source	Sample Date	Perfluorooctanesulfonic acid (nanograms per liter)	Perfluorooctanoic acid (nanograms per liter)	Perfluorohexanesulfonic acid (nanograms per liter)	Sample Purpose[a]
Water	CdV-16-02659	Alluvial groundwater	3/11/2024	ND	9.44	ND	REG
Water	CdV-16-2(i)r	Intermediate groundwater	3/07/2024	ND	9.96	ND	REG
Water	CdV-16-4ip S1	Intermediate groundwater	3/05/2024	ND	9.98	ND	REG
Water	CdV-16-611923	Alluvial groundwater	3/14/2024	ND	4.89	ND	REG
Water	CdV-16-611937	Alluvial groundwater	3/12/2024	ND	1.41	ND	REG
Water	CdV-9-1(i) S1	Intermediate groundwater	2/28/2024	ND	4.46	ND	REG
Water	Pajarito below S&N Ancho E Basin Confluence	Perennial baseflow	3/13/2024	1.76	ND	ND	REG
Water	R-69 S1	Regional groundwater	2/27/2024	ND	1.67 J	ND	REG
Water	R-69 S2	Regional groundwater	2/27/2024	ND	1.34 J	ND	REG
General Surveillance Monitoring Group							
Pajarito	03-B-13	Intermediate groundwater	9/10/2024	2.51	1.76 J	ND	REG
Pajarito	18-MW-18	Alluvial groundwater	9/19/2024	10.2	26.5	21.7	REG
Los Alamos	LAO-3a	Alluvial groundwater	6/10/2024	8.7	9.49	43.4	REG
Los Alamos	LLAO-4	Alluvial groundwater	6/11/2024	2.23	1.85	1.96	REG
Pueblo	PAO-5n	Alluvial groundwater	6/07/2024	94.0	25.5	5.91	REG
Pueblo	POI-4	Intermediate groundwater	6/07/2024	10.1	40.1	19.6	REG
Pueblo	R-2	Regional groundwater	6/05/2024	1.67	2.5	ND	REG
Pueblo	R-3i	Intermediate groundwater	6/04/2024	13.5 14.6	38.4 38.8	14.3 14.5	REG

Canyon	Location (well, spring, or perennial base flow sampling site)	Water Source	Sample Date	Perfluorooctanesulfonic acid (nanograms per liter)	Perfluorooctanoic acid (nanograms per liter)	Perfluorohexanesulfonic acid (nanograms per liter)	Sample Purpose[a]
Pueblo	TW-2Ar	Intermediate groundwater	6/20/2024	ND	1.19 J	2.4	REG
Sandia	Sandia below Wetlands	Baseflow	7/23/2024	22.3	7.73	3.72 J	REG
Sandia	Sandia right fork at Pwr Plant	Baseflow	7/23/2024	4.46	3.99	1.19	REG
Sandia	South Fork of Sandia at E122	Baseflow	7/30/2024	1.14 J 1.12 J	ND	ND	REG FD
MDA AB Monitoring Group							
Water/CdV	R-27	Regional groundwater	8/14/2024	ND	0.854 J	ND	REG

[a] ND = constituent not detected in the sample
[b] REG = regular investigative sample
[c] J = constituent is classified as detected, but the reported concentration value is expected to be more uncertain than usual because the value is under the practical quantitation limit
[d] FD = field duplicate

Quality Assurance

The 2024 Interim Facility-Wide Groundwater Monitoring Plan (N3B 2023) and the 2025 Interim Facility-Wide Groundwater Monitoring Plan (N3B 2024) document all methods and procedures used to perform the field activities associated with these data.

Sampling and data validation were conducted using standard operating procedures that are part of a comprehensive quality assurance program. For a comprehensive list of these standard operating procedures, refer to Appendix B of the 2024 Interim Facility-Wide Groundwater Monitoring Plan (N3B 2023).

Analytical results meet the N3B minimum data quality objectives as outlined in N3B-PLN-SDM-1000, Sample and Data Management Plan, which sets the validation frequency criteria at 100 percent Level 1 examination and Level 2 verification of data and at 10 percent minimum Level 3 validation of data.

- A Level 1 examination assesses the completeness of the data as delivered from the analytical laboratory, identifies any reporting errors, and checks the usability of the data based on the analytical laboratory’s evaluation of the data.
- A Level 2 verification evaluates the data to determine the extent to which the laboratory met the analytical method and the contract-specific quality control and reporting requirements.

- A Level 3 validation includes Levels 1 and 2 criteria and determines the effect of potential anomalies encountered during analysis and possible effects on data quality and usability. A Level 3 validation is performed manually with method-specific data validation procedures.

N3B personnel validate laboratory analytical data as outlined in N3B-PLN-SDM-1000; N3B-AP-SDM-3000, General Guidelines for Data Validation; N3B-AP-SDM-3014, Examination and Verification of Analytical Data; and additional method-specific analytical data validation procedures. All associated validation procedures have been developed, where applicable, from the U.S. Environmental Protection Agency document EPA QA/G-8, Guidance on Environmental Data Verification and Data Validation, the Department of Defense/ Department of Energy Consolidated Quality Systems Manual for Environmental Laboratories, the U.S. Environmental Protection Agency National Functional Guidelines for Data Validation, and the American National Standards Institute/American Nuclear Society 41.5-2012 (R2018), Verification and Validation of Radiological Data for Use in Waste Management and Environmental Remediation.

The N3B Groundwater Sampling SOP N3B-SOP-ER-3003 is used by sampling personnel when collecting PFAS samples.

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Chapter 6: Watershed Quality

Introduction

In the early years of site operations, unregulated liquid wastes that contained radionuclides, inorganic chemicals, and organic chemicals were released into nearby canyons. Efforts to reduce contaminants in these effluents began in the 1950s. Since 1978, all effluent discharges at the site have been conducted under regulatory permits and are treated to meet permit conditions.

Not all chemicals found in local stormwater and sediment come from site operations. Other sources include

- the natural composition of rocks and soils,
- residues from trees burned in wildfires,
- deposition of airborne radionuclides and chemicals such as polychlorinated biphenyls (PCBs), and
- discharges or emissions from nearby towns on the Pajarito Plateau.

Both natural and manufactured sources contribute to the levels of chemicals and radionuclides measured in surface water and sediment across the region. We monitor levels of chemical and radionuclides in surface water and sediment for two main reasons: to assess water quality in streams within and downstream of the site and to evaluate the potential risks to human and ecosystem health.

We compare our sampling results to

- New Mexico water quality standards,
- target action levels,
- radiological dose guidelines, and
- screening criteria for human and ecological health.

Target action levels are set in the Storm Water Individual Permit for stormwater discharges from Solid Waste Management Units and Areas of Concern. (Refer to Chapter 2 for more information about the permit.)

The data in this chapter come from three site programs:

- Annual environmental surveillance sampling of stormwater runoff and sediment (N3B 2024a, N3B 2025a, N3B 2025b)
- Implementation of the annual Interim Facility-Wide Groundwater Monitoring Plans, which includes sampling of persistent surface water in streams (N3B 2023, N3B 2024b)
- Stormwater runoff monitoring conducted under the Storm Water Individual Permit (N3B 2025c)

Hydrologic Setting

The LANL site includes all or parts of seven major watersheds that drain into the Rio Grande (Figure 6-1). Each watershed is named after its primary canyon. Listed from north to south, the major watersheds are Los Alamos, Sandia, Mortandad, Pajarito, Water, Ancho, and Chaquehui.

The headwaters of the Los Alamos, Pajarito, and Water canyon watersheds are located west of the site in the Jemez Mountains. The remaining watersheds originate on the Pajarito Plateau. Ancho Canyon watershed is the only watershed located entirely within site boundaries.

Sources of surface water in these watersheds include snowmelt, stormwater runoff, effluent discharges, and springs. Some springs on the edge of the Jemez Mountains supply perennial water to western sections of some canyons, but no year-round surface water flows cross to the downstream site boundary.

State of New Mexico Designated Uses and Assessments of Stream Reaches

The New Mexico Water Quality Control Commission defines designated uses for stream reaches in the state and establishes surface water quality standards that support each of these uses in Standards for Interstate and Intrastate Surface Waters, Title 20, Chapter 6, Part 4, of the New Mexico Administrative Code. The current standards for designated uses are available online at https://www.env.nm.gov/surface-water-quality/wqs/.

The New Mexico Environment Department's Surface Water Quality Bureau uses surface water sampling results to evaluate if stream reaches are impaired for their designated use(s) under Section 303(d) of the Clean Water Act. They update the list of impaired stream reaches, including those on Laboratory property, every 2 years (New Mexico Environment Department 2024a).

Each stream reach is divided into multiple assessment units. On the Laboratory site, each assessment unit has been assigned one or more of the following designated uses based on its characteristics: cold water aquatic life, marginal warm water aquatic life, limited aquatic life, livestock watering, wildlife habitat, primary (human) contact, secondary (human) contact, and human health-organism only.

Terms Related to Surface Water

Base flow – The portion of a perennial stream's flow that is sustained between precipitation events

Effluent – Water that results from industrial processes that is discharged to the environment

Floodplain – An area of land adjacent to a stream that could receive water when the stream floods

Monsoonal and Tropical Storm periods – The time period in New Mexico (summer through fall) when rain and thunderstorms can increase because of monsoon and tropical storm weather patterns that move moist air into the state

Runoff – Water that flows across the surface of the land, generally into stream channels or lakes

Snowmelt – The runoff that results from the melting of winter snowpack

Stormwater – Surface water that comes as runoff from rain and snowmelt events

Stream reach – A section of a stream or river along which similar hydrologic conditions exist, such as discharge, depth, area, geology, and slope

Surface water – Water on the surface of a continent, such as in a river, lake, or wetland

Watershed – The area of land that contributes water flow to a particular stream or river

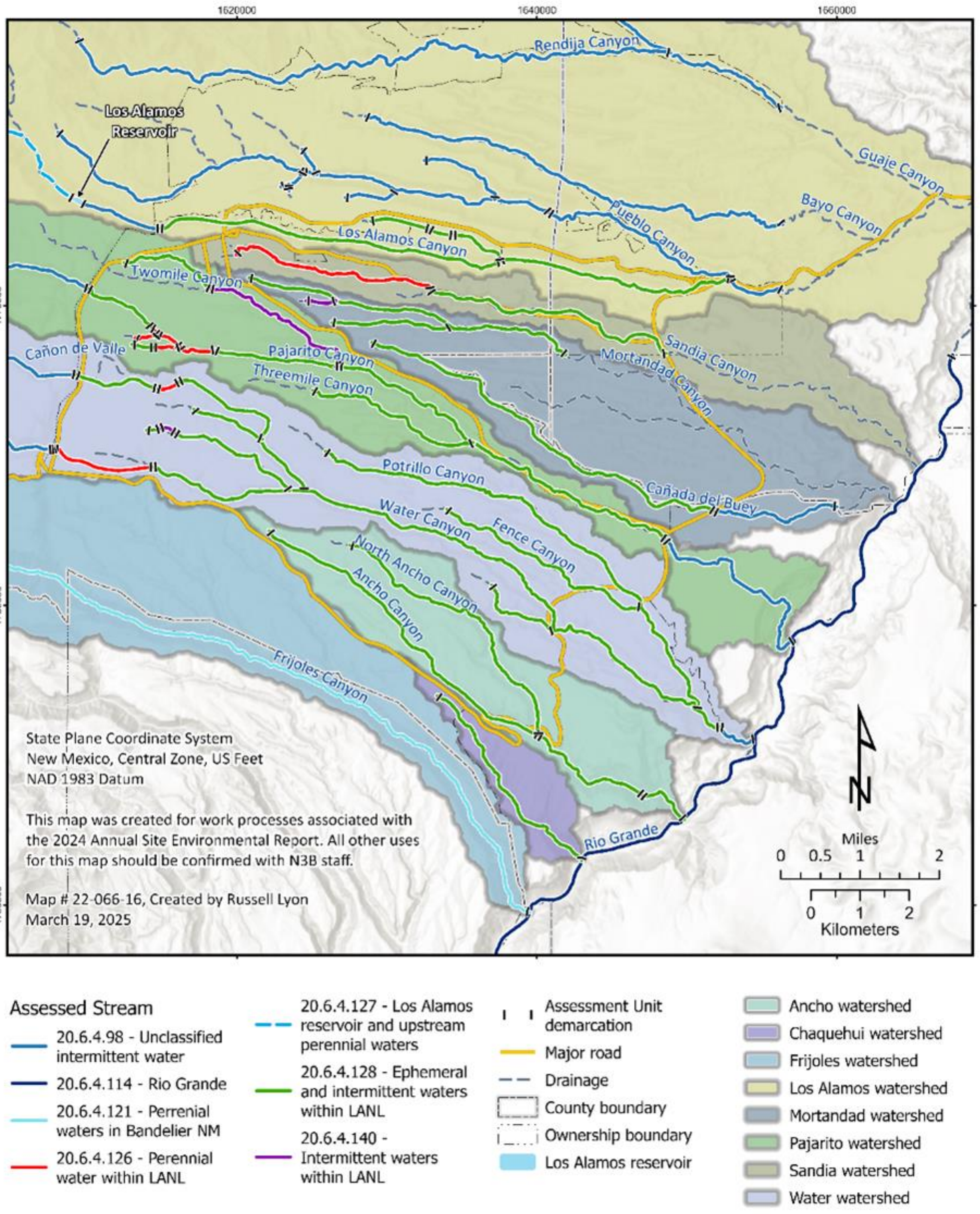


Figure 6-1. Stream reaches and watersheds within and around the Laboratory. Map shows the classifications of streams from Standards for Interstate and Intrastate Surface Waters, Title 20, Chapter 6, Part 4, of the New Mexico Administrative Code.

What is success in attaining the different designated uses?

- Cold Water Aquatic Life – The water can support a coldwater aquatic life community.
- Human Health-Organism Only – The water quality protects the health of humans who eat fish or other aquatic wildlife.
- Limited Aquatic Life – The water can support a very limited aquatic life community.
- Livestock Watering – The water can be safely used as a drinking water source for livestock.
- Marginal Warm Water Aquatic Life – The water can support a limited warmwater aquatic life community.
- Primary Contact – The water quality is suitable for activities that involve prolonged human contact with the water, such as swimming and water skiing.
- Secondary Contact – The water quality is suitable for activities that involve limited human contact with the water, such as fishing and boating.
- Wildlife Habitat – The water quality is suitable to support land-based plant and animal life in the surrounding environment.

Some designated-use standards for protection of aquatic life include both acute and chronic criteria. Acute criteria are based on toxicity to aquatic life that occurs within 96 hours, and chronic criteria are based on protecting aquatic life from long-term exposures.

An assessment unit is considered impaired when it fails to meet one or more of the standards based on its designated uses. Figure 6-1 shows the locations of assessment units on and around the site, and Table 6-1 lists the status of each designated use (supported, not supported, or not assessed) for each assessment unit, along with the identified cause of impairment. The New Mexico Environment Department's 2024–2026 report removed copper as a cause of impairment in Sandia Canyon (Sigma Canyon to NPDES Outfall 001; New Mexico Environment Department 2024a).

Table 6-1. LANL Site Assessment Units, Impairment Cause, and Designated Uses Supported, Not Supported, or Not Assessed during 2024–2026

Assessment Unit	Designated Use Supported	Designated Use Not Supported	Designated Use Not Assessed	Impairment Causes
Acid Canyon (Pueblo Canyon to headwaters)	None	Wildlife habitat, livestock watering, marginal warm water aquatic life	Primary contact	Gross alpha,[a] aluminum, PCBs,[b] copper
Ancho Canyon (above Ancho Springs to North Fork Ancho)	Livestock watering	Limited aquatic life, wildlife habitat	Secondary contact	PCBs, mercury
Ancho Canyon (North Fork to headwaters)	Wildlife habitat	Limited aquatic life	Secondary contact, livestock watering	PCBs
Ancho Canyon (Rio Grande to Ancho Springs)	Livestock watering	Limited aquatic life, wildlife habitat	Secondary contact	PCBs, mercury

Assessment Unit	Designated Use Supported	Designated Use Not Supported	Designated Use Not Assessed	Impairment Causes
Arroyo de la Delfe (above Kieling Spring to headwaters)	None	Limited aquatic life, livestock watering, wildlife habitat	Secondary contact	Copper, PCBs, aluminum, gross alpha
Arroyo de la Delfe (Pajarito Canyon to Kieling Spring)	None	Limited aquatic life, livestock watering, wildlife habitat	Secondary contact	Copper, PCBs, aluminum, gross alpha
Cañada del Buey (within LANL)	None	Limited aquatic life, livestock watering	Secondary contact, wildlife habitat	PCBs, gross alpha
Cañon de Valle (below LANL gage E256)	Wildlife habitat, limited aquatic life	Livestock watering	Secondary contact	Gross alpha
Cañon de Valle (LANL gage E256 to Burning Ground Spring)	Livestock watering	Cold water aquatic life, wildlife habitat	Secondary contact	PCBs
Cañon de Valle (upper LANL boundary to headwaters)	Wildlife habitat	Marginal warm water aquatic life, livestock watering	Primary contact	Gross alpha, PCBs
Cañon de Valle (within LANL above Burning Ground Spring)	Not applicable	Not applicable	Livestock watering, limited aquatic life, wildlife habitat, secondary contact	Not assessed
Chaquehui Canyon (within LANL)	Wildlife habitat, livestock watering	Limited aquatic life	Secondary contact	PCBs
DP Canyon (100 meters downstream of grade control to 400 meters upstream of grade control)	None	Livestock watering, limited aquatic life, wildlife habitat	Secondary contact	Copper, PCBs, aluminum, gross alpha
DP Canyon (400 meters upstream of grade control to upper LANL boundary)	None	Livestock watering, limited aquatic life, wildlife habitat	Secondary contact	Copper, PCBs, aluminum, gross alpha
DP Canyon (Los Alamos Canyon to 100 meters downstream of grade control)	None	Livestock watering, limited aquatic life, wildlife habitat	Secondary contact	PCBs, aluminum, gross alpha
Fence Canyon (above Potrillo Canyon)	Not applicable	Not applicable	Livestock watering, limited aquatic life, wildlife habitat, secondary contact	Not assessed

Assessment Unit	Designated Use Supported	Designated Use Not Supported	Designated Use Not Assessed	Impairment Causes
Graduation Canyon (Pueblo Canyon to headwaters)	Livestock watering	Wildlife habitat, marginal warm water aquatic life	Primary contact	Copper, PCBs
Indio Canyon (above Water Canyon)	Not applicable	Not applicable	Livestock watering, limited aquatic life, wildlife habitat, secondary contact	Not assessed
Kwage Canyon (Pueblo Canyon to headwaters)	Not applicable	Not applicable	Primary contact, wildlife habitat, livestock watering, marginal warm water aquatic life	Not assessed
Los Alamos Canyon (DP Canyon to upper LANL boundary)	None	Livestock watering, limited aquatic life, wildlife habitat	Secondary contact	PCBs, cyanide, selenium, gross alpha, mercury
Los Alamos Canyon (New Mexico Route 4 to DP Canyon)	None	Livestock watering, limited aquatic life, wildlife habitat	Secondary contact	Aluminum, PCBs, cyanide, radium, gross alpha, selenium
Mortandad Canyon (within LANL)	None	Livestock watering, limited aquatic life, wildlife habitat	Secondary contact	Copper, gross alpha, PCBs
North Fork Ancho Canyon (Ancho Canyon to headwaters)	None	Livestock watering, limited aquatic life, wildlife habitat	Secondary contact	Gross alpha, PCBs
Pajarito Canyon (Arroyo de La Delfe to Starmers Gulch)	Livestock watering, cold water aquatic life, wildlife habitat	None	Secondary contact	None
Pajarito Canyon (lower LANL boundary to Twomile Canyon)	None	Wildlife habitat, limited aquatic life, livestock watering	Secondary contact	Aluminum, PCBs, copper, gross alpha, cyanide
Pajarito Canyon (Twomile Canyon to 0.5 mi downstream of Arroyo de la Delfe)	Wildlife habitat	Limited aquatic life, livestock watering	Secondary contact	PCBs, silver, copper, gross alpha
Pajarito Canyon (0.5 mi downstream of and to Arroyo de La Delfe)	Wildlife habitat	Livestock watering, coldwater aquatic life	Secondary contact	PCBs, silver, copper, gross alpha
Pajarito Canyon (upper LANL boundary to headwaters)	None	Warm water aquatic life, livestock watering, wildlife habitat	Primary contact	Gross alpha, cyanide, PCBs, aluminum, mercury

Assessment Unit	Designated Use Supported	Designated Use Not Supported	Designated Use Not Assessed	Impairment Causes
Pajarito Canyon (Starmers Gulch to Homestead Spring)	Wildlife habitat	Livestock watering, coldwater aquatic life	Secondary contact	Aluminum, gross alpha
Potrillo Canyon (above Water Canyon)	Limited aquatic life, wildlife habitat	Livestock watering	Secondary contact	Gross alpha
Pueblo Canyon (Acid Canyon to headwaters)	None	Marginal warm water aquatic life, livestock watering, wildlife habitat	Primary contact	Gross alpha, PCBs, copper, aluminum
Pueblo Canyon (Los Alamos Canyon to Los Alamos Waste Water Treatment Plant)	None	Marginal warm water aquatic life, livestock watering, wildlife habitat	Primary contact	Gross alpha, aluminum, PCBs, selenium
Pueblo Canyon (Los Alamos Waste Water Treatment Plant to Acid Canyon)	None	Marginal warm water aquatic life, livestock watering, wildlife habitat	Primary contact	Gross alpha, PCBs
Sandia Canyon (Sigma Canyon to National Pollutant Discharge Elimination System Outfall 001)	Livestock watering	Wildlife habitat, cold water aquatic life	Secondary contact	PCBs, aluminum,[c] temperature
Sandia Canyon (within LANL below Sigma Canyon)	None	Livestock watering, limited aquatic life, wildlife habitat	Secondary contact	PCBs, aluminum,[c] gross alpha, mercury,[c] copper[c]
South Fork Acid Canyon (Acid Canyon to headwaters)	None	Marginal warm water aquatic life, livestock watering, wildlife habitat	Primary contact	Gross alpha, copper, PCBs
Ten Site Canyon (Mortandad Canyon to headwaters)	None	Livestock watering, limited aquatic life, wildlife habitat	Secondary contact	PCBs, gross alpha
Three Mile Canyon (Pajarito Canyon to headwaters)	Limited aquatic life, wildlife habitat	Livestock watering	Secondary contact	Gross alpha
Twomile Canyon (Pajarito Canyon to Upper Twomile Canyon)	None	Livestock watering, limited aquatic life, wildlife habitat	Secondary contact	PCBs, aluminum, copper, gross alpha
Twomile Canyon (Upper Twomile canyon to headwaters)	None	Livestock watering, limited aquatic life, wildlife habitat	Secondary contact	PCBs, aluminum, copper, gross alpha

Assessment Unit	Designated Use Supported	Designated Use Not Supported	Designated Use Not Assessed	Impairment Causes
Walnut Canyon (Pueblo Canyon to headwaters)	Livestock watering, wildlife habitat	Marginal warm water aquatic life	Primary contact	PCBs, copper
Water Canyon (Area A Canyon to New Mexico Route 501)	Cold water aquatic life, livestock watering, wildlife habitat	None	Secondary contact	None
Water Canyon (within LANL above New Mexico Route 501)	Not applicable	Not applicable	Livestock watering, limited aquatic life, wildlife habitat, secondary contact	Not assessed
Water Canyon (within LANL below Area A Canyon)	None	Livestock watering, limited aquatic life, wildlife habitat	Secondary contact	PCBs, aluminum, gross alpha, mercury

[a] Gross alpha levels in surface water samples are currently not adjusted to remove sources of radioactivity from source, special nuclear, or byproduct material regulated by DOE under the Atomic Energy Act of 1954.
[b] PCBs are total PCBs in the water column.
[c] We submitted a third-party IR Category 4b demonstration titled "Sandia Canyon Assessment Unit NM-9000.A_047 and NM-128.A_11 Dissolved Copper, Mercury and Total Recoverable Aluminum 4B Demonstration" (https://www.env.nm.gov/surface-water-quality/303d-305b/). Accordingly, the associated aluminum and copper listings in this assessment unit are noted as IR Category 4B.

Watershed Protection Measures

To minimize the migration of sediment and contaminants through erosion and stormwater flow, we have worked with regulators and stakeholders to design and implement engineered controls. We have installed stormwater control structures based on regulatory requirements, site conditions, post-fire flooding risks, and best management practices. These controls are an integral component of stormwater management at the LANL site.

Institutional Surface Water Controls

Triad manages stormwater control structures at the LANL site that are not associated with the Consent Order or Storm Water Individual Permit activities. The site's infrastructure and property face perennial risks from erosion and flooding. Stormwater controls designed to protect infrastructure are often built alongside new facilities to maintain pre-development runoff levels. Additional controls—located in canyon bottoms or at road crossings—are designed to reduce risk to downstream facilities and infrastructure.

Nearly 200 engineered stormwater management features have been installed at the LANL site to reduce runoff impacts and to control sediment transport. Although some of these controls were constructed to meet regulatory requirements, no single permit or regulation governs the ongoing maintenance and functionality of these features. Recognizing the need to ensure that these controls can perform their designed function, we have integrated their management into existing systems, ensuring their long-term management.

Surface Water and Sediment Sampling

Surface Water Sampling Locations and Methods

We operate 38 stream gaging stations on and near the Laboratory, 36 of which have automated samplers to collect stormwater. Additionally, we collect samples at eight other stream channel locations. These sampling locations are chosen to monitor surface water flow that enters and leaves the Laboratory and former Laboratory lands, as well as at canyon confluences.

The number of gaging stations and stream channel sampling locations remains fairly constant over time; however, not all gaging stations or channel sampling locations experience stormwater flow in any given year. As a result, the number of locations where samples are collected can vary widely from year to year.

The automated samplers at gaging stations are programmed to begin collecting water 10 minutes after the peak flow during a runoff event, a method known as “Peak + 10.” The year 2024 marks the fourteenth year of employing the Peak + 10 sampling method at these stations. This approach was implemented in response to feedback from the New Mexico Environment Department, which noted that water samples collected before the peak of the storm flow were highly variable and not ideal for monitoring contaminant and sediment transport. Before this change—from 2004 to 2010—samples were collected at the peak of the runoff event. As a result, current stormwater sampling results are not directly comparable to data collected before 2011.

To meet monitoring requirements under the Storm Water Individual Permit, we have deployed water samplers in 239 site monitoring areas to collect stormwater runoff from 397 Solid Waste Management Units and Areas of Concern. Because rainfall on the Pajarito Plateau is often highly localized, not all active Storm Water Individual Permit samplers collect samples each year. These samplers do not operate during months that have freezing temperatures.

Water discharged directly from springs is regulated under groundwater standards and is discussed in Chapter 5. Water from springs that has infiltrated into canyon bottoms and has resurfaced as base flow is regulated under surface water standards. We collected grab samples of base flow at locations identified in the “Interim Facility-Wide Groundwater Monitoring Plan for the 2024 Monitoring Year, October 2023–September 2024” and the “Interim Facility-Wide Groundwater Monitoring Plan for the 2025 Monitoring Year, October 2024–September 2025” (N3B 2023, N3B 2024b).

Figure 6-2 shows locations where we collected samples in 2024 for stormwater at stream gaging stations and for base flow. Figure 6-3 shows Storm Water Individual Permit site monitoring areas where we collected compliance samples in 2024. We collected 57 compliance samples from 32 Storm Water Individual Permit site monitoring areas and 1 per- and polyfluoroalkyl substances (PFAS) sample at each site monitoring area PJ-SMA-5 and W-SMA-8 in 2024.

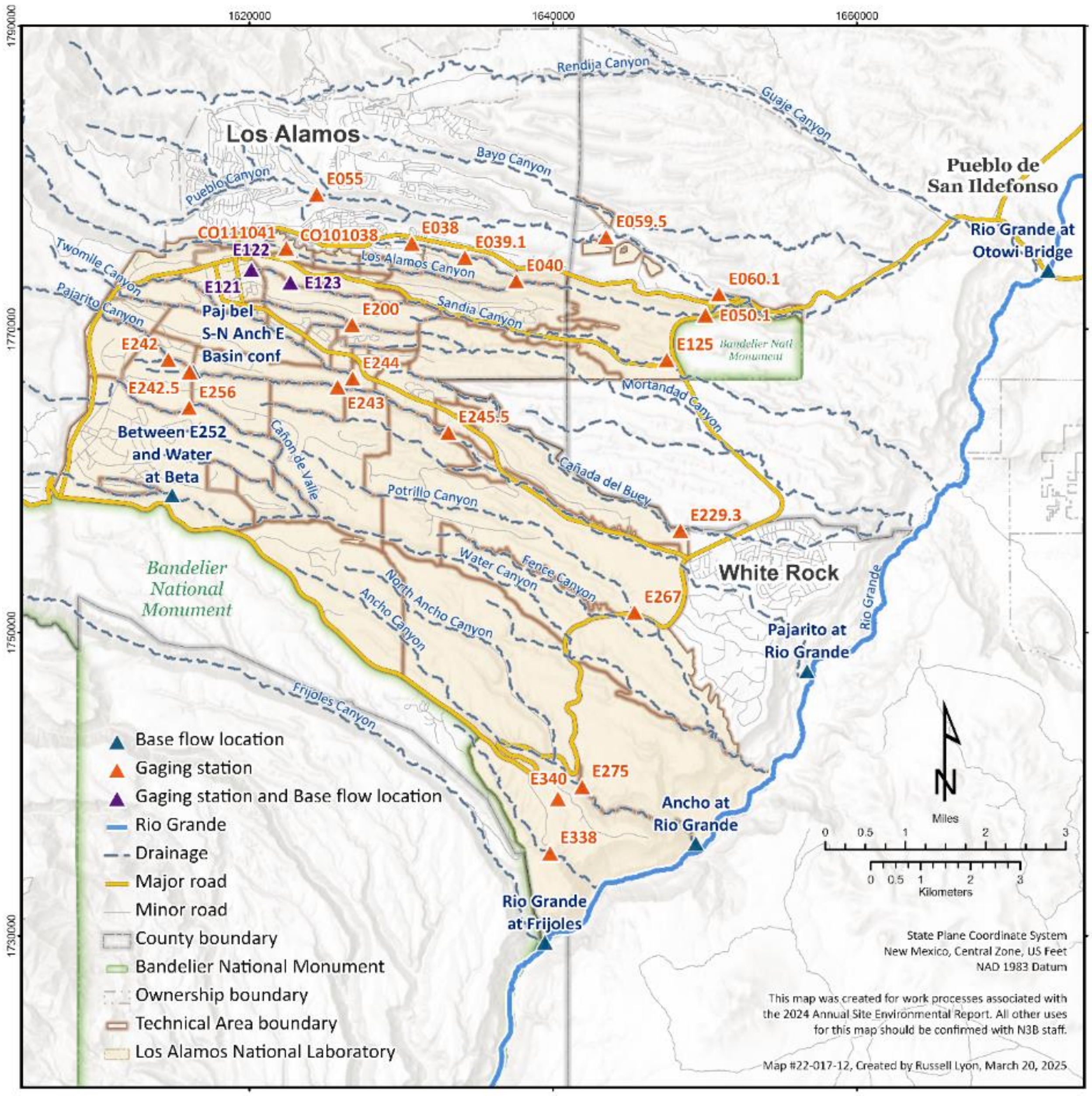
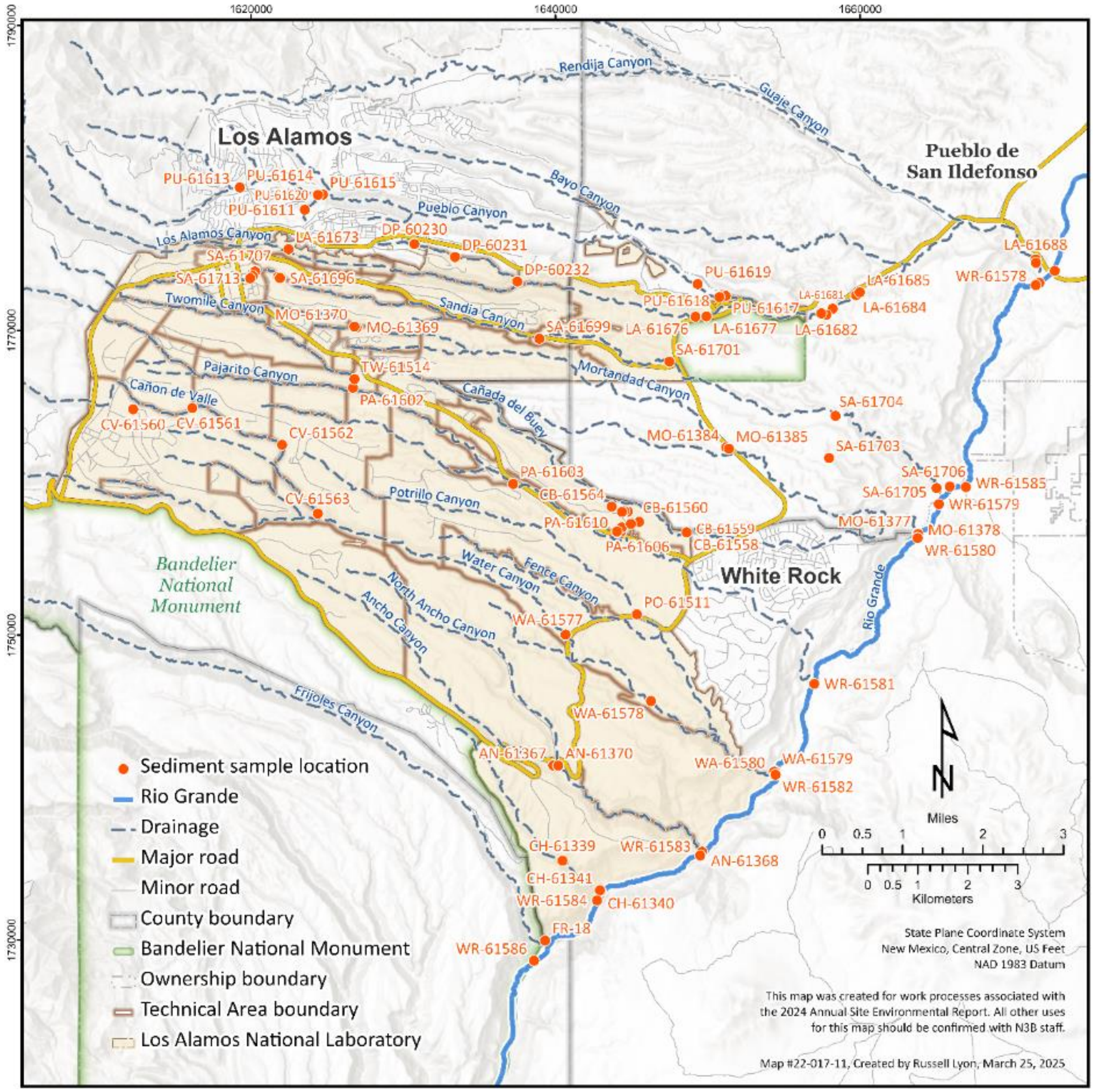


Figure 6-2. Locations sampled in 2024 at stream gaging stations and for base flow.

Figure 6-3. Storm Water Individual Permit (IP) site monitoring areas where automated samplers collected stormwater samples in 2024.

Sediment Sampling Locations and Methods

For the LANL site, we define sediment as any soil that is either suspended in water or deposited by surface water flow. Figure 6-4 shows locations sampled for sediment in 2024. We collected samples at depths that ranged from 0 to 1 inch, depending on the thickness of the uppermost sediment layer. Samples were taken from stream channels and floodplains where new sediment had been deposited during 2024. For streams with flowing water, sediment samples were collected near the edge of the main channel, adjacent to but not in the water. In 2024, stormwater runoff occurred in every canyon, allowing for sediment sampling across all major watersheds.



MDA = Material disposal area; RG = Rio Grande; BLW = below; @ = at; LA = Los Alamos Canyon; P = Pueblo Canyon; A or AN = Ancho Canyon; AC = Acid Canyon; S = Sandia Canyon; WA = Water Canyon; ABV = above; CdB = Cañada del Buey; PA = Pajarito Canyon; M or Mort = Mortandad Canyon; BKG = background; I = Indio Canyon

Figure 6-4. Locations sampled for sediment in 2024 as part of the annual environmental surveillance program.

Surface Water Screening Levels

We follow a protocol published by the New Mexico Environment Department to assess if surface waters meet assigned state standards (New Mexico Environment Department 2021). Hardness-dependent aquatic life criteria for metals are calculated using water hardness values from concurrent samples (U.S. Environmental Protection Agency 2006a, Water Quality Control Commission 2022).

U.S. Department of Energy (DOE) Order 458.1 Chg 4, Radiation Protection of the Public and the Environment, sets limits on the total dose of radioactivity that may be released during Laboratory operations. These limits apply to the public, plants, and animals. Therefore, the radiological assessment of surface water considers potential exposure to both aquatic organisms and land-dwelling animals (collectively referred to as “biota”).

We use the DOE biota concentration guides (DOE 2019) along with site-specific modifications by McNaughton et al. (2013) as screening levels to evaluate radioactivity in surface water. Biota concentration guides for aquatic, riparian, or terrestrial animals are used depending on how often surface water is present at a given location. For perennial and intermittent reaches, we apply aquatic, riparian, and terrestrial animal biota concentration guides. For ephemeral reaches, we use terrestrial animal biota concentration guides. Biota dose results are provided in Chapter 7. In Chapter 8, we evaluate human health risks associated with stormwater exposure.

We also use the New Mexico water quality standards to evaluate surface water results for gross alpha radioactivity and radium isotopes; however, the gross alpha standard does not apply to source, special nuclear, or byproduct material regulated by the DOE under the Atomic Energy Act of 1954. The gross alpha radioactivity data presented in this chapter have not been adjusted to exclude these sources of radioactivity.

Surface water results from Storm Water Individual Permit site monitoring areas are evaluated using target action levels provided in the Permit. Additional details on site monitoring area results are provided in the 2024 Annual Sampling Implementation Plan, NPDES Permit No. NM0030759 (N3B 2025d).

Sediment Screening Levels

We evaluate radioactivity in sediment using risk-based screening action levels (LANL 2015) and the DOE biota concentration guides (DOE 2019) with site-specific modifications by McNaughton et al. (2013). Biota concentration guides for riparian and terrestrial animals are used in these evaluations. Biota dose results are provided in Chapter 7. In Chapter 8, we evaluate human health risks associated with sediment exposure.

We evaluate chemical levels using the New Mexico Environment Department’s risk-based soil screening levels (New Mexico Environment Department 2022a) for chemicals that could cause cancer or harmful health effects. If a chemical poses both cancer and noncancer risks, separate screening levels are provided for each risk type. When no New Mexico Environment Department risk-based soil screening levels are available for a chemical, we use the U.S. Environmental Protection Agency’s regional screening level (U.S. Environmental Protection Agency 2024).

The soil screening levels for inorganic and organic chemicals and the screening action levels for radionuclides reflect levels that are considered safe for different exposure scenarios: what is safe for humans in industrial settings, what is safe for construction workers, and what is safe for residential exposure. If concentrations are below both the screening action levels and the soil screening levels, adverse human health effects are highly unlikely.

These screening levels provide a high level of confidence in determining a low probability of risk to human health; however, they are not intended to provide definitive risk estimates and might not reflect current land use (U.S. Environmental Protection Agency 2001). For example, we compare samples from onsite locations to all screening levels—including the residential exposure scenario levels—even though no residences are nearby.

Results

2024 Precipitation and Surface Water Runoff

Figure 6-5 shows the amount of precipitation across the LANL site and stormwater runoff at the site's most downstream gaging stations during the monsoonal and tropical storm period (June 1 through October 31) from 2012 to 2024.

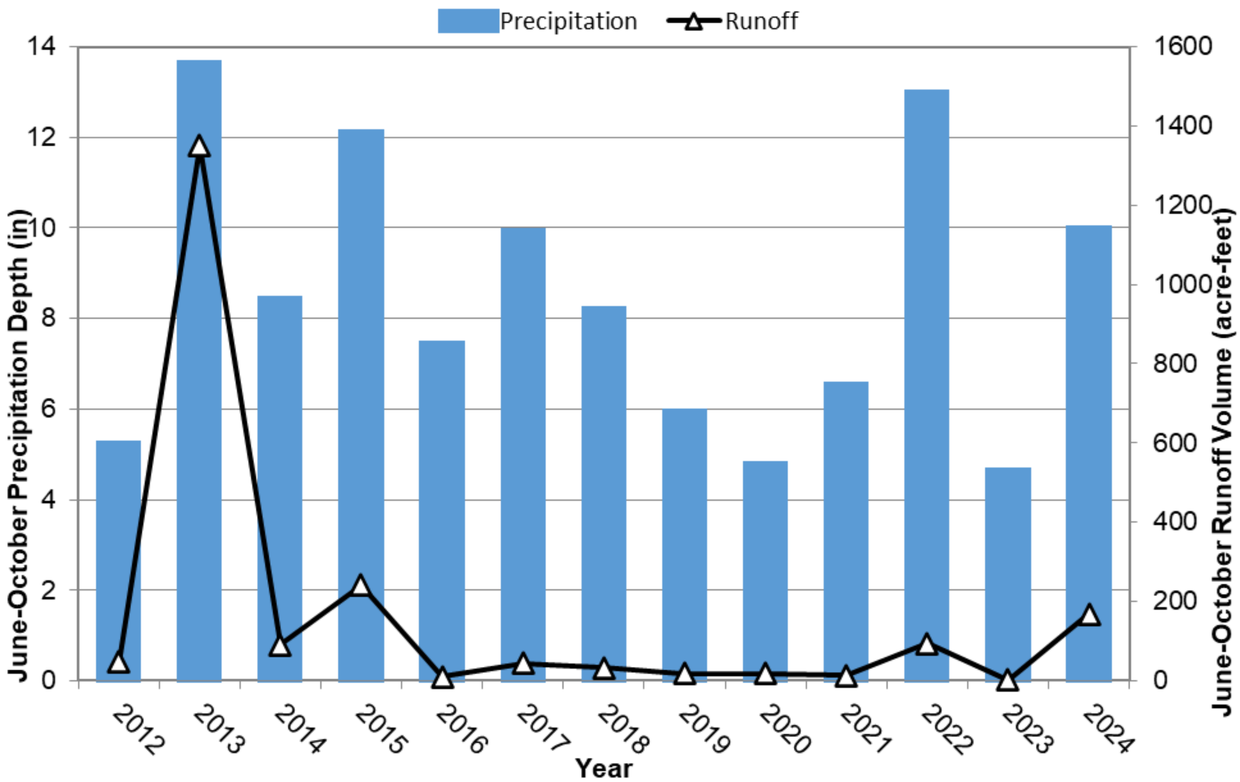


Figure 6-5. Total June–October precipitation from 2012 to 2024 averaged across the Laboratory's meteorological tower network (Technical Area 06, Technical Area 49, Technical Area 53, Technical Area 54, and northern community) and estimated June–October stormwater runoff past the downstream LANL site boundary.

Total surface water that left the site—as measured at downstream gaging stations—was 105 acre-feet during October 1, 2023, through September 30, 2024 (the 2024 water year), and 168 acre-feet during June 1, 2024, through October 31, 2024 (the monsoonal and tropical storm period for 2024).

During the 2024 water year (October 1, 2023, through September 30, 2024), snowmelt runoff reached the furthest downstream (eastern) gaging stations in Los Alamos, Sandia, Mortandad, Water, Ancho, and Chaquehui canyon watersheds. Total snowmelt runoff at these stations is estimated at 12 acre-feet, with 8.3 acre-feet occurring in Pueblo Canyon, a major tributary of the Los Alamos Canyon watershed.

In 2024, the precipitation during the monsoon and tropical storm periods was 9.9 inches. Most of the stormwater runoff that reached the furthest downstream (eastern) gaging stations during the monsoonal and tropical storm periods was measured in the following canyons: Ancho (59 acre-feet), Sandia (47 acre-feet), Chaquehui (38 acre-feet), Cañada del Buey (14 acre-feet), Water (6 acre-feet), Pueblo (2.3 acre-feet), and Potrillo (1.5 acre-feet). Trace runoff (less than 0.5 acre-feet) occurred in Los Alamos Canyon.

Los Alamos County operates a wastewater treatment facility in Pueblo Canyon that releases effluent into the stream channel. When the effluent combines with stormwater runoff, the surface water can flow some distance downstream. The maximum potential volume of surface water that contained effluent from the facility that reached lower Pueblo Canyon at monitoring station E060.1 (Figure 6-2) was 17 acre-feet. This surface water reached E060.1 as a result of snowmelt events between November 2023 and April 2024 and seven rain events between June and October 2024.

Constituents in Stormwater Samples

In 2024, we collected stormwater from 25 locations and base flow samples from 9 locations. For inorganic chemicals, 7 locations had no exceedances of their applicable New Mexico water quality standard, 2 locations had one exceedance, 9 locations had two exceedances, and 13 locations had more than two exceedances. For organic chemicals and radionuclides, 7 locations had no exceedances, 22 locations had one exceedance, 4 locations had two exceedances, and 1 location had more than two exceedances. Surface water monitoring data for 2024 and previous years are available on the IntellusNM website (https://intellusnm.com). Table 6-2 summarizes inorganic chemical results for 2024 stormwater and base flow samples, and Table 6-3 provides a summary of organic chemical and radionuclide results for 2024 stormwater and base flow samples. Table 6-4 summarizes surface water exceedances in 2024, showing the percentage of all locations analyzed for each chemical or radioactive constituent with an exceedance.
The tables do not include compliance sampling results for the Storm Water Individual Permit; however, these results are discussed in the text and are displayed in the figures within Discussion and Trends. Tables that contain the Storm Water Individual Permit sampling results for 2024 are available in the 2024 Update to the Site Discharge Pollution Prevention Plan (N3B 2025c).

Table 6-2. 2024 Stormwater and Base Flow Results for Inorganic Chemicals (Gray highlighting indicates that a chemical exceeded its screening level in at least one sample from a given location.)

