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2018 ANNUAL SITE ENVIRONMENTAL REPORT *Summary*

NEW

Four Accord Pueblos and the Museum of Indian Arts & Culture

A Backyard Homestead

Chromium Plume Updates

Los Alamos
NATIONAL LABORATORY
EST. 1943

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.

ANNUAL SITE ENVIRONMENTAL REPORT SUMMARY FOR 2018
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INTRODUCTION

COMPLIANCE SUMMARY

ENVIRONMENTAL PROGRAMS

AIR QUALITY

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2018 Compliance at a Glance

To protect human health and the environment, the Laboratory complies with many state and federal laws.

Note: Pink highlights indicate federal regulators.
Gray highlights indicate state regulators.

WASTE

DOE Order 435.1 – Radioactive Waste Management

Regulates the management and disposal of radioactive wastes.

Resource Conservation and Recovery Act

Regulates the management and disposal of hazardous wastes; mandates a hazardous waste facility permit.

2016 Compliance Order on Consent

Provides the process for cleanup of legacy wastes at the Laboratory.

Federal Facility Compliance Act

Requires an annually updated treatment plan for all mixed radioactive and hazardous wastes.

Waste Highlights for 2018

1. The Laboratory shipped about 3,400 tons of low-level radioactive waste offsite for disposal.
2. The Laboratory made four shipments of transuranic waste to the Waste Isolation Pilot Plant in Carlsbad, New Mexico.
3. Control of waste management units at Technical Area 54, Areas G, H, and L, was transferred to the legacy waste cleanup contractor Newport News Nuclear BWXT – Los Alamos (N3B).
4. The Laboratory staff completed treatment of remaining nitrate salt waste containers in March 2018.
5. The Laboratory performed several special environmental projects under a settlement agreement, including improving New Mexico State Route 502, which is used in waste shipments; completing the first triennial review of environmental regulatory compliance; and completing several storm water structures to improve surface water quality.
6. Twenty-six legacy waste corrective action sites received certificates of completion from the New Mexico Environment Department.

RADIATION PROTECTION

DOE Order 458.1 – Radiation Protection of the Public and the Environment

Sets radiation dose limits for the public, wildlife, and plants from DOE sites and requires that radiological releases are monitored and reported to the public.

Clean Air Act – Radionuclide National Emission Standards for Hazardous Air Pollutants

Sets radiation dose limits for air emissions.

Radiation Protection Highlights for 2018

1. The estimated maximum possible radiological dose to a member of the public from Laboratory operations was less than 1 millirem.
2. Estimated radiation doses to wildlife and to plants were below regulatory limits.

AIR

Clean Air Act

The Los Alamos National Laboratory Title V Operating Permit requires that all air emissions of regulated pollutants remain below the permit limits, and Title VI (Refrigerants and Halons) regulates ozone-depleting chemicals, like halons.

New Mexico Air Quality Control Act

Requires evaluation of new or modified sources of Laboratory air emissions.

Air Quality Highlights for 2018

1. The Laboratory's emissions of regulated air pollutants were significantly lower than its permit limits.
2. The Laboratory has only one remaining fire-suppression system that uses halon.

WATER

Clean Water Act

Requires National Pollutant Discharge Elimination System permits for several types of effluent and storm water discharges; it also has requirements for aboveground storage tanks and reporting of pesticide usage.

New Mexico Water Quality Act

Establishes water quality goals for surface waters by designating uses and setting standards; it also regulates effluent discharges to protect groundwater.

2016 Compliance Order on Consent

Provides the process for remediation of contaminated groundwater at the Laboratory.

Energy Independence and Security Act

Establishes storm water runoff requirements for federal development projects.

Water Quality Highlights for 2018

1. The Laboratory discharged about 102 million gallons of water through seven permitted effluent outfalls.
2. Two of 826 outfall samples (0.2 percent) had substances at concentrations exceeding outfall permit limits.
3. The Laboratory completed 213 corrective actions to address water quality at industrial sites regulated under the Multi-Sector General Permit for Storm Water Discharges.
4. Equipment to withdraw chromium-contaminated groundwater, clean it, and inject the treated water back into the regional aquifer operated for most of 2018 as part of the interim measure to control migration of the chromium groundwater plume.
5. The Laboratory continued investigating the RDX groundwater plume, including drilling a new regional aquifer monitoring well.

NATURAL AND CULTURAL RESOURCES

National Environmental Policy Act (NEPA)

Requires federal agencies to consider the environmental impact of its activities and operations during decision-making.