Location Description	Stream Gage	Total Aluminum[a]			Dissolved Copper			Total Iron			Dissolved Lead			Total Mercury			Total Selenium			Dissolved Zinc		
		Analyses[b]	Detects[c]	Exceedance[d]	Analyses	Detects	Exceedances	Analyses	Detects	Exceedances	Analyses	Detects	Exceedances	Analyses	Detects	Exceedances	Analyses	Detects	Exceedances	Analyses	Detects	Exceedances
Ancho at Rio Grande[e]	NA[f]	1	1	0	1	1	0	–	–	–	1	0	0	1	0	0	1	0	0	1	0	0
Ancho below SR-4	E275	5	5	5	5	5	0	–	–	–	5	3	0	5	4	3	5	5	5	5	2	0
Between E252 and Water at Beta[e]	NA	2	2	0	2	0	0	–	–	–	2	0	0	2	0	0	2	0	0	2	0	0
Cañon de Valle below MDA P	E256	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	0	1	0	0

Location Description	Stream Gage	Total Aluminum[a] Analyses[b]	Total Aluminum[a] Detects[c]	Total Aluminum[a] Exceedance[d]	Dissolved Copper Analyses	Dissolved Copper Detects	Dissolved Copper Exceedances	Total Iron Analyses	Total Iron Detects	Total Iron Exceedances	Dissolved Lead Analyses	Dissolved Lead Detects	Dissolved Lead Exceedances	Total Mercury Analyses	Total Mercury Detects	Total Mercury Exceedances	Total Selenium Analyses	Total Selenium Detects	Total Selenium Exceedances	Dissolved Zinc Analyses	Dissolved Zinc Detects	Dissolved Zinc Exceedances
Cañada Del Buey above SR-4	E229.3	6	6	5	6	6	0	–	–	–	6	1	0	6	6	1	6	5	5	6	3	0
Chaquehui at TA-33	E338	2	2	2	2	2	0	–	–	–	2	2	0	2	2	1	2	1	1	2	1	0
Chaquehui Tributary at TA-33	E340	5	5	5	5	5	2	–	–	–	5	1	0	5	5	0	5	3	3	5	3	0
CO101038	NA	2	2	0	2	2	0	–	–	–	2	0	0	2	0	0	2	0	0	2	1	0
CO111041	NA	7	7	4	7	7	5	–	–	–	7	1	0	7	2	0	7	2	1	7	7	0
DP above Los Alamos Canyon	E040	1	1	1	1	1	0	–	–	–	1	0	0	1	1	0	1	1	0	1	1	0
DP above TA-21	E038	2	2	2	2	2	2	–	–	–	2	0	0	2	0	0	2	0	0	2	2	0
DP below Grade Control Structure	E039.1	3	3	3	3	3	1	–	–	–	3	2	0	3	1	0	3	2	0	3	3	0
Mortandad below Effluent Canyon	E200	4	4	4	4	4	4	–	–	–	4	2	0	4	1	0	4	2	1	4	4	1
Pajarito below S-N Ancho E Basin Confluence[e]	NA	2	2	0	2	2	0	2	2	0	2	0	0	2	0	0	2	0	0	2	0	0
Pajarito above Threemile	E245.5	4	4	4	4	4	0	–	–	–	4	0	0	4	4	0	4	2	2	4	0	0
Pajarito above Twomile	E243	1	1	1	1	1	1	–	–	–	1	0	0	1	1	0	1	1	0	1	1	0
Pajarito at Rio Grande[e]	NA	1	1	0	1	0	0	1	1	0	1	0	0	1	0	0	1	0	0	1	0	0
Potrillo above SR-4	E267	2	2	2	3	3	2	–	–	–	3	1	0	3	3	1	3	1	1	3	0	0
Pueblo above Acid	E055	2	2	2	2	2	2	2	2	2	2	2	2	2	2	0	2	2	1	2	2	0
Pueblo below Grade Control Structure	E060.1	–	–	–	–	–	–	1	1	1	–	–	–	1	1	0	1	1	1	–	–	–
Rio Grande at Frijoles[e]	NA	1	1	1	1	1	0	1	1	1	1	0	0	1	0	0	1	0	0	1	0	0
Rio Grande at Otowi Bridge[e]	NA	2	2	2	2	1	0	2	2	2	2	0	0	2	0	0	2	0	0	2	0	0
Sandia above SR-4	E125	1	1	1	1	1	1	–	–	–	1	1	0	1	1	0	1	0	0	1	1	0

Location Description	Stream Gage	Total Aluminum[a]			Dissolved Copper			Total Iron			Dissolved Lead			Total Mercury			Total Selenium			Dissolved Zinc		
		Analyses[b]	Detects[c]	Exceedance[d]	Analyses	Detects	Exceedances	Analyses	Detects	Exceedances	Analyses	Detects	Exceedances	Analyses	Detects	Exceedances	Analyses	Detects	Exceedances	Analyses	Detects	Exceedances
Sandia below Wetlands[e]	E123	4	4	0	4	2	0	4	4	0	4	0	0	4	0	0	4	0	0	4	4	0
Sandia below Wetlands	E123	6	6	3	6	6	5	6	6	6	6	2	1	6	2	0	6	0	0	6	6	0
Sandia Left Fork at Asphalt Plant	E122	7	7	7	7	7	7	7	7	7	7	1	1	7	1	0	7	2	0	7	7	5
Sandia Right Fork at Power Plant[e]	E121	4	4	0	4	4	0	4	4	0	4	0	0	4	0	0	4	0	0	4	4	0
Sandia Right Fork at Power Plant	E121	5	5	5	5	5	5	5	5	5	5	4	4	5	3	0	5	2	0	5	5	4
South Fork of Sandia at E122[e]	E122	4	4	0	4	1	1	4	4	0	4	0	0	4	0	0	4	0	0	4	4	0
Starmers above Pajarito	E242	1	1	1	1	1	0	1	1	1	1	0	0	1	1	0	1	0	0	1	1	0
Twomile above Pajarito	E244	1	1	1	1	1	1	–	–	–	1	0	0	1	1	0	1	1	1	1	1	0

[a] Unfiltered aluminum is used for base flow samples; aluminum filtered to 10 µm is used for stormwater samples.
[b] Analyses are the number of samples analyzed for that constituent.
[c] Detects are the number of samples in which that constituent was detected.
[d] Exceedances are the number of results that were detected above the screening level.
[e] Indicates base flow sampling locations; all other locations are storm flow sampling locations. (Note that some locations have both storm flow and base flow samples.)
[f] NA = Not applicable.
A dash (–) indicates that data for iron are presented only for locations where the chronic aquatic life criteria apply.

Table 6-3. 2024 Stormwater and Base Flow Results for Organic Chemicals and Radionuclides (Gray highlighting indicates that a chemical exceeded its screening level in at least one sample from a given location.)

Location Description	Stream Gage	Benzo(a) pyrene			Benzo(b) fluoranthene			Bis(2-ethylhexyl) phthalate			Dibenz(a,h) anthracene			Dioxin			Gross Alpha			Indeno (1,2,3-cd) pyrene			Total Aroclor			Total PCB		
		Analyses[a]	Detects[b]	Exceedances[c]	Analyses	Detects	Exceedances	Analyses	Detects	Exceedances	Analyses	Detects	Exceedances	Analyses	Detects	Exceedances	Analyses	Detects	Exceedances	Analyses	Detects	Exceedances	Analyses	Detects	Exceedances	Analyses	Detects	Exceedances Exceedances
Ancho below SR-4	E275	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	4	4	4	–	–	–	4	0	0	–	–	–
Canon de Valle below MDA P	E256	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	1	1	–	–	–	1	0	0	–	–	–
CDB above SR-4	E229.3	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	7	7	6	–	–	–	7	0	0	–	–	–
Chaquehui at TA-33	E338	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	2	1	–	–	–	2	0	0	–	–	–
Chaquehui Tributary at TA-33	E340	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	5	5	5	–	–	–	5	0	0	–	–	–
CO111041	NA[d]	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	7	7	2	–	–	–	7	7	7	–	–	–
DP above Los Alamos Canyon	E040	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	1	1	–	–	–	1	0	0	–	–	–
DP above TA-21	E038	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3	3	1	–	–	–	3	0	0	–	–	–
DP below Grade Control Structure	E039.1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3	3	2	–	–	–	3	0	0	–	–	–
E059.5 Pueblo below LAC WWTF[e]	E059.5	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	2	1	–	–	–	1	0	0	–	–	–
Los Alamos below Low-Head Weir	E050.1	–	–	–	–	–	–	–	–	–	–	–	–	1	1	1	1	1	1	–	–	–	1	0	0	–	–	–
Mortandad below Effluent Canyon	E200	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	4	4	2	–	–	–	2	0	0	–	–	–
Pajarito above Threemile	E245.5	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	4	3	3	–	–	–	4	0	0	–	–	–
Pajarito above Twomile	E243	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	1	1	–	–	–	1	0	0	–	–	–
Potrillo above SR-4	E267	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	2	2	–	–	–	2	0	0	–	–	–

		Benzo(a) pyrene			Benzo(b) fluoranthene			Bis(2-ethylhexyl) phthalate			Dibenz(a,h) anthracene			Dioxin			Gross Alpha			Indeno (1,2,3-cd) pyrene			Total Aroclor			Total PCB		
Location Description	Stream Gage	Analyses[a]	Detects[b]	Exceedances[c]	Analyses	Detects	Exceedances	Analyses	Detects	Exceedances	Analyses	Detects	Exceedances	Analyses	Detects	Exceedances	Analyses	Detects	Exceedances	Analyses	Detects	Exceedances	Analyses	Detects	Exceedances	Analyses	Detects	Exceedances Exceedances
Pueblo above Acid	E055	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2	2	2	–	–	–	2	0	0	–	–	–
Pueblo below Grade Control Structure	E060.1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	1	1	–	–	–	–	–	–	–	–	–
Rio Grande at Otowi Bridge[f]	NA	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	1	0	–	–	–	1	1	1	–	–	–
Sandia above SR-4	E125	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	1	1	–	–	–	1	0	0	–	–	–
Sandia below Wetlands[f]	E123	5	0	0	5	0	0	5	0	0	5	0	0	–	–	–	1	0	0	5	0	0	4	0	0	2	2	2
Sandia below Wetlands	E123	6	0	0	6	0	0	4	1	1	6	0	0	–	–	–	6	2	0	6	1	1	6	0	0	–	–	–
Sandia Left Fork at Asphalt Plant	E122	6	1	1	6	2	2	7	6	0	6	1	1	–	–	–	6	5	0	6	1	1	8	0	0	–	–	–
Sandia Right Fork at Power Plant[f]	E121	5	0	0	5	0	0	5	0	0	5	0	0	–	–	–	1	0	0	5	0	0	4	0	0	2	2	1
Sandia Right Fork at Power Plant	E121	5	0	0	5	0	0	5	4	1	5	0	0	–	–	–	5	5	0	5	0	0	5	2	2	–	–	–
South Fork of Sandia at E122[f]	E122	4	0	0	4	0	0	4	0	0	4	0	0	–	–	–	–	–	–	4	0	0	4	0	0	2	2	2
Starmers above Pajarito	E242	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	1	1	–	–	–	1	0	0	–	–	–
Twomile above Pajarito	E244	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	1	1	–	–	–	1	0	0	–	–	–

[a] Analyses are the number of samples analyzed for that constituent.
[b] Detects are the number of samples in which that constituent was detected.
[c] Exceedances are the number of results that were detected above the screening level.
[d] NA = Not applicable.
[e] LAC WWTF = Los Alamos County Wastewater Treatment Facility.
[f] Indicates base flow sampling locations; all other locations are storm flow sampling locations (note some locations have both storm flow and base flow samples).

Table 6-4. Number of Locations (Percent of Locations Analyzed) where Stormwater and Base Flow Results Exceeded New Mexico Water Quality Standards in 2024 for Chemicals or Radioactive Constituents with at Least One Exceedance

Chemical or Radioactive Constituent	Irrigation and Irrigation Storage	Livestock Watering	Wildlife Habitat	Acute Aquatic Life	Chronic Aquatic Life	Human Health Organism Only
Aluminum	–	–	–	25 (81%)	10 (77%)	–
Dissolved copper	0	0	–	18 (58%)	8 (62%)	–
Total iron	–	–	–	–	11 (79%)	–
Dissolved lead	0	0	–	0	6 (46%)	–
Total mercury	–	0	4 (13%)	–	–	–
Total selenium	–	–	11 (34%)	6 (19%)	2 (14%)	–
Dissolved zinc	0	0	–	5 (16%)	3 (23%)	0
Benzo(a)pyrene	–	–	–	–	–	1 (11%)
Benzo(b)fluoranthene	–	–	–	–	–	1 (11%)
Bis(2-ethylhexyl)phthalate	–	–	–	–	–	2 (22%)
Dibenz(a,h)anthracene	–	–	–	–	–	1 (11%)
Dioxin	–	–	–	–	–	1 (100%)
Gross alpha	–	20 (67%)	–	–	–	–
Indeno(1,2,3-cd)pyrene	–	–	–	–	–	2 (22%)
Total Aroclor	–	–	3 (10%)	0	2 (17%)	3 (10%)
Total PCB	–	–	0	0	0	3 (100%)

A dash (–) indicates that no standard for this chemical or radionuclide exists for this category.
The percentage symbol (%) in parentheses represents the percentage of locations that have an exceedance for that analyte.

Constituents in Sediment Samples

In 2024, exceedances of screening levels for sediment samples were minimal. Of the 89 sediment samples collected, only 11 had exceedances of at least one screening level. Seven chemicals accounted for these exceedances, with five being a PFAS compound. No chemical level in a sediment sample exceeded its residential cancer, industrial cancer, or construction work cancer soil screening level. All radionuclide levels in 2024 sediment were below screening action levels and DOE biota concentration guides. Table 6-5 highlights chemical results from 2024 sediment samples where at least one chemical exceeded screening levels.

Table 6-5. 2024 Sediment Sampling Locations where Sample Result Exceeded At Least One Soil Screening Level (Gray highlighting indicates that a particular soil screening level was exceeded by a given chemical.)

Canyon	Stream Reach	Location ID	Chemical	Result (mg/kg)	Residential Noncancer Soil Screening Level (mg/kg)	Industrial Noncancer Soil Screening Level (mg/kg)	Construction Worker Noncancer Soil Screening Level (mg/kg)
Chaquehui	CHQ@ RG	CH-61340	Manganese	567	10,548	160,183	464
Los Alamos	DP-2	DP-60231	Perfluorodecanoic acid	0.28	0.000013[a]	0.00016[a]	–
			Perfluorododecanoic acid	0.359	0.32[a]	4.1[a]	–
			Perfluorononanoic acid	0.312	0.185	3.74	0.807
			Perfluorooctanesulfonic acid	0.877	0.185	3.74	0.807
			Perfluoroundecanoic acid	2.01	1.9[a]	25[a]	–
	DP-4	DP-60232	Perfluorodecanoic acid	0.314	0.000013[a]	0.00016[a]	–
			Perfluorononanoic acid	0.382	0.185	3.74	0.807
			Perfluorooctanesulfonic acid	0.75	0.185	3.74	0.807
	Ret Ponds	LA-61673	Aroclor-1254	2.08	1.14	16.4	4.91
	LA-3E	LA-61677	Perfluorodecanoic acid	0.0725	0.000013[a]	0.00016[a]	–
Acid	ACS	PU-61611	Perfluorodecanoic acid	0.067	0.000013[a]	0.00016[a]	–
			Perfluorooctanesulfonic acid	0.197	0.185	3.74	0.807
Pueblo	P-1E	PU-61612	Perfluorooctanesulfonic acid	0.242	0.185	3.74	0.807
	P-4FE	PU-61617	Perfluorodecanoic acid	0.11	0.000013[a]	0.00016[a]	–
			Perfluorooctanesulfonic acid	1.91	0.185	3.74	0.807
	P-4C	PU-61619	Perfluorodecanoic acid	0.107	0.000013[a]	0.00016[a]	–
			Perfluorooctanesulfonic acid	0.25	0.185	3.74	0.807
Sandia	S-2	SA-61696	Perfluorodecanoic acid	0.778	0.000013[a]	0.00016[a]	–
			Perfluorododecanoic acid	0.483	0.32[a]	4.1[a]	–
			Perfluorononanoic acid	0.476	0.185	3.74	0.807
			Perfluorooctanesulfonic acid	2.77	0.185	3.74	0.807
			Perfluoroundecanoic acid	2.14	1.9[a]	25[a]	–
		SA-61697	Perfluorodecanoic acid	0.12	0.000013[a]	0.00016[a]	–
			Perfluorooctanesulfonic acid	0.52	0.185	3.74	0.807

[a] Exceeded EPA's Regional Screening Level for Resident Soil or Industrial Soil
A dash (–) indicates that no screening level exists for a given chemical.

Discussion and Trends

The following sections discuss the 2024 and sediment results. Constituents are grouped based on their likely sources (background or Laboratory operations). Most 2024 stormwater and base flow results fell within the concentration ranges observed from 2011 to 2023. Notable exceptions include elevated iron concentrations in parts of the Mortandad Canyon and Pajarito Canyon watersheds.

Figure 6-6 through Figure 6-22 present analytical results for specific constituents by location. In each figure, the top panel displays sample locations (stream gaging stations, sediment detention basins, base flow locations, and Storm Water Individual Permit site monitoring areas) marked by colored circles. The color of each circle reflects the maximum constituent concentration at that location during 2011 to 2024 relative to other locations in the same watershed. Blue represents the lowest 10 percent of maximum concentrations, and orange represents the highest 10 percent. The range of concentration values represented by each color is shown at the top of each figure.

The bottom panel of each figure provides time-series graphs that show detected stormwater and base flow results for the constituent from 2011 through 2024. Different colors distinguish Storm Water Individual Permit samples and stream gaging station samples.

Constituents Related to Natural and Manufactured Background Sources

The following sections discuss chemicals that are primarily naturally occurring or originate from sources other than site operations.

Aluminum

Aluminum is commonly found in stormwater across the Pajarito Plateau, often exceeding New Mexico water quality standards; however, most or all surface water aluminum is naturally occurring because it is a natural component of local soils and the Bandelier Tuff (Reneau et al. 2010, Ryan et al. 2019). Aluminum is not produced in significant quantities by Laboratory operations. The New Mexico Environment Department Surface Water Quality Bureau has acknowledged that “natural conditions may contribute to high aluminum concentrations in the Jemez Mountains” (New Mexico Environment Department 2024a).

In 2024, total aluminum concentrations in stormwater and base flow samples exceeded an acute aquatic life criterion at 25 locations (81 percent of locations where the standard applied) and a chronic aquatic life criterion at 10 locations (77 percent of locations). Of the seven Storm Water Individual Permit compliance samples analyzed for aluminum, five exceeded the permit’s target action level. Of the 44 assessment units on Laboratory or former Laboratory lands, 16 are listed as impaired for aluminum (Table 6-1).

In 2024, no sediment samples exceeded soil screening levels for aluminum.

Arsenic

Arsenic originates from both natural and human-made sources. It occurs naturally in local volcanic rocks. Manufactured sources include coal-fired power plants. Although the coal-fired Four Corners Power Plant could have contributed to arsenic contamination, the Laboratory also operated coal-fired power plants historically.

In 2024, arsenic levels in filtered stormwater and base flow samples did not exceed applicable New Mexico surface water quality standards. Neither of the two Storm Water Individual Permit compliance samples analyzed for arsenic exceeded the permit's target action level. None of the 44 assessment units on Laboratory or former Laboratory lands are listed as impaired for arsenic (Table 6-1).

In 2024, no sediment samples exceeded soil screening levels for arsenic.

Copper

Copper is naturally occurring but can also come from sources such as explosives firing sites, forest fires, and urban infrastructure. In developed areas, copper is often associated with brake pad wear and building materials such as plumbing and electrical components (TDC Environmental 2004, Göbel et al. 2007). Historically, elevated copper concentrations have been observed in stormwater across all watersheds at the Laboratory, including at gaging stations located along the upstream boundary.

In 2024, copper concentrations in filtered stormwater and base flow samples exceeded an acute aquatic life criterion at 18 locations (58 percent of locations) and a chronic aquatic life criterion at 8 locations (62 percent of locations). Of the 19 Storm Water Individual Permit compliance samples analyzed for copper, 8 exceeded the permit's target action level. Of the 44 assessment units on Laboratory or former Laboratory lands, 16 are listed as impaired for copper (Table 6-1).

Figure 6-6 through Figure 6-9 show copper concentrations in filtered stormwater and base flow across the Ancho Canyon and Chaquehui Canyon watersheds, the Los Alamos Canyon watershed including Pueblo Canyon, the Pajarito Canyon watershed, and the Mortandad Canyon and Sandia Canyon watersheds, respectively. Copper concentrations measured in 2024 were consistent with those observed in previous years.

In 2024, no sediment samples exceeded soil screening levels for copper.

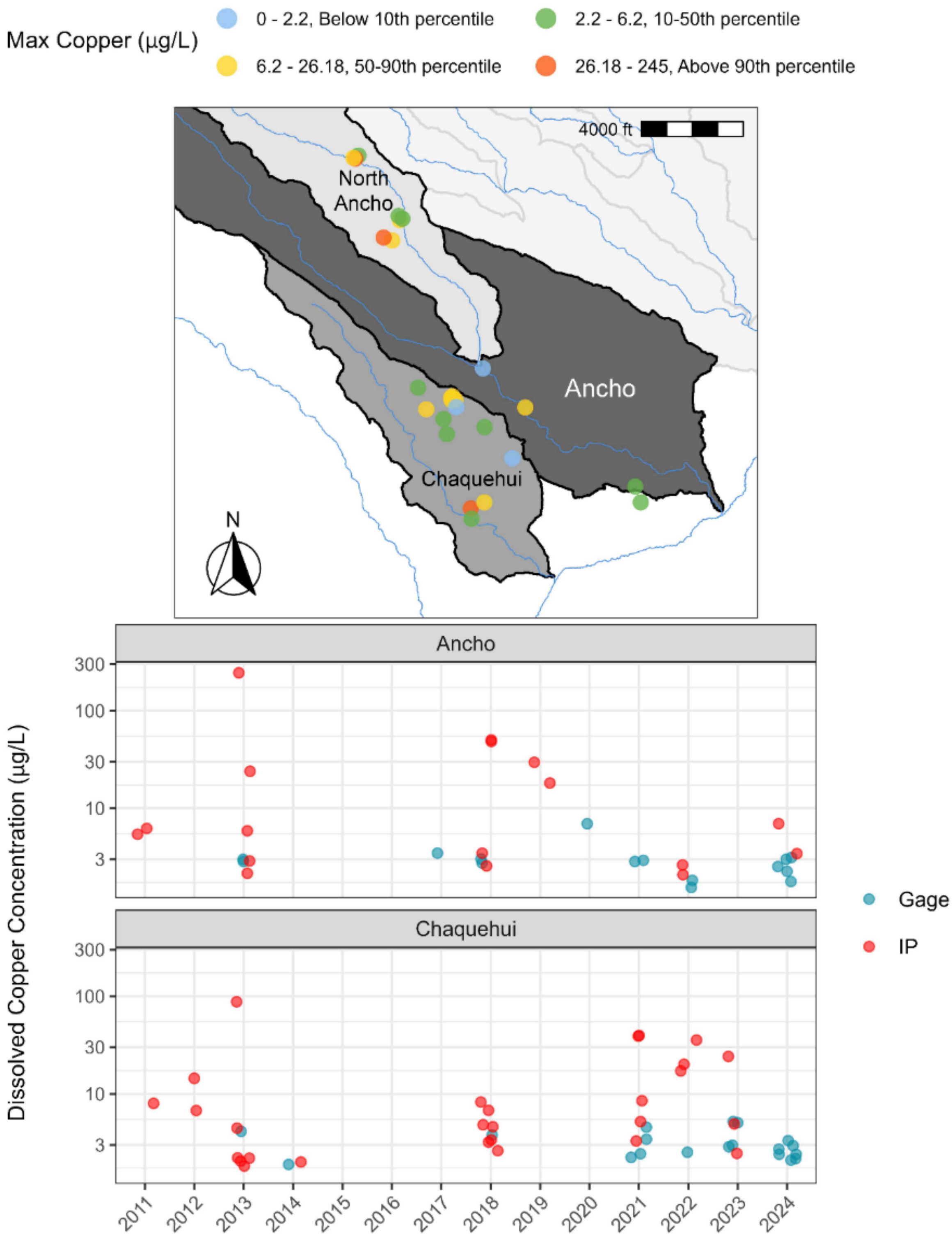


Figure 6-6. Dissolved copper concentrations in Ancho and Chaquehui canyon watersheds from Storm Water Individual Permit, gaging station, and base flow samples from 2011 to 2024. Top Panel: Maximum stormwater copper values for each sampling location from 2011 to 2024. Bottom panels: Detected dissolved copper concentrations from Storm Water Individual Permit, gaging station, and base flow samples from 2011 to 2024. Note: µg/L = micrograms per liter.

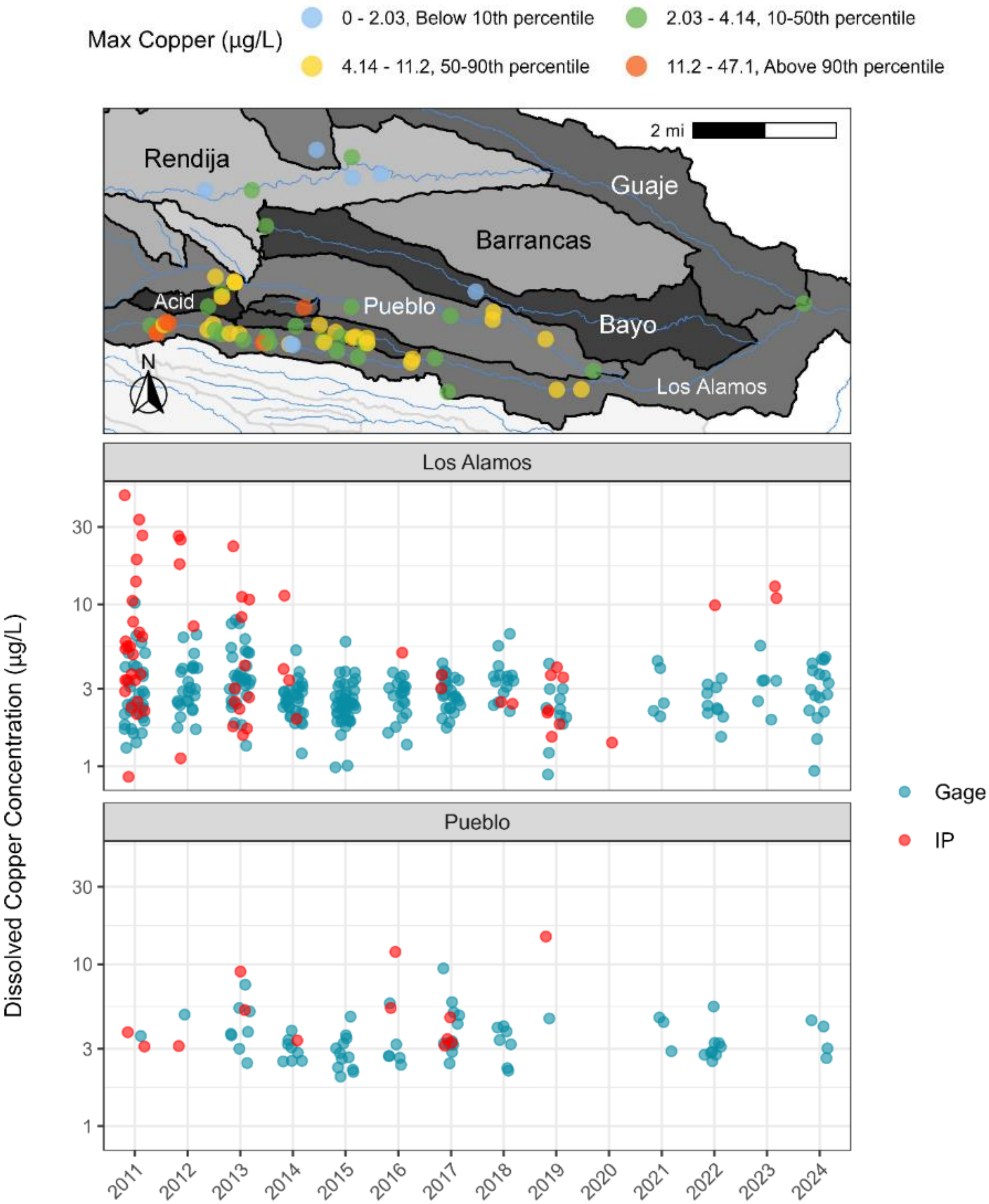


Figure 6-7. Dissolved copper concentrations in Los Alamos and Pueblo canyon watersheds from Storm Water Individual Permit, gaging station, and base flow samples from 2011 to 2024.Top Panel: Maximum stormwater copper values for each sampling location from 2011 to 2024. Bottom panels: Detected dissolved copper concentrations from Storm Water Individual Permit, gaging station, and base flow samples from 2011 to 2024. Note: µg/L = micrograms per liter.

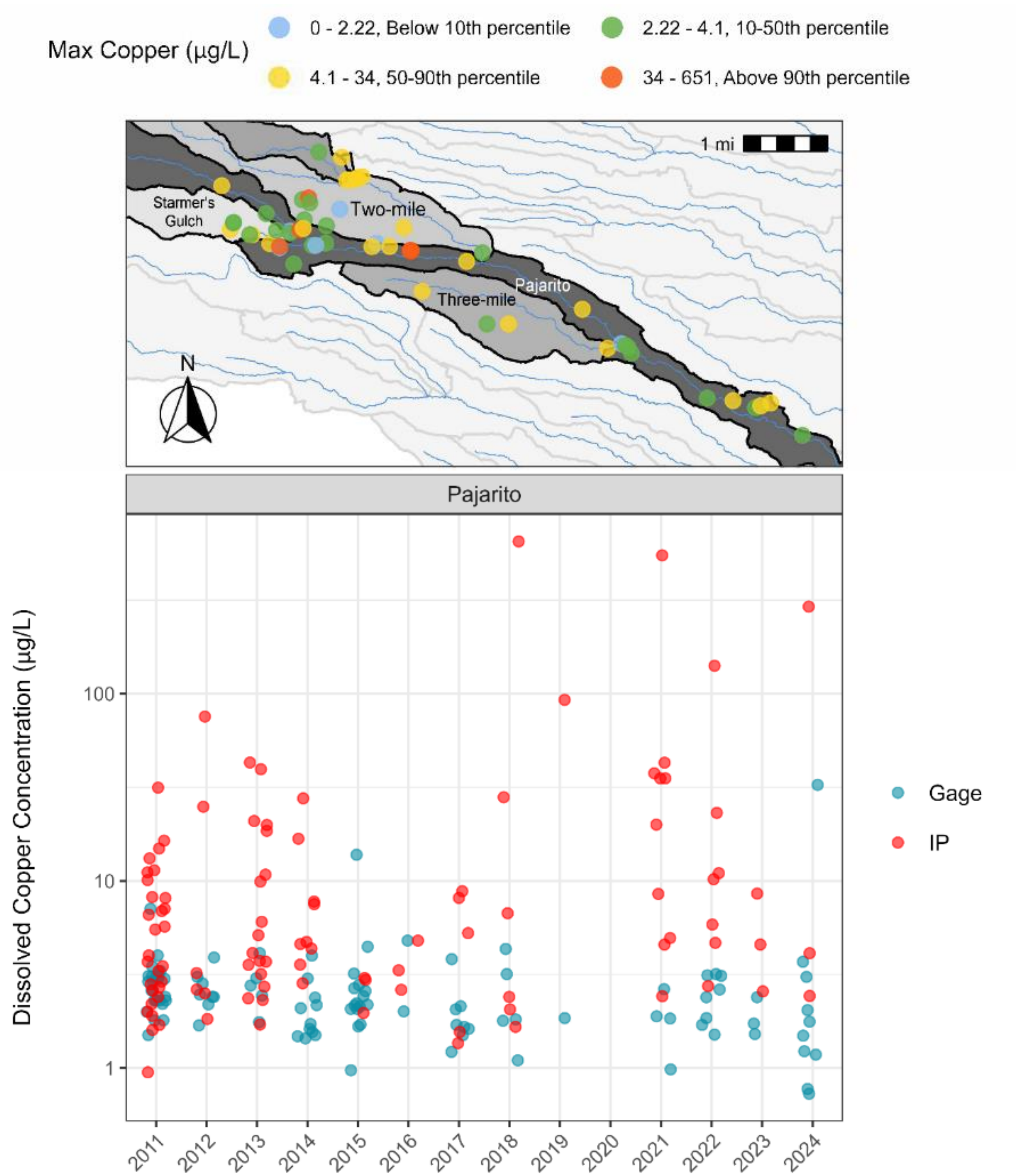


Figure 6-8. *Dissolved copper concentrations in Pajarito Canyon watershed from Storm Water Individual Permit, gaging station, and base flow samples from 2011 to 2024. Top Panel: Maximum stormwater copper values for each sampling location from 2011 to 2024. Bottom panels: Detected dissolved copper concentrations from Storm Water Individual Permit, gaging station, and base flow samples from 2011 to 2024. Note: µg/L = micrograms per liter.*

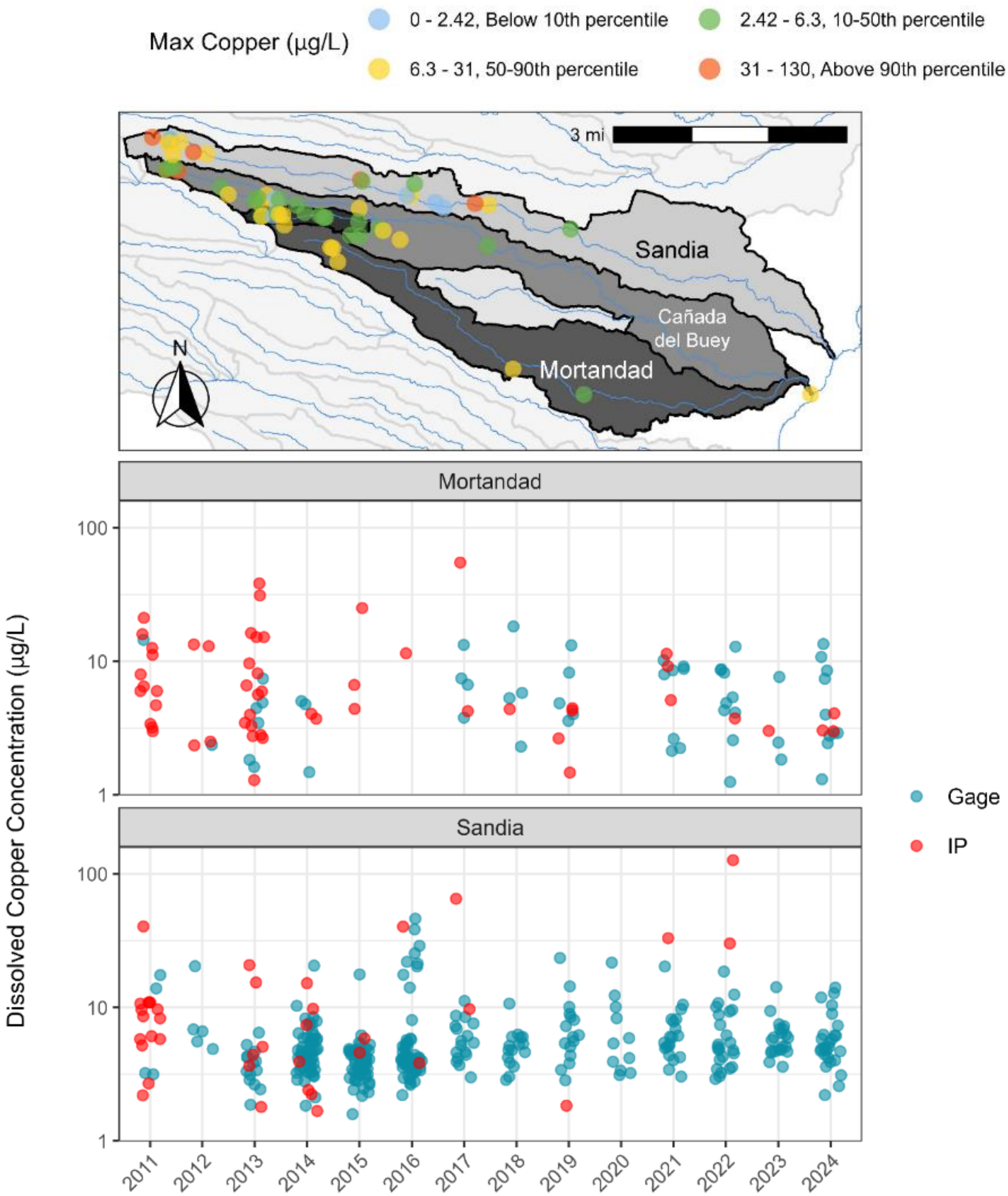


Figure 6-9. Dissolved copper concentrations in Sandia and Mortandad canyon watersheds from Storm Water Individual Permit, gaging station, and base flow samples from 2011 to 2024.Top Panel: Maximum stormwater copper values for each sampling location from 2011 to 2024. Bottom panels: Detected dissolved copper concentrations from Individual Permit, gaging station, and base flow samples from 2011 to 2024. Note: µg/L = micrograms per liter.

Iron

Iron is a naturally occurring element and is also associated with explosives firing sites. A surface water quality standard for total iron was established in 2022. In 2024, iron concentrations in storm water and base flow samples exceeded a chronic aquatic life criterion at 11 locations (79 percent of locations). The Storm Water Individual Permit does not include a target action level for iron. None of the 44 assessment units on Laboratory or former Laboratory lands are listed as impaired for iron (Table 6-1).

Figure 6-10 through Figure 6-12 show iron concentrations in storm water and base flow for the Los Alamos Canyon watershed including Pueblo Canyon, the Mortandad Canyon and Sandia Canyon watersheds, and the Pajarito Canyon watershed, respectively. In 2024, iron concentrations at gaging stations in the Mortandad Canyon and Pajarito Canyon watersheds were higher than in previous years.

In 2024, no sediment samples exceeded soil screening levels for iron.

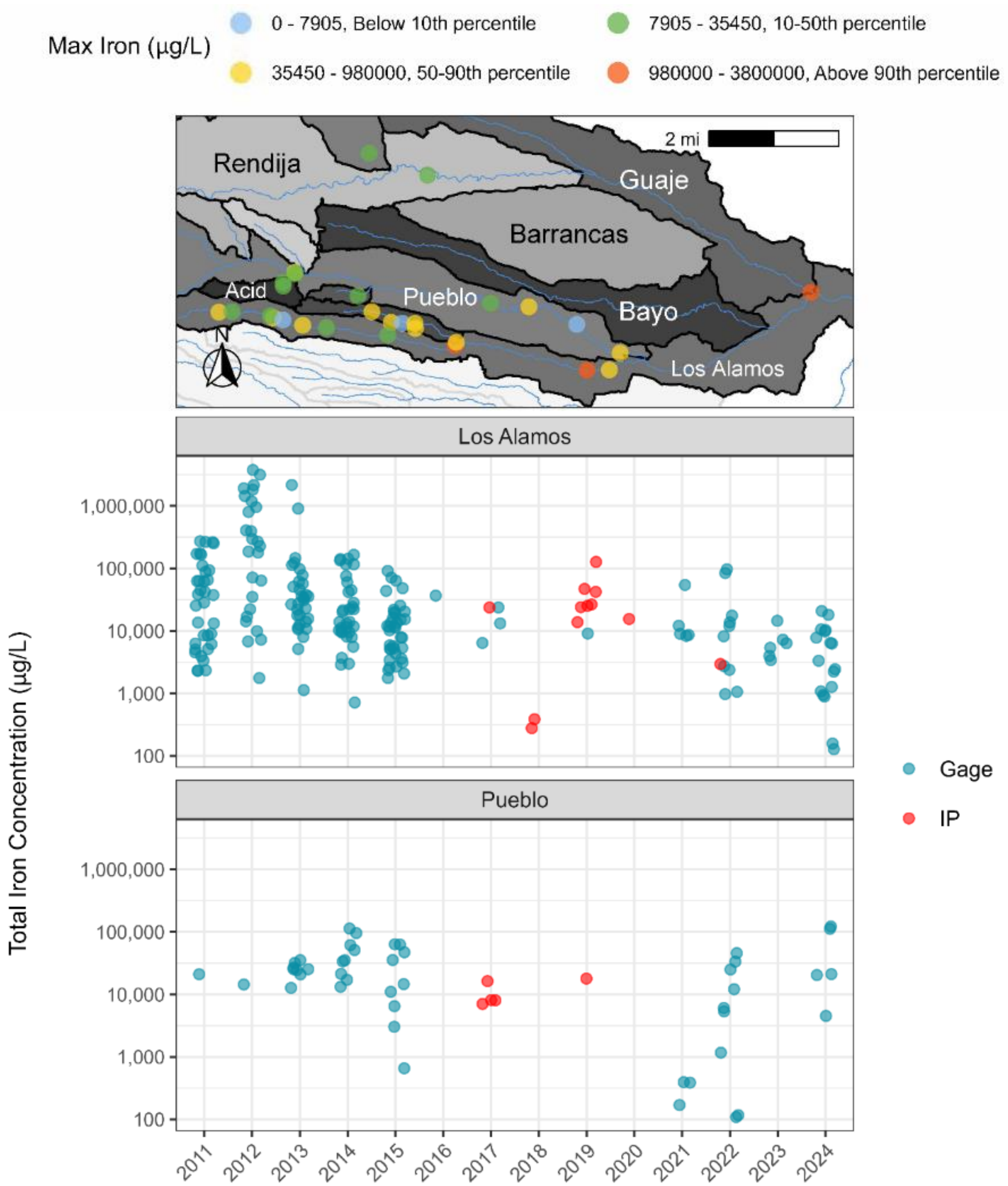


Figure 6-10. Total iron concentrations in Los Alamos and Pueblo canyon watersheds from Storm Water Individual Permit, gaging station, and base flow samples from 2011 to 2024.Top Panel: Maximum stormwater iron values for each sampling location from 2011 to 2024. Bottom panels: Detected total iron concentrations from Storm Water Individual Permit, gaging station, and base flow samples from 2011 to 2024. Note: µg/L = micrograms per liter.

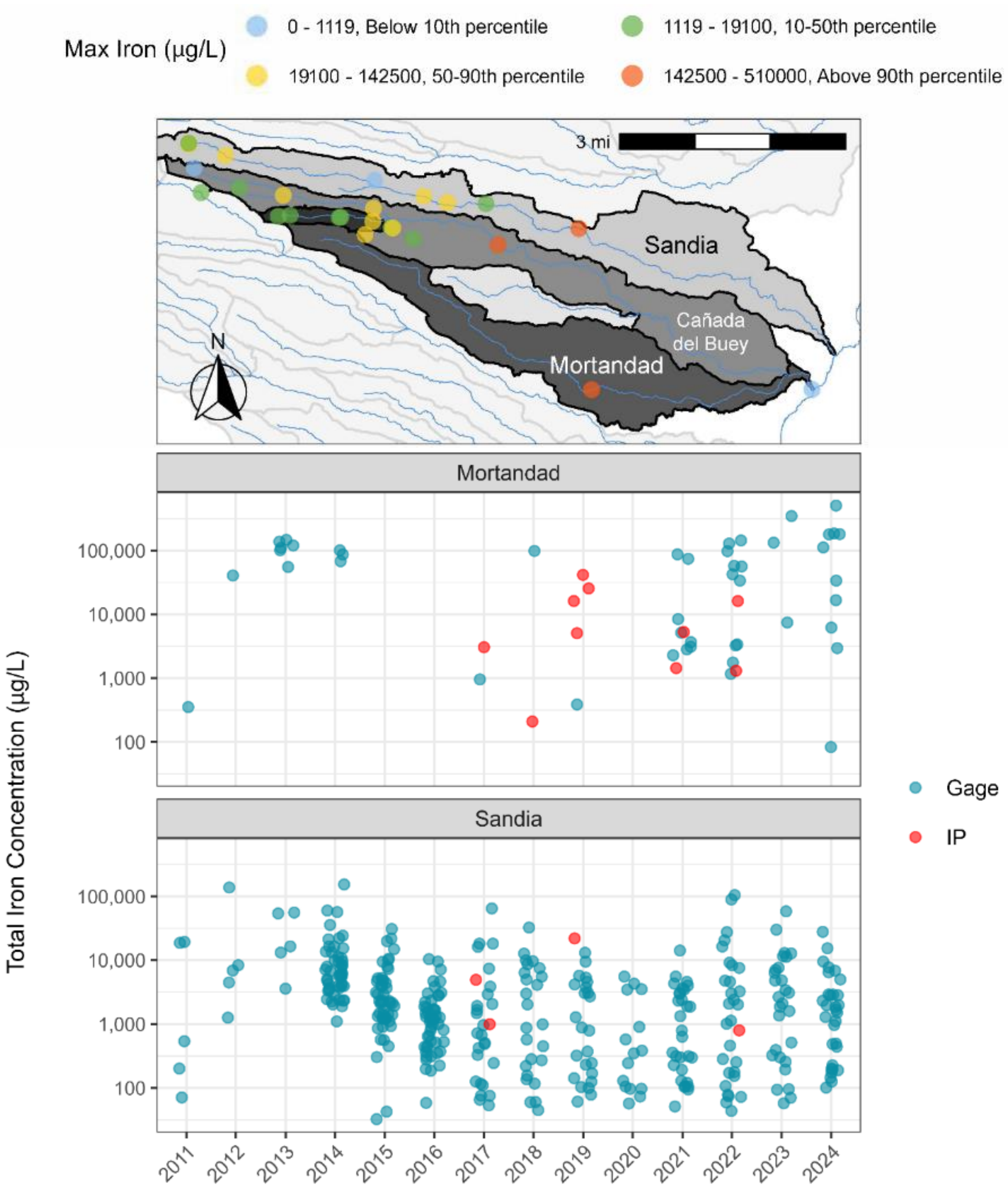


Figure 6-11. Total iron concentrations in Sandia and Mortandad canyon watersheds from Storm Water Individual Permit, gaging station, and base flow samples from 2011 to 2024. Top Panel: Maximum stormwater iron values for each sampling location from 2011 to 2024. Bottom panels: Detected total iron concentrations from Storm Water Individual Permit, gaging station, and base flow samples from 2011 to 2024. Note: µg/L = micrograms per liter.

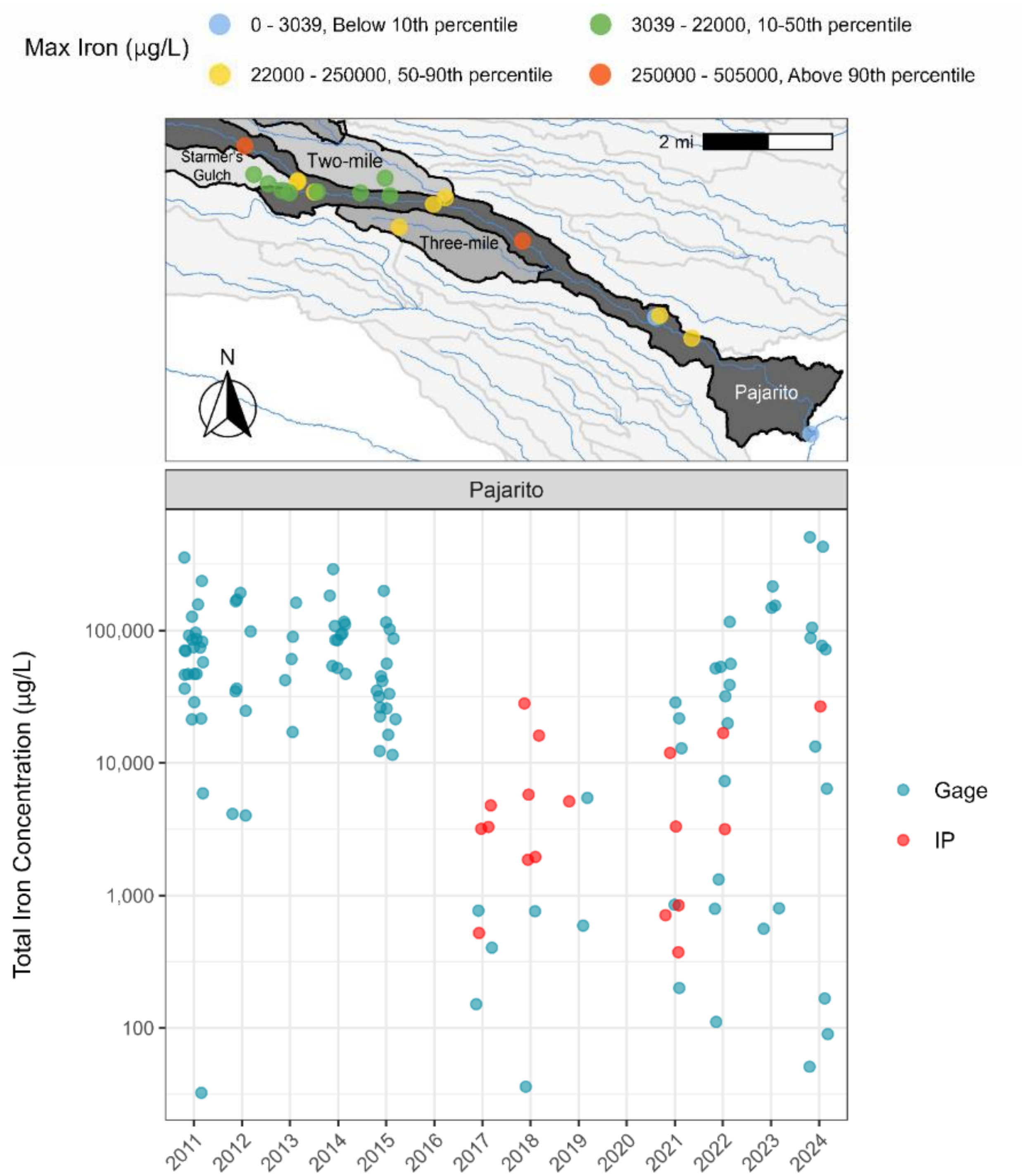


Figure 6-12. Total iron concentrations in Pajarito canyon watersheds from Storm Water Individual Permit, gaging station, and base flow samples from 2011 to 2024.Top Panel: Maximum stormwater iron values for each sampling location from 2011 to 2024. Bottom panels: Detected total iron concentrations from Storm Water Individual Permit, gaging station, and base flow samples from 2011 to 2024. Note: µg/L = micrograms per liter.

Lead

Lead is associated with explosives firing sites as well as buildings and parking lots in developed areas (Göbel et al. 2007). Common sources of lead in urban settings include lead-based paints, building sidings, and emission from vehicle operations (Davis and Burns 1999).

In 2024, lead concentrations in filtered stormwater and base flow exceeded a chronic aquatic life criterion at six locations (46 percent of locations). None of the 10 Storm Water Individual Permit compliance samples analyzed for lead exceeded the permit’s target action level. None of the 44 assessment units on Laboratory or former Laboratory lands are listed as impaired for lead (Table 6-1).

Figure 6-13 presents lead concentrations in filtered stormwater and base flow for the Mortandad Canyon and Sandia Canyon watersheds.

In 2024, no sediment samples exceeded soil screening levels for lead.

Manganese

Manganese is naturally occurring on the Pajarito Plateau. Laboratory operations have not historically generated manganese in significant quantities. Following the Cerro Grande Fire, dissolved manganese concentrations temporarily increased but declined in subsequent years (Gallaher and Koch 2004, 2005).

In 2024, manganese concentrations in stormwater and base flow samples did not exceed applicable water quality standards. No target action level for manganese is established under the Storm Water Individual Permit. None of the 44 assessment units on Laboratory or former Laboratory lands are listed as impaired for manganese (Table 6-1).

In 2024, manganese concentrations exceeded the construction worker noncancer soil screening level in one sediment sample.

Selenium

Selenium is naturally occurring on the Pajarito Plateau, and Laboratory operations have not contributed significant quantities. Similar to manganese, selenium concentrations were elevated following the Cerro Grande Fire but decreased in subsequent years (Gallaher and Koch 2004, 2005).