Endangered Species Act

Requires agencies to protect federally listed threatened and endangered species and habitats.

Migratory Bird Treaty Act

Makes it unlawful to harm any migratory bird except as allowed by U.S. Fish and Wildlife regulations.

Floodplain and Wetland Executive Orders

Requires federal agencies to prepare and publish an assessment in the event of a project on or near any floodplains or wetlands.

National Historic Preservation Act

Requires federal agencies to consider the impacts their activities may have on historic properties, such as archaeological sites or historic buildings.

Natural and Cultural Resources Highlights for 2018

1. Cultural resource specialists evaluated 71 archeological sites and documented historic buildings in six technical areas.
2. Laboratory staff banded 841 birds, caught using mist nets, to monitor migratory bird populations, and staff located two Mexican spotted owl nests during surveys.
3. The National Nuclear Security Administration published a Supplement Analysis to the 2008 Site-Wide Environmental Impact Statement for the Continued Operation of Los Alamos National Laboratory and found the environmental impacts for activities and operations planned through 2022 have not substantially changed.
4. The National Nuclear Security Administration also published an Environmental Assessment that found no significant environmental impacts from recategorizing the Radiological Laboratory/Utility/Office Building near the Laboratory's Plutonium Facility from a Radiological Facility to a Hazard Category 3 Nuclear Facility.

OTHER ENVIRONMENTAL PROTECTIONS

Toxic Substances Control Act

Requires record keeping and reporting on the production, use, and disposal of certain chemicals, such as polychlorinated biphenyls (PCBs).

Federal Insecticide, Fungicide, and Rodenticide Act

Regulates the distribution, sale, and use of pesticides.

New Mexico Pesticide Control Act

Regulates licensing of pesticide applicators and application, storage, and disposal of pesticides.

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

Requires collecting and reporting information on environmental issues that could impact public and environmental health.

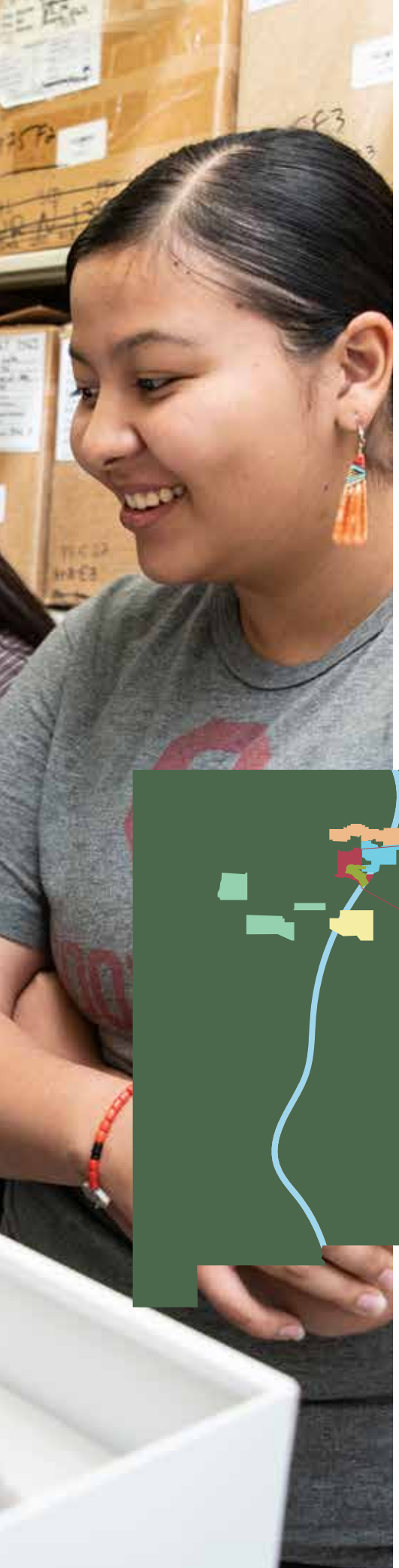
DOE Order 231.2 – Occurrence Reporting and Processing of Operations Information

Requires reporting of off-normal events or conditions, including events with potential environmental effects.

Emergency Planning and Community Right-to-Know Act

Requires plans and inventories for over 360 hazardous substances and notifications to local emergency planning committees when there is a leak or spill.