In 2024, total selenium concentrations in stormwater and base flow exceeded an acute aquatic life criterion at six locations (19 percent of locations), a chronic aquatic life criterion at two locations (14 percent of locations), and the wildlife habitat standard at 11 locations (34 percent of locations). None of the three Storm Water Individual Permit compliance samples analyzed for selenium exceeded the target action level. Of the 44 assessment units on Laboratory or former Laboratory lands, 3 are listed as impaired for selenium (Table 6-1).

In 2024, no sediment samples exceeded soil screening levels for selenium.

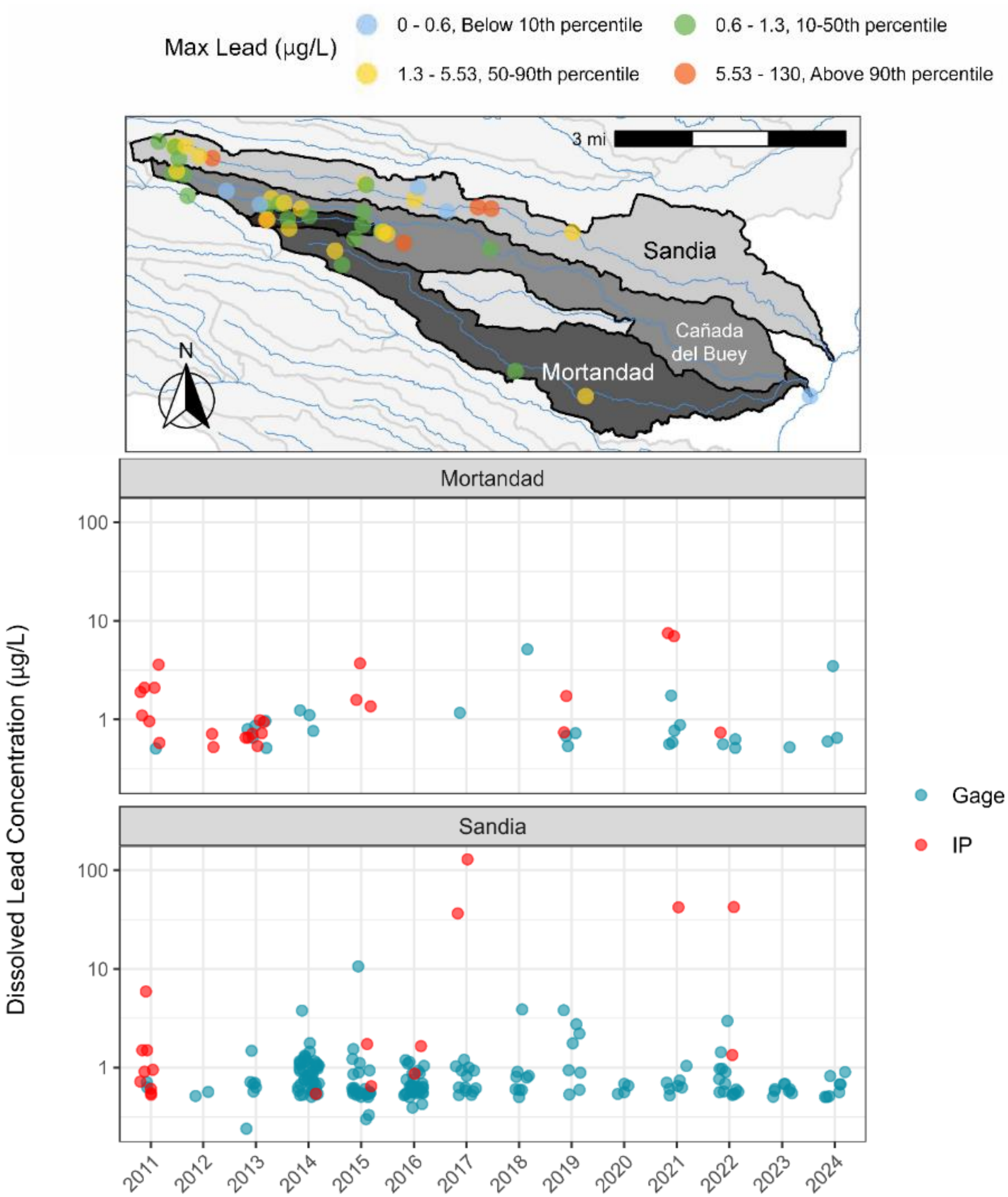


Figure 6-13. Dissolved lead concentrations in Sandia and Mortandad canyon watersheds from Storm Water Individual Permit, gaging station, and base flow samples from 2011 to 2024.Top Panel: Maximum stormwater lead values for each sampling location from 2011 to 2024. Bottom panels: Detected dissolved lead concentrations from Individual Permit, gaging station, and base flow samples from 2011 to 2024. Note: µg/L = micrograms per liter.

Zinc

Zinc is naturally occurring but is also commonly associated with developed areas. Sources of zinc in urban environments include automobile tires, galvanized materials, motor oil, and hydraulic fluid (Rose et al. 2001, Councell et al. 2004, Washington State Department of Ecology 2006).

In 2024, filtered zinc concentrations in stormwater and base flow samples exceeded an acute aquatic life criterion at five locations (16 percent of locations) and a chronic aquatic life criterion at three locations (23 percent of locations). One of the nine Storm Water Individual Permit compliance samples analyzed for zinc exceeded the target action level. None of the 44 assessment units on Laboratory or former Laboratory lands are listed as impaired for zinc (Table 6-1).

Figure 6-14 shows zinc concentrations in filtered stormwater and base flow for the Mortandad Canyon and Sandia Canyon watersheds. Zinc concentrations measured in 2024 were similar to those measured in 2023.

In 2024, no sediment samples exceeded soil screening levels for zinc.

Gross Alpha

Gross alpha activity measures the combined radioactivity from alpha-emitting isotopes, including naturally occurring isotopes of radium, thorium, and uranium, along with their decay products. Elevated gross alpha activities were observed in stormwater samples during 2011 through 2013, particularly in samples affected by ash and sediment from the 2011 Las Conchas Fire and the large flood event in September 2013.

In 2024, stormwater samples from 20 locations (67 percent of locations) exceeded the livestock watering standard for gross alpha activity. No target action level for gross alpha is established under the Storm Water Individual Permit. Of the 44 assessment units on Laboratory or former Laboratory lands, 29 are listed as impaired for gross alpha radioactivity (Table 6-1).

Figure 6-15 through Figure 6-18 show gross alpha concentrations in stormwater and base flow across the Ancho Canyon and Chaquehui Canyon watersheds, the Los Alamos Canyon watershed including Pueblo Canyon, the Pajarito Canyon watersheds, and the Mortandad Canyon and Sandia Canyon watersheds, respectively. Results from 2024 are consistent with previous findings, which confirms that most gross alpha radioactivity in stormwater on the Pajarito Plateau originates from the natural decay of isotopes in sediment and soil, with relatively small contributions from Laboratory operations (Gallaher 2007).

Sediment samples are not analyzed for gross alpha activity; instead, sediment analysis targets specific radionuclides of concern at designated locations.

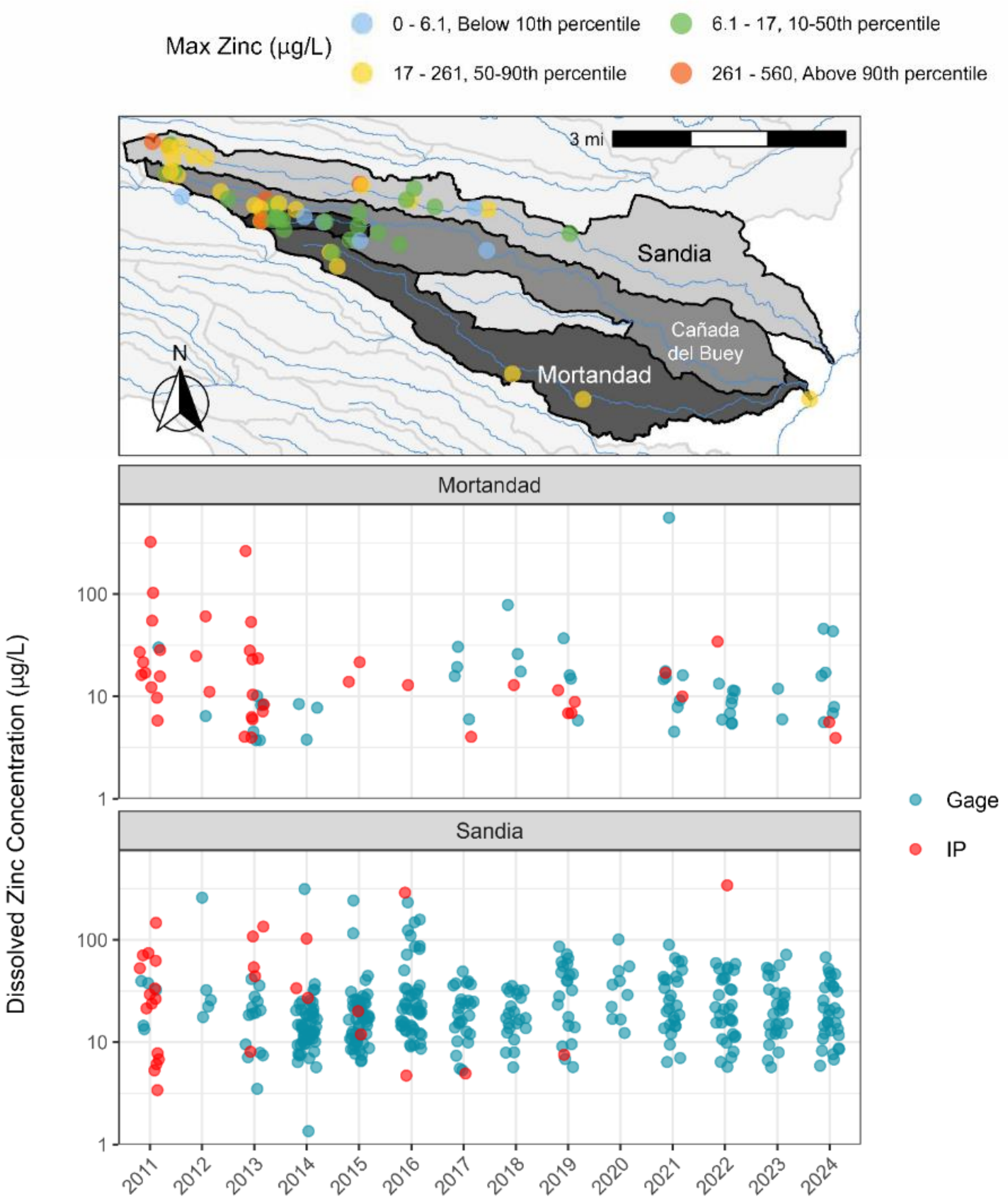


Figure 6-14. Dissolved zinc concentrations in Sandia and Mortandad canyon watersheds from Storm Water Individual Permit, gaging station, and base flow samples from 2011 to 2024.Top Panel: Maximum stormwater zinc values for each sampling location from 2011 to 2024. Bottom panels: Detected dissolved zinc concentrations from Individual Permit, gaging station, and base flow samples from 2011 to 2024. Note: µg/L = micrograms per liter.

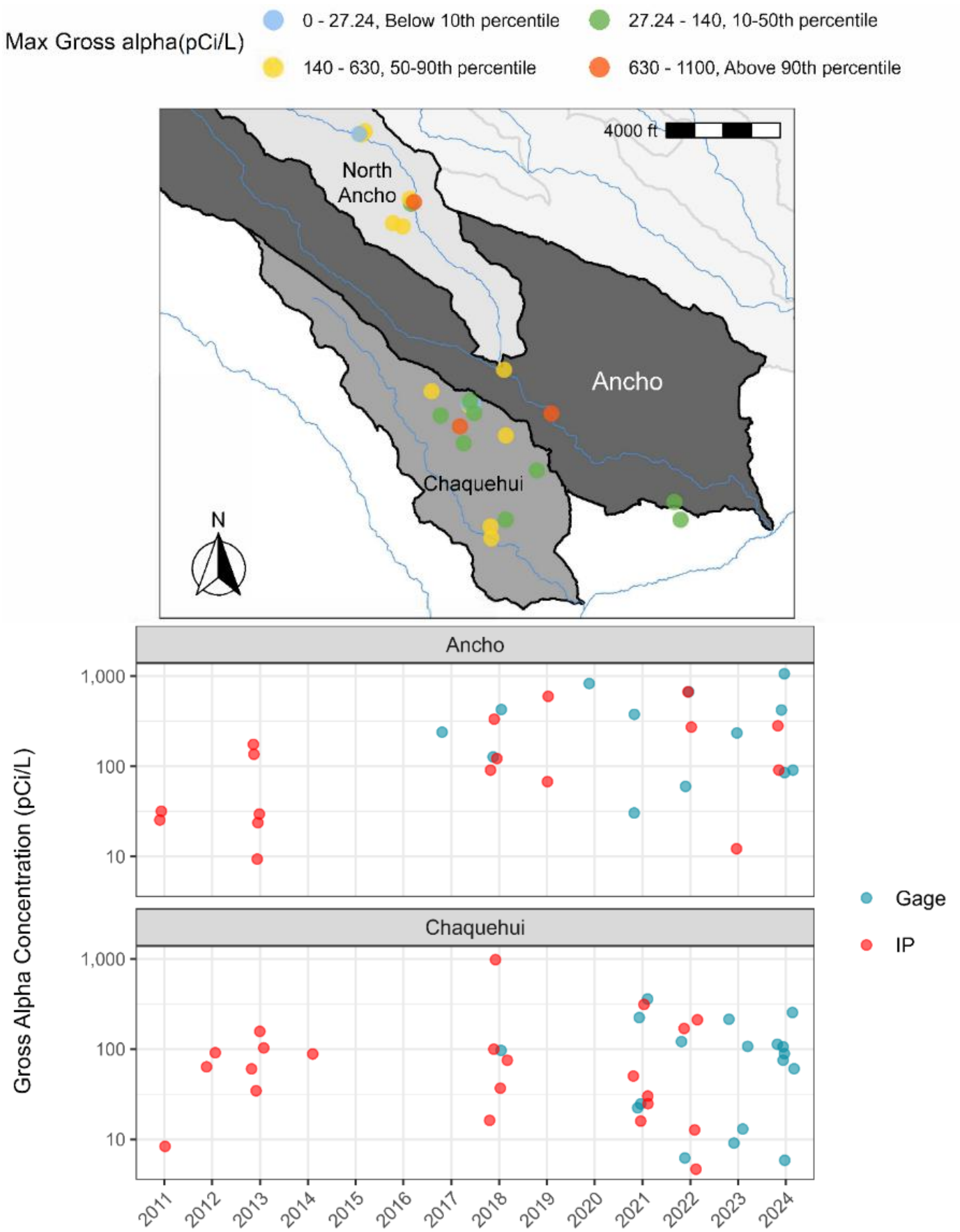


Figure 6-15. Gross alpha concentrations in Ancho and Chaquehui canyon watersheds from Storm Water Individual Permit, gaging station, and base flow samples from 2011 to 2024.Top Panel: Maximum stormwater gross alpha concentrations for each sampling location from 2011 to 2024. Bottom panels: Detected gross alpha concentrations from Storm Water Individual Permit, gaging station, and base flow samples from 2011 to 2024. Note: pCi/L = picocuries per liter.

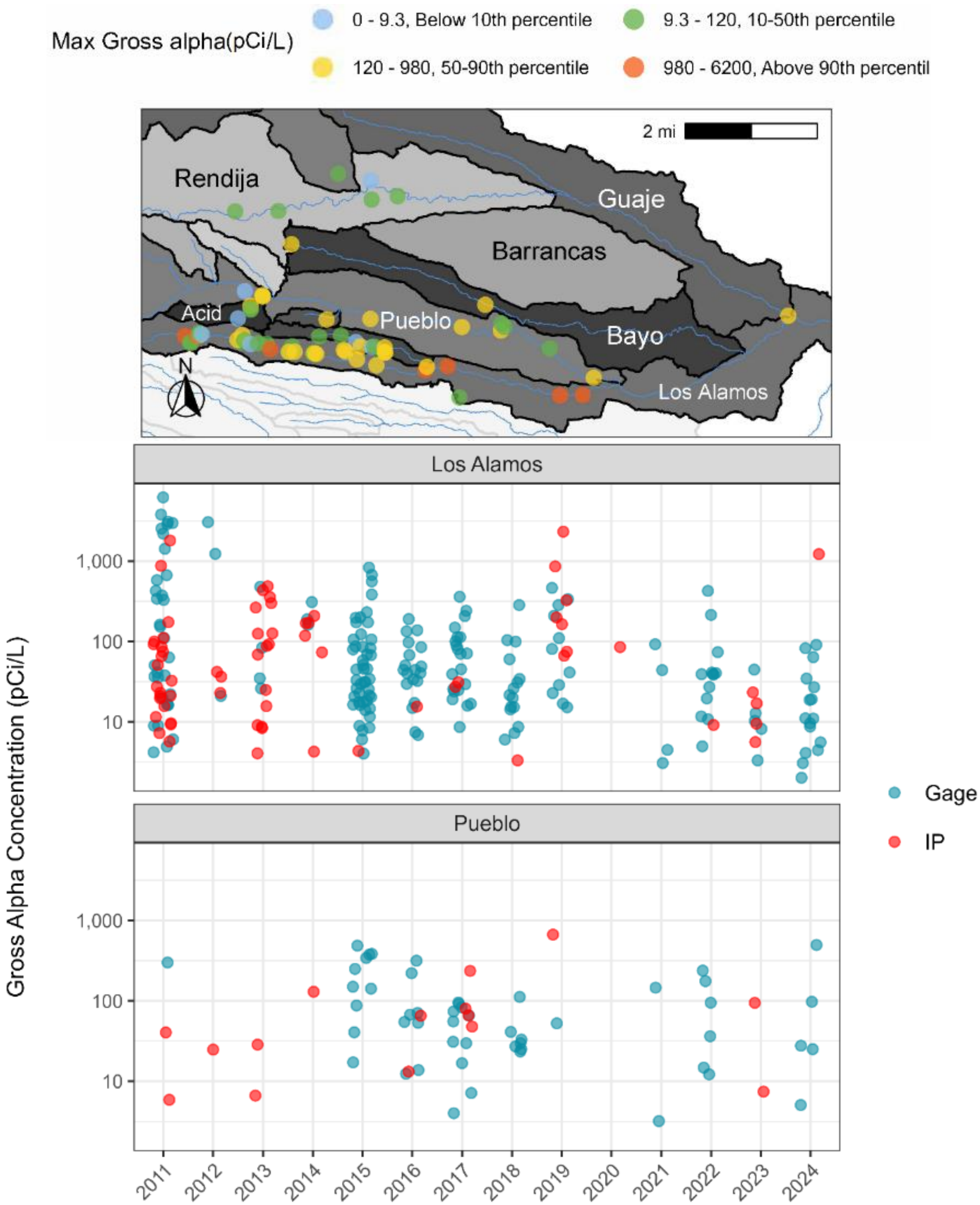


Figure 6-16. Gross alpha concentrations in Los Alamos and Pueblo canyon watersheds from Storm Water Individual Permit, gaging station, and base flow samples from 2011 to 2024.Top Panel: Maximum stormwater gross alpha concentrations for each sampling location from 2011 to 2024. Bottom panels: Detected gross alpha concentrations from Storm Water Individual Permit, gaging station, and base flow samples from 2011 to 2024. Note: pCi/L = picocuries per liter.

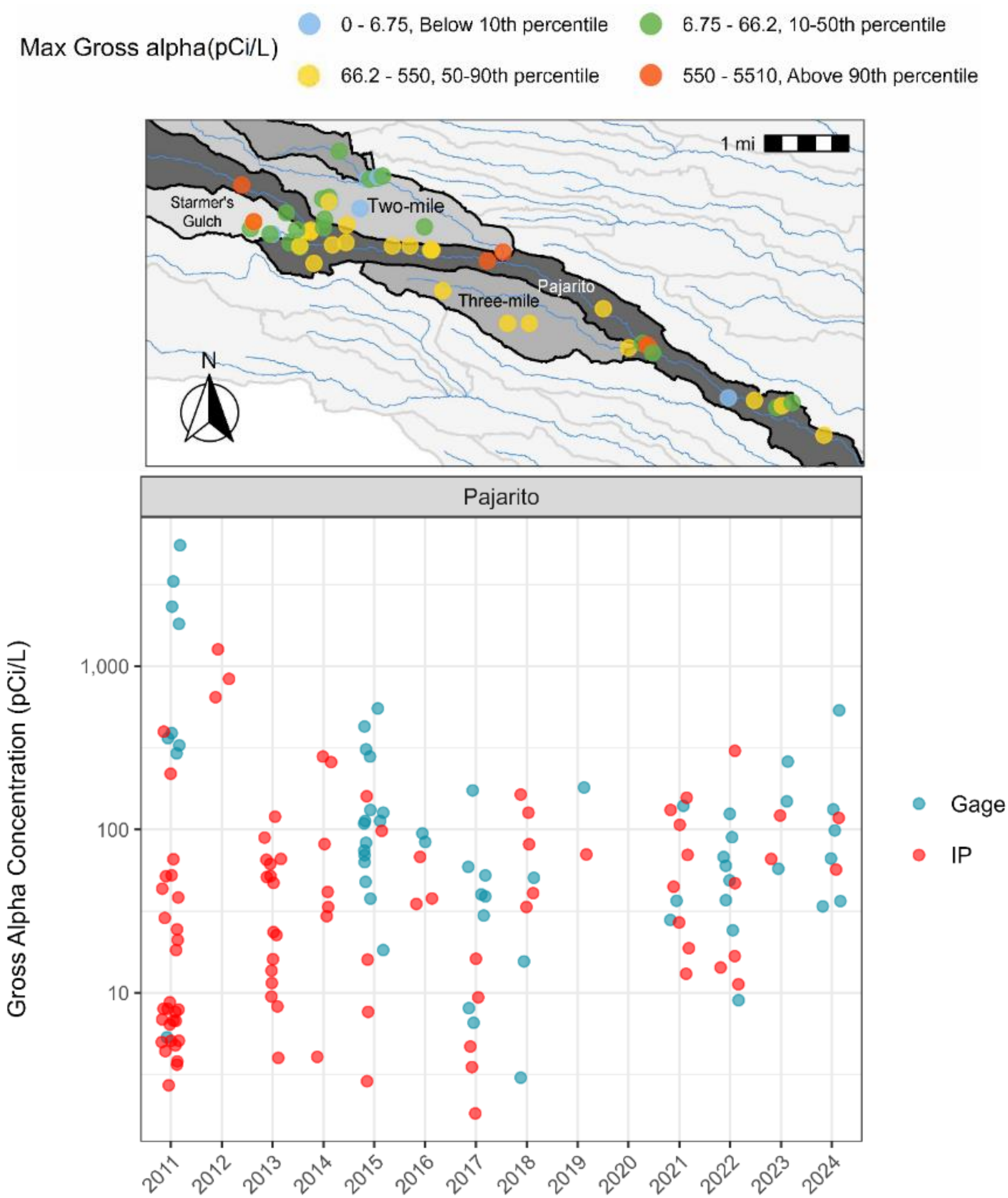


Figure 6-17. Gross alpha concentrations in Pajarito Canyon watershed from Storm Water Individual Permit, gaging station, and base flow samples from 2011 to 2024.Top Panel: Maximum stormwater gross alpha concentrations for each sampling location from 2011 to 2024. Bottom panels: Detected gross alpha concentrations from Storm Water Individual Permit, gaging station, and base flow samples from 2011 to 2024. Note: pCi/L = picocuries per liter.

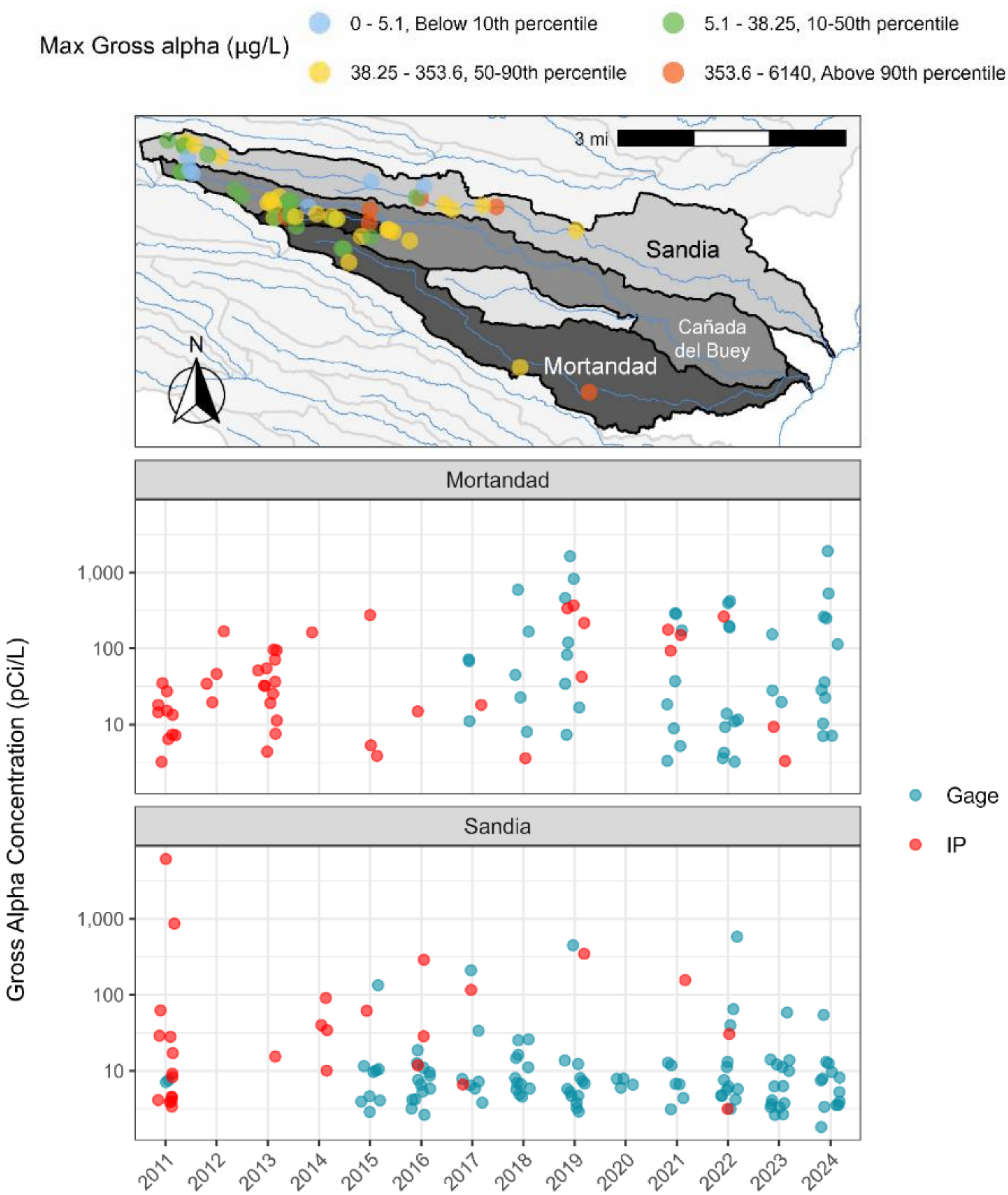


Figure 6-18. Gross alpha concentrations in Mortandad and Sandia canyon watersheds from Storm Water Individual Permit, gaging station, and base flow samples from 2011 to 2024. Top Panel: Maximum stormwater gross alpha concentrations for each sampling location from 2011 to 2024. Bottom panels: Detected gross alpha concentrations from Individual Permit, gaging station, and base flow samples from 2011 to 2024. Note: µg/L = micrograms per liter; pCi/L = picocuries per liter.

Radium-226 and Radium-228

Radium is a naturally occurring radioactive element that forms from the decay of uranium and thorium. In the past, radium was used in industrial and commercial applications and is still used for a few such purposes today (Nuclear Regulatory Commission 2025). It is found at trace levels in nearly all rock, soil, water, plants, and animals. Some regions have higher concentrations due to local geology; for example, elevated radium levels can be associated with uranium deposits (U.S. Environmental Protection Agency 2022).

In 2024, one Storm Water Individual Permit compliance sample was analyzed for radium-226 or radium-228 and did not exceed the target action level. Of the 44 assessment units on Laboratory or former Laboratory lands, 1 is listed as impaired for radium (Table 6-1).

Previous analytical results confirm that most of the radium-226 and radium-228 found in stormwater on the Pajarito Plateau originates from the natural decay of isotopes present in local sediment and soil (Gallaher 2007).

Constituents Related to Los Alamos National Laboratory Operations

Several constituents known to have been released during past site operations were detected in stormwater, base flow, and sediment. The nature and extent of the constituents in sediment are described in detail in the canyons' investigation reports (LANL 2004, 2005, 2006, 2009a, 2009b, 2009c, 2009d, 2011a, 2011b, 2011c).

The following sections describe site-related constituents in 2024 stormwater, base flow, and sediment samples.

Cadmium

Cadmium is associated with the combustion of fossil fuels, industrial processes such as the refinement of nickel-cadmium batteries, metal plating, pigments, and plastics, as well as activities like sewage sludge disposal and the application of phosphate fertilizers (Agency for Toxic Substances and Disease Registry 2012).

In 2024, no exceedances of surface water quality standards for cadmium were observed in filtered stormwater or base flow samples. None of the nine Storm Water Individual Permit compliance samples analyzed for cadmium exceeded the target action level. None of the 44 assessment units on Laboratory or former Laboratory lands are listed as impaired for cadmium, (Table 6-1).

In 2024, no sediment results exceeded soil screening levels for cadmium.

Chromium

Chromium is associated with the historical use of potassium dichromate as a corrosion inhibitor in the cooling system at the Technical Area 3 power plant (LANL 1973). This compound was discharged through Outfall 001 during 1956 to 1972.

In 2024, filtered stormwater and base flow results did not exceed surface water quality standards for either total chromium or hexavalent chromium. None of the eight Storm Water Individual Permit compliance samples analyzed for chromium or hexavalent chromium exceeded target action levels. None of the 44 assessment units for surface waters on Laboratory or former Laboratory lands are listed as impaired for chromium (Table 6-1).

In 2024, no sediment results exceeded soil screening levels for chromium.

Dioxins and Furans

Dioxins and furans are associated with the incineration of medical, industrial, municipal, and private wastes; municipal wastewater treatment sludge; coal-fired boilers; and diesel fuel emissions (U.S. Environmental Protection Agency 2006b). Forest fires are also a significant natural source of dioxins (Gullett and Touati 2003). Toxic equivalents are used to report the toxicity-weighted mass of dioxin and furan mixtures, providing a more meaningful measure of toxicity than the mass of individual compounds (U.S. Environmental Protection Agency 2010). Surface water quality standards apply to total dioxin toxic equivalents but not to individual dioxins or furans.

In 2024, total dioxin concentrations in stormwater or base flow samples exceeded the human health-organism only standard at the one location where it applied. None of the three Storm Water Individual Permit compliance samples analyzed for 2,3,7,8-tetrachlorodibenzodioxin exceeded the target action level. None of the 44 assessment units on Laboratory or former Laboratory lands are listed as impaired for dioxins or furans (Table 6-1).

In 2024, no sediment samples exceeded soil screening levels for dioxins or furans.

Mercury

Mercury originates from both natural sources, such as forest fires, and from human activities, including coal combustion and mining. Although the coal-fired Four Corners Power Plant has contributed to regional mercury contamination, the Laboratory also historically operated coal-fired power plants that could have been sources.

In 2024, mercury concentrations in stormwater and base flow exceeded the wildlife habitat standard at four locations (13 percent of locations). None of the seven Storm Water Individual Permit compliance samples analyzed for mercury exceeded the target action level. Of the 44 assessment units on Laboratory or former Laboratory lands, 6 are listed as impaired for mercury (Table 6-1).

Figure 6-19 shows mercury concentrations in unfiltered stormwater and base flow for Ancho Canyon and Chaquehui Canyon watersheds. Mercury concentrations measured in 2024 were similar to those measured in 2023.

In 2024, no sediment samples exceeded soil screening levels for mercury.

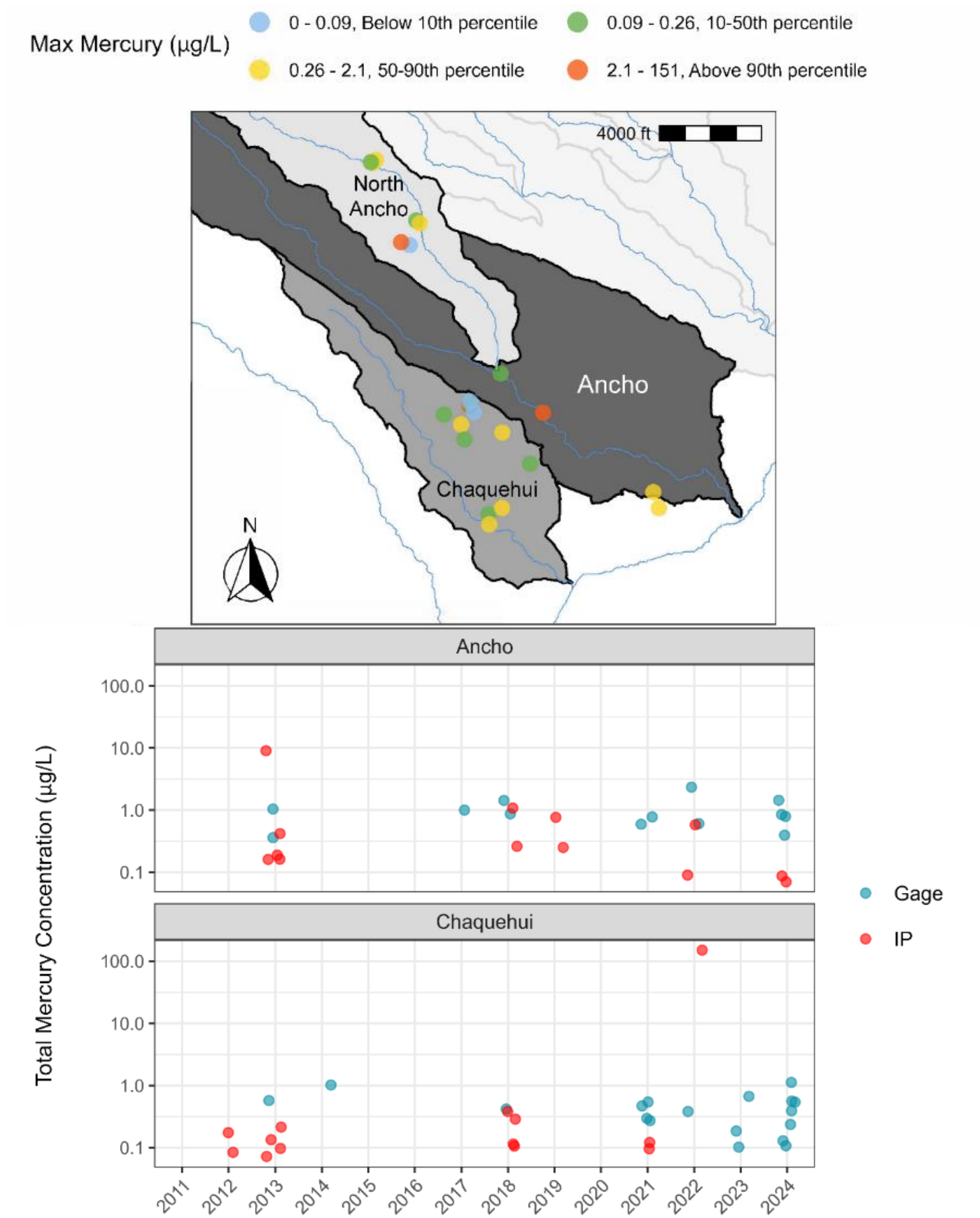


Figure 6-19. Total mercury concentrations in Ancho and Chaquehui canyon watersheds from Storm Water Individual Permit, gaging station, and base flow samples from 2011 to 2024.Top Panel: Maximum stormwater mercury concentrations for each sampling location from 2011 to 2024. Bottom panels: Detected mercury concentrations from Storm Water Individual Permit, gaging station, and base flow samples from 2011 to 2024. Note: µg/L = micrograms per liter.

Polychlorinated Biphenyls (PCBs)

PCBs are stable, persistent organic compounds that break down slowly in the environment. They were commonly used as plastic and paint stabilizers and coolants in electrical appliances before they were banned in the United States in 1979. Many legacy construction materials contain PCBs, including caulking, paints, window putty, and electrical components (Durell and Lizotte 1998, Kakareka and Kukharchyk 2006). As these materials weather and deteriorate, PCBs accumulate in the environment and are redistributed through surface runoff and atmospheric deposition (Chevreuil et al. 1996, Duinker and Bouchertall 1989, Grainer et al. 1990, LANL 2012). The Laboratory historically used materials that contained PCBs, such as transformer fluids, solvents, paints and operations at a former asphalt batch plant in Sandia Canyon. Some buildings that contain legacy PCB materials are still found on the LANL site.

During 2024, PCB monitoring transitioned from congener-based analysis to Aroclor-based analysis. Base flow samples collected in the first quarter were analyzed for PCB congeners. Total PCB concentrations in base flow from the first quarter of 2024 exceeded the human health-organism only standard at the three locations where the standard applied. During the remainder of the year, total Aroclor concentrations in stormwater and base flow exceeded the human health-organism only standard at three locations (10 percent of locations), a chronic aquatic life criterion at two locations (17 percent of locations), and the wildlife habitat standard at three locations (10 percent of locations). Of the 17 Storm Water Individual Permit compliance samples analyzed for total PCB concentrations, 11 exceeded the target action level. Of the 44 assessment units on Laboratory or former Laboratory lands, 33 are listed as impaired for PCBs (Table 6-1).

Figure 6-20 and Figure 6-21 present total PCB congener and total PCB Aroclor concentrations in unfiltered stormwater and base flow for Los Alamos Canyon watershed, including Pueblo Canyon and the Mortandad Canyon and Sandia Canyon watersheds, respectively.

In 2024, one sediment sample collected from Los Alamos Canyon exceeded the residential soil noncancer soil screening level for Aroclor-1254.

Polycyclic Aromatic Hydrocarbons

Polycyclic aromatic hydrocarbons are a group of chemicals commonly found in petroleum products, including asphalt. A former asphalt batch plant near Sandia Canyon discharged wastewater that contained polycyclic aromatic hydrocarbons into the canyon.

In 2024, polycyclic aromatic hydrocarbons concentrations in stormwater and base flow exceeded the human health-organism only standard at three locations (33 percent of locations). Exceedances occurred for 5 of the 19 polycyclic aromatic hydrocarbons with water quality standards: benzo(a)pyrene, benzo(b)fluoranthene, bis(2-ethylhexyl)phthalate, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene. Of the 23 Storm Water Individual Permit compliance samples analyzed for polycyclic aromatic hydrocarbons, 3 exceeded target action levels. None of the 44 assessment units on Laboratory or former Laboratory lands are listed as impaired for polycyclic aromatic hydrocarbons (Table 6-1). Figure 6-22 shows benzo(a)fluoranthene concentrations in unfiltered stormwater and base flow for the Sandia Canyon watershed.

In 2024, no sediment samples exceeded screening levels for polycyclic aromatic hydrocarbons.

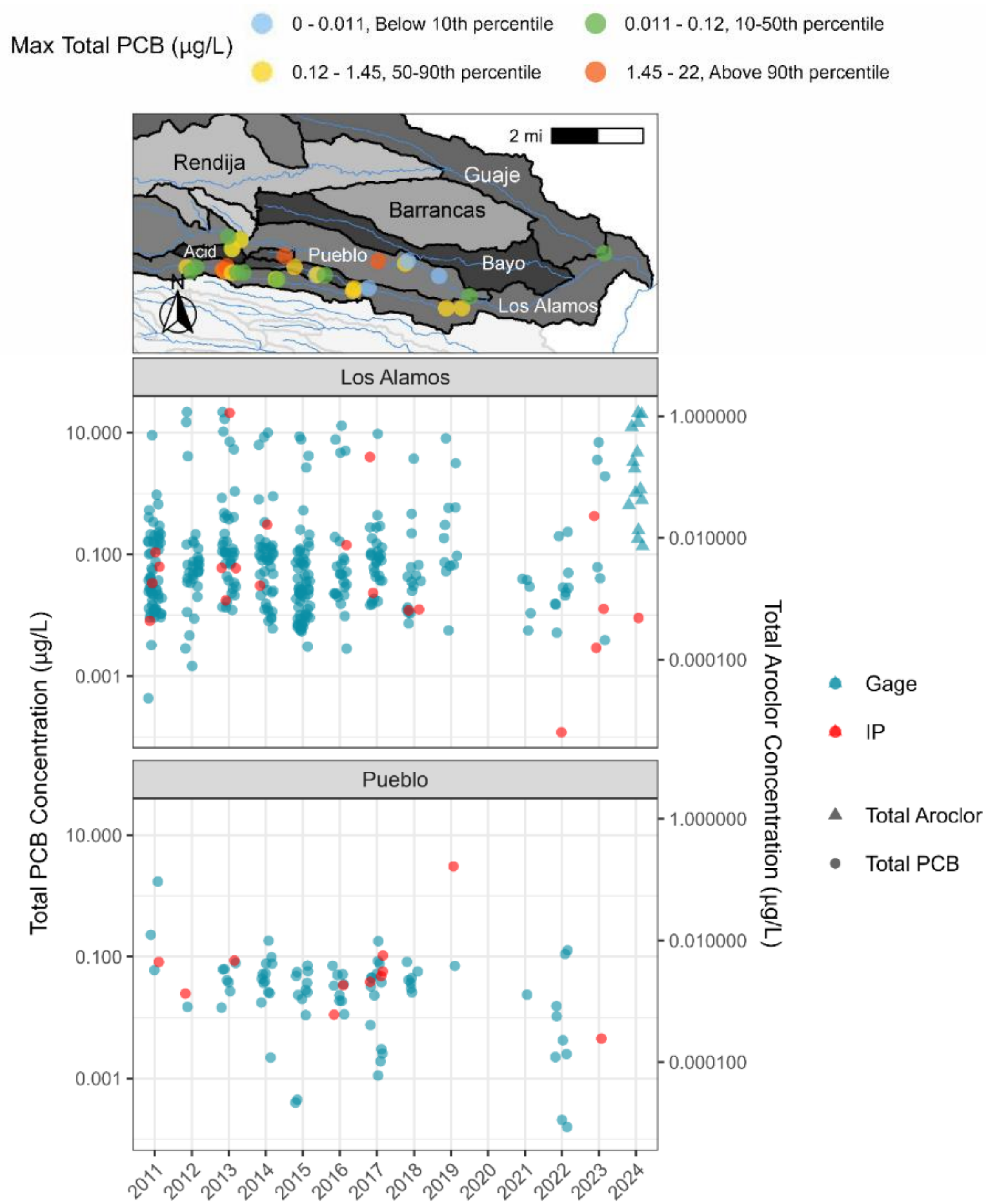


Figure 6-20. Total PCB congener and Aroclor concentrations in Los Alamos and Pueblo canyon watersheds from Storm Water Individual Permit, gaging station, and base flow samples from 2011 to 2024.Top Panel: Maximum stormwater total PCB concentrations for each sampling location from 2011 to 2024. Bottom panels: Detected total PCB concentrations from Storm Water Individual Permit, gaging station, and base flow samples from 2011 to 2024. Note: µg/L = micrograms per liter.

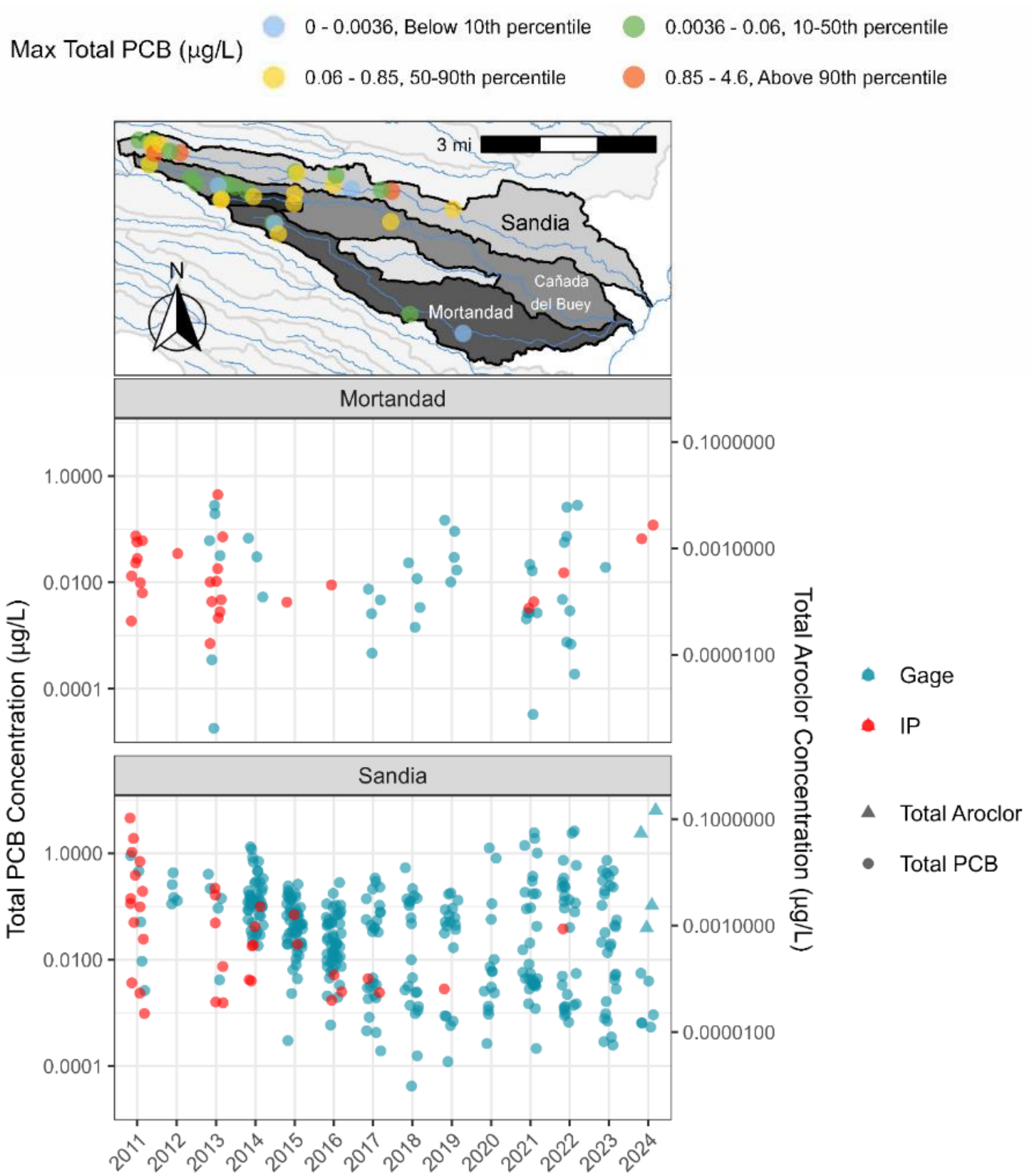


Figure 6-21. Total PCB congener and Aroclor concentrations in Sandia and Mortandad canyon watersheds from Storm Water Individual Permit, gaging station, and base flow samples from 2011 to 2024.Top Panel: Maximum stormwater total PCB concentrations for each sampling location from 2011 to 2024. Bottom panels: Detected total PCB concentrations from Storm Water Individual Permit, gaging station, and base flow samples from 2011 to 2024. Note: µg/L = micrograms per liter.

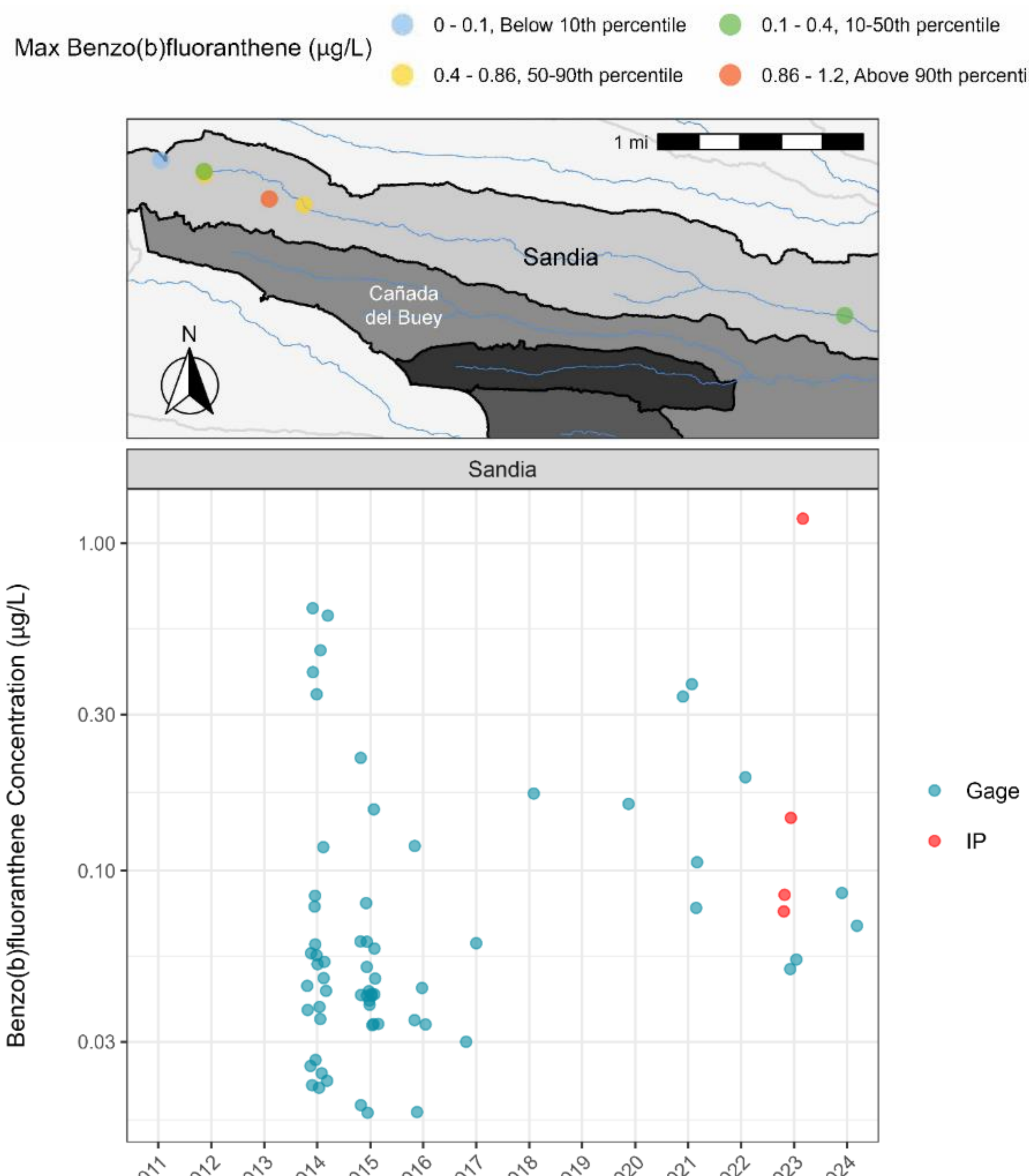


Figure 6-22. Total benzo(b)fluoranthene concentrations in Sandia Canyon watersheds from Storm Water Individual Permit, gaging station, and base flow samples from 2011 to 2024.Top Panel: Maximum stormwater total benzo(b)fluoranthene concentrations for each sampling location from 2011 to 2024. Bottom panels: Detected total benzo(b)fluoranthene concentrations from Storm Water Individual Permit, gaging station, and base flow samples from 2011 to 2024. Note: µg/L = micrograms per liter.

Radionuclides

Several radionuclides are associated with site operations. In 2024, no stormwater or sediment samples exceeded applicable water quality standards or screening levels for radionuclides.

Trends for americium-241, cesium-137, plutonium-239/240, and strontium-90 concentrations in sediment from Los Alamos Canyon are shown in Figure 6-23 through Figure 6-26, respectively.

Silver

Silver associated with site operations has been found in Pajarito Canyon and Cañon de Valle (LANL 2009a, LANL 2011c).

In 2024, no filtered stormwater or base flow samples exceeded surface water quality standards for silver. None of the nine Storm Water Individual Permit compliance samples analyzed for silver exceeded the target action level. Of the 44 assessment units on Laboratory or former Laboratory lands, 2 are listed as impaired for silver (Table 6-1).

In 2024, no sediment results exceeded soil screening levels for silver.

Thallium

Thallium emissions have been associated with cement factories and coal-fired power plants. Although the Four Corners Power Plant could have contributed to thallium contamination in the region, the Laboratory has also historically operated coal-fired power plants that could have been sources.

In 2024, no filtered stormwater or base flow samples exceeded surface water quality standards for thallium. None of the three Storm Water Individual Permit compliance samples analyzed for thallium exceeded the target action level. None of the 44 assessment units on Laboratory or former Laboratory lands are listed as impaired for thallium (Table 6-1).

In 2024, no sediment results exceeded soil screening levels for thallium.

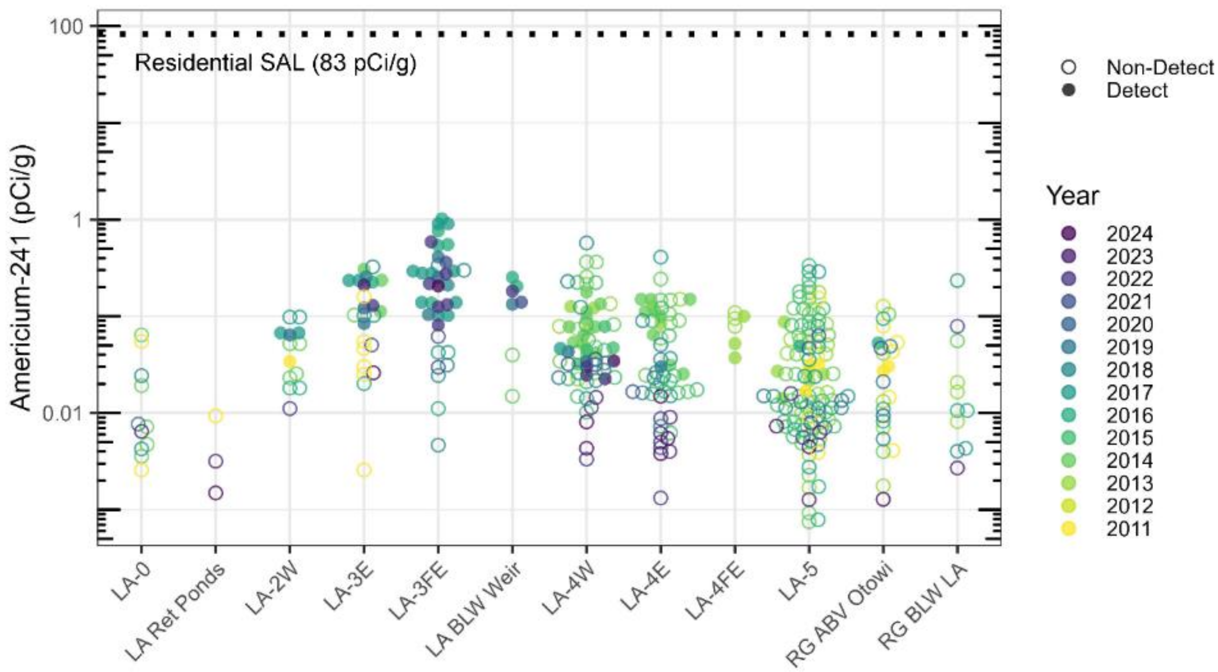


Figure 6-23. Americium-241 concentrations in sediment samples in Los Alamos Canyon and the Rio Grande from 2011 to 2024.The residential screening action level (SAL) is 83 pCi/g. Note: pCi/g = picocuries per gram.

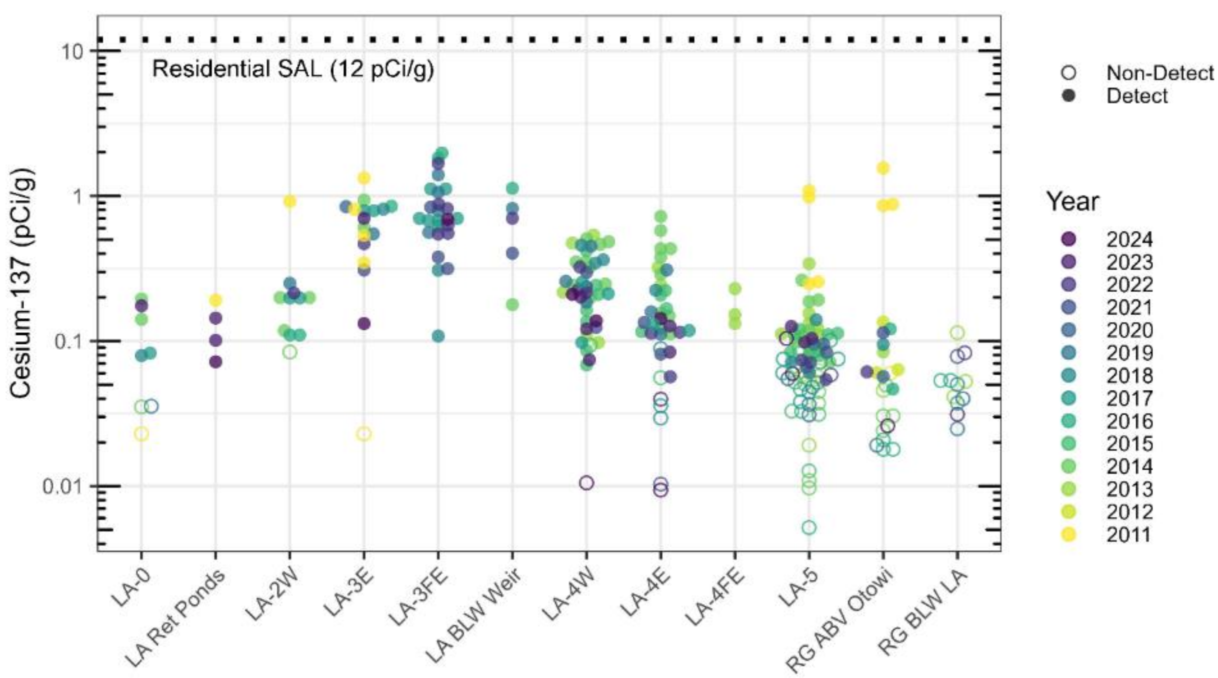


Figure 6-24. Cesium-137 concentrations in sediment samples in Los Alamos Canyon and the Rio Grande from 2011 to 2024.The residential screening action level (SAL) is 12 pCi/g. Note: pCi/g = picocuries per gram.

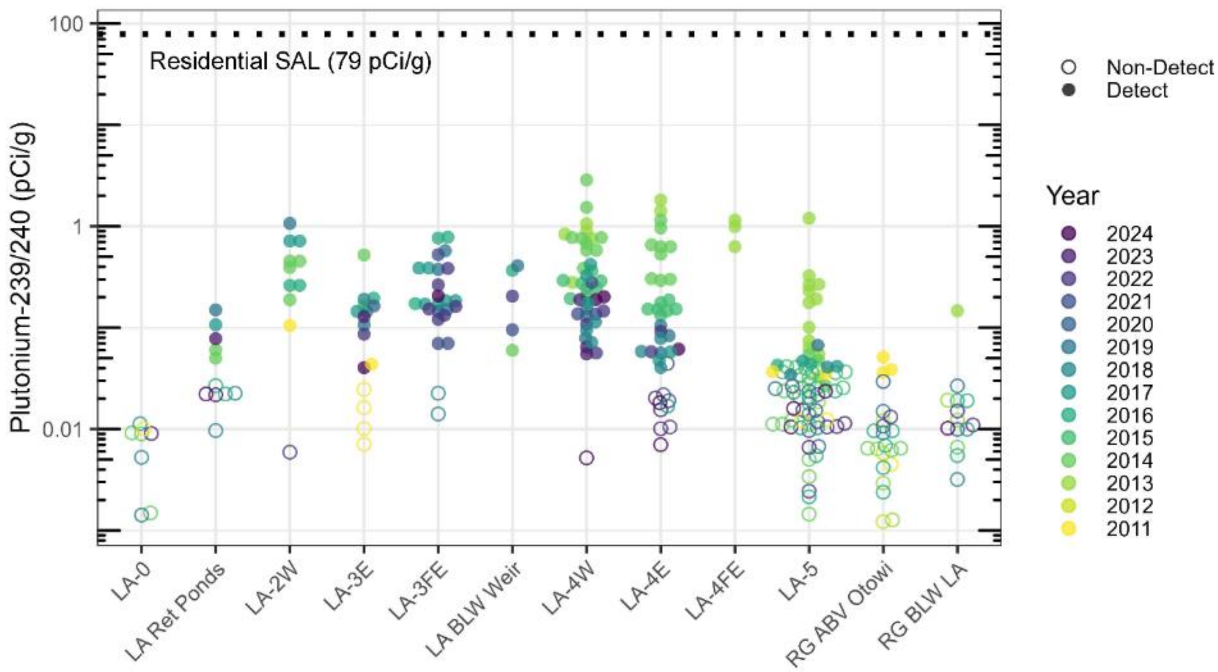


Figure 6-25. Plutonium-239/240 concentrations in sediment samples in Los Alamos Canyon and the Rio Grande from 2011 to 2024.The residential screening action level (SAL) is 79 pCi/g. Note: pCi/g = picocuries per gram.

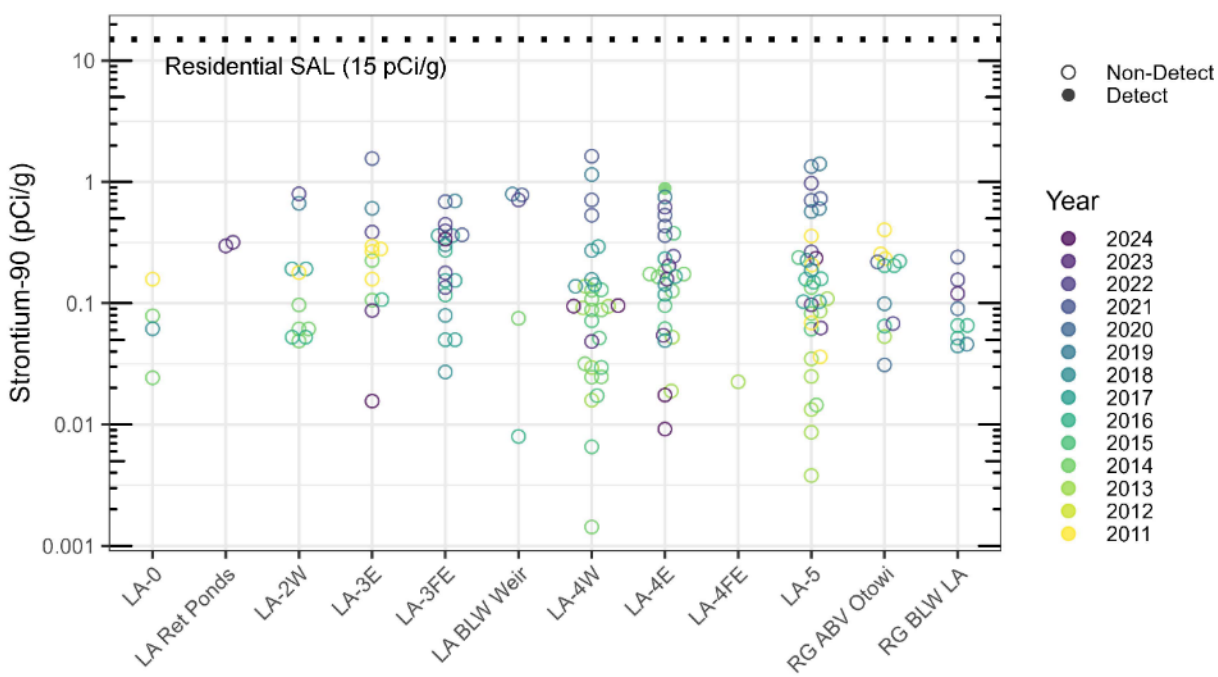


Figure 6-26. Strontium-90 concentrations in sediment samples in Los Alamos Canyon and the Rio Grande from 2011 to 2024.The residential screening action level (SAL) is 15 pCi/g. Note: pCi/g = picocuries per gram.

Summary – PFAS Monitoring Results

No surface water quality standards are established for PFAS, but we currently test for them in some samples for informational purposes. In 2024, PFAS were detected in stormwater or base flow samples at 15 locations. Two Storm Water Individual Permit locations were tested for PFAS, both of which had detections. Detailed analytical results and additional information can be found in the "2024 Annual Data Report for Per- and Polyfluoroalkyl Substances in Storm Water" (N3B 2024c).

The New Mexico Environment Department and the U.S. Environmental Protection Agency have established screening levels for some PFAS compounds in soils. In 2024, PFAS concentrations in sediment exceeded the New Mexico Environment Department's residential soil noncancer screening level in eight samples and the New Mexico Environment Department's construction worker soil noncancer screening level in three samples. Results for PFAS compounds without New Mexico Environment Department soil screening levels were compared with U.S. Environmental Protection Agency's regional screening levels, resulting in eight exceedances for both resident and industrial soil levels. We will continue to monitor PFAS in sediment.

Figure 6-27 through Figure 6-29 show 2024 concentrations in stormwater and base flow for the PFAS compounds perfluorohexane-sulfonic acid, perfluorooctanesulfonic acid, and perfluorooctanoic acid in the Los Alamos Canyon watershed, including Pueblo Canyon, and the Sandia Canyon watershed.

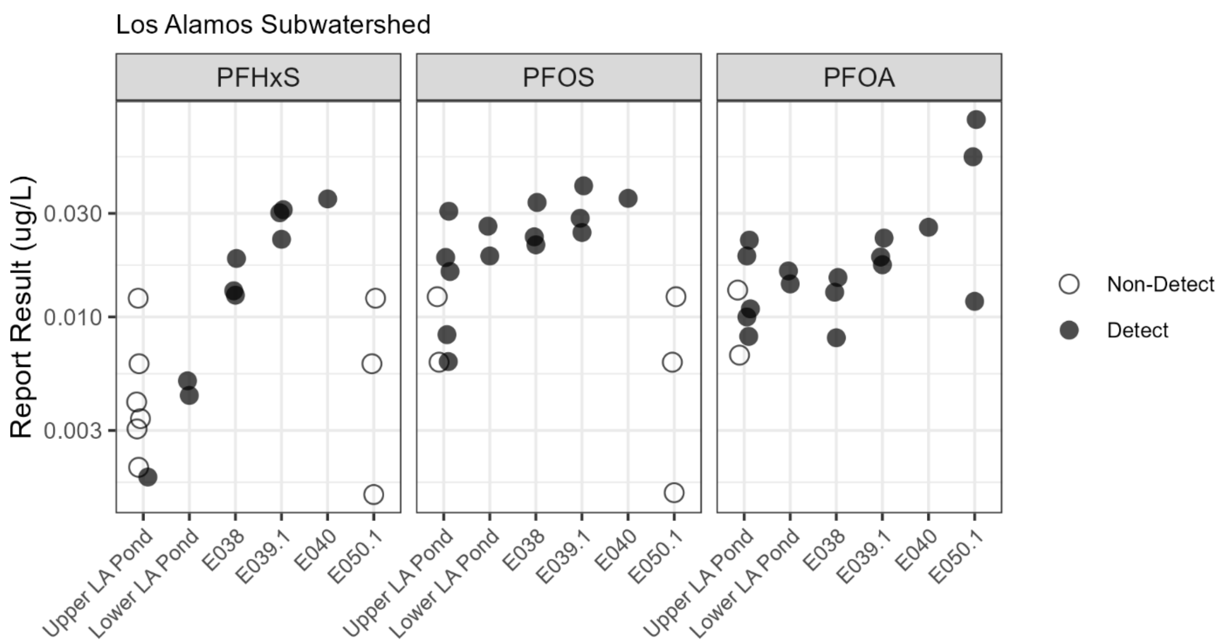


Figure 6-27. Perfluorohexanesulfonic acid (PFHxS), perfluorooctanesulfonic acid (PFOS), and perfluorooctanoic acid (PFOA) concentrations in Los Alamos Canyon subwatershed stormwater and baseflow samples in 2024. Note: µg/L = micrograms per liter.

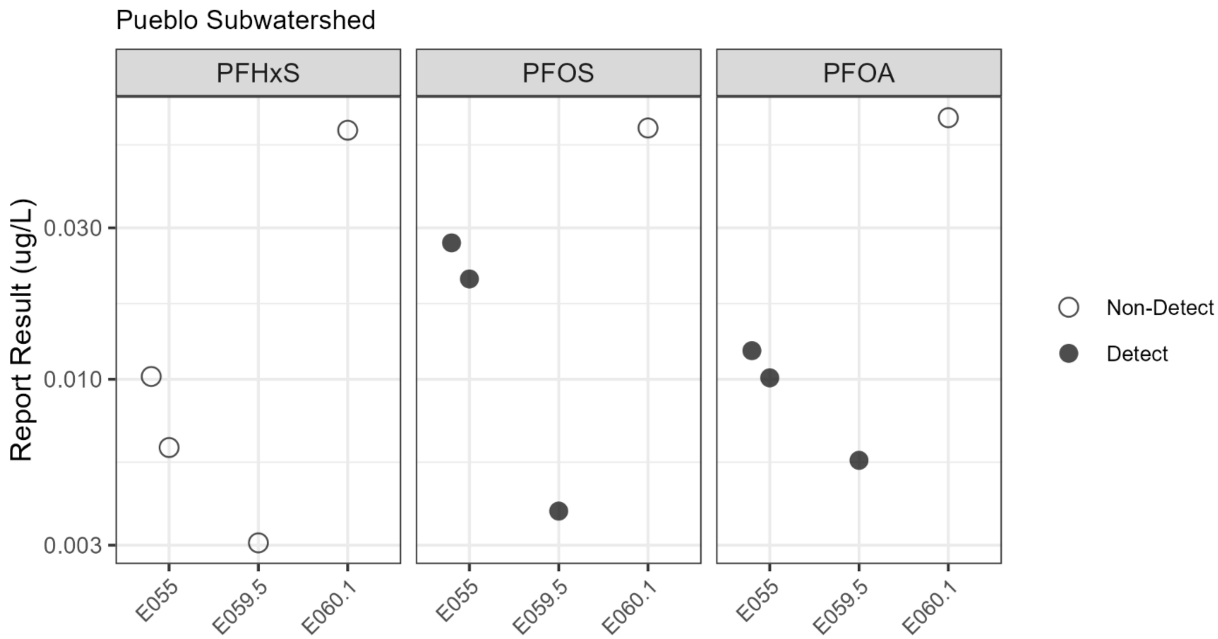


Figure 6-28. Perfluorohexanesulfonic acid (PFHxS), perfluorooctanesulfonic acid (PFOS), and perfluorooctanoic acid (PFOA) concentrations in Pueblo Canyon subwatershed stormwater and baseflow samples in 2024. Note: µg/L = micrograms per liter.

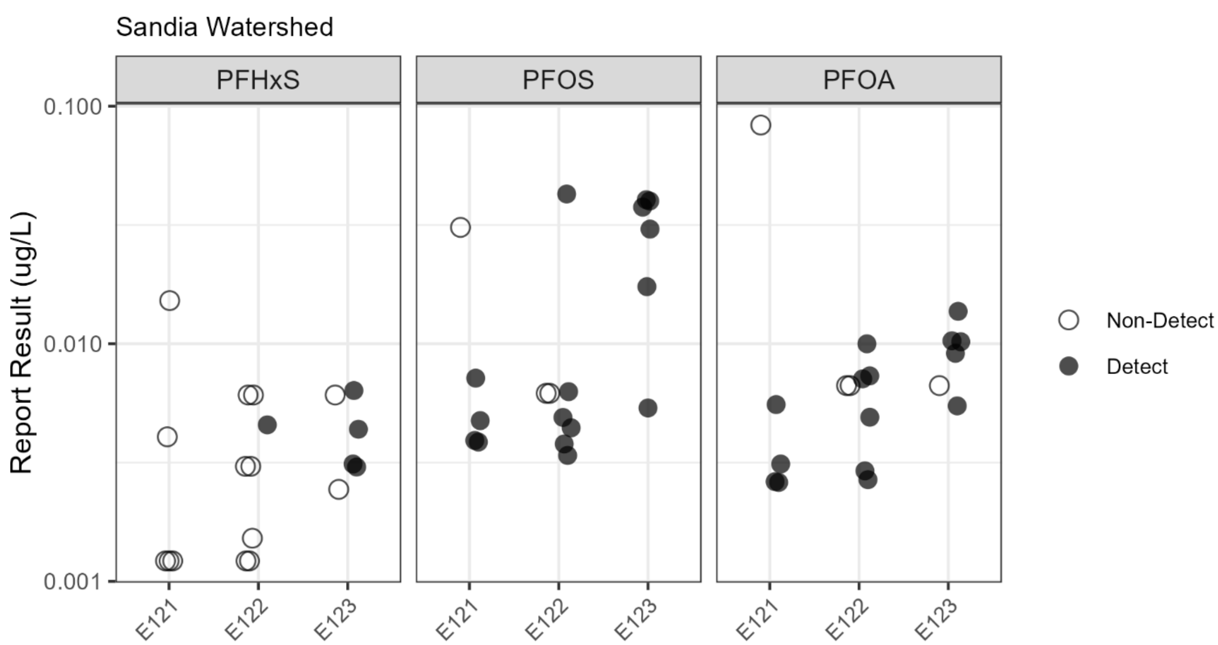


Figure 6-29. Perfluorohexanesulfonic acid (PFHxS), perfluorooctanesulfonic acid (PFOS), and perfluorooctanoic acid (PFOA) concentrations in Sandia watershed stormwater and baseflow samples in 2024. Note: µg/L = micrograms per liter.

Conclusion

The monitoring data continue to support our current conceptual model: that stormwater runoff in Laboratory canyons generally deposits sediment with concentrations of site-related substances that are equal to or lower than the concentrations observed in previous years. Through our ongoing surveillance program, we monitor the movement and concentration of contaminants in sediment over time and take action to mitigate or reduce sediment transport where needed.

The 2024 stormwater, base flow, and sediment data confirm the conceptual model. The results also support previous risk assessments presented in the canyons' investigation reports (LANL 2004, 2005, 2006, 2009a, 2009b, 2009c, 2009d, 2011a, 2011b, 2011c), which represent the upper bound of potential human and ecological health risks in these watersheds.

Concentrations of chemicals in storm flow and base flow samples remained within or below historical ranges, with the exception of elevated iron levels in Mortandad Canyon and Pajarito Canyon watersheds. In Sandia Canyon, total PCB concentrations have shown an increasing trend in recent years and will continue to be closely monitored.

In 2024, sediment exceedances were limited and included manganese, Aroclor-1254, and several PFAS chemicals. Sediment results are evaluated over multiple years and compared with nearby surface water data to assess long-term trends and to identify spatial patterns.

Based on the human health risk assessments in the canyons' investigation reports, along with the biota dose assessment (Chapter 7) and the human health risk assessment (Chapter 8) in this report, the cumulative total concentrations of chemicals and radionuclides in stormwater, base flow, and sediment are below levels that would impact human or biota health.

Our ongoing maintenance and construction of watershed-scale engineered controls continue to effectively minimize the downstream migration of contaminated sediment to the Rio Grande.

Quality Assurance

We perform sampling of storm flow, base flow, and sediment and measure stream flow according to written quality assurance and quality control procedures and protocols. Current versions of all procedures and guides are listed at https://eprr.em-la.doe.gov/. These procedures ensure that the collection, processing, and chemical analysis of samples and the validation and verification of analytical data are consistent from year to year.

Analytical results meet the N3B minimum data quality objectives as outlined in N3B-PLN-SDM-1000, "Sample and Data Management Plan." This plan sets the validation frequency criteria at 100 percent Level 1 examination and Level 2 verification of data and at 10 percent minimum Level 3 validation of data. A Level 1 examination assesses the completeness of the data as delivered from the analytical laboratory, identifies any reporting errors, and checks the usability of the data based on the analytical laboratory's evaluation of the data. A Level 2 verification evaluates the data to determine the extent to which the laboratory met the analytical method and the contract-specific quality control and reporting requirements. A Level 3 validation includes Levels 1 and 2 criteria and determines the effect of potential anomalies encountered during analysis and possible effects on data quality and usability. A Level 3 validation is performed manually with method-specific data validation procedures.

Data from analytical laboratories are validated by N3B personnel as outlined in N3B-PLN-SDM-1000; N3B-AP-SDM-3000, "General Guidelines for Data Validation"; N3B-AP-SDM-3014, "Examination and Verification of Analytical Data"; and additional method-specific analytical data validation procedures. All associated validation procedures have been developed, where applicable, from the U.S. Environmental Protection Agency QA/G-8 Guidance on Environmental Data Verification and Data Validation, the Department of Defense/DOE Consolidated Quality Systems Manual for Environmental Laboratories, the U.S. Environmental Protection Agency National Functional Guidelines for Data Validation, and the American National Standards Institute/American Nuclear Society 41.5: Verification and Validation of Radiological Data.

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Chapter 7: Ecosystem Health

Introduction

An ecosystem includes living organisms such as plants, animals, and bacteria; nonliving elements such as soil, air, and water; and the interactions among these components (Smith and Smith 2012). How an ecosystem functions is affected by disturbances, including wildfire, flooding, drought, invasive species, chemical spills, construction projects, vegetation removal, and other events (Rapport 1998).

To evaluate and support the health of our local ecosystems, we monitor and, in some cases, manage

- levels of radionuclide and chemical constituents in soil, sediment, plants, and animals;
- federally listed threatened or endangered species;
- populations of migratory bird species and other species of concern;
- state-listed threatened or endangered species or species of greatest conservation need; and
- forest conditions.

Our objectives are to

- determine whether operations at the Los Alamos National Laboratory (LANL or the Laboratory) site affect plant or animal populations (collectively called "biota");
- meet federal and state regulatory requirements;
- minimize future risk to ecological resources;
- reduce the potential for harm from wildland fire;
- increase forest and habitat resilience to disturbances; and
- implement the Invasive Species Management Plan (LANL 2024a) and Pollinator Protection Plan (LANL 2021).

We rotate some types of institutional monitoring we perform on a 3-year cycle (Figure 7-1). In 2024, we collected terrestrial soil and vegetation as part of our soil, foodstuffs, and biota monitoring program.

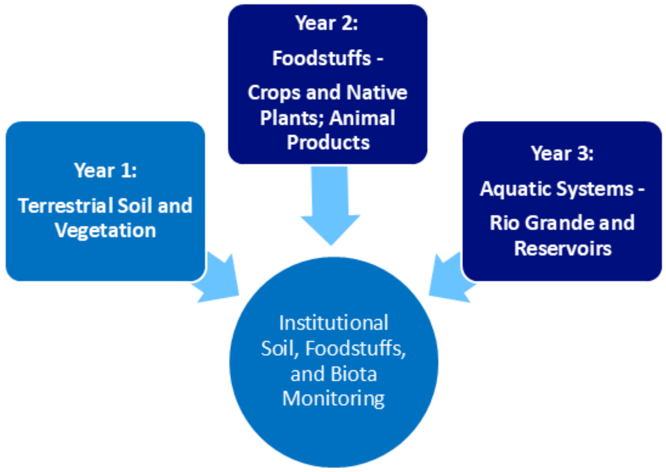

Figure 7-1. The 3-year cycle of monitoring activities for institutional soil, foodstuffs, and biota monitoring at the Los Alamos National Laboratory site.

Biota Dose and Risk Assessment Methods

Figure 7-2 shows our process for evaluating if plants or animals are affected by radionuclides or other chemicals (collectively known as constituents) released from the site.

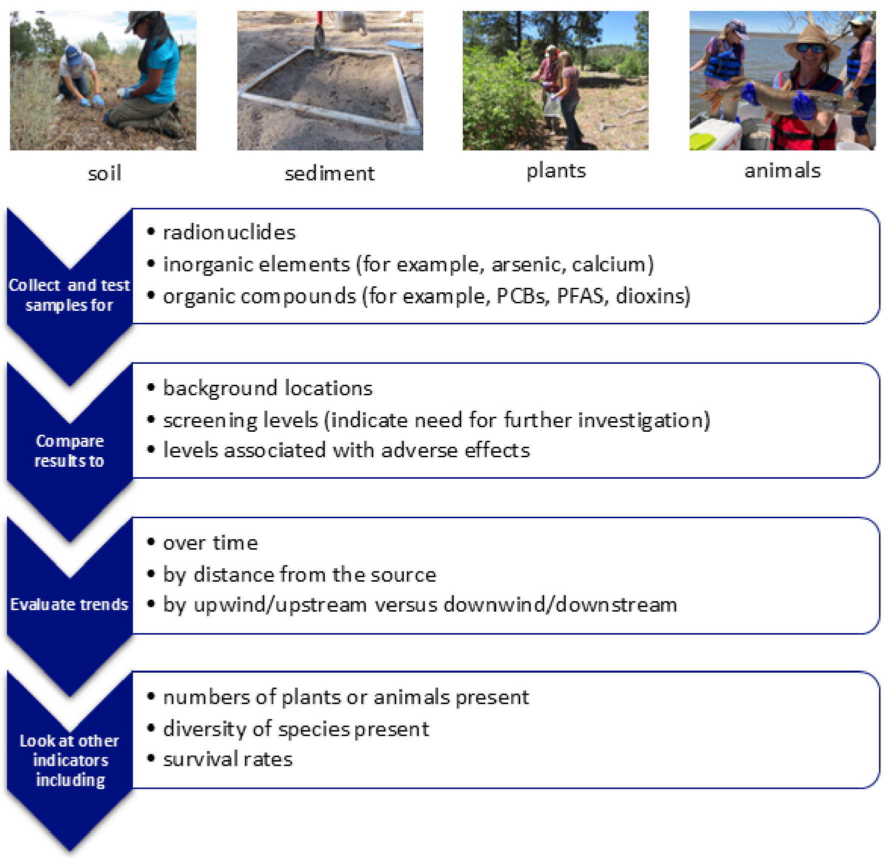

Figure 7-2. This graphic shows environmental media that are sampled and how the data are used to evaluate potential effects of radionuclides and other chemicals on ecosystem health in and around the Los Alamos National Laboratory site.

We compare levels of constituents with regional statistical reference levels for each type of sample. The regional statistical reference level is calculated using the results from similar samples collected at regional background locations during the previous 10 years (Figure 7-3).

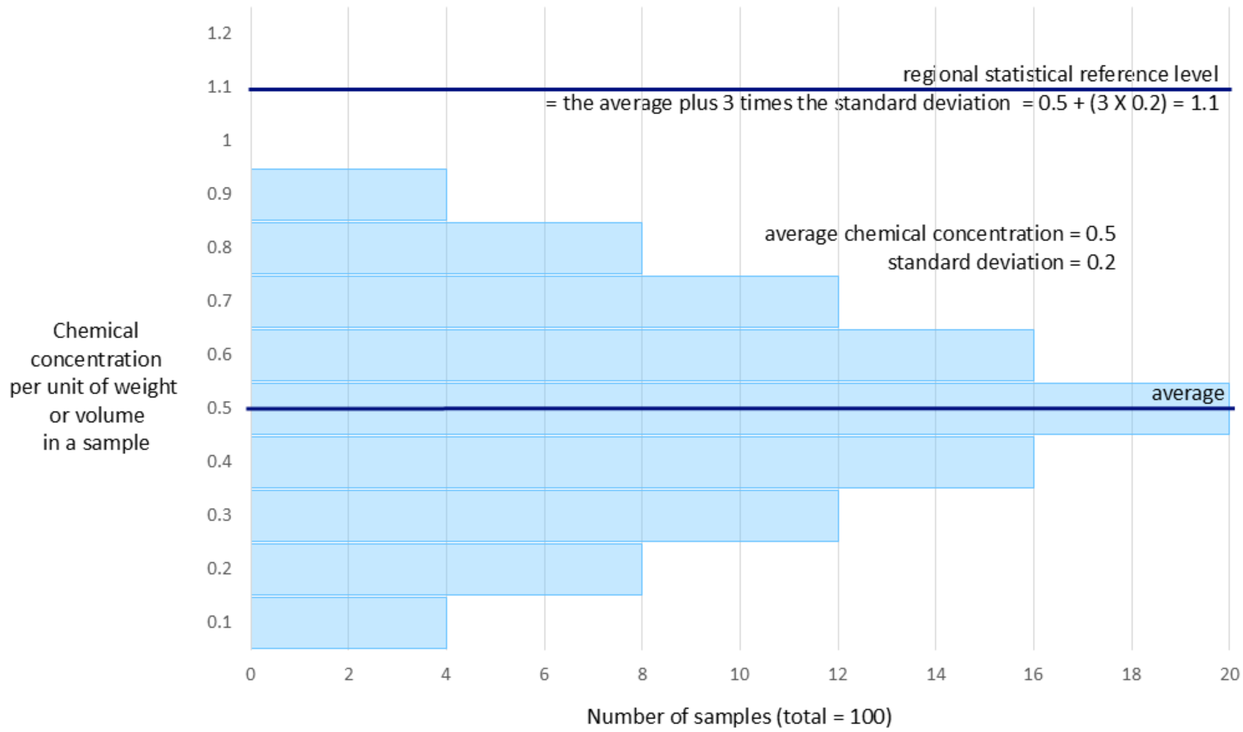

Figure 7-3. A chart that demonstrates how a regional statistical reference level is calculated using a hypothetical set of 100 background samples with a statistically normal distribution.

Constituent Levels in Soil and Sediment

Chemicals that are released into the air or that are attached to particles transported by wind and water are eventually deposited onto soil or sediment. Monitoring soil over time directly measures long-term trends in levels of radionuclides and other chemicals around nuclear facilities (DOE 2015).

We have estimated soil ecological screening levels for a series of plants and animals based on published research (Intellus 2024). One type of soil ecological screening level is the highest level of a radionuclide or chemical in the soil that is known not to affect a selected animal or plant (the no-effect soil ecological screening level). Another type is the lowest level in the soil known to be associated with an adverse effect on a selected animal or plant (the low-effect soil ecological screening level). Soil concentrations of constituents below these ecological screening levels are unlikely to harm plants or animals.

Because exposure to soil constituents can differ depending on what an animal eats and where it lives, we used biota that represent different trophic levels and feeding habits to develop these screening levels. We compare our soil and sediment results to soil ecological screening levels for the following plants and animals that could occur at the site:

Life Form and Feeding Habit		Representative LANL Site Biota
Terrestrial	Terrestrial autotroph	generic plant
	Soil-dwelling invertebrate	earthworm
	Mammalian herbivore	desert cottontail (*Sylvilagus audubonii*)
	Mammalian omnivore	deer mouse (*Peromyscus maniculatus*)
	Mammalian insectivore	montane shrew (*Sorex monticolus*)
	Burrowing mammals	Botta's pocket gopher (*Thomomys bottae*)
	Mammalian carnivore	gray fox (*Urocyon cinereoargenteus*)
	Mammalian aerial insectivore	occult little brown bat (*Myotis lucifugus occultus*)
	Avian generalist	American robin (*Turdus migratorius*)
	Avian aerial insectivore	violet-green swallow (*Tachycineta thalassina*)
	Avian carnivore	American kestrel (*Falco sparverius*)
Aquatic	Aquatic autotroph	algae
	Aquatic herbivore	aquatic snail
	Aquatic omnivore	daphnids (water fleas)
	Aquatic intermediate carnivore	fish
	Aquatic community organisms	benthic macroinvertebrates

Constituent Levels in Plant and Animal Tissues

We also directly measure levels of constituents in animal and plant tissues. These measurements are compared with the lowest concentration measured in a plant or animal's tissues that is associated with an adverse effect (called the lowest observable adverse effect level) when those levels are available (U.S. Environmental Protection Agency 2014). When lowest observable adverse effect levels are not available, concentrations of chemicals in plant and animal tissues are compared with levels reported in the literature. Levels of radionuclides in tissues are compared with biota dose screening levels, which are set at 10 percent of the U.S. Department of Energy (DOE) limit for radiation doses to biota (DOE 2019, McNaughton 2021).

Estimated Doses to Plants and Animals

We estimate biota radiation dose and chemical risk using dose and risk models developed or approved by the DOE or the state of New Mexico. The estimated dose from radiation to biota is calculated using RESRAD-BIOTA software (version 1.8; https://resrad.evs.anl.gov/codes/resrad-biota/), which is a DOE methodology for estimating radiation doses to aquatic and terrestrial plants and animals. This calculated dose is compared with DOE limits: 1 rad per day for terrestrial plants and aquatic animals and 0.1 rad per day for terrestrial animals (DOE 2019).

Comparisons among Sites and over Time

We perform statistical tests to evaluate differences in constituents among sites and to examine trends in constituent levels over time. As required by the DOE, soil background locations are at a similar elevation to the Laboratory site (most between 7,000 and 8,000 feet above sea level), are more than 9.3 miles away from the Laboratory boundaries, and are beyond the range of potential influence from normal Laboratory operations (DOE 2015). Samples collected within the past 10 years or so are used to study trends over time. Samples from this time frame are directly comparable because they were analyzed with similar analytical methods and instruments and have similar detection limits.

We test a null hypothesis of no effect for each set of data. For each test, we select a probability level, or p-value, of the null hypothesis being correct, and then we accept or reject the null hypothesis. A p-value of less than 5 percent ($p < 0.05$) is used as our threshold to reject the null hypothesis of no difference between locations or no trend over time. If the p-value is greater than 5 percent ($p > 0.05$), we accept the null hypothesis of no difference or no trend. Statistical analyses are not conducted on datasets in which 80 percent or more of the results for a specific chemical or radionuclide are not detected (Helsel 2012).

What does it mean if a chemical is not detected?

When a laboratory tests a sample for the presence of a chemical, the test results come back either **detected** or **not detected**. Generally, a laboratory test cannot tell if there is a very small amount of the chemical in a sample. The level of the chemical in a sample that the laboratory can detect with its test is call the **detection limit**. If the chemical is detected, the laboratory reports the amount of the chemical in the sample. If the chemical is not detected, it means the amount of the chemical in the sample is somewhere between zero and the detection limit. When a laboratory reports a nondetected result, it can report a value of 0, the detection limit, or some fraction of the detection limit. How the result is reported can affect any statistical test that includes the nondetected result.

Results of Facility-Specific Monitoring for Radionuclides and Chemicals

Area G at Technical Area 54

Area G was established in 1957 and is the site's primary low-level radioactive solid waste burial and storage area (DOE 1979, Martinez 2006; Figure 7-4). Tritium, plutonium, americium, and uranium are the main radionuclides in waste materials at Area G (Mayfield and Hansen 1983). We have conducted soil, vegetation, and small mammal monitoring at Area G since 1980 to monitor if radionuclides are migrating beyond the waste burial area (LANL 1981, Mayfield and Hansen 1983).

We collect surface soil and vegetation at Area G each year for testing. Surface soil grab samples (0 to 6 inches deep) and composite tree samples, primarily of one-seed juniper (*Juniperus monosperma*), were collected in May 2024 at 13 designated locations around the perimeter of Area G. We collected four soil and two composite tree samples at the bottom of Cañada del Buey, near the boundary between the LANL site and the Pueblo de San Ildefonso (Figure 7-4). All samples were analyzed for tritium, americium-241, cesium-137, plutonium-238, plutonium-239/240, strontium-90, uranium-234, uranium-235/236, and uranium-238.

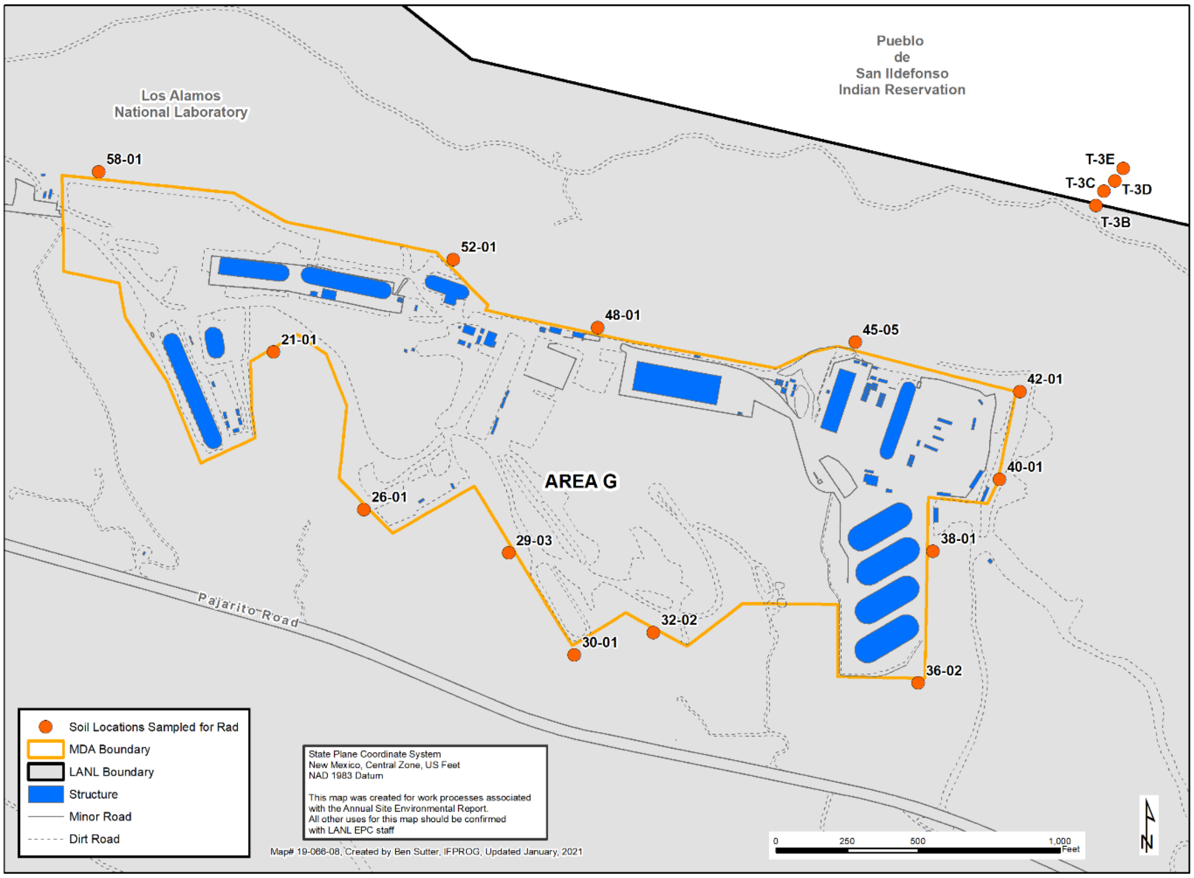

Figure 7-4. Locations of soil and vegetation samples collected around Area G and near the boundary between the LANL site and the Pueblo de San Ildefonso in 2024. (MDA = Material Disposal Area).

Area G Soil Results

The 2024 soil results at Area G are summarized as follows (refer to Supplemental Table S7-1 for individual results):

- Strontium-90 was not detected in soil around Area G.
- Cesium-137 was detected, but all values were below the regional statistical reference level.
- Tritium was detected at one location and was above the regional statistical reference level.
- Uranium-234, uranium-235/236, and uranium-238 levels were similar to or below the regional statistical reference levels.
- Americium-241, plutonium-238, and plutonium-239/240 levels were above the regional statistical reference levels in several locations.
- All radionuclide levels are far below their soil ecological screening levels.

Plutonium-238 and plutonium-239/240 levels in soil samples collected on the north, northeastern, and eastern side of Area G were above their regional statistical reference levels

(Table S7-1). Americium-241 levels in soil samples collected on the north, northeastern, eastern, and south side of Area G were above its regional statistical reference level (Table S7-1). These concentrations are similar to previous years (Figure 7-5). Plutonium-238 decreased over time at location 32-02 (Kendall's Tau, $p < 0.05$). Tritium increased at location 26-01 (Kendall's Tau, $p < 0.05$); however, a high percentage of non-detects for tritium (73 percent) could be affecting this result. Trend analyses were not performed on uranium-235/236; refer to Analytical Laboratory Quality Assessment in this chapter for more information. All radionuclide levels were far below their soil ecological screening levels.