Compliance Summary



The Four Accord Pueblos and the Museum of Indian Arts & Culture

The Laboratory works to preserve artifacts with the Four Accord Pueblos and the Museum of Indian Arts & Culture.

By Ashlyn Lovato

Federal agencies are required to follow the National Historic Preservation Act, which asks that they "consider the effects their activities may have on historic properties," and the Native American Graves Protection and Repatriation Act. In accordance, the Los Alamos National Laboratory works with the Four Accord Pueblos (Pueblo de San Ildefonso, Santa Clara Pueblo, Pueblo of Jemez, and Pueblo de Cochiti) and other pueblos and tribes because many sacred ancestral sites, like graves, remain on what is now Laboratory property.

Whenever any artifacts are collected, the Laboratory has them curated at the Museum of Indian Arts & Culture in Santa Fe, New Mexico. Then, every year, the DOE and Los Alamos National Laboratory archaeologists randomly inspect the collections to ensure they are preserved following federal regulations.

Caitlyn Cruz, Raven Alcott, and Ashlyn Lovato inspect recovered artifacts that are curated at the Center for New Mexico Archaeology.

Progress on Environmental Projects

Los Alamos National Laboratory makes headway on five supplemental environmental projects resulting from a settlement agreement with the New Mexico Environment Department.

By Chase Gruber

In 2014, the New Mexico Environment Department's Hazardous Waste Bureau issued an administrative compliance order to the Los Alamos National Laboratory for violations of the New Mexico Hazardous Waste Act.

The violations stemmed from the improper treatment of transuranic waste—artificially made, radioactive material—shipped from the Laboratory to the Department of Energy's Waste Isolation Pilot Plant near Carlsbad, New Mexico. As a result, the Department of Energy, the National Nuclear Security Administration, and the New Mexico Environment Department agreed to a settlement that includes five supplemental environmental projects. Below are brief project descriptions and status updates.

Road Improvement Project

Improve roads used for the transportation of transuranic waste from the Laboratory to the Waste Isolation Pilot Plant.

Work along NM Route 502 was finished in 2018. A proposed redesign of the State Route 4 and East Jemez Road intersection is being prepared, and a partial design is expected to be completed in 2019.

Surface Water Sampling Project

Increase sampling and monitoring of storm water runoff to better characterize sources of pollutants.

The Laboratory collected 47 water and sediment samples from 20 different sites in 2018. Nine sites were established to improve storm water monitoring capabilities for the Jemez, Santa Clara, Cochiti, and San Ildefonso Pueblos.

Watershed Enhancement Project

Improve local water quality by slowing storm water flow and decreasing sediment load.

Projects completed in 2018 include the following: completion of designs for all projects and installation of several low-impact development projects to manage and treat surface water runoff from several parking lots, restoration of a wetland in upper Mortandad watershed, and the installation of new erosion controls in North Ancho and Lower Sandia watersheds. Several more projects will be completed in 2019.

Potable Water Line Replacement Project

Replace aging potable water lines and install metering equipment to increase efficiency of Laboratory potable water systems.

Sierra Canyon Construction completed about 65 percent of Phase A, which includes directional drilling and pipe installation along East Jemez Road and Diamond Drive. Phase B begins in 2019 and will include upgrading lines along Bikini Atoll Road.

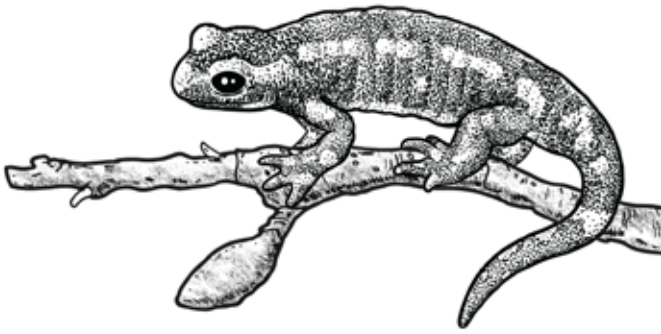
Triennial Review Project

Conduct independent triennial reviews to ensure the Laboratory's compliance with environmental regulations.

The first triennial review was finished in 2018 by Enterprise Construction Management Services with the final report issued on September 14, 2018.

Hazardous Waste Permit Upgrades

Los Alamos National Laboratory's Environmental Protection and Compliance Division makes seven new modifications to its hazardous waste permit.



By Chase Gruber

The meaning of effective environmental stewardship is constantly changing as new scientific discoveries and our understanding of natural systems evolve.