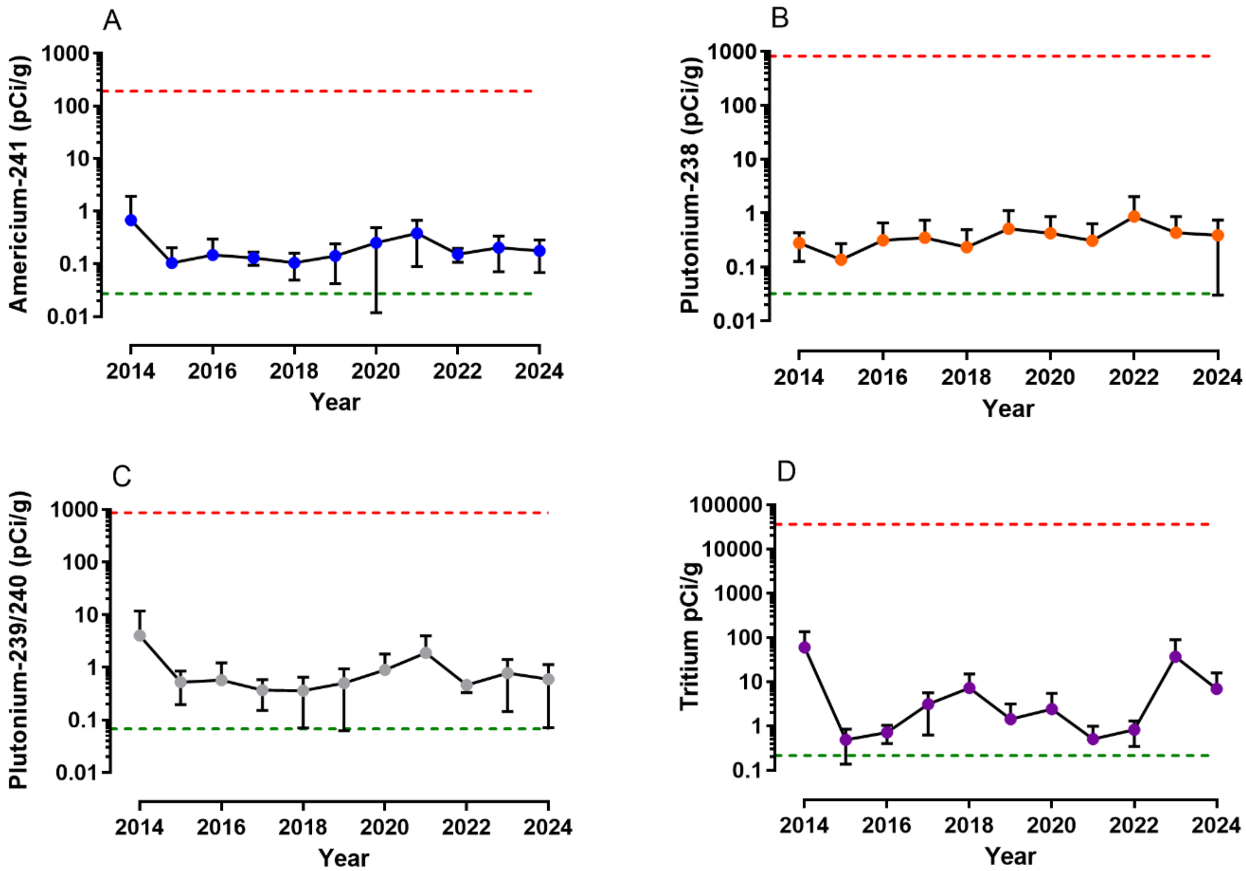

Figure 7-5. (A) Americium-241; (B) plutonium-238; (C) plutonium-239/240 levels in surface soil samples collected from five locations on the northern, northeastern, and eastern side (locations 38-01, 40-01, 42-01, 45-05 and 48-01); and (D) tritium levels in surface soil samples collected from two locations on the southern side (locations 29-03 and 30-01) of Area G at Technical Area 54 from 2014 to 2024.Data are compared with the regional statistical reference level (green dashed line) and the lowest no-effect ecological screening level (red dashed line). Note the logarithmic scale on the vertical axis. Points represent mean, and error bars represent standard deviation. Bottom error bars are absent on some points because the error would have been a negative value; however, negative values cannot be shown on a logarithmic axis. Note: pCi/g = picocuries per gram.

Area G Vegetation Results

Tree samples (primarily one-seed juniper) were collected at the same general locations as the soil samples (Figure 7-4); however, because of a firebreak along the fence line, some of the trees were located more than 30 feet away from the fence around Area G, particularly on the northern and eastern sides. Trees can acquire radionuclides either by taking them up through their root systems or by having radioactive material land on the surfaces of leaves and branches.

The 2024 native tree results at Area G are summarized as follows (refer to Supplemental Table S7-2 for individual results):

- Most radionuclides in overstory vegetation samples were either not detected or were below the regional statistical reference levels.
- All measured radionuclide levels were below the biota dose screening levels for terrestrial plants.

Similar to previous years, tritium levels in overstory vegetation were highest (up to 26,900 picocuries per milliliter) in trees growing in the southern sections of Area G near the tritium disposal shafts. Tritium levels are far below the biota dose screening level of 345,000 picocuries per milliliter. The levels of plant tritium are highly variable from year to year, which could be a result of any (or a combination) of the following: soil moisture, depth of roots, time of sampling, distance from the perimeter fence, temperature, or barometric pressure.

Strontium-90 was detected slightly above the regional statistical reference level of 2.20 picocuries per gram in one of the overstory vegetation samples collected around the perimeter of Area G (2.23 picocuries per gram; Table S7-2). This level is far below the biota dose screening level of 76,444 picocuries per gram.

Americium-241 was detected above the regional statistical level of 0.019 picocuries per gram in four of the overstory vegetation samples, ranging from 0.048 to 0.247 picocuries per gram. All of these values are far below the biota dose screening level of 778 picocuries per gram. Plutonium-239/240 slightly exceeded the regional statistical level (0.024 picocuries per gram) in one vegetation sample collected from the south side at 0.029 picocuries per gram (Table S7-2).

Uranium-234 and urainium-238 were detected in all overstory vegetation samples and were all below the regional statistical reference levels. Uranium-235/236 was not detected in any vegetation samples collected around Area G (Table S7-2). Plutonium-239/240 levels decreased at locations 21-01, 26-01, 30-01, 32-02, 36-02, 48-01, 52-01 and 58-01 (Kendall's Tau, $p < 0.05$). Uranium-238 levels are all below the regional statistical reference level, although uranium-238 levels increased at two locations, 30-01 and 32-02 (Kendall's Tau, $p < 0.05$). Trend analyses were not performed on uranium-235/236; refer to Analytical Laboratory Quality Assessment in this chapter for more information.

LANL Site/Pueblo de San Ildefonso Boundary in Cañada del Buey

In 2024, a duplicate split soil sample (where soil is thoroughly mixed in a bag and then split into two sample containers) was collected at location T-3B near the Technical Area 54 and Pueblo de San Ildefonso boundary (Figure 7-4). This location has been sampled from 2016 through 2024. We collected three additional soil samples on Pueblo de San Ildefonso property at locations T-3C, T-3D, and T-3E near the Pueblo de San Ildefonso boundary (Figure 7-3) and two vegetation samples near the boundary of Technical Area 54 and Pueblo de San Ildefonso at locations T-3B and T-3D (Figure 7-4).

Cañada del Buey Soil Results

The 2024 results at the Technical Area 54 and Pueblo de San Ildefonso boundary in Cañada del Buey are summarized as follows (refer to Supplemental Table S7-1 for individual results):

- Most radionuclide activities in soil were not detected or were below the regional statistical reference level.
- Levels of some uranium isotopes were above the regional statistical reference levels at locations T-3C, T-3D, and T-3E.
- All soil radionuclide levels were below soil ecological screening levels.

Strontium-90 and tritium were not detected in any of the soil samples collected near the boundary of Technical Area 54 and Pueblo de San Ildefonso. All detectable cesium-137 levels were below the regional statistical reference levels (Table S7-1).

Americium-241 and plutonium-239/240 levels were slightly above their respective regional statistical reference level at location T-3B, and plutonium-238 slightly exceeded the regional statistical reference level at location T-3C (Table S7-1). All detected radionuclide levels are far below the ecological screening levels.

All three uranium isotopes were detected in most soil samples collected near Technical Area 54 and the Pueblo de San Ildefonso boundary. Most observations were below their respective regional statistical reference level or only slightly above (Table S7-1). At T-3D and T-3E, uranium-234 was detected at 1.84 and 1.58 picocuries per gram respectively, and exceeded the regional statistical reference level of 1.49 picocuries per gram (Table S7-1). At T-3C, T-3D, and T-3E, uranium-238 was detected at 1.52, 1.91, and 1.92 picocuries per gram, respectively, which exceeded the regional statistical level of 1.50 picocuries per gram (Table S7-1). The near 1:1 ratio of uranium-234 to uranium-238 indicates that the uranium is from naturally occurring sources (International Atomic Energy Agency 2025) and the concentrations observed here are similar to Laboratory site background concentrations (Ryti et al. 1998). All of these observations are well below the most sensitive no-effect ecological soil screening levels (Table S7-1). Radionuclide levels are not changing over time in soil near the Technical Area 54 and Pueblo de San Ildefonso boundary (Kendall's Tau, $p > 0.05$; Figure 7-6). Trend analyses were not performed on uranium-235/236; refer to Analytical Laboratory Quality Assessment in this chapter for more information.

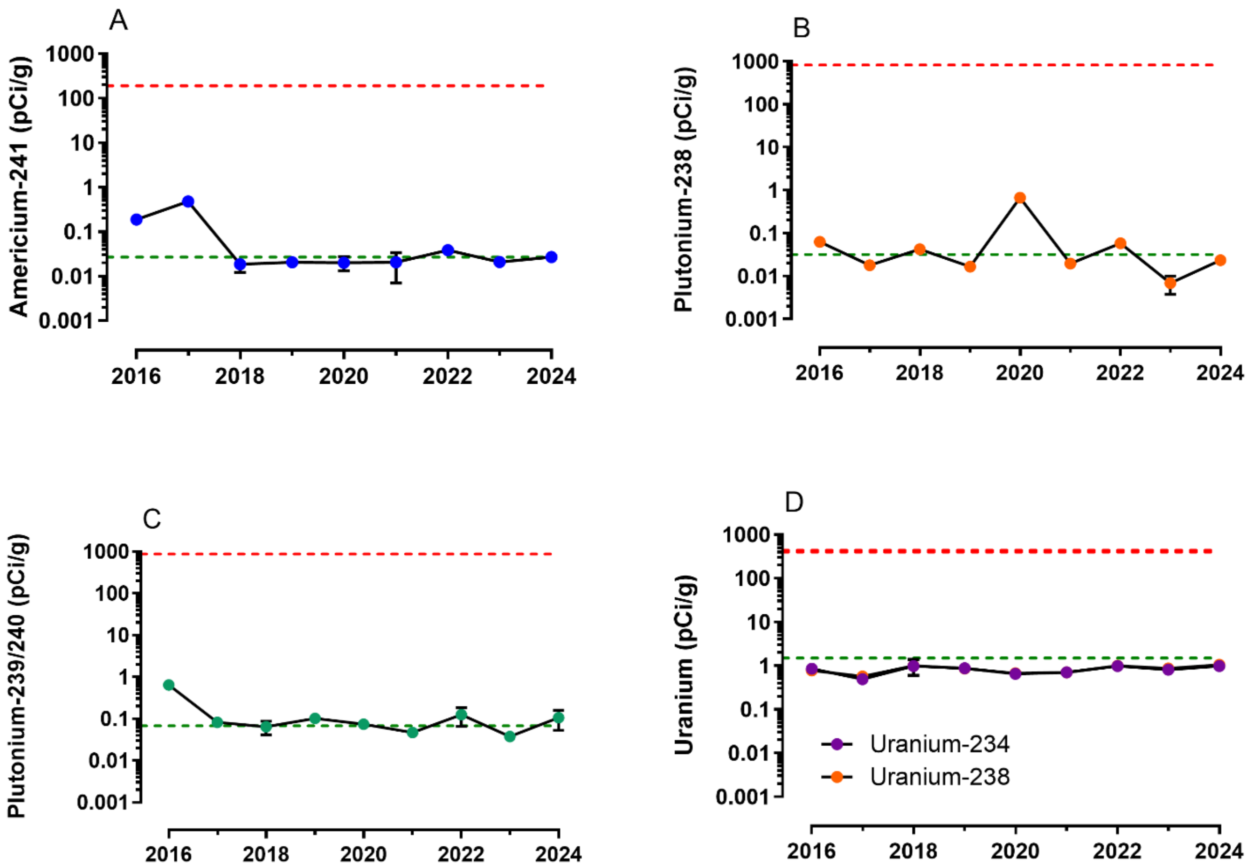

Figure 7-6. (A) Americium-241, (B) plutonium-238, (C) plutonium-239/240, and (D) uranium-234 and uranium-238 levels in soil collected near the Technical Area 54 and Pueblo de San Ildefonso border from 2016 through 2024 at the T-3B location on Laboratory property. Results from 2018 through 2024 are the average of duplicated samples. Data are compared with the regional statistical reference level (green dashed line) and the lowest no-effect ecological screening level (red dashed line). Note the logarithmic scale on the vertical axis. Points represent true values (between 2016 and 2017, n = 1 each) or represent mean values (between 2018 and 2024, n = 2 each), and error bars represent standard deviation. Error bars might appear absent on some points because standard deviations are too small to plot. Note: pCi/g = picocuries per gram.

Cañada del Buey Vegetation Results

The 2024 native tree results at the Technical Area 54 and Pueblo de San Ildefonso boundary in Cañada del Buey are summarized as follows (refer to Supplemental Table S7-2 for individual results):

- All radionuclides in overstory vegetation samples were either not detected or were below the regional statistical reference levels.
- All levels were below the biota dose screening level for terrestrial plants.

Americium-241, cesium-137, plutonium-238, plutonium-239/240, and uranium-235/236 were not detected in any of the vegetation samples collected near the boundary of Technical Area 54 and Pueblo de San Ildefonso (Table S7-2).

Strontium-90, tritium, uranium-234, and uranium-238 were detected in both vegetation sampling locations but were below their respective regional statistical reference levels (Table S7-2). All samples were well below the biota dose screening level, and no radionuclide levels are increasing over time in vegetation at this location (Kendall's Tau, $p > 0.05$). Trend analyses were not performed on uranium-235/236; refer to Analytical Laboratory Quality Assessment in this chapter for more information.

Dual-Axis Radiographic Hydrodynamic Test Facility at Technical Area 15

The Dual-Axis Radiographic Hydrodynamic Test Facility is used to study properties of the explosives that trigger nuclear weapons. We monitor soil, sediment from local drainages, plants, and animals to determine if constituents released from the facility could be affecting plants or animals and if observed levels are consistent with our expectations of radionuclide and chemical uptake. This environmental monitoring has occurred annually since 1996. The Dual-Axis Radiographic Hydrodynamic Test Facility began firing-site operations in 2000. The types of mitigations used to control releases from detonations at the facility have changed over time (Figure 7-7).

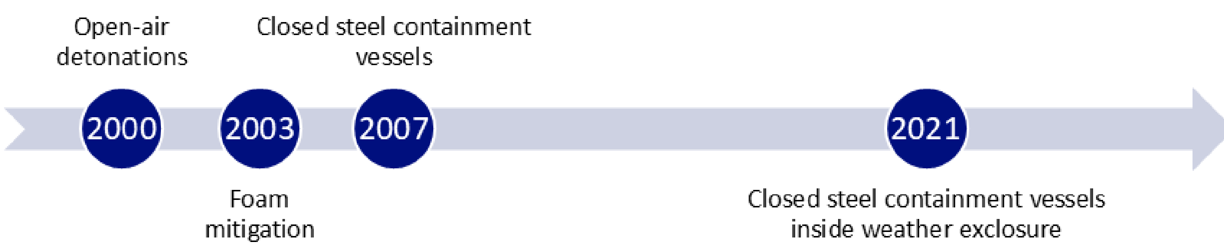

Figure 7-7. This timeline shows the types of mitigations for explosives tests at the Dual-Axis Radiographic Hydrodynamic Test Facility by year.

Biota or products of biota collected around the Dual-Axis Radiographic Hydrodynamic Test Facility have included overstory vegetation, small mammals, honeybees, honey, bird eggs, and bird nestlings. We rotate the collection of vegetation, honey, and small mammals on a 3-year cycle. Bird samples are collected opportunistically when abandoned or infertile eggs or deceased nestlings are found in local nest boxes.

In 2024, we collected soil, sediment, small mammals, and bird egg samples at the facility. Radionuclide and chemical levels were not detected at concentrations detrimental to human health or to the environment. Refer to LANL (2025) for soil, sediment, and small mammal results and Gadek et al. (2025) for bird results.

Open-Detonation and Open-Burn Firing Sites

In 2024, nonviable bird eggs and a nonviable nestling were opportunistically collected from open firing sites at Technical Area 36 Minie, Technical Area 39 Point 6, and at Technical Area 16 Burn Grounds and were analyzed for per- and polyfluoroalkyl substances (PFAS). PFAS are synthetic compounds that have been produced since the 1940s and are found in many manufactured items such as cookware, food packaging, cosmetics, stain repellents, semiconductors, lubricants, textiles, paints, and fire-fighting foams (Phong Vo et al. 2020, Gaines 2023). PFAS compounds repel oil, stains, grease, and water and are fire resistant.

Most PFAS compounds were not detected, and all detected compounds were below the regional statistical reference levels. Refer to Gadek et al. (2025) for results.

Sediment and Flood Retention Structures

Many chemicals and radionuclides released into the environment adhere to soil and sediment particles. Stormwater flows can transport these soil and sediment particles downstream in canyons. We have constructed flood and sediment retention structures to reduce flood risks and to stop or slow the movement of sediments and associated chemicals and radionuclides off the LANL site.

The Los Alamos Canyon weir and the Pajarito Canyon flood retention structure were built following the Cerro Grande Fire in 2000. As part of an environmental analysis of actions taken in response to the Cerro Grande Fire, DOE identified various measures to minimize impacts that resulted from the fire (DOE 2000). One of the measures is monitoring soil, surface water, groundwater, and biota upstream of flood-control structures; within sediment-retention basins; and within sediment traps to determine if constituent concentrations in these areas adversely affect plants or animals.

We collect native grasses, forbs, and small mammals in the retention basins of the Los Alamos Canyon weir and the Pajarito Canyon flood retention structure on an annual basis for monitoring.

We aim to collect the following samples:

- a composite understory vegetation sample for radionuclide, inorganic element, and PFAS analyses;
- a composite sample of approximately 100 grams of whole-body small mammals for radionuclide analyses;
- three individual small mammals for inorganic elements analyses;
- three individual small mammals for polychlorinated biphenyl (PCB) analysis; and
- three individual small mammals for PFAS analysis.

The following two sections report the 2024 results of this monitoring.

Los Alamos Canyon Weir

The Los Alamos Canyon weir is made of rock-filled wire cages called gabions and is designed to slow water flow and reduce the movement of sediment off Laboratory property. The weir was built in Los Alamos Canyon near the northeastern boundary of the Laboratory site. The retention basin upstream of the weir covers more than 1 acre. Accumulated sediment was excavated from the retention basin in 2009, 2011, 2013, and 2014. Sediment excavated in 2009 was placed on the west side of the basin and stabilized, whereas sediment excavated in 2011, 2013, and 2014 was analyzed, placed on a plastic liner, contained within a berm, compacted, and seeded approximately 0.5 miles west of the weir in Los Alamos Canyon.

Vegetation Results

We collected one composite understory vegetation sample within the retention basin and submitted it in June 2024 for radionuclide, inorganic element, and PFAS analyses. Plants collected included buckwheat (*Eriogonum sp.*), burningbush (*Bassia scoparia*), curly dock

(Rumex crispus), dropseed grass (*Sporobolus sp*.), prairie sagewort (*Artemisia frigida*), tansy mustard (*Descurainia pinnata*), tumbleweed (*Salsola tragus*), and white goosefoot (*Chenopodium album*).

The 2024 understory vegetation results within the Los Alamos Canyon retention basin are summarized as follows (refer to supplemental Tables S7-3 and S7-4 for individual results):

- Some radionuclides in the composite vegetation sample were detected and exceeded the regional statistical reference levels; all constituents were below biota dose screening levels.
- Some inorganic elements in the composite vegetation sample were detected; all detectable concentrations were below the regional statistical reference levels.
- No PFAS compounds were detected.

In 2024, americium-241, plutonium-238, tritium, and uranium-235/236 were not detected in the composite vegetation sample. Uranium-234 and uranium-238 were both detected and below their respective regional statistical reference levels (Table S7-3). Cesium-137, plutonium-239/240, and strontium-90 were detected and exceeded their respective regional statistical reference levels (Table S7-3). All detected radionuclide levels were far below the biota dose screening levels (Table S7-3). We did not do trend analyses because of a small sample size ($n = 10$).

Several inorganic elements were not detected. All detectable concentrations were below the regional statistical reference levels (Table S7-4). Antimony and thallium are increasing over time (Kendall's Tau, $p < 0.05$); however, high percentages of non-detects (64 and 55 percent, respectively) could be affecting these results. Additionally, antimony was not detected in 2024, and thallium has not been detected since 2021.

No PFAS compounds were detected in understory vegetation samples in 2024. Refer to Analytical Laboratory Quality Assessment in this chapter for more information.

Small Mammal Results

We collected small mammals from the retention basin in June 2024 using Sherman live traps. LANL's Institutional Animal Care and Use Committee approved all animal-handling procedures. We collected one Mexican woodrat (*Neotoma mexicana*) for radionuclide analyses, two white-footed mice (*Peromyscus leucopus*) and one brush mouse (*Peromyscus boylii*) for inorganic element analyses, three pinyon mice (*Peromyscus truei*) for PCB analyses, and one pinyon mouse and two white-footed mice for PFAS analyses.

The 2024 small mammal results at the Los Alamos Canyon weir are summarized as follows (refer to Tables S7-5 through S7-8 for individual results):

- We detected some radionuclides in the small mammal samples, but all constituents were below the biota dose screening levels.
- Strontium-90 is increasing over time.
- We detected most inorganic elements in small mammal samples; most detected elements were below the regional statistical reference levels.
- Some inorganic elements are increasing over time.

- We detected PCBs in small mammal samples, but levels are decreasing over time, and all were below the regional statistical reference levels.
- Perfluorooctanesulfonic acid was the only PFAS compound detected and concentrations were below the regional statistical reference level. The concentrations of detected PFAS compounds were also within the range reported for mammals collected from non-polluted sites.

We did not detect americium-241, plutonium-238, plutonium-239/240, tritium, uranium-234, uranium-235/236, or uranium-238 in small mammals (Table S7-5). Cesium-137 and strontium-90 were detected and exceeded their respective regional statistical reference levels but were far below the biota dose screening levels (Table S7-5). We did not perform trend analyses because of a small sample size (n = 8).

Antimony, arsenic, beryllium, cadmium, chromium, mercury, selenium, thallium, and vanadium were not detected in any small mammal samples. All inorganic elements in individual small mammal samples, except for nickel concentrations in one pinyon mouse, were below their respective regional statistical reference levels (Table S7-6).

Most inorganic element concentrations in small mammals are not changing over time; however, concentrations of antimony, arsenic, cobalt, mercury, silver, thallium, and vanadium are increasing (Kendall’s Tau, $p < 0.05$). The range of non-detect results for these elements is 29 to 52 percent. We have not detected mercury since 2019; arsenic, cobalt, or thallium since 2021; or antimony or vanadium since 2022. In 2022 through 2024, samples were analyzed at a different analytical laboratory than in previous years. Additionally, some of the current detection limits are higher than in previous years (2020 and earlier), which results in recent reported non-detect values that are higher than detected values from previous years. These observations about the laboratory analyses reduce our confidence in the statistical results of increasing trends.

Magnesium is also increasing over time and was detected in all small mammals. The increasing trend of magnesium is likely an artifact of switching analytical labs in 2022. Furthermore, because magnesium is an essential mineral and because most observations during the past 11 years are below the regional statistical reference level, this result is not of ecological concern to small mammal populations.

Total PCBs were detected in all individual small mammal samples and were below the regional statistical reference level (Table S7-7). All observed concentrations are two orders of magnitude below tissue concentrations in mice (2.5 milligrams per kilogram) reported from PCB-contaminated sites where wild mouse populations were negatively affected (Batty et al. 1990). The levels of PCBs in small mammals collected from the retention basin are decreasing over time (Kendall’s Tau, $p < 0.05$, Figure 7-8). The variability in PCB concentrations could be related to the removal of sediment from the basin between 2009 and 2014 and accumulation of sediment since that time.

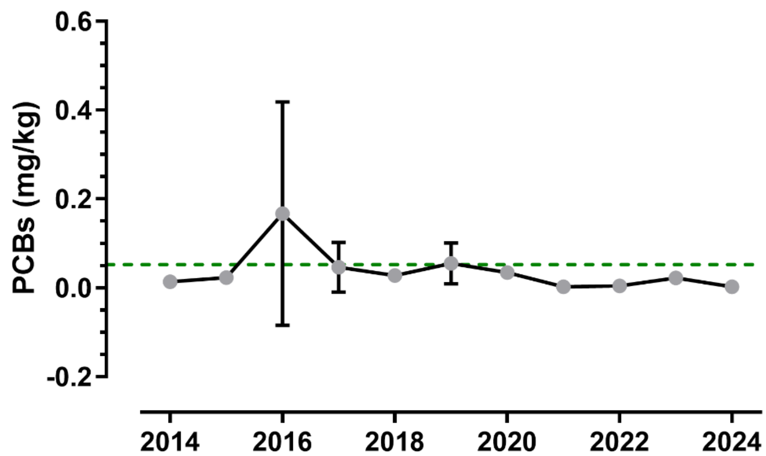

Figure 7-8. PCB concentrations in whole-body small mammal samples collected upstream (in the retention basin) of the Los Alamos Canyon weir from 2014 to 2024 compared with the regional statistical reference level (mean plus three standard deviations of small mammals collected from background locations: green dashed line). Note the linear scale on the vertical axis. Points represent the mean and error bars represent standard deviation. Error bars could appear absent on some points, as standard deviations are too small to plot. Note: mg/kg = milligrams per kilogram.

We evaluated 39 PFAS compounds in individual small mammals. Perfluorooctanesulfonic acid was the only PFAS compound detected. It was observed in two of the three small mammals, both of which had levels below the regional statistical reference level (Table S7-8). Refer to Analytical Laboratory Quality Assessment in this chapter for more information on the overall fewer detections of total PFAS compounds in small mammals compared with previous years. Concentrations of PFAS compounds observed here are within the range of observations reported in the published literature for mammals collected from non-polluted sites (Aas et al. 2014; Bossi et al. 2015).

Pajarito Canyon Flood Retention Structure

The Pajarito Canyon flood retention structure is located upstream of Technical Area 18. The structure extends 390 feet across the canyon and is about 70 feet high. The bottom of the retention structure is equipped with one 42-inch-diameter drainage culvert, which allows storm water to drain. Accumulated water is retained behind the retention structure for no longer than 96 hours; water drains into the existing streambed.

Biota were not monitored at the Pajarito Canyon flood retention structure in 2024.

Small Mammal Monitoring at Pueblo de San Ildefonso

Small mammals are collected once every 3 years on Pueblo de San Ildefonso property in Los Alamos Canyon downstream of the weir to determine whether constituents are being carried downstream of the Laboratory site. We collected small mammals in July 2024 using Sherman live traps. All animal-handling procedures were approved by LANL’s Institutional Animal Care and Use Committee.

We collected one Mexican woodrat (*Neotoma mexicana*) for radionuclide analyses, two brush mice and a deer mouse for inorganic element analyses, three brush mice for PCB analyses, and two brush mice and one pinyon mouse for PFAS analyses.

The 2024 small mammal results at Pueblo de San Ildefonso downstream of the Los Alamos Canyon weir are summarized as follows (refer to Tables S7-9 through S7-11 for individual results):

- No radionuclides were detected in the Mexican woodrat.
- We detected most inorganic elements in small mammal samples; most detected elements were below their regional statistical reference levels.
- We detected PCBs in small mammal samples, but all were below the regional statistical reference level, and levels are not changing over time.
- No PFAS compounds were detected in small mammals.

No radionuclides were detected in the Mexican woodrat sample collected downstream of the Los Alamos Canyon weir on Pueblo de San Ildefonso property (Table S7-9). We did not perform trend analyses due to small sample size ($n = 3$).

Similar to the small mammals collected upstream of the Los Alamos Canyon weir, antimony, arsenic, beryllium, cadmium, cobalt, mercury, nickel, silver, thallium, and vanadium were not detected in any small mammals (Table S7-10). All inorganic elements in individual small mammal samples (except for lead concentrations in one brush mouse) were below their regional statistical reference levels (Table S7-10). We did not perform trend analyses due to small sample size ($n = 10$).

PCBs were detected in all small mammal samples at very low concentrations (range 0.000168 to 0.00141 milligrams per kilogram), and all were well below the regional statistical reference level of 0.052 milligrams per kilogram (Table S7-11). All observed concentrations are three orders of magnitude below tissue concentrations in mice (2.5 milligrams per kilogram) reported from PCB-contaminated sites where wild mouse populations were negatively affected (Batty et al. 1990). Thus, the current PCB levels are not expected to negatively affect the wild mouse populations. PCB concentrations in small mammals collected downstream of the Los Alamos Canyon weir on Pueblo de San Ildefonso property did not change over time (Kendall's Tau, $p > 0.05$; Figure 7-9).

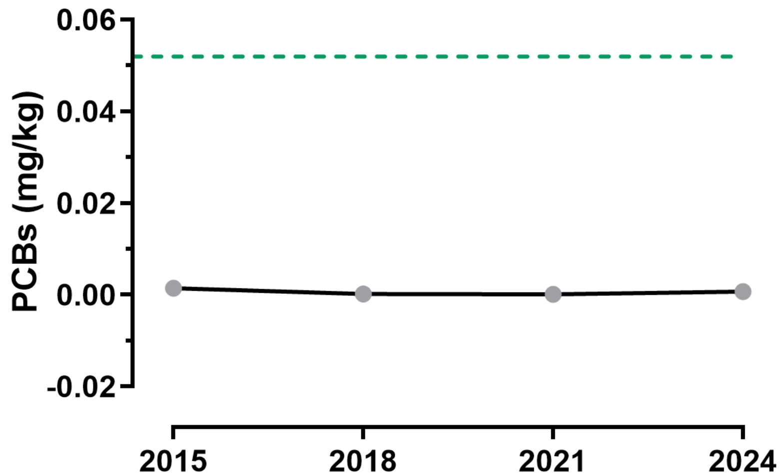

Figure 7-9. PCB concentrations in individual whole-body small mammal samples collected downstream of the Los Alamos Canyon weir (retention basin) from 2015 to 2024 compared with the regional statistical reference level (mean plus three standard deviations of small mammals collected from background locations: green dashed line). Note the linear scale on the vertical axis. Points represent the mean and error bars represent standard deviation. Error bars could appear absent on some points, as standard deviations are too small to plot. Note: mg/kg = milligrams per kilogram.

In 2024, no PFAS compounds were detected in any small mammals collected downstream of the weir on Pueblo de San Ildefonso property.

These data suggest that the Los Alamos Canyon weir is retaining constituents on site.

Special Assessment – PFAS in Avian Blood Samples

In 2024, we continued a special assessment of PFAS concentrations in avian blood samples collected at the Sandia Canyon wetland and at the Pueblo Canyon wetland. The Sandia Canyon wetland receives water from permitted outfall 001 (refer to Outfall Permit in Chapter 2). Sources of water for the outfall include effluent from the sanitary wastewater system plant, water from the sanitary effluent reclamation facility, and wastewater discharged from industrial equipment such as cooling towers (LANL 2008, LANL 2016a). The Sandia Canyon wetland is also located directly south of the Los Alamos County Eco Station, which receives Los Alamos County municipal waste and is the site of a closed landfill (refer to Figure 7-8 in LANL 2023). Wastewater treatment plants and landfills are sources of PFAS (Banzhaf et al. 2017, Dalahmeh et al. 2018, Phong Vo et al. 2020, Bai and Son 2021). We chose the Pueblo Canyon wetland as a perimeter location for comparison purposes. The Pueblo Canyon wastewater treatment plant is located on Pueblo Canyon Road and is operated by the Los Alamos County Department of Public Utilities. The discharge from the wastewater treatment plant creates similar wetland habitat to the Sandia Canyon wetland.

From May through June 2024, avian blood samples were collected during bird-banding operations. All animal-handling procedures were approved by LANL's Institutional Animal Care and Use Committee. We collected blood from two American robins (*Turdus migratorius*) at Sandia Canyon wetland and one American Robin at Pueblo Canyon wetland. We targeted American robins because they were the most common avian species for blood sample collection in 2023 (LANL 2024b). The blood samples were sent to Eurofins in Sacramento, California, and analyzed for 43 PFAS compounds. We combined the data from 2023 and 2024 for the analyses reported in this section.

Of the 43 PFAS compounds evaluated in the avian blood samples, 27 were detected in at least one sample (Table S7-12 and Figure 7-10). Concentrations of individual PFAS compounds in the avian blood samples ranged from 0.051 to 49 nanograms per milliliter (Table S7-12). The maximum concentration of a PFAS compound in avian blood was perfluorooctanesulfonic acid at 49 nanograms per milliliter in an American robin from the Sandia Canyon wetland (Table S7-12). PFAS compounds with the highest concentrations were perfluorooctanesulfonic acid, perfluorotetradecanoic acid, and perfluorododecanoic acid (Table S7-12 and Figure 7-10).

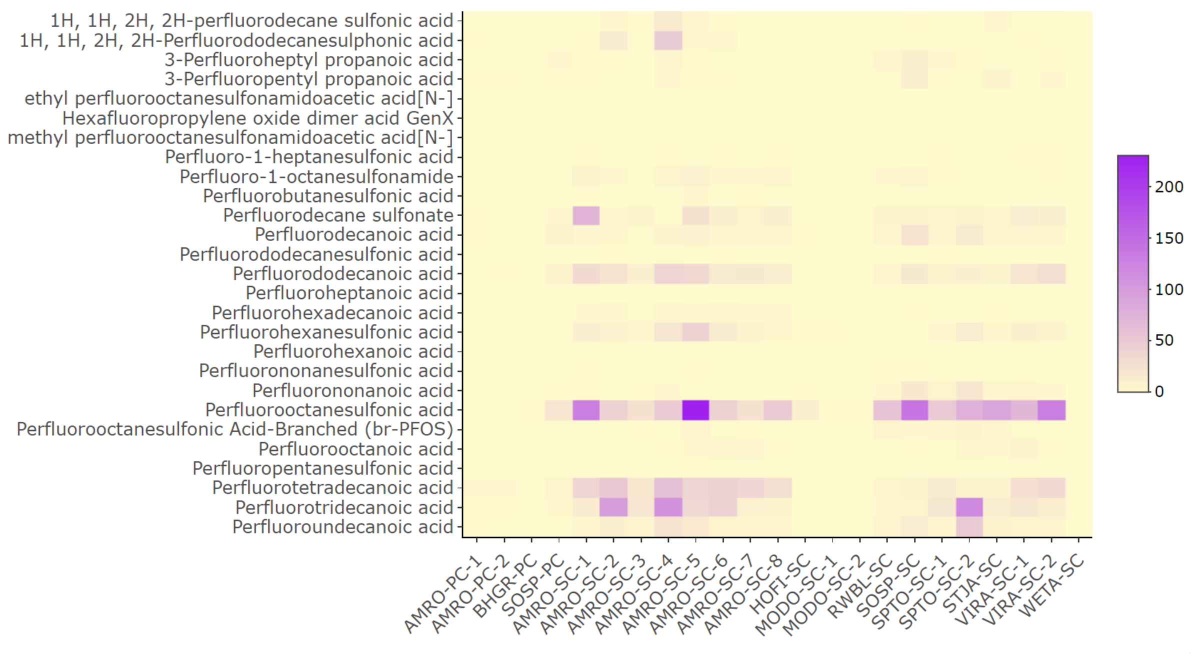

Figure 7-10. PFAS compounds (27 compounds total) that were detected in at least one avian blood sample collected from the Pueblo Canyon or Sandia Canyon wetlands in 2023 and 2024. Note: PFOS = perfluorooctanesulfonic acid, SC = Sandia Canyon, PC = Pueblo Canyon, AMRO = American robin, BHGR = black-headed grosbeak, SOSP = song sparrow, HOFI = house finch, MODO = mourning dove, RWBL = red-winged blackbird, SPTO = spotted towhee, STJA = Steller's jay, VIRA = Virginia's rail, WETA = western tanager.

We used nonmetric, multidimensional scaling with a Bray-Curtis dissimilarity matrix to assess overall differences in PFAS composition in avian blood collected at the Sandia Canyon and Pueblo Canyon wetlands in 2023 and 2024. Results showed differences in the patterns of PFAS compounds in avian blood samples between the wetlands ($p = 0.007$).

We also assessed differences in PFAS occurrences in avian blood based on foods consumed. We analyzed the results based on the species' feeding strategies (insectivore, granivore, or omnivore) and based on blood-stable isotope results; stable isotopes can be used as an indicator of the consumption of plant materials like seeds. Results showed that there were differences in PFAS occurrences when comparing insectivores to granivores ($p = 0.02$).

To investigate which PFAS compounds are driving the distribution patterns and how they relate to different feeding strategies, we used a similarity percentage analysis. The compounds with the strongest influences on the distribution of points were perfluorotetradecanoic acid, perfluorohexadecanoic acid, and perfluorododecanoic acid, and their influence was associated with the taxa of insectivores (Figure 7-11).

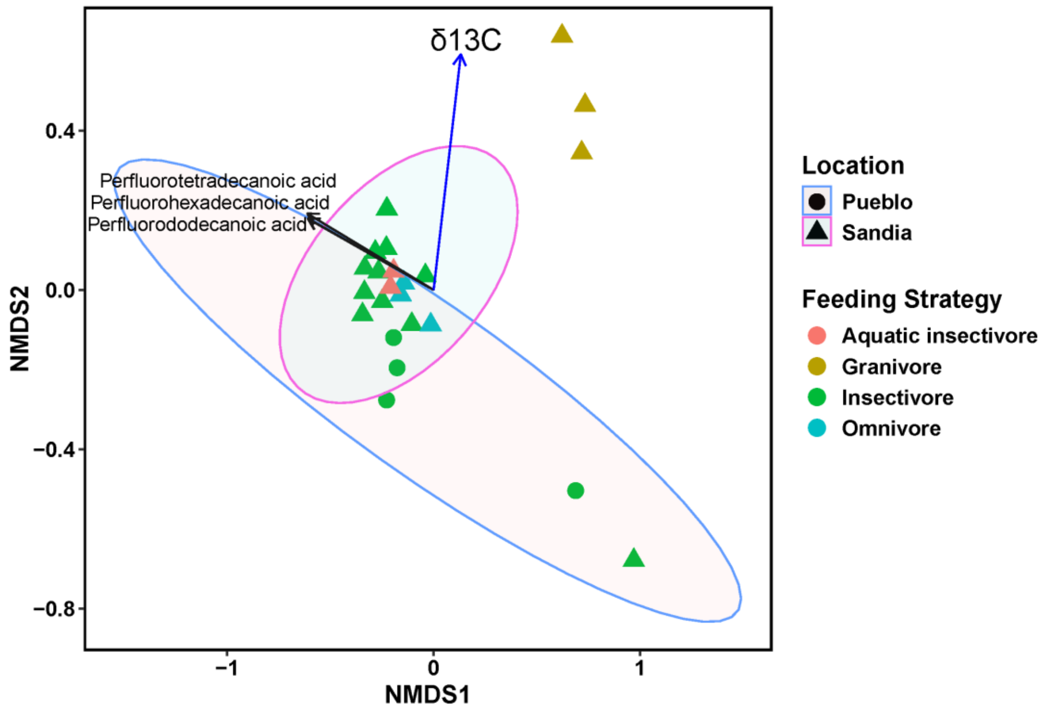

Figure 7-11. Nonmetric Multidimensional Scaling of PFAS composition in avian blood samples taken from Sandia Canyon wetlands and Pueblo Canyon wetlands in 2023 and 2024. Different locations are indicated by triangles (Sandia Canyon) and circles (Pueblo Canyon); colors denote various feeding strategies. Vector arrows show significant variables (PFAS compounds and stable isotope data) and the direction of significant influence driving the distribution patterns of PFAS composition ($p < 0.05$).

Perfluorooctanesulfonic acid, perfluorododecanoic acid, perfluorohexadecanoic acid, perfluorotridecanoic acid, and perfluorotetradecanoic acid are PFAS compounds frequently detected in treated wastewater and in sediments in urban watersheds (Bai and Son 2021; Dalahmeh et al. 2018, Phong Vo et al. 2020, Zhou et al. 2024). Perfluorohexane sulfonate and perfluorooctanesulfonic acid are the most frequently detected PFAS compounds in human blood serum from around the world (Liu et al. 2023). Recent studies suggest that long-chain PFAS compounds, such as those listed, are more likely to bioaccumulate in individuals and biomagnify in aquatic food webs (Lewis et al. 2022, Munoz et al. 2022).

We have regional statistical reference levels for some PFAS compounds for animals that live in dry habitats. It is not appropriate to compare these levels with the results from the Sandia Canyon or Pueblo Canyon wetland. PFAS compounds are recently emerging chemicals of concern; therefore, little is known about wildlife tissue concentrations and their relation to adverse effects. The lowest observable adverse effect level in tissues for birds has not yet been determined.

Although we did find differences between the Sandia Canyon wetland and the Pueblo Canyon wetland, our sample size of birds from Pueblo Canyon was quite small (n = 4). More data are needed to make robust assessments about PFAS compounds at these locations and within these aquatic food webs.

Institutional Monitoring for Radionuclides and Chemicals

Large Animal Monitoring Methods

We have collected tissue samples from road-killed mule deer (*Odocoileus hemionus*) and elk (*Cervus canadensis*) from onsite, perimeter, and background locations since the 1970s (Los Alamos Scientific Laboratory 1973). In 2015, we began collecting samples from more species, including mountain lion (*Puma concolor*), bobcat (*Lynx rufus*), black bear (*Ursus americanus*), coyote (*Canis latrans*), gray fox, great horned owl (*Bubo virginianus*), western screech-owl (*Megascops kennicottii*), red-tailed hawk (*Buteo jamaiciensis*), gopher snake (*Pituophis catenifer*), and additional species killed by vehicles or other accidents.

As a note, we consider all samples collected within the Valles Caldera National Preserve as background and include them in the regional statistical reference levels even if they are within 9 miles of the site's boundary. We made this decision because the Valles Caldera is upstream and upwind of the LANL site, considering the predominant wind direction in the region, and does not have industrial or urban development. Additionally, we consider all samples collected from Cochiti Pueblo as perimeter—even though it is more than 9 miles away—because it is located downstream of the LANL site. Results from samples collected from background locations that are included in the regional statistical reference level calculations are not individually reported in the supplemental tables.

In 2024, we collected a blood sample for PFAS analysis from a live mountain lion at Technical Area 51. The blood sample was collected as part of collaborative research project with staff members from Bandelier National Monument and New Mexico State University. All animal-handling procedures were approved by New Mexico State University and LANL's Institutional Animal Care and Use Committee.

Here, we report results from five elk, three mule deer, one common raven (*Corvus corax*), one coyote, one gopher snake, three great horned owls, and one mountain lion. Animals were collected from onsite and perimeter locations in 2024 (Figure 7-12). Most animals collected were casualties from vehicle strikes.

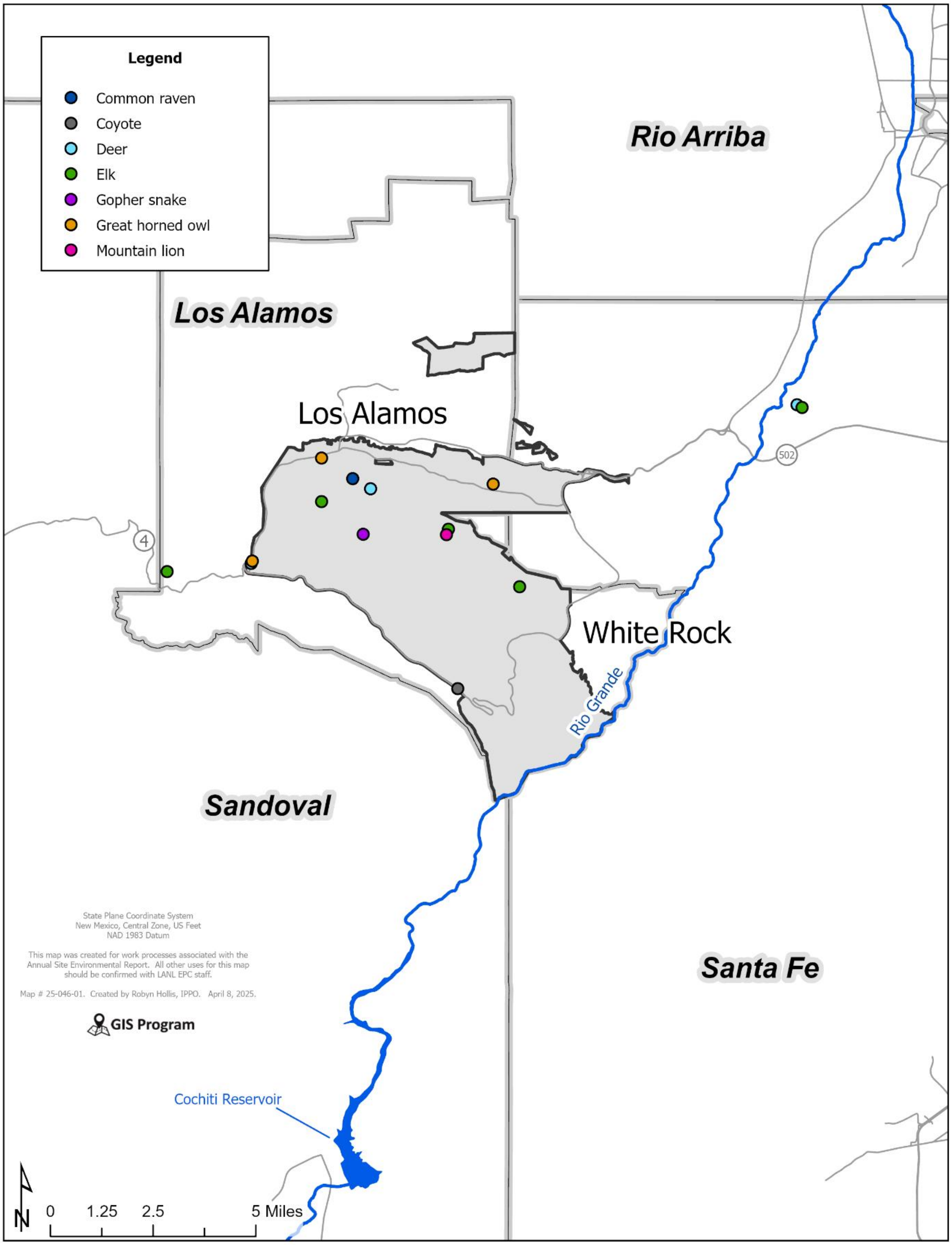

Figure 7-12. This map shows the locations of animals that were collected opportunistically from within and around the Laboratory site in 2024.

Muscle and bone were harvested from the deer, elk, and coyote. Bone was analyzed for radionuclides, and muscle was analyzed for radionuclides, inorganic elements, and PCBs or PFAS or both. Muscle samples were harvested from the great horned owls and the gopher snake. The muscle samples were analyzed for PCBs or PFAS or both, and the remaining bodies (feathers included and unwashed) were analyzed for radionuclides and inorganic elements. Due to limited mass, the common raven was analyzed via whole body for radionuclides only. We collected a blood sample from one live mountain lion, and we collected liver samples from four animals (two elk and two great horned owls) for PFAS analysis.

Large Animal Monitoring Results

Large animal monitoring results are summarized as follows (refer to Table S7-13 through Table S7-21 for individual results):

- Most radionuclide results fell into one or more of the following categories: not detected, below the regional statistical reference level, or below the biota dose screening level.
- Most inorganic element concentrations were below their regional statistical reference levels.
- PCBs were detected in most samples. All PCB concentrations were below the regional statistical reference level. Deer and elk PCB levels were also far below the U.S. Food and Drug Administration red meat consumption guidelines.
- Most PFAS compounds were not detected. The concentrations of most detected compounds are within the range reported in published literature for animal tissues collected from non-polluted sites.

Radionuclide Results in Large Animals

Tests for radionuclides in deer and elk tissues found that almost all radionuclides were not detected (Table S7-13). Strontium-90 was detected in one deer bone sample at 3.42 picocuries per gram and was above the regional statistical reference level of 0.769 picocuries per gram but was far below the biota dose screening level that is protective of biota (Table S7-13). Tritium was detected in one deer muscle sample at 2.08 picocuries per milliliter and was above the regional statistical reference level of 0.976 picocuries per milliliter but was far below the biota dose screening level that is protective of biota (Table S7-13).

No radionuclides were detected in the great horned owl samples (Table S7-14). In the gopher snake, most radionuclides were either not detected or were below their regional statistical reference levels; only cesium-137 was detected above the regional statistical reference level at 0.373 picocuries per gram (Table S7-14).

In the common raven, uranium-234 and uranium-238 were detected at 0.046 and 0.040 picocuries per gram, respectively. The uranium-238 value exceeded the regional statistical reference levels of 0.033 picocuries per gram (Table S7-14). The near 1:1 ratio of uranium-234 to uranium-238 indicates that the uranium is from naturally occurring sources (International Atomic Energy Agency 2025).

In the coyote, no radionuclides were detected in the muscle sample. Strontium-90 was the only radionuclide detected in bone at 0.956 picocuries per gram and was above the regional statistical reference level of 0.552 picocuries per gram (Table S7-14).

The regional statistical reference levels for these groups of animals are based on small sample sizes, and more data are needed to make robust assessments; however, levels of radionuclides observed in all animals were well below the biota dose screening levels.

Inorganic Element Results in Large Animals

Several inorganic elements were not detected in deer or elk. Most inorganic elements that were detected in deer and elk were below their regional statistical reference levels. Only manganese (0.246 milligrams per kilogram) in one deer sample slightly exceeded the regional statistical reference level of 0.227 milligrams per kilogram (Table S7-15).

Most inorganic elements in the gopher snake and great horned owls were either not detected or were below their regional statistical reference levels. We did not detect arsenic, beryllium, cadmium, chromium, cobalt, mercury, nickel, silver, thallium, or vanadium in any samples. Aluminum and antimony were higher than the regional statistical reference level in one or more of the animals (Table S7-16). As previously mentioned, we need more data from background locations to make robust assessments for these species.

PCB Results in Large Animals

PCBs were detected in one deer and five elk muscle samples; the other deer muscle sample had no PCB detections (Table S7-17). All detectable PCB concentrations in deer and elk muscle were below the regional statistical reference levels (Table S7-17). Additionally, our observations for both deer and elk are well below the U.S. Food and Drug Administration standard of 3 milligrams per kilogram for red meat consumption by humans (U.S. Food and Drug Administration 1987).

PCBs were detected in the gopher snake and the three great horned owls (Table S7-18); however, total PCBs for all samples were below the regional statistical reference levels (Table S7-18). Altered parental care has been observed when PCBs in tissues were between 1 and 30 milligrams per kilogram in avian eggs and 2 to 4 milligrams per kilograms in avian adult plasma (Harris and Elliott 2011). The levels we observed are well below this effect level in tissues for birds. Although no lowest observable adverse effect levels in tissues for PCBs in deer, elk, snakes, or great horned owls have been reported, adverse effects in other animals are not observed until concentrations are above 1 milligram per kilogram (Batty et al. 1990, Harris and Elliott 2011).

PFAS Results in Large Animals

We submitted samples to be tested for 39 PFAS compounds from two deer, five elk, one coyote, three great horned owls, and one gopher snake. We collected a muscle sample from all animals and a corresponding liver sample from four of those animals. We collected a duplicate blood sample from one live mountain lion.

No PFAS compounds were observed in the two deer muscle samples or three of the five elk muscle samples. Methyl perfluorooctane sulfonamidoethanol [N-] was detected in one of the elk muscle samples at 1.5 nanograms per gram, and perfluorobutanesulfonic acid was detected in another elk muscle sample at 0.250 nanograms per gram (Table S7-19). PFAS compounds were observed in two elk liver samples, however, the muscle sample from the same individuals did not contain detectable PFAS (Table S7-19). We did not collect liver samples for the two deer or the other three elk. One elk liver contained perfluorononanoic acid at 0.350 nanograms per gram and perfluorooctanesulfonic acid at 1.40 nanograms per gram. The other elk liver contained perfluorooctanesulfonic acid at 2.80 nanograms per gram (Table S7-19). All detected values were below the regional statistical reference levels (Table S7-19).

A coyote muscle sample collected from a perimeter location contained four detectable PFAS compounds, which included perfluorobutanoic acid, perfluorohexanesulfonic acid, perfluorononanoic acid, and perfluorooctanesulfonic acid (Table S7-20). The highest concentration observed in the coyote was 1.0 nanograms per gram of perfluorooctanesulfonic acid. Currently, we have only one coyote from a background location for comparison; therefore, no regional statistical reference levels can be calculated.

A gopher snake collected from an onsite location contained perfluorononanoic acid and perfluorooctanesulfonic acid at 0.290 and 0.550 nanograms per gram, respectively (Table S7-20). Currently, there are no regional statistical reference levels for gopher snakes PFAS concentrations for comparisons.

Five samples (three muscle and two liver samples) were submitted for PFAS analysis from great horned owls in 2024. No PFAS compounds were detected in the muscle from the great horned owl collected from Technical Area 16. In the owl collected from Jemez Road, only perfluorodecanoic acid and perfluorooctanesulfonic acid were detected. Perfluorononanoic acid and perfluoroundecanoic acid were also detected in the muscle tissue collected from the owl collected from Technical Area 03 (Table S7-20). Both great horned owl liver samples also contained detectable PFAS levels; the highest number of detectable compounds was seven within one owl liver, and the highest concentration was perfluorodecanoic acid at 2.90 nanograms per gram (Table S7-20). Perfluorooctanesulfonic acid results in the liver samples from both owls were rejected and not reported (Table S7-20); refer to Analytical Laboratory Quality Assessment in this chapter for more information. Currently, there are no owl samples from background locations for PFAS comparisons.

Two blood samples were collected from a single live mountain lion and submitted for PFAS analysis as duplicate samples. Perfluorooctanesulfonic acid, branched perfluorooctanesulfonic acid, perfluorodecanoic acid, perfluorononanoic acid, perfluorohexadecanoic acid, perfluorohexanesulfonic acid, and perfluoroundecanoic acid were all detected in both blood samples (Table S7-21). Perfluorotetradecanoic acid was detected in one of the duplicate samples (Table S7-21). All detections were below 1.0 nanograms per milliliter except for perfluorooctanesulfonic acid, which was detected at 2.2 and 2.0 nanograms per milliliter (Table S7-21). Perfluorooctanesulfonic acid is a commonly detected PFAS that we find in most of our biological samples. Currently, there are no mountain lion blood samples from background for PFAS comparisons.

Perfluorooctanesulfonic acid was the most frequently detected and highest concentration of a PFAS compound in ungulates, whereas perfluorononanoic acid was the most commonly detected PFAS compound in non-ungulates. Most of our observations are within the ranges of PFAS concentrations observed in animal tissues from published studies that occurred away from point-source pollution, including in the Antarctic, where global fallout is the primary source of PFAS in the environment (Aas et al. 2014, Bossi et al. 2015). When liver and muscle samples were taken from the same animal, PFAS compounds typically occurred more frequently and had higher concentrations in liver samples, which is similar to findings in other published studies (Robuck et al. 2021, Draghi et al. 2024). Our results also suggest that lower concentrations are found in herbivores, such as deer and elk, compared with carnivores; however, our sample sizes are still small, and we cannot draw robust conclusions at this time. Because PFAS are recently emerging chemicals of concern, little is known about wildlife tissue concentrations and their relation to adverse effects.

Soil and Vegetation Monitoring

Monitoring Network

Institutional surface soil and vegetation samples are collected once every 3 years. Most onsite soil-sampling stations are located on undisturbed mesa tops close to and, if possible, downwind from major facilities or operations at the LANL site. In 2024, we collected surface soil and vegetation from 18 onsite locations, 12 perimeter locations, and 6 regional background locations (Figure 7-13). Many locations have been sampled for radionuclides since the early 1970s (Purtymun et al. 1980, Purtymun and Stoker 1987).

Onsite soil sampling locations include (1) west and (2) east of Technical Area 53 (Los Alamos Neutron Science Center); (3) near Technical Area 33 (former firing sites and current experimental sites); (4) near Test Well DT-9 at Technical Area 49 (former experimental site and current hazardous materials training facility); (5) north of technical areas 50 and 35 (Plutonium Facility and Radioactive Liquid Waste Treatment Facility); (6) Potrillo Drive at Technical Area 36 (firing sites that support explosive testing); (7) R-Site Road east at Technical Area 15 (explosives firing sites); (8) K-Site at Technical Area 11 (high-explosives processing and storage areas and firing sites); (9) Technical Area 51 (environmental research site of radioactive materials); (10) Two-Mile Mesa at Technical Area 06 (former radioactive materials processing facilities); (11) Lower Slobbovia at Technical Area 36 (explosives firing sites); (12) Minie at Technical Area 36 (explosives firing sites); (13) Q site at Technical Area 14 (explosives firing sites); (14) Technical Area 16 (burning grounds); (15) Transuranic Waste Facility at Technical Area 63 (transuranic waste facility); (16) Ten-Site Canyon at Technical Area 35 (received effluent from radioactive liquid waste treatment facility; (17) Technical Area 21 (former plutonium and tritium processing facilities); and (18) Technical Area 54 (low-level radioactive solid waste burial and storage site) near its border with the Mirador housing development off of State Route 4 (Figure 7-13). Two sampling locations (Technical Area 21 and Technical Area 54) were previously considered perimeter locations but were re-classified as onsite locations as they are within the site boundary.

All the perimeter stations except the Sportsman's Club are located within 2.5 miles of the current site boundary (Figure 7-13). Los Alamos townsite locations include (1) North Mesa, (2) the Sportsman's Club, (3) along Quemazon Trail near Western Area, (4) east of the Los Alamos airport, (5) Acid Canyon; and (6) south side of NM 502 at Technical Area 73. Pueblo de San Ildefonso locations include (7) White Rock (east); (8) Pueblo de San Ildefonso Sacred Area lands directly north of Technical Area 54; (9) near the Otowi bridge over the Rio Grande; and (10) near Bandelier National Monument unit of Tsankawi at the intersection of NM 4 and East Jemez Road. West and southwest locations near the LANL site include (11) west of Technical Area 08 and (12) south of Technical Area 49.

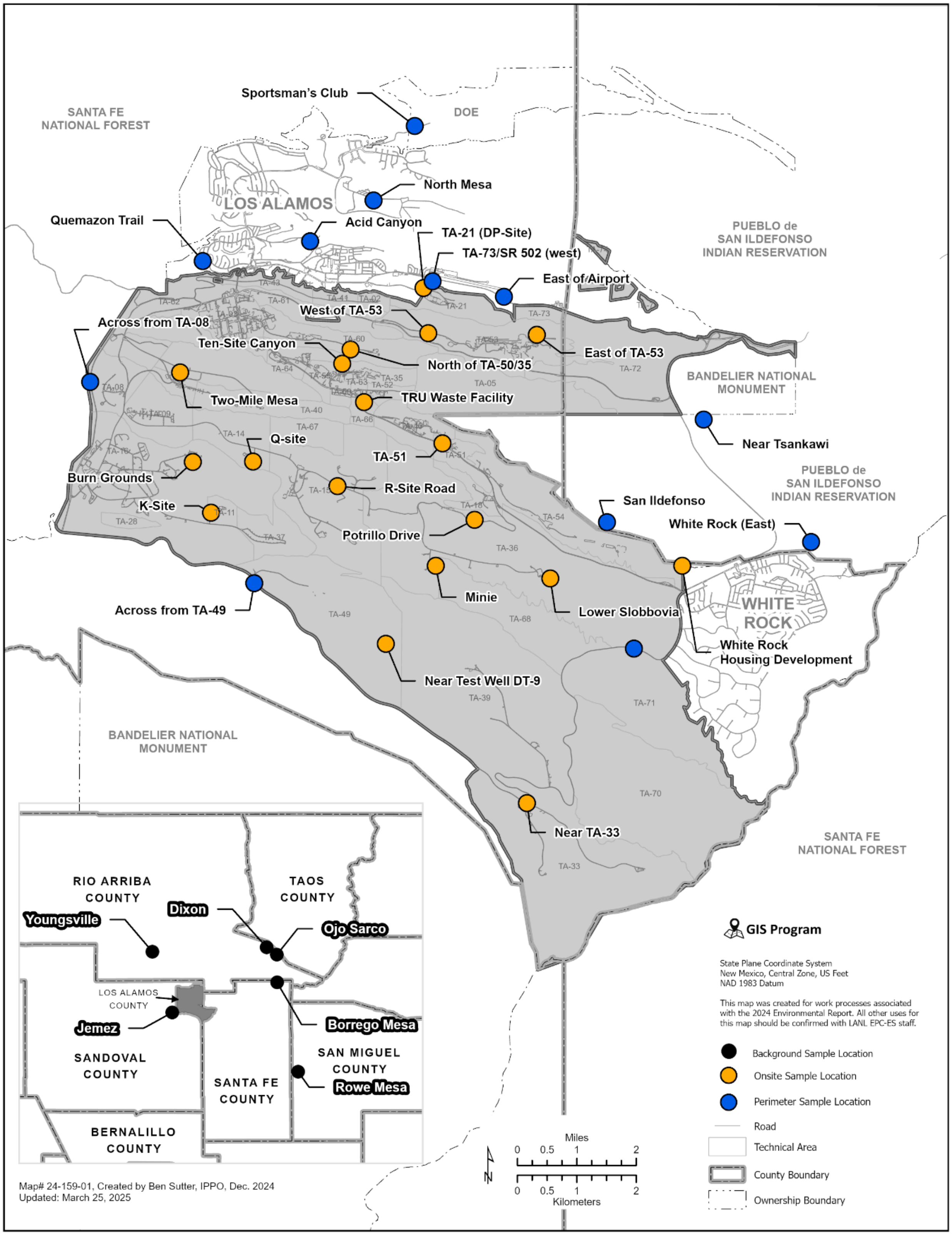

Figure 7-13. Onsite, perimeter, and regional (background) soil and vegetation sampling locations. The Otowi perimeter station is not shown but is about five miles east of the Laboratory, near the confluence of Los Alamos Canyon and the Rio Grande. Note: TA = Technical Area.

Surface soil samples were collected from six regional background locations near (1) Ojo Sarco, (2) Dixon, and (3) Borrego Mesa (near Santa Cruz dam) to the northeast of the Laboratory site; (4) Rowe Mesa (near Pecos) to the southeast of the Laboratory site; (5) Youngsville to the northwest of the Laboratory site; and (6) Jemez Springs to the southwest (Figure 7-13).

Methods and Analyses

At each soil sampling location, five surface soil subsamples were collected at the center and in the corners of an approximately 10-meter by 10-meter square area. The subsamples were collected using a stainless steel soil ring 10 centimeters in diameter pushed 5 centimeters into the ground. The five subsamples per location were combined and mixed thoroughly in a large plastic bag to form a composite sample. Composite samples were placed into polyethylene sample bottles, then labeled, sealed with chain-of-custody tape, placed on ice, and submitted to the Sample Management Office. Samples were shipped under full chain of custody to contracted analytical laboratories. The samples were analyzed for the radionuclides americium-241, cesium-137, plutonium-238, plutonium-239/240, strontium-90, tritium, uranium-234, uranium-235/236, uranium-238; for 23 inorganic elements (aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, sodium, selenium, silver, thallium, vanadium, and zinc); and for 39 PFAS compounds.

A separate soil grab sample was collected near the center of each soil sample location from the 0- to 15-centimeter depth using a stainless steel scoop. Each grab sample was placed into an amber-colored glass sample bottle, then labeled, sealed with chain-of-custody tape, placed on ice, and submitted to the Sample Management Office. Samples were shipped under full chain of custody to contracted analytical laboratories and analyzed for high explosives compounds, dioxins, furans, semi-volatile organic compounds, volatile organic compounds, and PCBs.

Native understory, such as grasses and forbs, were collected in the same general location that soil samples were collected (Figure 7-13). During the years of institutional soil and vegetation monitoring, vegetation sample types are alternated. In 2024, understory vegetation was collected and analyzed; overstory vegetation was last collected in 2021 (LANL 2022a). Understory vegetation samples were clipped, then placed into a zippered plastic bag, labeled, sealed with chain-of-custody tape, placed on ice, and submitted to the Sample Management Office. All samples were shipped under full chain of custody to contracted analytical laboratories for radionuclide, inorganic elements, and PFAS analyses.

All soil chemical results were compared with the regional statistical reference level, ecological screening levels, and New Mexico Environment Department soil screening levels. Vegetation chemical results were compared with the regional statistical reference levels, and radionuclide results were also compared with biota dose screening levels. We statistically tested the results from our soil and vegetation analyses from 2015, 2018, 2021, and 2024. Generalized linear models were used to assess the effects of year, location (onsite, perimeter, and background), and the interaction of year by location. When there was a difference among locations, we used analyses of variance or Steel-Dwass tests to assess pairwise comparisons. We used a Kruskal-Wallis test to compare the levels of constituents that did not have results over multiple years (for example, PFAS). Statistical analyses were not performed on datasets that contained 80 percent non-detects for a specific chemical or radionuclide (Helsel 2012).

The 2024 soil results are summarized as follows (refer to supplemental Tables S7-22 through S7-28 for individual results):

- Many radionuclides were below regional statistical reference levels, and all were below ecological screening levels.
- The levels of uranium isotopes varied among locations.
- Most inorganic elements were detected but were below the regional statistical reference levels and/or the no-effect ecological screening levels.
- Lead concentrations exceeded the regional statistical reference level at three locations and exceeded the no-effect ecological screening level at several locations.
- Levels of several inorganic elements were higher in soil samples collected from background locations.
- Most inorganic elements were not changing over time.
- Most soil samples did not contain detectable PCB Aroclors and all detected concentrations were below the regional statistical reference level and below ecological screening levels.
- The majority of PFAS compounds were not detected in soil samples.
- The majority of semi-volatile organic compounds were not detected.
- No volatile organic compounds were detected in soil samples.
- No high explosives were detected in soil samples.
- The majority of dioxin and furan congeners were not detected or were below the regional statistical reference levels and/or the no-effect ecological screening levels.

Radionuclide Results in Soil

Americium-241 and strontium-90 were not detected in any soil samples. All detectable concentrations of cesium-137 and tritium were below the regional statistical reference levels. Uranium isotopes (uranium-234 and uranium-238) occur naturally in soil and were detected in all soil samples. Most detected levels of plutonium and uranium isotopes were below their regional statistical reference levels (Table S7-22).

Five onsite and two perimeter locations contained one or more radionuclide levels that were higher than the regional statistical reference levels. Plutonium-238 exceeded its regional statistical reference level at one location, and uranium-238 exceeded its regional statistical reference level at five locations. Onsite locations with exceedances were in technical areas 15, 21, 36, 51, and 63; perimeter locations included Acid Canyon and south side of NM 502 at Technical Area 73. All detected radionuclide levels were far below the no-effect ecological screening levels (Table S7-22).

One perimeter location, Acid Canyon, contained plutonium-239/240 (0.283 picocuries per gram) and uranium-238 (1.52 picocuries per gram) at levels that exceeded the regional statistical reference levels of 0.068 and 1.50 picocuries per gram, respectively (Table S7-22). These observations are consistent with previous findings. Acid Canyon received radioactive waste from Laboratory operations between the mid-1940s and mid-1960s. The canyon has been remediated three times since then; however, residual radionuclides remain. Recent dose assessments within Acid Canyon are reported in Chapter 8 and in McNaughton et al. (2018).

There were no differences in trends or concentrations of americium-241, plutonium-238, plutonium-239/240, or tritium among locations (Generalized Linear Model, $p > 0.05$). Strontium-90 decreased over time, and this trend was consistent among locations (Generalized Linear Model, $p < 0.05$). Cesium-137 did not change over time (Generalized Linear Model, $p > 0.05$); however, concentrations of cesium-137 were higher in soil collection from background when compared with soil collected from perimeter locations (Tukey-Kramer, $p < 0.05$).

Similar to previous years, uranium-234 and uranium-238 levels in soil differed by location where onsite locations had the highest levels, and background locations had the lowest levels (Steel-Dwass, $p < 0.05$; Figure 7-14). There were no differences in uranium-235/236 levels in soil among locations (Kruskal-Wallis, $p > 0.05$; Figure 7-14). There were no differences in uranium isotopes in soil over time (Generalize Linear Model, $p > 0.05$). Trend analyses were not performed on uranium-235/236; refer to Analytical Laboratory Quality Assessment in this chapter for more information. The differences in uranium isotope levels among locations could be due to natural variation of uranium levels in different soil types; for example, Bandelier Tuff, a common rock type in the sampling area, contains more uranium than other soil types (Longmire et al. 1995). Most soil samples contained a near 1:1 ratio of uranium-234 to uranium-238, indicating that this uranium is from naturally occurring sources (International Atomic Energy Agency 2025). However, some locations, such as R-Site Road and Lower Slobbovia, did have uranium isotope ratios that suggest a depleted uranium source (Table S7-22; International Atomic Energy Agency 2025). The concentrations observed at the onsite locations in 2024 are within the range of background concentrations from a previous study (Ryti et al. 1998), and all detected radionuclide levels were far below the no-effect ecological screening levels.

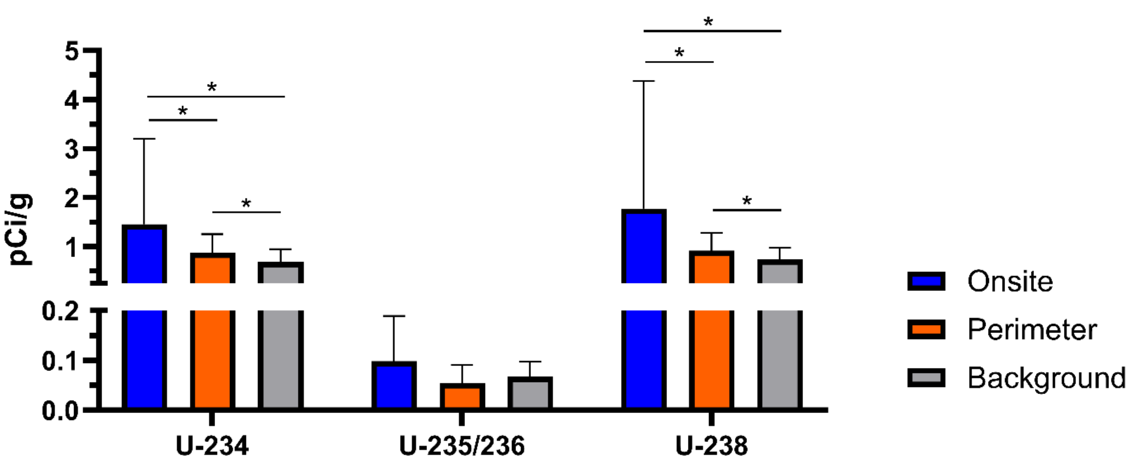

Figure 7-14. Uranium isotope levels in soil samples collected from 2015 through 2024 from onsite, perimeter, and background locations. Note the linear scale on the vertical axis. Column bars represent the mean and error bars represent standard deviation. A horizontal line with an asterisk indicates a significant pairwise comparison ($p < 0.05$). Note: U = uranium and pCi/g = picocuries per gram.

Inorganic Element Results in Soil

Very few inorganic element results in soil exceeded the regional statistical reference levels (Table S7-23). The following elements exceed their regional statistical reference level at one or more locations (maximum four locations; Table S7-23): copper, lead, mercury, selenium, sodium, and zinc. Results at some locations exceeded no-effect ecological screening levels for barium, cadmium, copper, lead, manganese, mercury, selenium, thallium, and vanadium. The regional statistical reference levels of these elements are also above no-effect ecological soil screening levels. All levels were below the New Mexico Environment Department soil screening levels protective of human health (Table S7-23).

Lead concentrations exceeded the regional statistical reference level of 20.9 milligrams per kilogram at three locations. These locations are Quemazon Trail, R-Site Road east of Technical Area 15, and near DP Road (near Technical Area 21). Lead concentrations exceeded the no-effect ecological screening level (11 milligrams per kilogram) at 23 locations. As mentioned above, the regional statistical reference level of lead is above its no-effect ecological soil screening level. The three highest observations exceeded the low-effect ecological screening level (23 milligrams per kilogram) for the American robin (Table S7-23).

Lead has previously been detected above the regional statistical reference levels at Acid Canyon, Quemazon Trail, and near DP Road (near Technical Area 21; LANL 2016b; LANL 2019a; LANL 2022a). In 2015, elevated lead (140 milligrams per kilogram) was detected in the soil sample collected from the location near DP Road (near Technical Area 21); this level resulted from the demolition of a water tower in August 2014 (Parsons 2014). The collapse of the tower onto the ground distributed fragments of lead-based paint from the tower. The elevated lead levels observed at this site in 2024 are likely still related to the paint from the water tower. We do not know the cause of the elevated lead levels observed in Acid Canyon, Quemazon Trail, or R-Site Road east of Technical Area 15.

There were no differences in concentrations of inorganic elements in soil samples among locations for antimony, lead, mercury, selenium, silver, sodium, thallium, or zinc (Generalized Linear Model and Steel-Dwass or Tukey-Kramer test, $p < 0.05$). Similar to previous years, concentrations of several elements were higher in soil samples collected from background locations compared with onsite and/or perimeter samples, including aluminum, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, magnesium, manganese, nickel, potassium, and vanadium (Steel-Dwass or Tukey-Kramer, $p < 0.05$). Most levels of inorganic elements were not changing over time. Aluminum, magnesium, selenium, and silver were increasing over time, and arsenic, iron, and sodium were decreasing over time, but these trends were consistent among locations (Generalized Linear Model, $p < 0.05$). Antimony was increasing over time, but there was a significant interaction of year by location for antimony (Generalized Linear Model, $p < 0.05$), indicating that the rate of increase differed between locations.

Power plants are one of the leading sources of air pollution (U.S. Environmental Protection Agency 2019). It is possible that releases from the Four Corners Power Plant (located in northeastern New Mexico) could explain why concentrations of some elements were higher in soil collected from background locations. These findings also could result from varying soil types and disturbance activities.

PCB Results in Soil

We reverted to testing for PCB Aroclor mixtures in 2024 to aid in meaningful comparisons with ecological screening levels after implementing tests for individual PCB congeners in 2021. Similar to previous years, PCB Aroclors were not detected in many soil samples (Table S7-24). Only Aroclor-1254 and Aroclor-1260 were detected out of the seven Aroclors analyzed (Table

S7-24). Both Aroclor-1254 and Aroclor-1260 were detected in soil from four locations: two onsite locations (Technical Areas 15 and 21) and two perimeter locations (Acid Canyon and south side of NM 502 at Technical Area 73). Aroclor-1254 was also detected in one additional onsite location: east of Technical Area 53 (Table S7-24). All PCB Aroclor concentrations detected in soil were less than 0.003 milligrams per kilogram, were below their respective regional statistical reference levels, below the lowest no-effect ecological screening levels, and below the New Mexico Environment Department soil screening levels (Table S7-24). Statistical analyses were not performed because there were more than 80 percent non-detects (Helsel 2012).

PFAS Results in Soil

Most PFAS compounds were not detected in soil samples. Only seven compounds were detected out of the 39 tested for compounds. A total of four locations did not contain any detectable PFAS, including the onsite location Q-site at Technical Area 14 and three perimeter locations on Pueblo de San Ildefonso property, White Rock (east), near the Otowi Bridge over the Rio Grande, and near Bandelier National Monument unit of Tsankawi at the intersection of NM 4 and East Jemez Road (Table S7-25). All soil samples collected from background locations contained detectable PFAS.

A maximum of three and four PFAS compounds were detected within a single soil sample from onsite locations and perimeter locations, respectively. The most common PFAS compounds detected in soil were perfluorononanoic acid (n = 16, range 0.06 to 0.18 nanograms per gram); perfluorooctanesulfonic acid (n = 23, range 0.07 to 0.52 nanograms per gram); and perfluorooctanoic acid (n = 21, range 0.06 to 0.48 nanograms per gram). There were no differences in PFAS concentrations among locations (Kruskal-Wallis, $p > 0.05$; Figure 7-15).

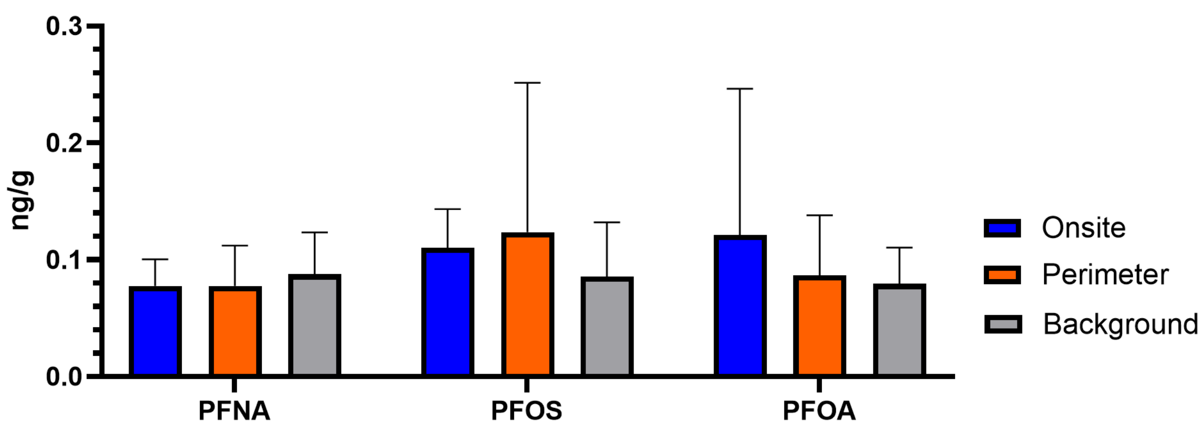

Figure 7-15. PFAS concentrations in soil samples collected from in 2024 from onsite, perimeter, and background locations. Note the linear scale on the vertical axis. Column bars represent the mean and error bars represent standard deviation. Note: PFNA = perfluorononanoic acid, PFOS = perfluorooctanesulfonic acid, PFOA = perfluorooctanoic acid, and ng/g = nanograms per gram.

Five PFAS compounds exceeded their respective regional statistical reference level in at least one location (Table S7-25). Soil concentrations of perfluorodecanoic acid exceeded the regional statistical reference level at six locations (Table S7-25). The soil sample collected from Acid Canyon contained five PFAS compounds that exceeded their respective regional statistical reference level (Table S7-25). All detectable PFAS concentrations were far below available ecological screening levels (Table S7-25).

Overall, few PFAS compounds were observed in soil samples, and all detectable concentrations were less than 1 nanogram per gram. Although some of these observations exceeded the regional statistical reference levels, all were below available ecological screening levels and New Mexico Environment Department soil screening levels (Table S7-25). Concentrations of total PFAS compounds observed here are within the range of global observations of concentrations in soil collected from unpolluted sites (Brusseau et al. 2020).

Semi-Volatile Organic Compound Results in Soil

Soil samples were analyzed for 72 semi-volatile organic compounds. Only 22 compounds had detectable concentrations at sampling locations. The perimeter soil sample collected east of the airport contained the greatest number of detectable semi-volatile organic compounds (n = 21 compounds, Table S7-26).

Benzoic acid was the most commonly detected semi-volatile organic compound at both onsite and perimeter locations (n = 12, range 0.338 to 0.644 milligrams per kilogram). All concentrations of benzoic acid were below the regional statistical reference level and ecological screening levels (Table S7-26). Benzoic acid is used in many consumer products (National Center for Biotechnology Information 2025a) and is the transformation product of an herbicide, Dichlobenil (Christensen et al. 2022). However, benzoic acid is also produced by natural processes, such as the degradation of organic matter, and has been detected at elevated levels in coniferous forests (Christensen et al. 2022). Therefore, the benzoic acid detections observed in soil reported here could be due to natural processes.

Bis(2-ethylhexyl)phthalate exceeded the no-effect ecological screening level for the American robin at six locations: onsite at technical areas 11, 14, 51, and 53 and perimeter locations east of the airport and Quemazon Trail. However, all observed concentrations were below the regional statistical reference level of 0.240 milligrams per kilogram, were below the low-effect ecological screening level for the American robin, and below the New Mexico Environment Department soil screening levels (Table S7-26). Bis(2-ethylhexyl)phthalate is a plasticizer and is commonly used in the production of polyvinyl chloride (U.S. Environmental Protection Agency 2000a, National Center for Biotechnology Information 2025b). Bis(2-ethylhexyl)phthalate concentrations observed here are within the range of observations of concentrations in soil collected from unpolluted sites reported in the literature (Zhu et al. 2018).

A carbazole concentration (0.13 milligrams per kilogram) in soil collected east of the airport exceeded the regional statistical reference level of 0.03 milligrams per kilogram but was below the no-effect and low-effect ecological screening levels (Table S7-26). Carbazole is produced during the incomplete combustion of fossil fuels (U.S. Environmental Protection Agency 2008). Concentrations of carbazole observed here are within the range of observations of concentrations in soil collected from unpolluted sites reported in the literature (Mumbo et al. 2016).

Di-n-butyl phthalate exceeded the no-effect ecological screening level for the American robin at three locations and exceeded the low-effect ecological screening level for the American robin at one location east of the airport. However, all observed concentrations were below the regional statistical reference level of 0.505 milligrams per kilogram and below the New Mexico Environment Department soil screening levels (Table S7-26). Di-n-butylphthalate is commonly used to make synthetic materials softer and more flexible and is used in many consumer and industrial products (U.S. Environmental Protection Agency 2000b). Concentrations of di-n-butyl phthalate observed here are below the range of observations of concentrations in soil collected from contaminated sites reported in the literature (Agency for Toxic Substances and Disease Registry 2001).

All other detectable concentrations of semi-volatile organic compounds were below the regional statistical reference levels; no-effect, low-effect ecological screening levels; and below the New Mexico Environment Department soil screening levels (Table S7-26). Statistical analyses were not performed because there were more than 80 percent non-detects (Helsel 2012).

Volatile Organic Compound Results in Soil

No volatile organic compounds were detected in any soil samples in 2024.

High Explosives Results in Soil

No high explosives were detected in any soil samples in 2024.

Dioxin and Furan Results in Soil

Dioxins and furans were first analyzed in soil as part of the institutional monitoring program in 2018. Dioxins and furans are produced from both manufactured and natural combustion processes, such as industrial sources, combustion of fossil fuels, incinerators, and forest fires (Kanan and Samara 2018, Sharma et al. 2004). During 2024, some dioxin and furan compounds were detected above their regional statistical reference levels (Tables S7-27 and S7-28).

Each compound was multiplied by its respective World Health Organization toxic equivalent factor (Van den Berg et al. 2006) and then compared with the tetrachlorodibenzodioxin-2,3,7,8 ecological screening levels. Only two dioxin congeners exceeded the no-effect ecological screening level for the montane shrew; all levels were below the low-effect ecological screening levels. The first dioxin congener, 1,2,3,4,6,7,8-heptachlorodibenzodioxin, exceeded the no-effect ecological screening level at four locations, including east and west of Technical Area 53, Technical Area 16 (burning grounds), and a perimeter location at North Mesa. The second dioxin congener, 1,2,3,7,8-pentachlorodibenzodioxin, exceeded the no-effect ecological screening level at two locations: west of Technical Area 53 and a perimeter location at North Mesa. All concentrations were below the New Mexico Environment Department soil screening levels.

The majority of polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans concentrations observed here are within the range of observations of concentrations in soil collected from unpolluted sites reported in the literature (Mumbo et al. 2016).

Only four dioxin and furan congeners had enough detections to make statistical comparisons among locations and over time (Helsel 2012). There were no changes over time in any dioxin or furan concentrations (Generalized Linear Model, $p > 0.05$); however, there were differences in concentrations across sites (Generalized Linear Model, $p < 0.05$). The congeners 1,2,3,4,6,7,8-hepatachlorodibenzofuran and 1,2,3,4,6,7,8,9-octachlorodibenzofuran were higher in soil collected on site when compared with concentrations in soil collected from background locations (Steel-Dwass, $p < 0.05$). However, the high percentages of non-detects (61 and 47 percent, respectively) could be affecting these observations. 1,2,3,4,6,7,8-heptachlorodibenzodioxin concentration differed across all locations, and differences were observed among all pairwise comparisons, with onsite soil containing the highest concentrations and soil from background contained the lowest concentrations (Steel-Dwass, $p < 0.05$). However, this observation was driven by one value observed from Technical Area 63; when the data point was removed, there were no differences in concentrations among sites. 1,2,3,4,6,7,8,9-octachlorodibenzodioxin was higher in soil collected from onsite and perimeter locations when compared with concentrations in soil collected background locations (Steel-Dwass, $p < 0.05$).

Overall, only 1.2 percent of the congeners evaluated exceeded no-effect ecological screening levels. The number of locations with concentrations potentially associated with adverse effects at an individual level are minimal, and no impacts to populations or communities of plants and animals are expected.

In preparing this section, we discovered errors in the Dioxin and Furan Results in Soil section in Chapter 7 of the 2021 Annual Site Environmental Report (LANL 2022a), which we are reporting here. Specifically,

- there were four furan compounds (not three) from the soil sample collected at Technical Area 63 that exceeded only the no-effect ecological screening level,
- one dioxin compound (not two) from the soil sample collected from North Mesa exceeded the no-effect ecological screening level,
- one furan (not dioxin) compound in the soil samples collected from Technical Area 21 exceeded the no-effect ecological screening level, and
- a total of 3.5 percent (not 2.6 percent) of the congeners exceeded the ecological screening levels.

Overstory Vegetation Monitoring Results

The 2024 overstory vegetation results are summarized as follows (refer to supplemental Tables S7-29 and S7-30 for individual results):

- Most radionuclide levels in vegetation were not detected or were below the regional statistical reference levels and all were far below biota dose screening levels.
- Strontium-90 was higher in plants collected from perimeter locations when compared with background locations.
- Uranium-238 activity was higher in vegetation collected on site when compared with background vegetation samples.
- The majority (approximately 98 percent) of inorganic elements in vegetation were below the regional statistical reference levels.
- Onsite vegetation contained less vanadium than perimeter locations, and cadmium was higher in vegetation on site than background and perimeter locations.
- No PFAS compounds were detected in understory vegetation samples.

Radionuclide Results in Understory Vegetation

Results of radionuclide analyses in understory vegetation collected from onsite and perimeter locations either did not detect any (in most cases), were below regional statistical reference levels, or were far below the screening levels set for the protection of biota (Table S7-29). These results are consistent with previous measurements that have been reported (in LANL 2019a and LANL 2022a).

Amercium-241, plutonium-238, and plutonium-239/240 were not detected in any vegetation samples (Table S7-29). All detected levels of cesium-137 and uranium-234 were below the regional statistical reference levels (Table S7-29). A vegetation sample from Technical Area 36 contained tritium at levels above the regional statistical reference level (Table S7-29). Uranium-235/236 and uranium-238 in understory vegetation from Technical Area 49 exceeded their regional statistical reference levels (Table S7-29). Strontium-90 in vegetation exceeded the regional statistical reference level at six locations, including Pueblo de San Ildefonso, Los Alamos townsite, and onsite locations (Table S7-29).

No differences in levels of americium-241, cesium-137, plutonium-238, plutonium-239/240, tritium, or uranium-234 were observed among sites or over time (Generalized Linear Model, $p > 0.05$). Trend analyses were not performed on uranium-235/236; refer to Analytical Laboratory Quality Assessment in this chapter for more information. There was a significant difference in strontium-90 activity in vegetation among locations (Generalized Linear Model, $p < 0.05$). Strontium-90 activity was higher in perimeter understory vegetation samples when compared with background (Tukey-Kramer, $p < 0.05$) whereas no other pairwise comparisons differed (Tukey-Kramer, $p > 0.05$). There was also a significant interaction in strontium-90 levels between year and location (Generalized Linear Model, $p < 0.05$). Levels at perimeter locations increased over time, whereas levels at onsite and background locations did not (Generalized Linear Model, $p < 0.05$; Figure 7-14). This increase in strontium-90 was not observed at the majority of the perimeter locations and was not observed in the soil results. The significant result was driven by unusually high strontium-90 at two perimeter locations in 2024; the cause is not fully understood.

Strontium-90 can be absorbed by plants from the soil, water, or the air around them (Burger and Lichtscheidl 2019). Several factors can influence how much strontium-90 gets taken up by vegetation, including the pH of the soil; the concentrations of certain inorganic elements in the soil, such as barium, calcium, manganese, magnesium, and potassium; the amount of rainfall; the type of plant species; the plant's physiology; and the structure of the plant's roots (Burger and Lichtscheidl 2019, Chawla et al. 2010). Calcium, potassium, and strontium-90 behave in similar ways in the environment. DOE (2019) suggests that the amount of strontium-90 that gets absorbed by plants is inversely proportional to the concentration of calcium in the soil or water, which means that plants could take up more strontium-90 from soils with low calcium levels.

The soil samples collected from the background locations had higher concentrations of calcium, as well as several other inorganic elements like barium, manganese, and potassium (refer to Inorganic Element Results in Soil). Additionally, the vegetation samples analyzed in 2024 were tested at a different analytical laboratory than in previous years. The variability observed in the levels of strontium-90 in the vegetation could be due to any one or a combination of these factors.

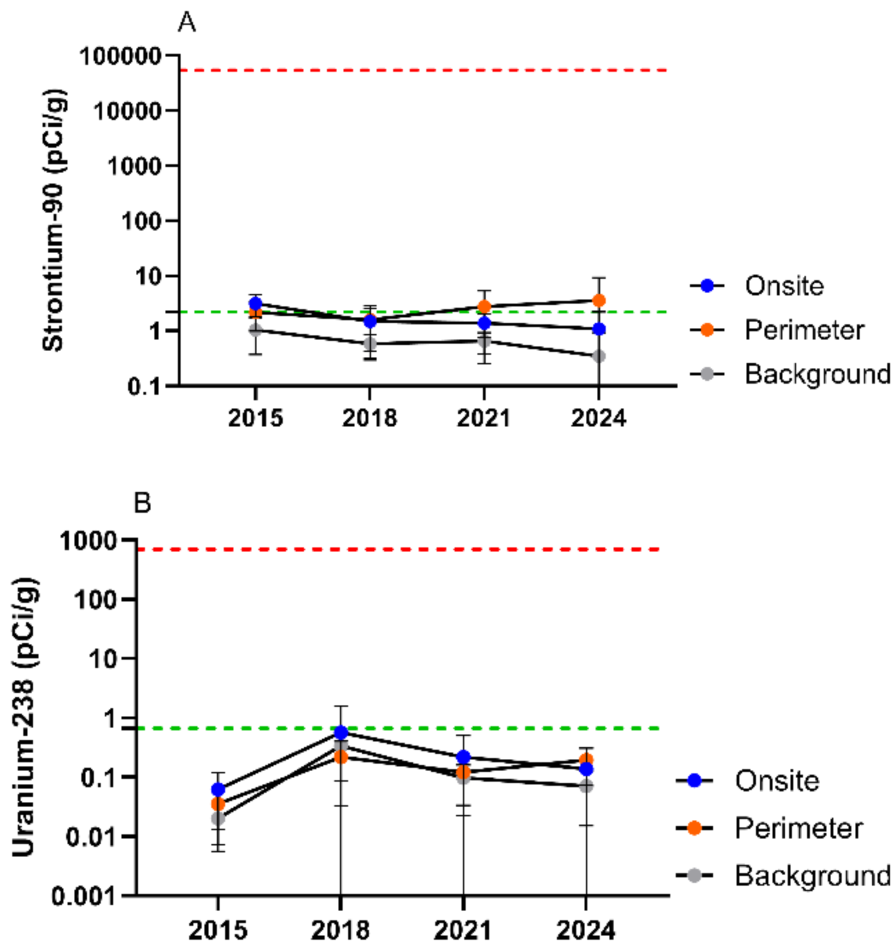

Figure 7-16. (A) Strontium-90 and (B) uranium-238 levels in understory vegetation samples collected from 2015 through 2024 from onsite, perimeter, and from background locations. Note the logarithmic scale on the vertical axis. Points represent the mean and error bars represent standard deviation. Data are compared with the regional statistical reference level (green dashed line) and biota dose screening level (red dashed line). Note: pCi/g = picocuries per gram.

There was a significant difference in uranium-238 levels in understory vegetation among locations (Generalized Linear Model, $p < 0.05$). Uranium-238 was higher in onsite understory vegetation samples than in samples from background locations (Steel-Dwass, $p < 0.05$). No other pairwise comparisons differed (Steel-Dwass, $p > 0.05$). Uranium-238 levels had a significant interaction between year and location (Generalized Linear Model, $p < 0.05$; Figure 7-16).

The difference in uranium levels among locations could be due to natural variation of uranium levels in soil or aerosolized dust of uranium from natural sources or site operations. Vegetation samples are not rinsed before analysis. Most understory vegetation samples contained a near 1:1 ratio of uranium-234 to uranium-238 activity, which indicates that the uranium is from naturally occurring sources (International Atomic Energy Agency 2025). Some locations, such as Minie and Lower Slobbovia, had ratios of uranium-234 to uranium-238 activity, which suggest a depleted uranium source (Table S7-29; International Atomic Energy Agency 2025). The observed levels are far below the biota dose screening level, which are protective of biota (Table S7-29).

Inorganic Elements Results in Understory Vegetation

Most inorganic element concentrations in understory vegetation collected from onsite and perimeter locations were below regional statistical reference levels (Table S7-30). Arsenic, selenium, silver, and thallium were not detected in any of the samples collected. Antimony was detected slightly above the regional statistical reference level of 1.20 milligrams per kilogram in 11 samples within and around the perimeter of the Laboratory site (range 1.25 to 2.43 milligrams per kilogram). At the Technical Area 21 sampling location, lead was detected at 0.996 milligrams per kilogram, which was slightly above the regional statistical reference level of 0.889 milligrams per kilogram. Mercury was also slightly elevated above the regional statistical reference level of 0.017 milligrams per kilogram in four samples (range 0.018 to 0.047 milligrams per kilogram); all four samples were collected from perimeter locations (Table S7-30).

Due to the high percentage of non-detects (greater than 80 percent), we did not statistically compare beryllium and silver concentrations over time or among locations. There were no differences in concentrations among sites for the following: aluminum, antimony, arsenic, barium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, selenium, sodium, thallium, and zinc concentrations (Generalized Linear Model and Steel-Dwass, $p < 0.05$).

Cadmium and vanadium concentrations varied by location (Generalized Linear Model, $p < 0.05$). Onsite vegetation contained higher levels of cadmium than background and perimeter vegetation (Steel-Dwass, $p < 0.05$), whereas perimeter locations contained more vanadium than onsite vegetation (Steel-Dwass, $p < 0.05$). The percentages of non-detects (35 and 61 percent, respectively) could be influencing these observations.

There was a significant interaction of year and location in cobalt concentrations in vegetation, indicating that the rate of change differed among locations; however, there was also an overall decreasing trend in cobalt concentrations (Generalized Linear Model, $p < 0.05$). The high percentage of non-detects (70 percent) could be influencing this observation.

Antimony, arsenic, and selenium were increasing at all locations over time (Generalized Linear Model, $p < 0.05$); however, high percentages of non-detects (49, 58, and 75 percent, respectively) could be affecting these results. Thallium was increasing over time, and there was a significant interaction of year and location (Generalized Linear Model, $p < 0.05$), indicating that the rate of increase differed among locations. However, a high percentage of non-detects (68 percent) could be affecting this test result. No other elements in understory vegetation were increasing over time (Generalized Linear Model, $p > 0.05$).

PFAS Results in Understory Vegetation

No PFAS compounds were detected in understory vegetation samples. Refer to Analytical Laboratory Quality Assessment in this chapter for more information.

Summary—PFAS Monitoring Results

Perfluorooctanesulfonic acid, perfluorodecane sulfonate, perfluorotridecanoic acid, and perfluorotetradecanoic acid are PFAS compounds frequently detected in treated wastewater and in sediments in urban watersheds (Bai and Son 2021, Dalahmeh et al. 2018, Phong Vo et al.

2020). PFAS accumulate in animal tissues. PFAS also have possible impacts on human health (National Academies of Sciences, Engineering, and Medicine 2022).

In 2024, we tested 136 biota, soil, and sediment samples from on and off the LANL site for PFAS compounds, including 42 soil samples, 4 sediment samples, 37 vegetation samples, 9 small mammal samples, 1 avian nestling sample, 6 avian egg samples, 3 avian blood samples, 2 mountain lion blood samples, and 32 road-killed animal samples (23 muscle samples and 9 liver samples). Table 7-1 lists the sections in this chapter that discuss the results of these tests.

Table 7-1. Sections of This Chapter where Results of PFAS Testing Are Discussed

Section of Chapter 7 where Results Are Discussed	Sample Type(s)	Reference Reports
Dual-Axis Radiographic Hydrodynamic Test Facility at Technical Area 15	Soil, sediment, nonviable eggs from nestboxes	LANL 2025; Gadek et al. 2025
Open-Detonation and Open-Burn Firing Sites	Nonviable eggs from nestboxes	Gadek et al. 2025
Sediment and Flood Retention Structures	Vegetation, small mammals	NA
Small Mammal Monitoring at Pueblo de San Ildefonso	Small mammals	NA
Special Assessment – PFAS in Avian Blood Samples	Avian blood samples	NA
Large Animal Monitoring	Mammals, birds, snakes	NA
Soil Monitoring	Soil	NA
Vegetation Monitoring	Vegetation	NA

NA = not applicable.

Overall, most PFAS compounds were not detected in soil, sediment, vegetation, or animals. No PFAS were detected in vegetation. Perfluorononanoic acid, perfluorooctanesulfonic acid, and perfluorooctanoic acid were the most commonly detected PFAS compounds in soil.

Perfluorooctanesulfonic acid was the most commonly detected PFAS compound in animals. Perfluorooctanesulfonic acid is a type of PFAS chemical that has a longer chain structure, which means that it is more likely to build up in the tissues of animals because it is hard for their bodies to break it down and get rid of it. In general, we found that blood samples and liver samples had a higher number of detectable PFAS compounds than muscle samples or whole-body samples from small mammals.

The concentrations of detected PFAS compounds were generally within the range of global observations of concentrations in soil and animals collected from non-polluted sites (Aas et al. 2014, Bossi et al. 2015, Brusseau et al. 2020). For most of our samples, we suspect that the PFAS concentrations observed are due to nonpoint source pollution. We are exploring potential sources for some of the PFAS compounds detected in the different sample types and locations.

Biota Radiation Dose Assessment

Introduction

The purpose of the biota dose assessment is to ensure that plant and animal populations are protected from effects of radioactive materials released from past or current site operations, as required by DOE Order 458.1. This assessment follows the guidance of the DOE standard, A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota, DOE-STD-1153-2019 (DOE 2019), and uses the standard DOE dose calculation program, RESRAD-BIOTA version 1.8.

Previous biota dose assessments reported in past annual site environmental reports concluded that biota doses for populations at the Laboratory site were well below the DOE limits of 1 rad per day for terrestrial plants and aquatic animals and 0.1 rad per day for terrestrial animals (DOE 2019).

Plants and animals receive doses from external radiation. Plants receive internal doses from radionuclides taken up through their roots. Animals receive internal doses when they eat plants. When a predator eats its prey, there is a possibility for bioaccumulation as the ingested material passes up the food chain. Bioaccumulation is measured with “bioaccumulation factors” or “concentration ratios,” which are the ratios of the levels of radionuclides in living tissue to the levels in the local soil and water.

Published concentration ratios allow us to estimate the levels of radionuclides in living tissue from the levels in soil. The biota doses reported in the following paragraphs are calculated using site-representative values as described in Appendix F of DOE-STD-1153-2019 (DOE 2019). Whenever the data allow calculations of the dose from either soil or tissue data, the largest dose is reported.

The material that potentially contributes to the biota doses at the LANL site is legacy waste material. Ongoing remediation and radioactive decay result in decreasing radionuclide activity levels over time, so a decreasing trend in biota dose is expected. However, ongoing operations and movement of soil or sediment could cause an accumulation of radioactive material, so key locations are reassessed annually.

In the following sections, we calculate the worst-case biota doses for plants and animals at Material Disposal Area G, at the Dual-Axis Radiographic Hydrodynamic Test Facility, at the Los Alamos Canyon weir, and at the Pajarito Canyon flood-retention structure. To provide an assessment of the biota dose throughout Los Alamos, we also calculate the worst-case doses using the site-wide soil and vegetation data reported in Tables S7-22 and S7-29 and the data from road-kill animals reported in Tables S7-13 and S7-14.

Mesa-Top Facilities

Area G

This chapter reports new measurements of soil and vegetation around Material Disposal Area G, known as Area G. The data, listed in supplementary Tables S7-1 and S7-2, are generally comparable with previous years, although there is some year-to year variation depending on the exact locations sampled. This year, the largest variation is for tritium, which is called “H-3” in RESRAD-BIOTA.

The biota dose caused by tritium varies as a function of both time and location. The uptake of tritiated water into plants varies with time depending on several variables: the ambient temperatures of the soil, air, and vegetation; the moisture from intermittent rain or snow; and the daily and annual growth cycles. It also varies with location depending on the distance from the perimeter fence and which roots are in contact with buried waste, as well as the concentrations and containment of the waste. A more realistic assessment of tritium dose would use averages of several locations and several times instead of the single worst-case value used here.

As recommended by the DOE standard (DOE 2019), the following assessments use the highest measured activity levels. We report the Area G results in Table 7-2 and Table 7-3. The largest tritium concentrations are located near the tritium burial shafts, which are near locations 29-03 and 30-1, as indicated in Figure 7-5.

Table 7-2. Dose Rate to Terrestrial Animals at Area G for 2024. The DOE Limit is 0.1 rad per day (rad/day) for terrestrial animals. Values are given in scientific notation.

Nuclide	External		Internal		Nuclide Total (rad/day)
	Water (rad/day)	Soil (rad/day)	Water (rad/day)	Soil (rad/day)	
Americium-241	2.2E−10	2.2E−06	3.7E−08	8.5E−06	1.1E−05
Cesium-137	2.4E−08	2.4E−05	3.1E−09	1.6E−06	2.6E−05
Tritium	4.0E−03	7.9E−03	7.8E−03	7.8E−03	2.8E−02
Plutonium-238	1.3E−10	5.1E−07	1.3E−07	9.2E−06	9.8E−06
Plutonium-239	1.1E−10	4.3E−07	1.9E−07	1.2E−05	1.3E−05
Strontium-90	1.7E−07	1.0E−05	1.4E−06	4.1E−05	5.3E−05
Uranium-234	1.2E−08	1.2E−06	4.5E−06	1.7E−05	2.3E−05
Uranium-235	2.1E−08	2.1E−06	2.6E−07	9.6E−07	3.3E−06
Uranium-238	8.9E−07	8.9E−05	4.4E−06	1.6E−05	1.1E−04
Total	4.0E−03	8.0E−03	7.8E−03	7.9E−03	Overall Dose Rate 2.8E−02

Table 7-3. Dose Rate to Terrestrial Plants at Area G for 2024. The DOE Limit is 1.0 rad per day (rad/day) for terrestrial plants. Values are given in scientific notation.

Nuclide	External		Internal	Nuclide Total (rad/day)
	Water (rad/day)	Soil (rad/day)	Soil (rad/day)	
Americium-241	2.2E−10	2.2E−06	1.6E−05	1.8E−05
Cesium-137	2.4E−08	2.4E−05	1.6E−06	2.6E−05
Tritium	4.0E−03	7.9E−03	8.3E−03	2.0E−02
Plutonium-238	1.3E−10	5.1E−07	2.8E−05	2.9E−05
Plutonium-239	1.1E−10	4.3E−07	6.0E−05	6.1E−05
Strontium-90	1.7E−07	1.0E−05	4.1E−05	5.1E−05

Nuclide	External		Internal	Nuclide Total (rad/day)
	Water (rad/day)	Soil (rad/day)	Soil (rad/day)	
Uranium-234	1.2E−08	1.2E−06	1.7E−05	1.8E−05
Uranium-235	2.1E−08	2.1E−06	9.9E−07	3.1E−06
Uranium-238	8.9E−07	8.9E−05	1.7E−05	1.1E−04
Total	4.0E−03	8.0E−03	8.5E−03	Overall Dose Rate 2.1E−02

The results in Table 7-2 show that the biota doses at Area G are below the DOE limits of 0.1 rad per day for animals, and Table 7-3 shows that the doses are also below the limit of 1 rad per day for plants. Overall, there are no expected impacts to biota health.

Dual-Axis Radiographic Hydrodynamic Test Facility

The Dual-Axis Radiographic Hydrodynamic Test Facility biota dose assessment uses the same methods described in Mesa-Top Facilities, Area G in this chapter. The doses were calculated from the soil data reported in the Mitigation Action Plan Annual Report (LANL 2025). The highest soil activity levels were entered into RESRAD-BIOTA, and the results are reported in Table 7-4 and Table 7-5.

Table 7-4. Dose Rate to Terrestrial Animals at the Dual-Axis Radiographic Hydrodynamic Test Facility for 2024. The DOE Limit is 0.1 rad per day (rad/day) for terrestrial animals. Values are given in scientific notation.

Nuclide	External		Internal		Nuclide Total (rad/day)
	Water (rad/day)	Soil (rad/day)	Water (rad/day)	Soil (rad/day)	
Americium-241	3.5E−12	3.5E−08	5.9E−10	1.4E−07	1.7E−07
Cesium-137	1.5E−08	1.5E−05	1.9E−09	9.3E−07	1.5E−05
Tritium	1.9E−09	3.8E−09	3.8E−09	3.8E−09	1.3E−08
Plutonium-238	3.3E−12	1.3E−08	3.4E−09	2.4E−07	2.6E−07
Plutonium-239	2.4E−12	9.7E−09	4.2E−09	2.7E−07	2.9E−07
Strontium-90	3.4E−07	2.1E−05	2.8E−06	8.3E−05	1.1E−04
Uranium-234	4.7E−08	4.7E−06	1.8E−05	6.7E−05	8.9E−05
Uranium-235	9.7E−08	9.7E−06	1.2E−06	4.5E−06	1.6E−05
Uranium-238	4.8E−06	4.8E−04	2.4E−05	8.8E−05	6.0E−04
Total	5.3E−06	5.3E−04	4.5E−05	2.4E−04	Overall Dose Rate 8.2E−04

Table 7-5. Dose Rate to Terrestrial Plants at the Dual-Axis Radiographic Hydrodynamic Test Facility for 2024. DOE Limit: 1.0 rad per day (rad/day) for terrestrial plants. Values are given in scientific notation.

Nuclide	External		Internal	Nuclide Total (rad/day)
	Water (rad/day)	Soil (rad/day)	Soil (rad/day)	
Americium-241	3.5E−12	3.5E−08	2.6E−07	3.0E−07
Cesium-137	1.5E−08	1.5E−05	9.3E−07	1.5E−05
Tritium	1.9E−09	3.8E−09	4.0E−09	9.8E−09
Plutonium-238	3.3E−12	1.3E−08	7.4E−07	7.5E−07
Plutonium-239	2.4E−12	9.7E−09	1.3E−06	1.3E−06
Strontium-90	3.4E−07	2.1E−05	8.3E−05	1.0E−04
Uranium-234	4.7E−08	4.7E−06	6.7E−05	7.1E−05
Uranium-235	9.7E−08	9.7E−06	4.6E−06	1.4E−05
Uranium-238	4.8E−06	4.8E−04	8.9E−05	5.7E−04
Total	5.3E−06	5.3E−04	2.5E−04	Overall Dose Rate 7.8E−04

The largest dose contribution at the Dual-Axis Radiographic Hydrodynamic Test Facility is from uranium, most of which is depleted uranium from Laboratory site operations. The levels of the other radionuclides are consistent with natural background and global fallout. Table 7-4 and Table 7-5 show that the biota doses are well below the DOE limits of 0.1 rad per day for animals and 1 rad per day for plants. No impacts are expected to biota health.

Sediment-Retention Sites in Canyons

Los Alamos Canyon Weir

The Los Alamos Canyon weir receives drainage from former technical areas 01, 02, and 21. The soil and sediment trapped by the weir include slightly elevated activities of fission products (cesium-137 and strontium-90) and transuranic radionuclides (americium and plutonium). Tritium and uranium concentrations are consistent with natural background. The resulting concentrations in plants and animals are listed in supplementary Tables S7-3 and S7-5.

The largest biota dose is from naturally occurring uranium. As shown in Table 7-6 and Table 7-7, the doses are all well below the DOE limits. No impacts are expected to biota health.

Table 7-6. Dose to Terrestrial Animals in Los Alamos Canyon Weir for 2024. DOE Limit: 0.1 rad per day (rad/day) for terrestrial animals. Values are given in scientific notation.

Nuclide	External		Internal		Nuclide Total (rad/day)
	Water (rad/day)	Soil (rad/day)	Water (rad/day)	Soil (rad/day)	
Americium-241	6.1E−11	6.1E−07	1.0E−08	2.4E−06	3.0E−06
Cesium-137	8.0E−08	8.0E−05	1.0E−08	5.2E−06	8.6E−05
Tritium	7.6E−09	1.5E−08	1.5E−08	1.5E−08	5.3E−08
Plutonium-238	1.3E−11	5.1E−08	1.3E−08	9.2E−07	9.9E−07
Plutonium-239	1.9E−11	7.7E−08	3.4E−08	2.2E−06	2.3E−06
Strontium-90	1.2E−07	7.0E−06	9.3E−07	2.8E−05	3.6E−05
Uranium-234	1.5E−08	1.5E−06	5.5E−06	2.1E−05	2.8E−05
Uranium-235	1.8E−08	1.8E−06	2.3E−07	8.5E−07	2.9E−06
Uranium-238	1.0E−06	1.0E−04	5.1E−06	1.9E−05	1.3E−04
Total	1.3E−06	2.0E−04	1.2E−05	7.9E−05	Overall Dose Rate 2.9E−04

Table 7-7. Dose Rate to Terrestrial Plants in Los Alamos Canyon Weir for 2024. DOE Limit: 1 rad per day (rad/day) for terrestrial plants. Values are given in scientific notation.

Nuclide	External		Internal	Nuclide Total (rad/day)
	Water (rad/day)	Soil (rad/day)	Soil (rad/day)	
Americium-241	6.1E−11	6.1E−07	4.5E−06	5.1E−06
Cesium-137	8.0E−08	8.0E−05	5.2E−06	8.6E−05
Tritium	7.6E−09	1.5E−08	1.6E−08	3.9E−08
Plutonium-238	1.3E−11	5.1E−08	2.8E−06	2.9E−06
Plutonium-239	1.9E−11	7.7E−08	1.1E−05	1.1E−05
Strontium-90	1.2E−07	7.0E−06	2.8E−05	3.5E−05
Uranium-234	1.5E−08	1.5E−06	2.1E−05	2.2E−05
Uranium-235	1.8E−08	1.8E−06	8.7E−07	2.7E−06
Uranium-238	1.0E−06	1.0E−04	1.9E−05	1.2E−04
Total	1.3E−06	2.0E−04	9.2E−05	Overall Dose Rate 2.9E−04

Pajarito Canyon Flood Retention Structure

The Pajarito Canyon flood retention structure does not receive significant quantities of Laboratory site radionuclides. During 2023, any contribution from DOE operations was indistinguishable from background levels. During 2024, no samples were collected at this location. The total biota dose in Pajarito Canyon is less than 1 percent of the DOE limits and has no expected impact on biota health.

Site-Wide Assessment

Every 3 years, soil and vegetation samples are collected from selected locations throughout the LANL site. The data are listed in supplementary Tables S7-22 and S7-29 and are used for the site-wide biota-dose assessment shown in Table 7-8 and Table 7-9. Most of the biota dose is from depleted uranium near R-Site Road in Technical Area 15.

As shown in Table 7-8 and Table 7-9, the doses are all well below the DOE limits. No impacts are expected to biota health.

Table 7-8. Dose to Terrestrial Animals Site Wide for 2024. DOE Limit: 0.1 rad per day (rad/day) for terrestrial animals. Values are given in scientific notation.

Nuclide	External		Internal		Nuclide Total (rad/day)
	Water (rad/day)	Soil (rad/day)	Water (rad/day)	Soil (rad/day)	
Americium-241	2.9E−11	2.9E−07	4.9E−09	1.1E−06	1.4E−06
Cesium-137	2.4E−08	2.4E−05	3.0E−09	1.5E−06	2.5E−05
Tritium	4.1E−07	8.1E−07	8.0E−07	8.0E−07	2.8E−06
Plutonium-238	2.2E−11	8.9E−08	2.3E−08	1.6E−06	1.7E−06
Plutonium-239	1.8E−10	7.4E−07	3.2E−07	2.1E−05	2.2E−05
Strontium-90	2.9E−07	1.8E−05	2.3E−06	7.0E−05	9.0E−05
Uranium-234	4.5E−08	4.5E−06	1.7E−05	6.5E−05	8.6E−05
Uranium-235	8.3E−08	8.3E−06	1.0E−06	3.9E−06	1.3E−05
Uranium-238	4.6E−06	4.6E−04	2.3E−05	8.5E−05	5.7E−04
Total	5.5E−06	5.2E−04	4.4E−05	2.5E−04	Overall Dose Rate 8.2E−04

Table 7-9. Dose Rate to Terrestrial Plants Site Wide for 2024. DOE Limit: 1 rad per day (rad/day) for terrestrial plants. Values are given in scientific notation.

Nuclide	External		Internal	Nuclide Total (rad/day)
	Water (rad/day)	Soil (rad/day)	Soil (rad/day)	
Americium-241	2.9E−11	2.9E−07	2.1E−06	2.4E−06
Cesium-137	2.4E−08	2.4E−05	1.5E−06	2.5E−05
Tritium	4.1E−07	8.1E−07	8.6E−07	2.1E−06
Plutonium-238	2.2E−11	8.9E−08	5.0E−06	5.1E−06

Nuclide	External		Internal	Nuclide Total (rad/day)
	Water (rad/day)	Soil (rad/day)	Soil (rad/day)	
Plutonium-239	1.8E−10	7.4E−07	1.0E−04	1.0E−04
Strontium-90	2.9E−07	1.8E−05	7.0E−05	8.8E−05
Uranium-234	4.5E−08	4.5E−06	6.4E−05	6.9E−05
Uranium-235	8.3E−08	8.3E−06	4.0E−06	1.2E−05
Uranium-238	4.6E−06	4.6E−04	8.6E−05	5.5E−04
Total	5.5E−06	5.2E−04	3.4E−04	Overall Dose Rate 8.6E−04

Roadkill and Donated Animals

Whenever possible, we analyze samples from animals killed on the roads or in other accidents or harvested by hunters for levels of radionuclides and chemicals. As shown in Tables S7-13 and S7-14, in 2024 these samples included deer, elk, a coyote, a snake, owls, and a raven. The radionuclide concentrations in animal tissue were converted to soil concentrations using the bioaccumulation factors listed in DOE-STD-1153-2019 (DOE 2019). Almost all the results were consistent with natural background and global fallout concentrations (Ryti et al. 1998), and the worst-case biota doses were less than those for the site-wide assessment shown in Table 7-8. The only result above background was a measurement of 2.08 picocuries per milliliter of tritium in a deer collected 600 meters from the Weapons Engineering Tritium Facility. The dose caused by this tritium was 1 microrad/day, which is far below the DOE limit of 0.1 rad/day.

Conclusion

Previous biota dose assessments have shown that biota doses at the Laboratory site are far below the DOE limits. This 2024 assessment confirms the previous assessments and shows that there are no expected harmful effects to the health of biota populations from Laboratory-sourced radioactive materials.

Biological Resources Management Program

We monitor federally listed threatened and endangered species and migratory birds; provide guidelines and requirements for site operations to minimize impacts to sensitive species and their habitats; and ensure that all operations comply with federal and state regulations.

Threatened and Endangered Species

In 2024, we completed surveys for four species protected under the Endangered Species Act: the Mexican spotted owl (*Strix occidentalis lucida*), the southwestern willow flycatcher (*Empidonax traillii extimus*), the Jemez Mountains salamander (*Plethodon neomexicanus*), and the western distinct population of the yellow-billed cuckoo (*Coccyzus americanus*).

Mexican Spotted Owl

The Mexican spotted owl generally inhabits mixed conifer, ponderosa pine (*Pinus ponderosa*), and Gambel oak (*Quercus gambelii*) forests in mountains and canyons (U.S. Fish and Wildlife Service 2012). Mexican spotted owls in the Jemez Mountains of northern New Mexico prefer cliff faces in canyons for their nest sites (Johnson and Johnson 1985). As part of the Laboratory's Threatened and Endangered Species Habitat Management Plan, we have identified Mexican spotted owl habitat based on a combination of cliff habitat and forest characteristics (LANL 2022b). In 2024, we detected Mexican spotted owls in the Mortandad, Threemile, and Los Alamos canyon habitat areas. We confirmed occupancy of the Mortandad sites by a breeding pair, and the pair successfully fledged three young. Mexican spotted owls have occupied Mortandad and Threemile sites in previous years (Thompson et al. 2023). The detection in Los Alamos Canyon could have been a wandering male because we were unable to confirm occupancy.

Southwestern Willow Flycatcher

The southwestern willow flycatcher occurs in close association with dense stands of willows (*Salix sp.*), arrowweed (*Pluchea sp.*), buttonbush (*Cephalanthus occidentalis*), tamarisk (*Tamarix sp.*), Russian olive (*Elaeagnus angustifolia*), and other riparian vegetation, often with a scattered overstory of cottonwood (*Populus sp.*; U.S. Fish and Wildlife Service 2002). Under the Laboratory's Threatened and Endangered Species Habitat Management Plan, we have identified southwestern willow flycatcher habitat based on the presence of riparian habitat with suitable wetland vegetation (LANL 2022b). Only one area has been identified as habitat for the southwestern willow flycatcher in the Habitat Management Plan: in the bottom of Pajarito Canyon. There were no detections in 2024.

Jemez Mountains Salamander

The Jemez Mountains salamander occurs predominantly at elevations between 7,000 and 11,000 feet in mixed-conifer and spruce-fir forests (Degenhardt et al. 1996). Under the Laboratory's Threatened and Endangered Species Habitat Management Plan, we have identified Jemez Mountains salamander habitat based on a geographical information systems analysis and a field-validated inspection of areas with suitable habitat components (LANL 2022b). Currently, five Jemez Mountains salamander habitat areas exist at the Laboratory site in four canyons. We conduct surveys in these areas where there is a specific project need and when suitable environmental conditions are met. There were no surveys conducted in 2024.

Yellow-Billed Cuckoo

The yellow-billed cuckoo is a riparian obligate species, and it nests almost exclusively in low- to mid-elevation riparian habitat dominated by cottonwoods and willows (Halterman et al. 2015). Potential habitat on Laboratory property for this species is located along the Rio Grande; there are no current operations in this area. No breeding habitat is identified for the species under the Laboratory's Threatened and Endangered Species Management Plan (LANL 2022b).

We do not conduct surveys every year, but we review any work activities that could affect habitat for this species (Keller 2015). Several planned utility line projects will require river crossings in this area. In 2024, we conducted cuckoo surveys. We also placed acoustic recorders to monitor bird calls and songs from 1 hour before sunrise until 3 hours after sunrise for 30 minutes every hour. No cuckoos were detected.

Migratory Bird Monitoring

Bird Banding Mark-Recapture Studies

We have operated a breeding-season bird-banding station in the Sandia Canyon wetland since 2014. This wetland contains primarily broadleaf cattail (*Typha latifolia*), lanceleaf cottonwood (*Populus acuminata*), narrowleaf willow (*Salix exigua*), and Russian olive (Newport News Nuclear BWXT-Los Alamos 2019). Beginning in May of each year, we operate the bird-banding station using a national protocol called Monitoring Avian Productivity and Survivorship (DeSante et al. 2021). By following a standardized protocol, we produce data that can be compared among sites. Since 2014, we have captured 2,209 birds that represent 82 species. In 2024, we captured 134 birds that represented 31 species. The most-captured species in 2024 was the pygmy nuthatch (*Sitta pygmaea*).

We also operate a bird-banding station on Laboratory property during fall migration in a wetland and riparian complex in Technical Area 36 on the north side of Pajarito Road. Since 2010, we have captured 6,246 birds at the fall banding site, representing 95 species. In 2024, we captured 484 birds that represented 44 species. The most-captured bird species at this site in 2024 was the Wilson’s warbler (*Cardellina pusilla*).

More information about bird-banding methods and annual results can be found in Stanek and Hathcock (2019).

Bird Monitoring at Open-Detonation and Open-Burn Firing Sites

In 2013, we began documenting bird populations at two open-detonation sites, an open-burn site, and three control areas using point-count surveys and nestbox monitoring. We test explosives at open-detonation sites. Materials are ignited for self-sustained combustion (for example, to remove residues of high explosives) at the open burn site. The two open-detonation sites are Minie Site at Technical Area 36 and Point 6 at Technical Area 39; the open-burn site is in Technical Area 16. The project objective is to determine whether operations at these sites impact bird species richness (the number of different species present), species diversity (a combination of the number of species present and their relative abundance), or composition (the presence or absence of each individual species). Analyses of this long-term dataset indicate that operations at the three sites are not negatively affecting local bird populations. Refer to Gadek et al. (2025) for a detailed presentation and discussion of results.

Pinyon Jay Monitoring

We initiated a site-wide pilot study in late 2022 to look for pinyon jays (*Gymnorhinus cyanocephalus*) at the Laboratory site. Pinyon jays are highly associated with woodlands dominated by piñon pines (*Pinus monophylla*) and one-seed juniper. Although this species is not federally protected under the Endangered Species Act, it has been petitioned to be listed and is currently under review (U.S. Fish and Wildlife Service 2023).

We began using acoustic recorders in fall 2022 to detect pinyon jay calls in the landscape. In spring 2023, we also conducted ground surveys using the Pinyon Jay Working Group survey protocol (Boone et al. 2023). From March through April 2024, we conducted eight pinyon jay ground surveys with no detections. We also placed acoustic recorders in eight locations in Technical Areas 36, 39, and 49. There were three positive detections in Technical Area 36.

Wildland Fire and Forest Health Programs

The Wildland Fire Program and the Forest Health Program prepare for wildland fires with fuel mitigation and forest management projects. Staff plan, implement, and monitor treatments—including forest thinning—to reduce the potential for harm from wildland fire and to increase forest and habitat resilience to disturbances. Monitoring allows us to assess our effectiveness at reducing fuels, restoring forests for improved forest resiliency, and protecting threatened and endangered species' habitat (LANL 2019b).

Monitoring and Documentation of Forest Management Activities

Our monitoring results allow assessment and adaptive management for the following objectives:

- Implement treatments to manage vegetative communities for resilience, including fire-related disturbances
- Protect habitat for federally listed threatened and endangered species
- Minimize soil erosion and offsite sediment transport
- Assess effectiveness of fuel treatments
- Increase forest resilience to drought and fire (in other words, achieve more water availability to individual trees and shrubs by establishing lower tree densities, increased water infiltration, and slower water runoff)
- Establish a mosaic forest structure in both space and time (for example, treatments will be implemented over several years, with spatial gaps between heavily treated areas)
- Increase adequate forest gaps and openings to increase available light to and diversity of understory herbaceous vegetation
- Stop the spread of invasive plant species, including Siberian elm (*Ulmus pumila*), Russian olive, common teasel (*Dipsacus fullonum*), and invasive thistles (*Cirsium spp.*)
- Preserve the oldest ponderosa and piñon pine individuals for their genetic and habitat importance
- Limit the spread of damaging insects
- Improve riparian ecosystem function (for example, increase cover of native riparian vegetation and reduce channel downcutting, thereby improving access of water to floodplain)

Rendija Canyon Thinning Project

In 2024, thinning treatments were implemented on 167 acres in Rendija Canyon. This project had the primary objective of decreasing the risk of catastrophic wildfire by implementing fuel breaks and open space treatment standards to provide defensible space to the adjacent Los Alamos community and managing existing vegetation to be more drought resistant and productive. We collected pre-treatment and post-treatment data from 47 plots in the Rendija Canyon open space thinning project area Figure 7-17). We collected data regarding stand density and structure, understory vegetation, and fuel loading.

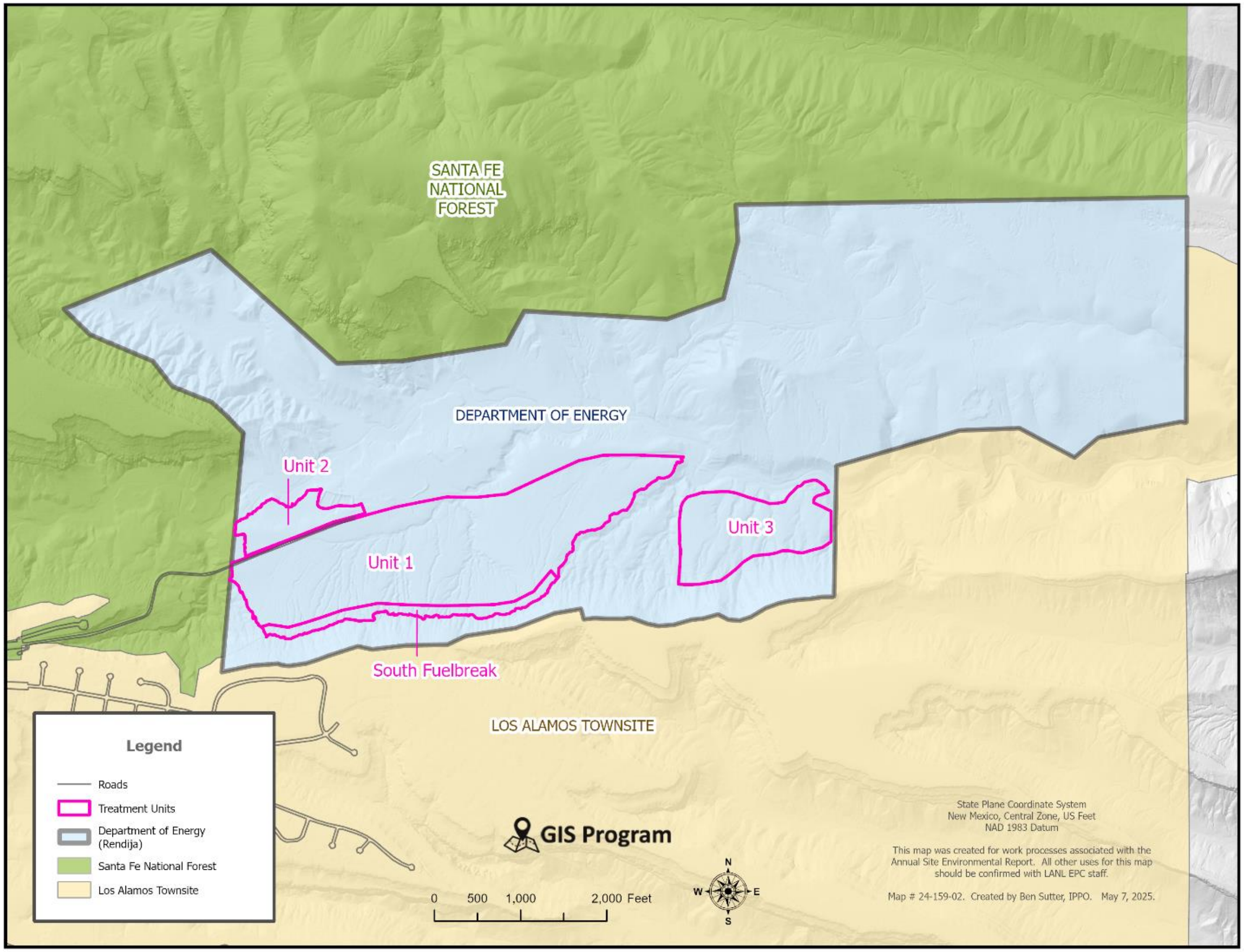

Figure 7-17. Forest Treatment Units for the Rendija Canyon thinning project. Treatment Units 1 and 2 are separated by Rendija Canyon Road. Treatment Unit 3 is further east on the south side of the Rendija Canyon Road. The South Fuelbreak is near the Los Alamos County Barranca Mesa Community.

Basal area per acre (the sum of the cross-sectional area of tree trunks at 4.5 feet high) and the number of trees per acre are two common ways to describe the density of a stand of trees. Using a wedge prism tool, we quickly estimate basal area for planning and evaluation during treatment. Our long-term monitoring plots collect data on both basal area and trees per acre before and after thinning. These data are presented in Table 7-10.

There were 37 monitoring plots randomly located across the 167-acre treatment area, averaging about 1 plot per 4.5 acres. The thinning treatment resulted in post-treatment mature tree (diameter at breast height greater than 12 inches) densities between 8 and 51 trees per acre, matching pre-European settlement ponderosa pine densities (Allen et al. 2002) and average total tree densities near or higher than the 10 and 125 trees per acre average target in the LANL Wildland Fire Mitigation and Forest Health Plan standards (LANL 2019b; Table 7-10). Some parts of treatment units were not thinned because of steep slopes that limited the use of equipment or to retain tree species diversity, resulting in higher average trees per acre in those units.

Table 7-10. Rendija Canyon Open Space Thinning Project Tree Statistics

Treatment Unit	Acres	Average Basal Area (square feet) per Acre		Average Mature Trees per Acre		Average Total Trees per Acre	
		Pre-Treatment[a]	Post-Treatment[b]	Pre-Treatment	Post-Treatment	Pre-Treatment	Post-Treatment
1	114	87	63	32	26	299	137
2	11	110	75	41	29	259	116
3	32	70	58	33	26	289	148
South Fuelbreak	10	122	64	31	21	334	106
Total	167	90	63	33	26	300	134

[a] Pre-treatment: summary of plot data collected before the thinning treatment.
[b] Post-treatment: summary of plot data for trees remaining after the thinning treatment.

Overall, most of the monitoring plots had a final basal area within the desired range of 40–70 square feet per acre (Table 7-10 and Figure 7-18). The frequency of mature trees per acre pre- and post-treatment indicates that not many mature trees were removed (Figure 7-19). Frequency of total trees per acre for pre- and post-treatment shows that primarily smaller trees (diameter at breast height less than 10 inches) were removed (Figure 7-20).

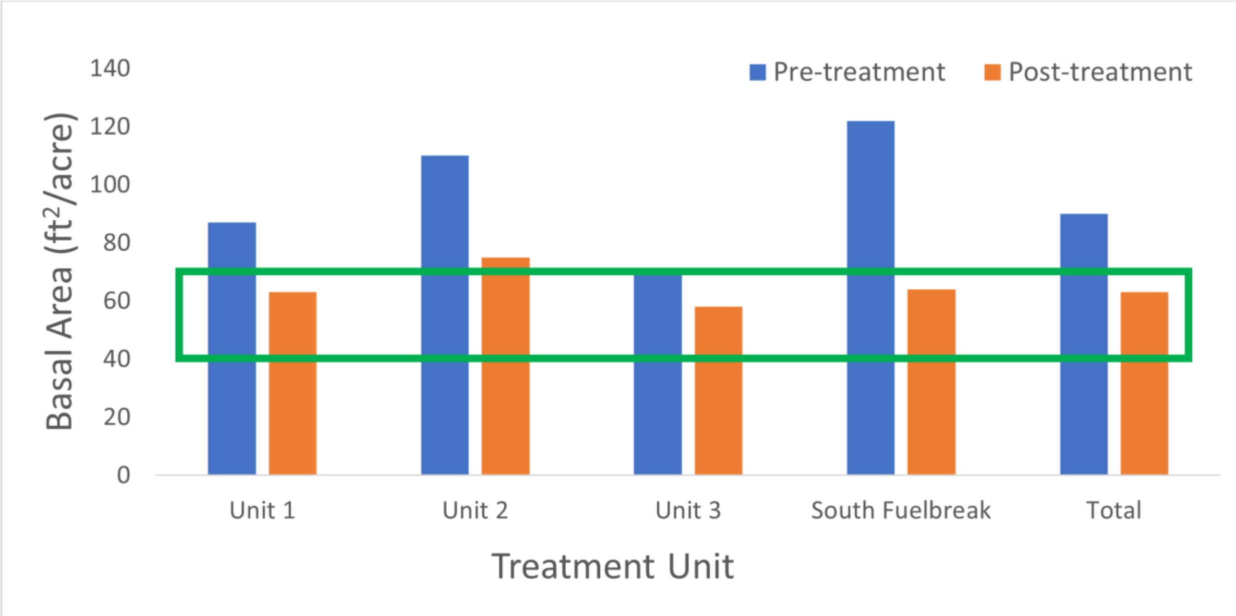

Figure 7-18. Basal area (square feet per acre) for each Forest Monitoring Unit, presented for pre- and post-treatment. The green box indicates the desired basal area (40 to 70 square feet per acre) according to the LANL Wildland Fire Mitigation and Forest Health Plan standards. Note: ft^2 = square foot.

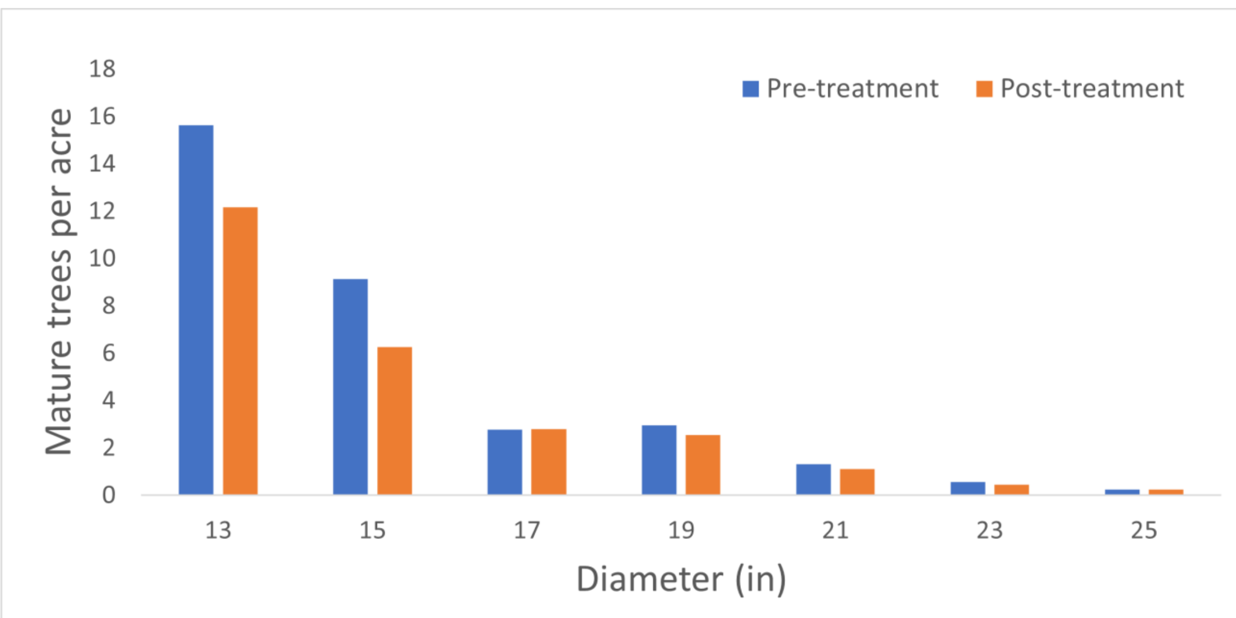

Figure 7-19. Mature trees (trees with a diameter greater than 12 inches) per acre counts pre- and post-treatment by 2-inch diameter class, combining all units. Note: in = inches.

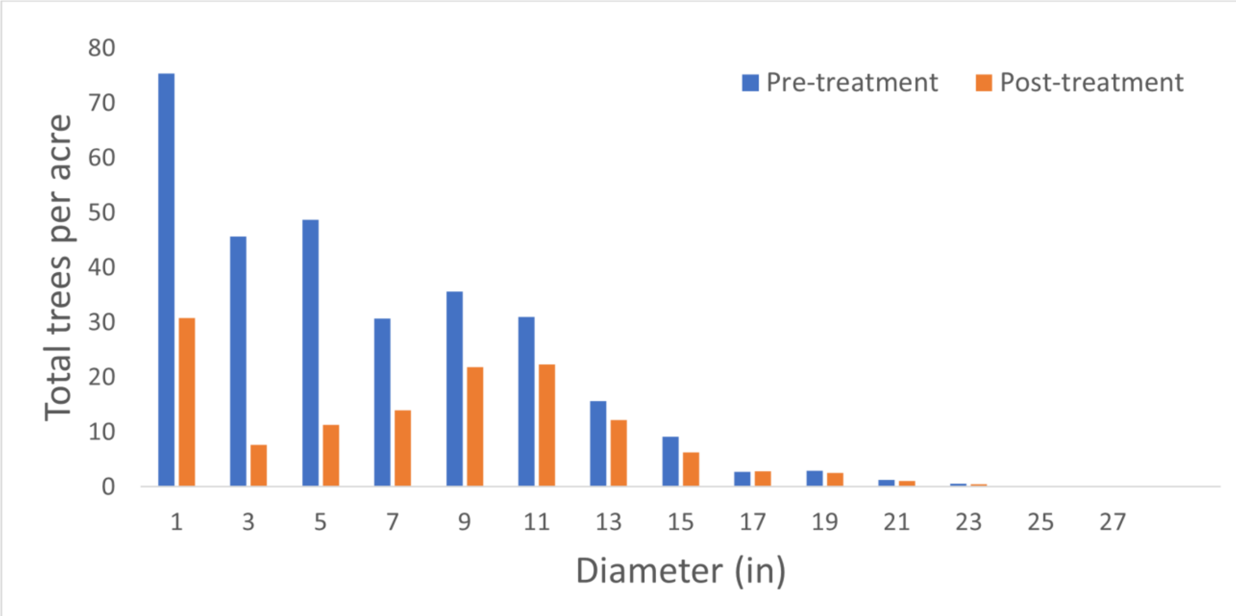

Figure 7-20. Total trees per acre counts pre- and post-treatment by 2-inch diameter class, combining all units. Smaller trees were primarily removed in the forest thinning treatment. Note: in = inches.

Invasive Species Management

We prepared an Invasive Species Management Plan in 2022. In support of this plan, we conducted two large projects to treat invasive species in 2024. Staff from the Environmental Stewardship group worked with grounds maintenance staff to cut and treat 16 Russian olive and Siberian elm trees in five areas near Technical Area 03. We cut the trees and injected herbicide into holes drilled into the live outer portion of the stumps to prevent resprouting. Additionally, several previously cut and re-sprouting trees were re-treated with herbicide, which controlled some but not all re-sprouting.

To limit the spread of an invasive teasel plant in Los Alamos Canyon, a collaborative effort successfully removed and disposed of teasel seedheads from a 2.5-mile reach of the bottom of Los Alamos Canyon, with most plants concentrated in a reach that was less than 1 mile long. To monitor the spread of this plant, we mapped the location of plants with brown seedheads (previous year's growth), current year flowering plants, and current year rosettes that would have produced seeds next year.

Quality Assurance

The Soil, Foodstuffs, and Biota Program collects samples according to written standard quality assurance and quality control procedures and protocols. These procedures and protocols are identified in our implementation of the Soil, Foodstuffs, and Biota Program, Quality Assurance Project Plan (EPC-ES-QAP-001) and in the following procedures:

- EPC-ES-GUIDE-015, "General PFAS Sampling Guidance for the Soil, Foodstuffs, and Biota Program"

- EPC-ES-TP-003, “Soil and Vegetation Sampling for the Environmental Surveillance Program”
- EPC-ES-TP-004, “Foodstuffs Sampling”
- EPC-ES-TP-005, “Fish Sampling”
- EPC-ES-TP-006, “Soil and Vegetation Sampling at Facility Sites”
- EPC-ES-TP-007, “Roadkill Sampling”
- EPC-ES-TP-008, “Crayfish Sampling”
- EPC-ES-TP-013, “Benthic Macroinvertebrate Sampling”
- EPC-ES-TP-017, “Soil Sampling for Land Transfer and Conveyance and Other Special Projects”
- EPC-ES-TP-035, “Sediment Sampling in Reservoirs and Rivers”
- EPC-ES-TP-201, “Live Trapping of Small Mammals”
- EPC-ES-TP-219, “Managing and Sampling Honeybee Hives”
- EPC-ES-TP-516, “Sample Preparation for Stable Isotope Analysis”
- EPC-ES-TP-518, “Operation, Towing, and Maintenance of Sun Tracker Pontoon Boat”

The Soil, Foodstuffs, and Biota Program collects biological samples under approved New Mexico Game and Fish Scientific Collection Permits as well as approved Institutional Animal Care and Use Committee protocols.

These procedures ensure that the collection, processing, and chemical analysis of samples; the validation and verification of data; and the tabulation of analytical results are conducted in a consistent manner from year to year. Locations and samples have unique identifiers to provide chain-of-custody control from the time of collection through analysis and reporting.

The Health Physics Program calculates dose to nonhuman biota according to a written quality control procedure: EPC-ES-TP-001, “Calculating Dose to Nonhuman Biota.”

In addition, procedures and protocols for biota dose assessment can be found in EPC-ES-TPP-002, “Technical Project Plan for Biota Dose Assessment.”

The Biological Resources Program collects field data and conducts compliance reviews according to the following written technical procedures:

- EPC-ES-AP-014, “Institutional Animal Care and Use Committee Operations”
- EPC-ES-TP-214, “Project Reviews for Biological Resources”
- EPC-ES-TP-203, “Threatened and Endangered Species Surveys”
- EPC-ES-TP-205, “Avian Monitoring”
- EPC-ES-TP-014, “Herpetological Monitoring”
- EPC-ES-TP-201, “Live Trapping of Small Mammals”

In addition to these procedures, some parts of our work require the following federal and state permits. These permits are individual permits and not institutional. Personnel who work as wildlife biologists must have the training and background to be able to obtain such permits.

Surveys for federally listed species follow specific protocols set forth by the U.S. Fish and Wildlife Service and training to these protocols is a prerequisite to obtaining a permit.

- Federal bird-banding permits issued by the U.S. Geological Survey's bird-banding laboratory
- Federal recovery permits to survey or handle federally listed species issued by the U.S. Fish and Wildlife Service
- State permits for scientific research issued by the New Mexico Department of Game and Fish
- Surveys for federally listed species follow specific protocols set forth by the U.S. Fish and Wildlife Service, and training to these protocols is a prerequisite to obtaining a permit

The Forest Health Program collects and quality checks monitoring data using the following procedure: EPC-TP-01-2022, "Monitoring and Documentation of Forest Management Activities for Los Alamos National Laboratory."

Field Sampling Quality Assurance

Overall, the quality of field sampling is maintained through the rigorous use of carefully documented procedures (listed in Quality Assurance in this chapter) that govern all aspects of the sample collection program.

We collect samples under full chain-of-custody procedures to minimize the chance of data transcription errors. Once collected, we hand deliver the samples to the Sample Management Office, where staff ship the samples by express mail directly to an external analytical laboratory under full chain-of-custody control. Sample Management Office personnel track all samples. Upon receipt of data from the analytical laboratory, staff assess the completeness of the field sample process and other variables. They create a quality assessment and provide it in the data package. Field data completeness for sample collection in 2024 was 100 percent.

Water and equipment blanks are commonly used within analytical studies to determine whether contamination has been inadvertently introduced into a sample set. In our investigation, we used water and equipment blanks to determine whether PFAS contamination was introduced into field samples through carryover from potentially contaminated equipment, experimental procedures, or atmospheric conditions. We typically collect water blanks for PFAS detection during each sampling event. In 2024, we collected 32 water blanks for PFAS, including background samples. We collected PFAS-free water blanks alongside environmental samples, including at the Dual Axis Radiographic Hydrodynamic Test facility at Technical Area 15, the Los Alamos Canyon weir, roadkill samples, and soil and vegetation sampling events.

One PFAS-free water blank sample contained detectable PFAS concentrations. Perfluorobutane-sulfonic acid was detected at 11 nanograms per liter in a water blank from a roadkill sampling event collected at a background location. However, perfluorobutanesulfonic acid was not detected in any of the tissue samples associated with this sampling event. Contamination within the water blanks for this sample could have been the result of atmospheric contamination or dust associated with this location that would not have been found within the roadkill sample.

No PFAS compounds were detected in any of the water blank samples collected from the Dual Axis Radiographic Hydrodynamic Test facility, the Los Alamos Canyon weir, or soil and vegetation sampling events.

Analytical Laboratory Quality Assessment

Uranium-235

We have seen significant differences in uranium-235 results obtained from analytical laboratories; therefore, we are not using uranium-235 results from different laboratories for comparisons or calculations. Specifically, Australian Laboratory Services (ALS) in Fort Collins, Colorado, was used for radionuclide analyses until they ceased operations in 2022, after which we began using GEL in Charleston, South Carolina. The differences between the laboratories include apparent differences in detection limits for uranium-235 (the levels at which they reported detecting uranium-235 in environmental media). The values reported for non-detected results by GEL are frequently higher than the values that were reported for detected results by ALS (refer to "What does it mean if a chemical is not detected?"), which makes statistical tests using results from both laboratories unreliable.

Information regarding the type of uranium (enriched, depleted, or natural) found can be obtained more reliably using uranium-234 and uranium-238 results instead of uranium-235. Measurements of uranium-234 and uranium-238 using alpha spectroscopy are much more accurate than those of uranium-235 because uranium-234 and uranium-238 spectra have well defined peaks. In contrast, the uranium-235 peak is broad and sparse, extending from 4.1 to 4.6 megaelectronvolts, overlapping with uranium-238 at the low-energy end and with uranium-234 at the high-energy end. Alpha-spectrometry technicians define a region of interest that includes uranium-235 and excludes the other isotopes, but there are differences across analytical laboratories despite certification by the DOE Consolidated Audit Program (refer to Chapter 3 for more information on the DOE Consolidated Audit Program). This result introduces biases that affect the comparison of data from different analytical laboratories.

As a technical note, in alpha spectroscopy (method HASL-300), uranium-235 and uranium-236 peaks are not distinguishable, so alpha spectroscopy reports as sum of uranium-235 and uranium-236 (noted as uranium-235/236). However, the abundance of uranium-236 in the natural environmental samples is negligible (on the order of 10^{-10}). It is safe to assume that, in alpha spectroscopy, only uranium-235 is measured.

PFAS

In 2024, the PFAS analytical method changed from U.S. Environmental Protection Agency Method 537 to U.S. Environmental Protection Agency Method 1633. Method 1633 was approved for PFAS analysis in aqueous, solids, biosolids, and tissue samples, which is most appropriate for the soil, plant, and animal samples we collected in 2024. In comparison, Method 537 was developed for drinking water and modified by analytical laboratories for non-water samples.

Some PFAS results were rejected under the 1633 Method, which inherently uses more internal standards than the 537 Method. Sample preparation processes and sample matrix interference also contribute to rejected data under the 1633 Method.

In general, when biological samples were analyzed by the 1633 Method, fewer overall PFAS compounds were detected. Reported non-detect values, particularly in plants, were generally higher using Method 1633 than using Method 537. Therefore, the PFAS analytical method was considered when comparing concentrations among locations and when calculating the regional statistical reference levels.

In 2024, using the quality assurance process for analytical data described in Chapter 3, 40 individual PFAS results of 1,404 total results were rejected from 2 plant samples (out of 36 plant samples), and PFOS results were rejected from two great-horned owl liver samples.

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Chapter 8: Public Dose and Risk Assessment

Introduction

In this chapter, we assess the dose and risk from radiological and chemical releases to ensure that the public is protected and to demonstrate compliance with federal regulations and U.S. Department of Energy (DOE) orders. The data are analyzed using standard methods and models to calculate potential effects of exposures for the public. These methods do not include Tribal-specific exposure scenarios. The results are compared with regulatory limits and international standards based on current knowledge of biological effects caused by radiation.

Overview of Radiological Dose

Radiological dose is the primary measure of harm from radiation. We calculate doses using standard DOE and U.S. Environmental Protection Agency methods (DOE 2022, DOE 2025, U.S. Environmental Protection Agency 2020). In this chapter, we assess doses to the public. Doses to plants and animals are assessed in Chapter 7.

DOE regulations limit the total annual dose to any member of the public from site operations to 100 millirem. Furthermore, doses must be as low as reasonably achievable (LANL 2023). The annual dose received by any member of the public from airborne emissions of radionuclides is limited to 10 millirem by the National Emission Standards for Emissions of Radionuclides Other Than Radon From Department of Energy Facilities, Title 40, Part 61, Subpart H, of the Code of Federal Regulations. The annual dose from community drinking water supplies is limited under the Safe Drinking Water Act to 4 millirem (National Primary Drinking Water Regulations, Title 40, Part 141 of the Code of Federal Regulations).

To provide context for these limits, the dose from natural background and from medical and dental procedures is about 800 millirem per year. Doses from site operations to members of the public are typically less than 1 millirem per year. The Los Alamos County background dose is discussed briefly in Dose from Naturally Occurring Radiation later in this chapter and in detail in Gillis et al. (2014).

Exposure Pathways

Potential doses to the public from radionuclides associated with site operations are calculated by evaluating all exposure pathways. DOE Order 458.1, Radiation Protection of the Public and the Environment, lists the "likely exposure pathways" as follows:

1. Direct external radiation from sources located on site, evaluated by the direct penetrating radiation monitoring network described in Chapter 4.
2. External radiation from airborne radioactive material, evaluated using data from the ambient air and stack emission monitoring programs described in Chapter 4.
3. External radiation from radioactive material deposited on surfaces off-site, evaluated using the RESRAD program (https://resrad.evs.anl.gov/).
4. Internal radiation from inhaled airborne radioactive material, evaluated using data from the ambient air and stack emission monitoring programs described in Chapter 4.

5. Internal radiation from ingested radioactive material is evaluated using data from the Soil, Foodstuffs, and Biota program reported in Chapters 7 and 8.

Direct Penetrating Radiation

We monitor direct penetrating radiation, such as gamma rays and neutrons, at 73 locations in and around the Laboratory site (Chapter 4). Direct penetrating radiation from Laboratory sources contributes to a measurable dose only within about 1 kilometer of the source. At distances of more than 1 kilometer, dispersion, scattering, and absorption of photons and neutrons decrease the dose to less than 0.1 millirem per year. Direct penetrating radiation that can be measured above naturally occurring background radiation occurs on Laboratory property only within Technical Areas 53 and 54, as reported in Chapter 4.

Air Pathways

At distances of more than 1 kilometer, exposure to radioactivity from site operations is mostly the result of airborne radionuclides. We measure airborne radioactivity using the environmental air-sampling network described in Chapter 4 under Ambient Air Sampling for Radionuclides. We also measure the emissions at the stacks as reported in Chapter 4 under Exhaust-Stack Sampling for Radionuclides. We use a standard computer modeling program called the Clean Air Act Assessment Package 1988, PC Version 4.1 (CAP88) (https://www.epa.gov/radiation/cap88-pc; U.S. Environmental Protection Agency 2013, 2020) to calculate the airborne radioactivity levels and the resulting doses to the public. CAP88 calculates the internal dose from inhalation of materials such as plutonium, as well as the external dose from airborne gamma-ray emitters such as carbon-11 (McNaughton et al. 2017a,b).

Ingestion

Exposure through ingestion occurs when people consume liquids and food that contain radionuclides. The ingestion pathway includes drinking local water or beverages prepared with local water, eating locally grown food, and eating meat from either domesticated or hunted animals that eat local vegetation or drink local water that contains radionuclides. Radioactivity measurements of groundwater are reported in Chapter 5; measurements of surface water and sediment are reported in Chapter 6; and measurements of soil, plants, and animals are reported in Chapter 7. Foodstuffs are formally sampled once every 3 years, and when they are sampled, the results are reported in this chapter.

Dose from Naturally Occurring Radiation

In Los Alamos County, naturally occurring sources of radioactivity include

- cosmic rays;
- direct penetrating radiation from the Earth due to radioactive elements in minerals, rocks, and soils;
- radon gas; and
- radioactive elements that occur naturally inside the human body, such as potassium-40.

Annual doses from cosmic radiation range from 50 millirem per year at lower elevations near the Rio Grande to about 90 millirem per year in the higher elevations in mountains west of Los Alamos (Bouville and Lowder 1988, Gillis et al. 2014). Annual background doses from external, direct penetrating radiation from the Earth (from sources such as naturally occurring uranium and thorium and their decay products) range from about 50 millirem to 150 millirem (DOE 2012).

The inhalation of radon gas and its decay products constitutes a large proportion of the annual dose for members of the public. Nationwide, the average annual dose from radon is 200 to 300 millirem (National Council on Radiation Protection 1987). In Los Alamos County, the average residential radon concentration results in an annual dose of about 300 millirem (Whicker 2009). An additional 30 millirem per year results from naturally occurring radioactive materials in the body, such as potassium-40, which is present in all food and living cells.

Dose from Manufactured Products

Manufactured products that contain or use radiation also contribute to the total average annual background dose (Gillis et al. 2014). Members of the U.S. population receive an average annual dose of 300 millirem from medical and dental uses of radiation (National Council on Radiation Protection 2009). Another 10 millirem per year comes from building materials such as stone or adobe walls.

Average Annual Background Dose

In total, the average annual dose from sources other than site operations is about 800 millirem for a typical Los Alamos County resident. Figure 8-1 compares the average radiation background in Los Alamos County with the average background dose in the United States. Generally, any dose from site operations of less than 0.1 millirem per year cannot be distinguished from the dose generated by background levels of radiation.

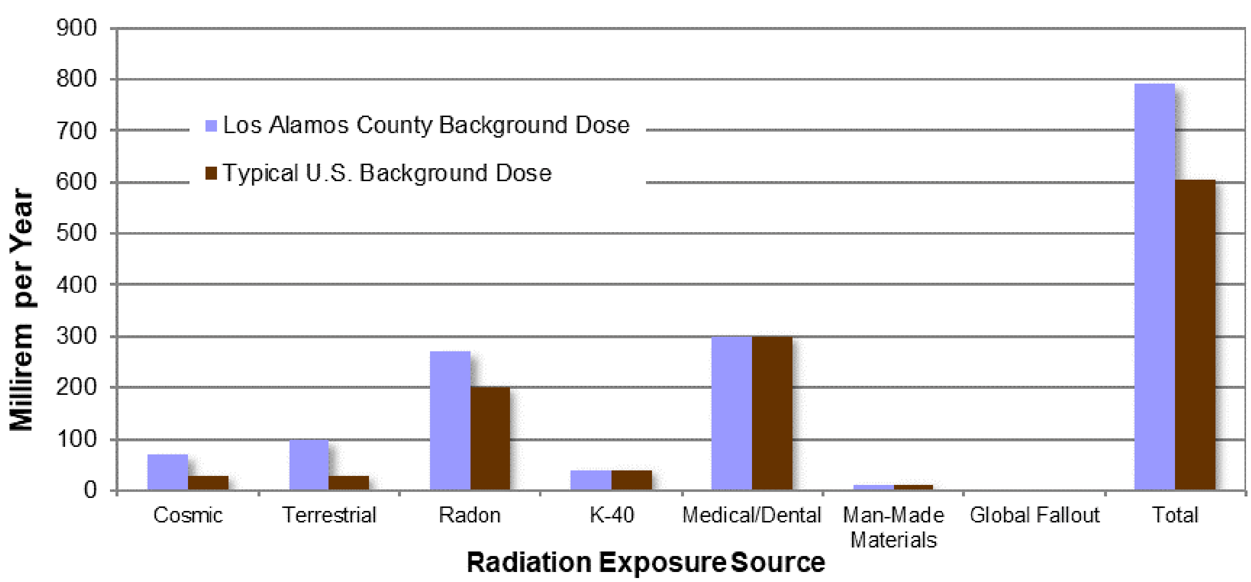

Figure 8-1. The average Los Alamos County radiation background dose compared with average U.S. radiation background dose (Gillis et al. 2014). Note: K-40 = Potassium-40.

Individual Pathway Dose Calculations

Dose from Direct Penetrating Radiation

Results from the direct penetrating radiation monitoring network are described in Chapter 4 and discussed in Maximally Exposed Individual Onsite Dose later in this chapter.

Dose from Air Pathways

The CAP88 model is used to estimate inhalation and external radiation doses considering meteorological data, such as humidity, temperatures, and wind direction and speed, along with the monitoring data from stack emissions and the environmental air-monitoring network. This air-pathway dose assessment is described in detail in the Annual Radionuclide Air Emissions Report (Fuehne and Lattin 2025). The calculated maximum potential dose to a member of the public from air pathways in 2024 was 0.78 millirem and is discussed further in Maximally Exposed Individual Offsite Dose later in this chapter.

Dose from Foodstuffs

Methods and Analyses

The Soil, Foodstuffs, and Biota Program monitors constituents in a wide variety of foodstuffs to determine if past or current site operations are affecting human health through the food chain. We collect foodstuffs from locations on the site, from communities surrounding the site (perimeter locations), from areas downstream of the site that are irrigated with Rio Grande water, and from background locations that are more than 15 kilometers (9.3 miles) from the Laboratory boundaries and represent worldwide fallout or natural levels.

We generally collect foodstuffs samples once every 3 years, most recently in 2022; however, in 2023, we collected additional foodstuffs because of drought and wildfire impacts on sampling in 2022. We also collect deer and elk samples on an annual basis, primarily as roadkill or hunter donations. Results from deer and elk samples are reported in Chapter 7. DOE Standard 1196 (DOE 2022) is used to calculate the dose from eating locally grown food.

Results for Foodstuffs

Overall, the data for foodstuffs demonstrate that the individual dose from eating local or regional foodstuffs—including crops, eggs, milk, tea, deer, and elk—is less than 0.01 millirem per year. Radionuclide concentrations in publicly available food are consistent with global fallout or naturally occurring material, and any contributions from the site are too small to measure and consistent with zero.

Dose from Water

We report measurements from water in Chapters 5 and 6. Local drinking water contains no measurable radioactivity from current or historical site operations. For further information regarding Los Alamos County drinking water, refer to the Los Alamos Department of Public Utilities 2024 Annual Drinking Water Quality Report (Los Alamos County 2025). The dose pathway from surface water to humans is through foodstuffs, discussed previously in Dose from Foodstuffs.

Dose from Soil

Radioactive materials in soil can contribute to dose by any of the exposure pathways discussed previously. Potential doses are calculated using the RESRAD family of codes, which analyze potential human and biota radiation exposures from residual radioactive materials in the environment (https://resrad.evs.anl.gov/).

In 2024, soil and vegetation samples were collected by the Soil, Foodstuffs, and Biota Program and are reported in Chapter 7. The results are similar to previous years. Radionuclide concentrations are above background in Acid Canyon, though potential doses are less than 0.1 millirem per year (McNaughton et al. 2018).

Extensive soil data are reported in the Intellus database (https://intellusnm.com). The resulting doses in 2024 were less than 0.6 mrem (Fuehne and Lattin 2025).

All-Pathway Radiological Dose Calculations

As required by DOE Order 458.1 Chg 5, Radiation Protection of the Public and the Environment, we calculated doses from the site to the total human population that reside within 80 kilometers (50 miles) of the site and to the hypothetical "maximally exposed individual." The maximally exposed individual represents a person who does not work at the site and who, because of their location and activities, has the potential to receive the largest radiation dose (DOE 2025).

Collective Dose to the Population within 80 Kilometers

The collective population dose from site operations is the sum of the doses for each member of the public within an 80-kilometer radius of the site (DOE 2025). Outside of Los Alamos County, the doses are too small to measure directly, so the collective dose was calculated using CAP88. In 2024, the collective population dose was 0.14 person-rem (Fuehne and Lattin 2025).

Collective population doses for recent years are provided in Figure 8-2. The trend line shows a general decrease, which is the result of improved engineering controls at the Los Alamos Neutron Science Center and tritium facilities.

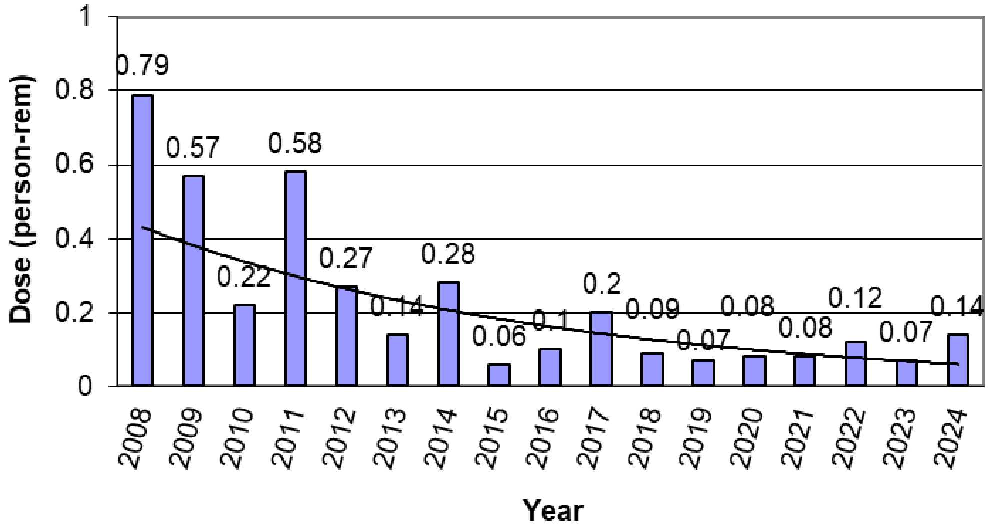

Figure 8-2. Annual collective dose (person-rem) to the population that reside within 80 kilometers of the Laboratory.

Dose to the Maximally Exposed Individual

To identify the location of and total dose to the hypothetical maximally exposed individual, we consider all exposure pathways that could cause a dose and all publicly accessible locations, both within the site boundaries (on site) and outside the boundaries (off site).

Maximally Exposed Individual Offsite Dose

In 2024, the offsite location of the hypothetical maximally exposed individual was on DP Road close to environmental air-monitoring station #317, which is at the east end of the business section of DP Road. The total offsite dose for the maximally exposed individual during 2024 was 0.78 millirem (Fuehne and Lattin 2025).

Contributions to this annual dose were from measurements at the environmental air-monitoring station #317 (0.60 millirem), the potential dose contribution from unmonitored stacks (0.17 millirem), and other stacks (0.01 mrem). As described in the 2024 LANL Radionuclide Air Emissions Report (Fuehne and Lattin 2025), these measurements are based on conservative assumptions.

The annual maximally exposed individual doses are provided in Figure 8-3. The general downward trend is the result of improved engineering controls. As described in previous annual site environmental reports, the 6.46-millirem dose in 2005 resulted from a leak at Technical Area 53, and the 3.53-millirem dose in 2011 was from the remediation of Material Disposal Area B.

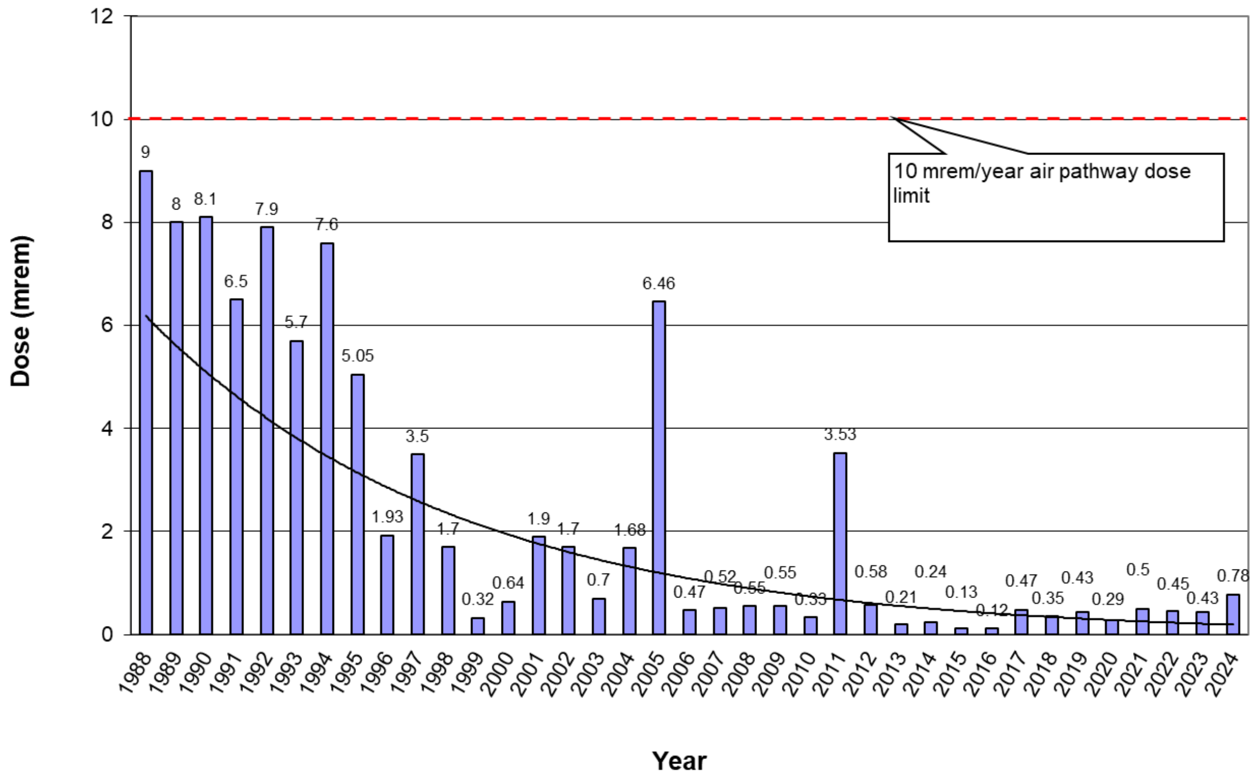

Figure 8-3. Annual maximally exposed individual dose.

Maximally Exposed Individual Onsite Dose

The only publicly accessible onsite location with a measurable dose from site operations is on East Jemez Road near Technical Area 53 (McNaughton et al. 2013). The dose from stack emissions at this location was calculated assuming that a member of the public was on East Jemez Road in the canyon with a plume of airborne emissions that originated from the mesa-top facilities. Calculations using CAP88 and the methods of McNaughton et al. (2017a, 2017b) found that the 2024 maximally exposed individual onsite dose from stack emissions at East Jemez Road—0.0245 millirem—was less than the maximally exposed individual offsite dose at East Gate (Fuehne and Lattin 2025). As reported in Chapter 4 (Monitoring for Gamma and Neutron Direct Penetrating Radiation), at this location in 2024, the neutron dose was 0.3 millirem, and the gamma dose was 0.05 millirem, for a total dose of less than 0.4 millirem. This dose would be received by an individual who stayed at this location 24 hours per day for 365 days per year. However, members of the public—such as joggers, cyclists, or bus drivers—spend no more than 1 hour per week at this location, an occupancy factor of approximately 1/167 (National Council on Radiation Protection 2005). Therefore, after applying the occupancy factor, the dose for a maximally exposed individual on site is less than 0.01 millirem.

As reported in Chapter 4, neutron dose was measured in Cañada del Buey, north of Technical Area 54, Area G, and near the Pueblo de San Ildefonso boundary. Transuranic waste at Area G emits neutrons while awaiting shipment to the Waste Isolation Pilot Plant in Carlsbad, New Mexico. After subtracting background, the measured neutron dose in Cañada del Buey in 2024 was 3 millirem. After applying the standard factor of 1/20 for occasional occupancy (National Council on Radiation Protection 2005), the individual neutron dose in 2024 was 0.15 millirem.

Using the dose conversion factors from DOE Standard 1196 (DOE 2022) and assuming 1/20 occupancy, the inhalation dose in Cañada del Buey from radioactive material at Area G was less than 0.01 millirem. Thus in 2024, the total dose in Cañada del Buey from site operations at Area G was less than 0.2 millirem.

Maximally Exposed Individual Summary

At the location for the maximally exposed individual at DP Road, the direct penetrating radiation and ingestion doses are consistent with zero, so the maximum all-pathway dose for 2024 was the same as the air-pathway dose of 0.78 millirem.

The dose of 0.78 millirem in 2024 is far below the 10 millirem annual air-pathway limit in the National Emission Standards for Emissions of Radionuclides Other Than Radon From Department of Energy Facilities (Title 40, Part 61, Subpart H of the Code of Federal Regulations), and the 100 millirem all-pathway DOE limit (DOE 2025). The dose for the maximally exposed individual is less than 0.1 percent of the average U.S. background radiation dose presented in Figure 8-1.

Radiological Dose Conclusion

The doses to the public from site operations are summarized in Table 8-1. All doses are below the limits stated in regulations and standards.

Table 8-1. LANL Site Radiological Doses for Calendar Year 2024

Pathway	Dose to Max Exposed Individual (millirem per year)	Percentage of DOE 100-millirem-per-year Limit	Estimated Population Dose (person-rem)	Number of People within 80 Kilometers	Estimated Background Population Dose (person-rem)
Air	0.78	0.78%	0.14	NA[a]	NA
Water	<0.1	<0.1%	0	NA	NA
Other pathways (foodstuffs, soil, etc.)	<0.1	<0.1%	0	NA	NA
All pathways	0.78	0.78%	0.14	~365,000	~285,000[b]

[a] NA = Not applicable. Background population dose is not calculated for individual exposure pathways.
[b] Background population dose is equal to the number of people multiplied by the dose per person based on 780 millirem per person, as shown in Figure 8-1.

Nonradiological Materials

This section summarizes the potential human health risk from nonradiological materials released from the site in 2024. Air emissions are reported in Chapters 2 and 4; groundwater is reported in Chapter 5; surface water and sediment are reported in Chapter 6; and soil, plants, and animals are reported in Chapter 7. The results from all chapters are summarized as follows.

Results Summary

Air

The data reported in Chapters 2 and 4 demonstrate that in general, Los Alamos County air quality is good and meets all applicable state and federal air quality standards. Our air emissions of regulated pollutants are below the amounts allowed in LANL's Title V Operating Permit. There are no measurable health effects to the public from site air emissions.

Groundwater

Groundwater data are reported in Chapter 5. Los Alamos County monitors its water supply in compliance with the Safe Drinking Water Act. We analyzed additional samples from Los Alamos County water supply wells in 2024. The drinking water supply meets New Mexico Environment Department and U.S. Environmental Protection Agency drinking water standards (Los Alamos County 2025).

Additional supplemental water sampling was conducted in the City of Santa Fe's Buckman Well Field. No site-related constituents were detected.

Within site boundaries, hexavalent chromium from the site has been detected above the New Mexico groundwater standard (50 micrograms per liter) in the regional aquifer below Mortandad Canyon. As described in Chapter 5, we have implemented an interim measure to control migration of this chromium plume.

Los Alamos County drinking water contains 5 micrograms per liter of naturally occurring chromium unrelated to the site (Los Alamos County 2025).

Surface Water and Sediment

The concentrations of chemicals in surface water and sediment are reported in Chapter 6. The sediment data demonstrate that the movement and addition of sediment from repeated flood events results in lower concentrations of site-related constituents in newer sediment deposits. The data also show that the human health risk assessments in the canyons' investigation reports (Chapter 6) represent an upper bound of potential risks. Human exposure scenarios were discussed in the investigation reports. The conclusions in the investigation reports—that there were no human health risks—remain accurate because the constituent concentrations are decreasing with time.

In Chapter 6, we compared unfiltered storm water concentrations with drinking water standards as screening levels; however, storm water is not a drinking water source and therefore is not a significant pathway to human exposure. The plant and animal measurements reported in Chapter 7 confirm no significant uptake into the food chain.

Chapter 6 presents data for polychlorinated biphenyls (PCBs) in Pajarito Plateau surface water, which could be used by hunted wild animals such as deer and elk. The data reported in Chapter 7 show that the concentrations of PCBs in deer and elk are far below the human health screening values and are not associated with adverse human-health effects.

The only aquatic animals that could be influenced by surface water runoff from the site and that are eaten by people are found in the Rio Grande and in the Cochiti Reservoir. In the Rio Grande, PCB concentrations in aquatic animals are similar upstream and downstream of the site. No data exist that support a site contribution to the PCBs found within aquatic animals of the Rio Grande.

We conclude that there is no measurable risk to the public from exposure to surface water and sediment that results from either current or previous site operations.

Conclusion

The environmental data collected in 2024 show that no measurable risk to the public currently exists from site-related activities. The public doses and risks from LANL site operations are smaller than regulatory limits and naturally occurring background levels.

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Appendix A: Standards and Screening Levels for Radionuclides and Other Chemicals in Environmental Samples

General Formation of a Standard or Screening Level

A standard is a reference value designed to protect a target group from a harmful level of exposure to a chemical. It may be used as a regulatory limit. Regulatory agencies, such as the U.S. Environmental Protection Agency, typically define standards.

In developing standards, agencies consider

- pathways of exposure to target groups,
- exposure scenarios, and
- the length of time target groups are exposed.

A target group could refer to, for example, the general public, animals, or a sensitive population such as children. Possible pathways of exposure include inhalation of air or ingestion of water, soil, animals, or plants. Exposure scenarios describe the activities of a target group at a site that influence both the likelihood and length of exposures. Examples of exposure scenarios include resident (someone living on a site) and worker (someone disturbing soil during construction activities at a site).

A screening level is a chemical concentration that, when exceeded in a sample, indicates that the sampled location might warrant further investigation or action. Screening levels can be calculated by a regulatory agency or by another party.

Throughout this annual site environmental report, levels of radioactive and chemical constituents in air, water, soil, and sediment samples are compared with standards or other guidance established by regulations of federal and state agencies. For environmental samples and chemicals that do not have standards or guidance, levels are compared with screening levels.

DOE Radiation Dose Limits

DOE Order 458.1 Chg 4, Radiation Protection of the Public and the Environment, describes radiation protection standards for the public, referred to as public dose limits (Table A-1). DOE's public dose limits apply to the effective dose that a member of the public receives from DOE operations. For all exposure pathways combined, the total limit is 100 millirem per year.

Table A-1. DOE Public Dose Limits for External and Internal Exposures

Exposure Pathway	Dose Equivalent at Point of Maximum Probable Exposure
All pathways	100 millirem per year
Air pathway only[a]	10 millirem per year
Drinking water	4 millirem per year

[a] Defined by U.S. Environmental Protection Agency's regulations issued under the Clean Air Act (Code of Federal Regulations Title 40, Part 61, Subpart H)

For water, radionuclide levels are compared with DOE's derived concentration standards (DOE 2021; Table A-2) to evaluate the potential for impacts to members of the public. The derived concentration standards for water (in picocuries per liter) are the concentrations that would result in a dose of 100 millirem per year if a *reference person* (as defined in the standard) consumed the water.

Table A-2. DOE-Derived Concentration Standards for Radionuclide Levels in Water

Nuclide	Derived Concentration Standard for Water (picocuries per liter)
Hydrogen-3	2,600,000
Beryllium-7	2,500,000
Strontium-89	39,000
Strontium-90	1,700
Cesium-137	4,100
Uranium-234	1,200
Uranium-235	1,300
Uranium-238	1,400
Plutonium-238	430
Plutonium-239	400
Plutonium-240	400
Americium-241	740

The DOE has also defined biota dose limits that apply to populations of animals and plants. For details, refer to DOE Standard 1153 (DOE 2019).

Clean Air Act Radiation Dose Limits for DOE Facilities

In addition to the DOE standards for air emissions, in 1985 and 1989, the U.S. Environmental Protection Agency established the "National Emission Standards for Emissions of Radionuclides Other Than Radon From Department of Energy Facilities," in Title 40, Part 61, Subpart H, of the Code of Federal Regulations. This Clean Air Act regulation states that emissions of radionuclides to the ambient air from DOE facilities "shall not exceed those amounts that would cause any member of the public to receive in any year an effective dose equivalent of 10 millirem per year." DOE has adopted this amount as a dose limit (Table A-1). The regulation requires monitoring of all release points that can produce a dose of 0.1 millirem per year to a member of the public.

National Pollutant Discharge Elimination System Permits

The types of monitoring required under the National Pollutant Discharge Elimination System and the limits established for sanitary and industrial outfalls can be found at http://water.epa.gov/polwaste/npdes.

Drinking Water Standards

For chemical constituents in drinking water, the U.S. Environmental Protection Agency issued regulations and standards under the federal Safe Drinking Water Act, which the New Mexico Environment Department adopted.

Appendix A: Standards and Screening Levels for Radionuclides and Other Chemicals in Environmental Samples

Radioactivity in drinking water is regulated by U.S. Environmental Protection Agency regulations contained in Title 40, Part 141, of the Code of Federal Regulations and by the New Mexico Drinking Water Regulations, Sections 206 and 207. These regulations stipulate that combined radium-226 and radium-228 activity in drinking water may not exceed 5 picocuries per liter. Gross-alpha activity (including radium-226 but excluding radon and uranium) may not exceed 15 picocuries per liter.

For manufactured beta- and photon-emitting radionuclides, U.S. Environmental Protection Agency drinking water standards are limited to levels that would result in doses that do not exceed 4 millirem per year.

Surface Water Standards

Levels of radionuclides in surface water samples may be compared with either the DOE-derived concentration standards (DOE 2021) or the New Mexico Water Quality Control Commission stream standards. The concentrations of nonradioactive constituents can be compared with the New Mexico Water Quality Control Commission stream standards, which are available at https://www.env.nm.gov/surface-water-quality/wqs/. The New Mexico Water Quality Control Commission groundwater standards can also be applied in cases where discharges could affect groundwater.

Soils and Sediment Screening Levels

If chemical or radionuclide levels in soil exceed regional statistical reference levels (regional background levels), the levels are then compared with screening levels. The human health screening levels for soil from publicly accessible locations are the levels that would produce (1) a dose of 15 millirem or greater to an individual for radionuclides, (2) an estimated excess cancer risk of 1×10^{-5} for cancer-causing chemicals, or (3) a hazard quotient greater than 1 for hazardous chemicals that do not cause cancer. The screening levels differ for different exposure scenarios. Soil and sediment screening levels are used mostly in evaluating sites for remediation. Screening levels for radionuclides are found in a Laboratory document (LANL 2015); screening levels for nonradionuclides are found in a New Mexico Environment Department document (NMED 2021).

Foodstuffs Standards and Screening Levels

Federal standards exist for radionuclides and selected nonradionuclides (for example, mercury and polychlorinated biphenyls [PCBs]) in foodstuffs. The Laboratory has established screening levels for radionuclides. If levels in foodstuffs exceed regional statistical reference levels, they are then compared with screening levels and existing standards. The Laboratory has established a screening level of 1 millirem per year for activities of individual radionuclides in individual foodstuffs (for example, fish and crops), assuming a residential scenario. The U.S. Environmental Protection Agency has established screening levels for mercury and PCBs in fish (EPA 2018).

Biota Standards and Screening Levels

If radionuclide or chemical levels in biota (wild animals and plants) exceed regional statistical reference levels, the levels are then compared with screening levels. For radionuclides in biota, the Laboratory sets screening levels at 0.1 rad per day for terrestrial plants and aquatic biota and 0.01 rad per day for terrestrial animals, which is 10 percent of the DOE standard (DOE 2019). If a chemical in biota tissue exceeds the regional statistical reference level, detected concentrations in the tissue are compared with the lowest observed adverse effect levels reported in published literature, if available, and concentrations in the soil at the place of collection are compared with ecological screening levels (LANL 2020).

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Appendix B: Units of Measurement

Throughout the annual site environmental report, the U.S. customary (English) system of measurement has generally been used. For units of radiation activity, exposure, and dose, U.S. customary units (curie, roentgen, rad, and rem) are retained as the primary measurement because current standards are written in terms of these units. The equivalent units from the International System of Units are the becquerel, coulomb per kilogram, gray, and sievert, respectively. Table B-1 presents factors for converting U.S. customary units into units from the International System of Units (metric).

Table B-1. Approximate Conversion Factors for Selected U.S. Customary Units

Multiply U.S. Customary (English) Unit	by	to Obtain International System of Units (Metric) Unit
degrees Fahrenheit	5/9 (first subtract 32)	degrees Celsius
inches	2.54	centimeters
cubic feet	0.028	cubic meters
acres	0.4047	hectares
ounces	28.3	grams
pounds	0.453	kilograms
miles	1.61	kilometers
gallons	3.785	liters
feet	0.305	meters
parts per million	1	micrograms per gram
parts per million	1	milligrams per liter
square miles	2.59	square kilometers
picocuries	37	millibecquerel
rad	0.01	gray
millirem	0.01	millisievert

Table B-2 presents prefixes used in this report to define fractions or multiples of the base units of measurements. Scientific notation is used in this report to express very large or very small numbers. Translating from scientific notation to a more traditional number requires moving the decimal point either left or right from the number. If the value given is 2.0×10^3, the decimal point should be moved three numbers (insert zeros if no numbers are given) to the right of its present location. The number would then read 2,000. If the value given is 2.0×10^{-5}, the decimal point should be moved five numbers to the left of its present location. The result would be 0.00002.

Table B-2. Prefixes Used with International System of Units (Metric) Units

Prefix	Factor	Symbol
mega	1,000,000 or 10^{6}	M
kilo	1000 or 10^{3}	k
centi	0.01 or 10^{-2}	c
milli	0.001 or 10^{-3}	m
micro	0.000001 or 10^{-6}	µ
nano	0.000000001 or 10^{-9}	n
pico	0.000000000001 or 10^{-12}	p
femto	0.000000000000001 or 10^{-15}	f
atto	0.000000000000000001 or 10^{-18}	a

Data Handling of Radiochemical Samples

Measurements of radioactivity in samples require that analytical or instrumental backgrounds be subtracted to obtain net values. Thus, net values are sometimes obtained that are lower than the minimum detection limit of the analytical technique, and results for individual measurements can be negative numbers. Although a negative value does not represent a physical reality, a valid long-term average of many measurements can be obtained only if the very small and negative values are included in the population calculations (Gilbert 1975).

For individual measurements, uncertainties are reported as one standard deviation. The standard deviation is estimated from the propagated sources of analytical error.

Standard deviations for the ambient air-monitoring network station and group (offsite regional, offsite perimeter, and on site) means are calculated using the standard equation,

$$s = \left(\Sigma(c_i - \bar{c})^2/(N-1)\right)^{1/2} \quad ,$$

where

c_i = sample i,

$\bar{c}$ = mean of samples from a given station or group, and

N = number of samples in the station or group.

This value is reported as one standard deviation for the station and group means.

Reference

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Appendix C: Descriptions of Technical Areas and Their Associated Programs

Locations of the technical areas operated by Los Alamos National Laboratory (LANL or the Laboratory) in Los Alamos County are shown in Figure 1-4 in Chapter 1. Some offsite facilities are also located in Los Alamos, Santa Fe, and Rio Arriba counties. The main programs conducted at each of the areas are listed in this appendix.

Technical Area	Location and Activities
00 Offsite Facilities	The Technical Area 00 designation is assigned to structures leased by the U.S. Department of Energy outside the Laboratory boundary in Los Alamos County. Leased space includes bioscience facilities
02 Omega Site or Omega West Reactor	Omega West Reactor, an 8-megawatt nuclear research reactor, was located at Technical Area 02. In 2002, the reactor was decontaminated and decommissioned. Technical Area 02 is now the location of the Omega West Monument and interpretive panels. The monument commemorates the historic reactors and other historical events that took place at Technical Area 02.
03 Core Area or South Mesa Site	Technical Area 03 is the Laboratory's core scientific and administrative area and contains approximately half of the Laboratory's employees and total floor space. It is the location of many key Laboratory facilities, including the Sigma Complex, the machine shops, the Material Sciences Laboratory, and the Nicholas C. Metropolis Center for Modeling and Simulation.
05 Beta Site	Between East Jemez Road and the Pueblo de San Ildefonso, Technical Area 05 contains physical support facilities and an electrical substation. It is also the site of the Laboratory's interim measure to control chromium plume migration in the regional aquifer.
06 Twomile Mesa Site	Technical Area 06 is sited in the northwestern part of the Laboratory and is mostly open land. It contains a meteorological tower, gas-cylinder-staging buildings, the Western Technical Area Substation, and buildings awaiting demolition. Properties listed for the Manhattan Project National Historical Park are also located in this technical area.
08 GT Site or Anchor Site West	Located along West Jemez Road, Technical Area 08 is a testing site where nondestructive dynamic testing techniques are used to ensure the quality of materials in items that range from test weapons components to high-pressure dies and molds. Techniques used include radiography, radioisotope techniques, ultrasonic and penetrant testing, and electromagnetic test methods. The Manhattan Project National Historical Park also hosts the historic Gun Site properties in this technical area.
09 Anchor Site East	Technical Area 09 is located on the western edge of the Laboratory. Fabrication feasibility and the physical properties of explosives are explored at this technical area, and new organic compounds are investigated for possible use as explosives. Storage and stability problems are also studied.

Technical Area	Location and Activities
11 K-Site	Technical Area 11 is used for testing explosives components and systems, including vibration analysis and drop-testing materials and components under a variety of extreme physical environments. Facilities are arranged so that testing can be controlled and observed remotely, allowing devices that contain explosives, radioactive materials, and nonhazardous materials to be safely tested and observed. Properties listed for the Manhattan Project National Historical Park are also located in this technical area.
14 Q-Site	Technical Area 14 is located in the northwestern part of the Laboratory and is one of 14 active firing areas. Most operations are remotely controlled and involve detonations and certain types of high-explosives machining. Dynamic experiments and hydrodynamic testing are conducted at Technical Area 14. Properties listed for the Manhattan Project National Historic Park are also located in this technical area.
15 R-Site	Technical Area 15 is located in the central portion of the Laboratory; it is used for high-explosives research, development, and testing, mainly through hydrodynamic testing and dynamic experimentation. It contains two active firing sites; the Dual-Axis Radiographic Hydrodynamic Test Facility, which has an intense high-resolution, dual-machine radiographic capability; and Building 306, a multipurpose facility where primary diagnostics are performed. Technical Area 15 is also used to investigate weapons functioning and systems behavior in nonnuclear testing.
16 S-Site	Technical Area 16 lies in the western part of the Laboratory and includes the Weapons Engineering Tritium Facility. Technical Area 06's high explosive research, development, and testing capabilities include high explosive processing; powder manufacturing; casting, machining, and pressing; inspection and radiography of high explosive components to guarantee integrity and ensure quality control; test device assembly; thermal testing; flight simulation testing; and chemical analysis. The Manhattan Project National Historical Park also hosts the V-Site property in this technical area.
18 Pajarito Site	Technical Area 18 is sited in Pajarito Canyon and was the location of the Los Alamos Critical Experiment Facility, a general-purpose nuclear experiments facility. All operations here have ceased. The technical area, including the Pond Cabin and the Slotin Building, is now part of the Manhattan Project National Historical Park.
21 DP Site	Technical Area 21 is located on the northern border of the Laboratory, next to the Los Alamos townsite. The former radioactive materials (including plutonium) processing facility was in the western part of Technical Area 21. The Tritium Systems Test Assembly and the Tritium Science and Fabrication Facility were in the eastern part. Operations from these facilities have been transferred, and demolition was completed in 2010.
22 TD Site	Technical Area 22 is located in the northwestern portion of the Laboratory and houses the Detonator Production Facility. Research, development, and fabrication of high-energy detonators and related devices are conducted at this facility. Properties listed for the Manhattan Project National Historic Park are also located in this technical area.

Technical Area	Location and Activities
28 Magazine Area A	Technical Area 28 is sited near the southern edge of the Laboratory and was an explosives storage area. It contains five empty storage magazines that are being decontaminated and decommissioned.
33 HP Site	Technical Area 33 is a remotely located technical area at the southeastern boundary of the Laboratory. Activities at this site include programs intended to protect, deter, and respond to weapons of mass destruction. Laboratories and testbeds include additive manufacturing, machining, pulsed power, laser interaction, power delivery and response, chemical compatibility, cryogenics, biological measurements, and radiological material detection and effects. The National Radioastronomy Observatory's Very Long Baseline Array telescope is here. A portion of the White Rock Canyon Reserve is also located here.
35 Ten Site	Technical Area 35 is located in the north-central portion of the Laboratory. The Target Fabrication Facility, located here, houses activities related to weapons production and laser fusion research. The facility conducts high-energy density physics test and supports plutonium pit rebuild operations.
36 Kappa Site	Technical Area 36 is a remotely located area in the eastern portion of the Laboratory; it has four active firing sites that support explosives testing. The sites are used for a wide variety of nonnuclear ordnance tests.
37 Magazine Area C	Technical Area 37, used as an explosives storage area, is sited along the eastern perimeter of Technical Area 16.
39 Ancho Canyon Site	Technical Area 39, at the bottom of Ancho Canyon, is used to study the behavior of nonnuclear weapons (primarily by photographic techniques) and various phenomenological aspects of explosives.
40 DF Site	Technical Area 40 is centrally located within the Laboratory and is used for general testing of explosives or other materials and development of special detonators for initiating high-explosives systems.
41 W-Site	Technical Area 41 is located in Los Alamos Canyon and is no longer used. Many buildings have been decontaminated and decommissioned; the remaining structures include historic properties.
43 Bioscience Facilities	Technical Area 43 lies adjacent to the Los Alamos Medical Center at the northern border of the Laboratory; it is the location of the Bioscience Facilities (formerly called the Health Research Laboratory). The Bioscience Facilities house Biosafety Level 1 and 2 laboratories and are the focal point of bioscience and biotechnology at LANL. Research performed at the Bioscience Facilities includes structural, molecular, and cellular radiobiology; biophysics; radiobiology; biochemistry; and genetics.
46 WA Site	Technical Area 46 is sited between Pajarito Road and the Pueblo de San Ildefonso. It is one of the Laboratory's basic research sites. Activities have focused on applied photochemistry operations and have included development of technologies for laser isotope separation and laser enhancement of chemical processes. The Sanitary Wastewater Systems Plant is also here.
47 Offsite Facilities	Technical Area 47 contains leased office and warehouse space in Santa Fe.
48 Radiochemistry Site	Technical Area 48 is located in the north-central portion of the Laboratory. It supports research and development in nuclear and radiochemistry, geochemistry, production of medical radioisotopes, and chemical synthesis. Hot cells are used to produce medical radioisotopes.

Technical Area	Location and Activities
49 Frijoles Mesa Site	Technical Area 49 is located near Bandelier National Monument. It is used as a training area and for outdoor tests on materials and equipment components that involve generating and receiving short bursts of high-energy, broad-spectrum microwaves. The National Park Service operates the Interagency Wildfire Center and helipad near the entrance to the technical area.
50 Waste Management Site	Technical Area 50 is located near the center of the Laboratory. It is the location of waste management facilities, including the Radioactive Liquid Waste Treatment Facility and the Waste Characterization, Reduction, and Repackaging Facility. The Actinide Research and Technology Instruction Center is also here.
51 Environmental Research Site	Technical Area 51 is located on Pajarito Road in the eastern portion of the Laboratory. Four warehouses have been constructed to support plutonium pit production.
52 Reactor Development Site	Technical Area 52 is located in the north-central portion of the Laboratory. A wide variety of theoretical and computational research and development activities related to nuclear reactor performance and safety, as well as to several environmental, safety, and health activities, are carried out here.
53 Los Alamos Neutron Science Center	Technical Area 53 is located in the northern portion of the Laboratory and includes the Los Alamos Neutron Science Center. This facility houses one of the largest research linear accelerators in the world and supports basic and applied research programs. Basic research includes studies of subatomic and particle physics. Applied research provides experimental data for dynamic radiography, materials science, nuclear physics, and neutron radiography to support stockpile assessment and certification, part qualification, and the development and validation of advanced models. The facility also irradiates targets for medical isotope production.
54 Waste Disposal Site	Technical Area 54 is located on the eastern border of the Laboratory and is one of the largest technical areas at the Laboratory. Its primary function is management of solid radioactive and hazardous chemical wastes, including storage, treatment, decontamination, and disposal operations.
55 Plutonium Facility Complex Site	Technical Area 55 is located in the center of the Laboratory along Pajarito Road and includes the Plutonium Facility Complex and the Radiological Laboratory/Utility/Office Building. The manufacture of plutonium pits and parts, fabrication of samples for research and development activities, and pit surveillance takes place here. Other activities include chemistry and metallurgy research, actinide chemistry, and materials characterization.
57 Fenton Hill Site	Technical Area 57 is located about 20 miles west of the Laboratory on land administered by the U.S. Forest Service. The Laboratory has used this site since 1974, and the site is subject to an interagency agreement between the U.S. Department of Energy and the U.S. Forest Service. The site was originally developed for the Hot Dry Rock geothermal energy program, which was terminated in 1995, and subsequently used for astronomical studies. In 2012, the Laboratory demolished and removed several small structures, trailers, equipment pads, and equipment and implemented site stabilization. Some astronomy activities may continue.
58 Twomile North Site	Technical Area 58 is located near the Laboratory's northwest border on Twomile Mesa North, a forested area reserved for future use because of its proximity to Technical Area 03. The technical area houses the protective force running track, a few Laboratory-owned storage trailers, and a temporary storage area.

Technical Area	Location and Activities
59 Occupational Health Site	Technical Area 59 is located on the south side of Pajarito Road adjacent to Technical Area 03. Facilities provide LANL support services in the areas of health physics, risk management, industrial hygiene and safety, policy and program analysis, air quality, water quality and hydrology, hazardous and solid waste analysis, and radiation protection.
60 Sigma Mesa	Technical Area 60 is sited southeast of Technical Area 03 and is primarily used for physical support and infrastructure activities. The historic buildings for the Nevada Test Site Test Fabrication Facility and a test tower are also sited here. This facility is used as a waste storage area.
61 East Jemez Site	Technical Area 61 is located in the northern portion of the Laboratory. It contains physical support and infrastructure facilities. It also hosts a 1-megawatt solar power plant and the Los Alamos County Eco Transfer Station that are operated by Los Alamos County. This technical area is the former site of the Los Alamos County landfill, which is now closed and capped.
62 Northwest Site	Adjacent to Technical Area 03 and West Jemez Road in the northwest corner of the Laboratory, Technical Area 62 serves as a forested buffer zone. This technical area is reserved for future use.
63 Pajarito Service Area	Technical Area 63 lies in the north-central portion of the Laboratory and contains physical support and infrastructure facilities and the Transuranic Waste Facility.
64 Central Guard Site	Technical Area 64 is located in the north-central portion of the Laboratory and provides offices and storage space.
66 Central Technical Support Site	Technical Area 66 is on the southeast side of Pajarito Road in the center of the Laboratory. The Nonproliferation And National Security Center and Advanced Technology Assessment Center—the only facility at this technical area—provides office and technical space for technology transfer and other industrial partnership activities.
67 Pajarito Mesa Site	Technical Area 67 is a forested buffer zone in the north-central portion of the Laboratory and has no operations or facilities.
68 Water Canyon Site	In the southern portion of the Laboratory, Technical Area 68 contains environmental study areas.
69 Anchor North Site	In the northwestern corner of the Laboratory, Technical Area 69 serves as a forested buffer zone. The Emergency Operations Center is located here.
70 Rio Grande Site	Technical Area 70 is located on the southeastern boundary of the Laboratory. It is an undeveloped technical area that serves as a buffer zone and includes part of the White Rock Canyon Reserve.
71 Southeast Site	Technical Area 71 is located on the southeastern boundary of the Laboratory and is adjacent to White Rock to the northeast. This undeveloped technical area serves as a buffer zone for the High Explosives Test Area and encompasses a portion of the White Rock Canyon Reserve.
72 East Entry Site	Technical Area 72 is located along East Jemez Road on the northeastern boundary of the Laboratory. It is used by protective force personnel for required firearms training and practice purposes.

Appendix D: Related Websites

For more information on environmental topics at Los Alamos National Laboratory (LANL or the Laboratory), visit the following websites.

Current and past environmental reports and supplemental data tables	https://www.osti.gov/
The Laboratory's website	https://www.lanl.gov
U.S. Department of Energy/National Nuclear Security Administration Los Alamos Field Office	https://www.energy.gov/nnsa/locations https://www.energy.gov/contact-us/mailing-addresses-and-information-numbers-operations-field-and-site-offices
U.S. Department of Energy Environmental Management Los Alamos Field Office	https://energy.gov/em-la/environmental-management-los-alamos-field-office
U.S. Department of Energy website	https://www.energy.gov
The Laboratory's environmental stewardship pages	https://www.lanl.gov/engage/environment
N3B – Los Alamos Legacy Cleanup Contract website	https://n3b-la.com
The Laboratory's Electronic Public Reading Room website	https://eprr.lanl.gov
Los Alamos Legacy Cleanup Contract Electronic Public Reading Room website	https://ext.em-la.doe.gov/EPRR
The Laboratory's environmental database	https://www.intellusnm.com

Appendix E: Acknowledgments

The following Los Alamos National Laboratory organizations performed environmental surveillance, ensured environmental compliance, and provided environmental data for this report:

- Associate Directorate for Environment, Safety, Health, and Quality
- Environmental Protection and Compliance Division
- N3B Los Alamos
- Environmental Remediation Program

Previous reports in the series:

LA-UR-24-28629	LA-UR-14-27564	LA-14304-ENV
LA-UR-23-29640	LA-UR-13-27065	LA-14341-ENV
LA-UR-22-29103	LA-14427-ENV	LA-14369-ENV
LA-UR-21-28555	LA-13775-ENV	LA-14407-ENV
LA-UR-20-26673	LA-13861-ENV	LA-14427-ENV
LA-UR-19-28565	LA-13979-ENV	LA-14445-ENV
LA-UR-17-27987	LA-14162-ENV	LA-14461-ENV
LA-UR-16-26788	LA-14239-ENV	
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