Faced with these changes, Los Alamos National Laboratory undergoes constant self-review to find ways it can be more efficient, produce less waste, and better protect the environment and local communities.

One way in which this is achieved is through the Laboratory's compliance with the Resource Conservation and Recovery Act. The act was initially implemented in 1976 to reduce hazardous waste, such as that generated by the Laboratory, through source reduction, pollution prevention, and recycling—all while seeking to prevent this waste from impacting the environment and human health.

In order to meet the guidelines of the Resource Conservation and Recovery Act, the Laboratory maintains a hazardous waste facility permit issued through the New Mexico Environment Department. This permit establishes the standards for the Laboratory's management of hazardous wastes and provides specific reporting requirements to the New Mexico Environment Department, ultimately ensuring the Laboratory's accountability to the public.

In 2018, the Laboratory and the Department of Energy National Nuclear Security Administration submitted seven new permit modifications to the New Mexico Environment Department for approval, all of which were considered Class 1 modifications (minor changes that keep a permit current with routine alterations to the facility or its operations). The most notable of these changes is a modification that allows the Laboratory's transuranic waste facility to accept radioactive waste generated after April 21, 2011.

Two other modification examples are of transferring control of several hazardous waste management units at Technical Area 54 to Newport News Nuclear BWXT-Los Alamos, as well as transferring management and operations from Los Alamos National Security, LLC, to Triad National Security, LLC, the Laboratory's new and current management and operating contractor.

The Resource Conservation and Recovery Act also requires that the Laboratory self-reports any noncompliance to the New Mexico Environment Department, that is, instances in which the environmental regulations are not being met.

We reported 69 such instances in fiscal year 2018, versus 25 in fiscal year 2017.

"We often see increases in noncompliance directly following new upgrades to the permit, then decreases as time goes by," says Fil Dominguez, an environmental inspector at the Laboratory. "It takes time for generators (employees who generate hazardous waste through their work) to learn and implement new regulations."

Environmental Programs

A Backyard Homestead

The Laboratory makes headway on the excavation of the Vigil y Montoya Homestead.

By Aaliya Casados

In late 1942, the United States government began acquiring privately owned land in preparation for the Manhattan Project's secret Project Y—a clandestine proposal in Los Alamos to build the world's first atomic bomb. About 36 families, some with roots in the area reaching back to the late 1800s, were forced to sell their land, including the Enrique Montoya family, who owned what today is called the Vigil y Montoya Homestead.

Of the homestead families living in this area who were forced to sell their land, the largest payments to families on the plateau went to the Anglo landowners, according to some descendants of Hispanic homesteaders. In 2004, the Department of Energy settled a lawsuit with the Hispanic descendants for $10 million, which was to be split among the homesteaders' descendants. As part of this settlement, the Department of Energy agreed to write a historical book, *Homesteading on the Pajarito Plateau, 1887–1942*, released in 2013. The Los Alamos National Laboratory also agreed to finish excavation and research at the Vigil y Montoya Homestead.

As part of this agreement, in 2018, Laboratory archaeologist Alison Livesay began a project

Archaeologists work to excavate portions of the Vigil y Montoya Homestead during the early 1990s.

Lab archaeologists excavating

By CHARMIAN SCHALLER
Monitor Managing Editor

For about a month now, Los Alamos National Laboratory commuters have been driving by an archaeological excavation on East Jemez Road, across from Royal Crest Trailer Park.

Ellen McGehee, a contract staff archaeologist with the laboratory, told the Monitor in a telephone interview today that the site is the "Vigil y Montoya Homestead," which was occupied by two different families from about 1916 to 1942.

The excavation lies in the path of the laboratory's planned Infrastructure Support Facilities gas line, a project that will cut through a portion of the old homestead and bring heavy construction machines close to the remainder.

As a result, an archaeological crew of seven people is racing to finish its work as the pipeline approaches.

McGehee said the homestead probably had fields that lay on land now occupied by Royal Crest and the highway.

Work at the site so far has revealed a cabin foundation, a privy depression, what might once have been an "horno" (a beehive-shaped bread oven), and an animal pen, she said.

Archaeologists also found a pile of rocks. They excavated in the area of the rocks, but found nothing. McGehee said the rocks might have been piled up when fields were cleared.

There are no standing remains of the homestead above ground, but McGehee said the foundation wall is "pretty much intact."

It reveals the outline of a basic, one-room structure.

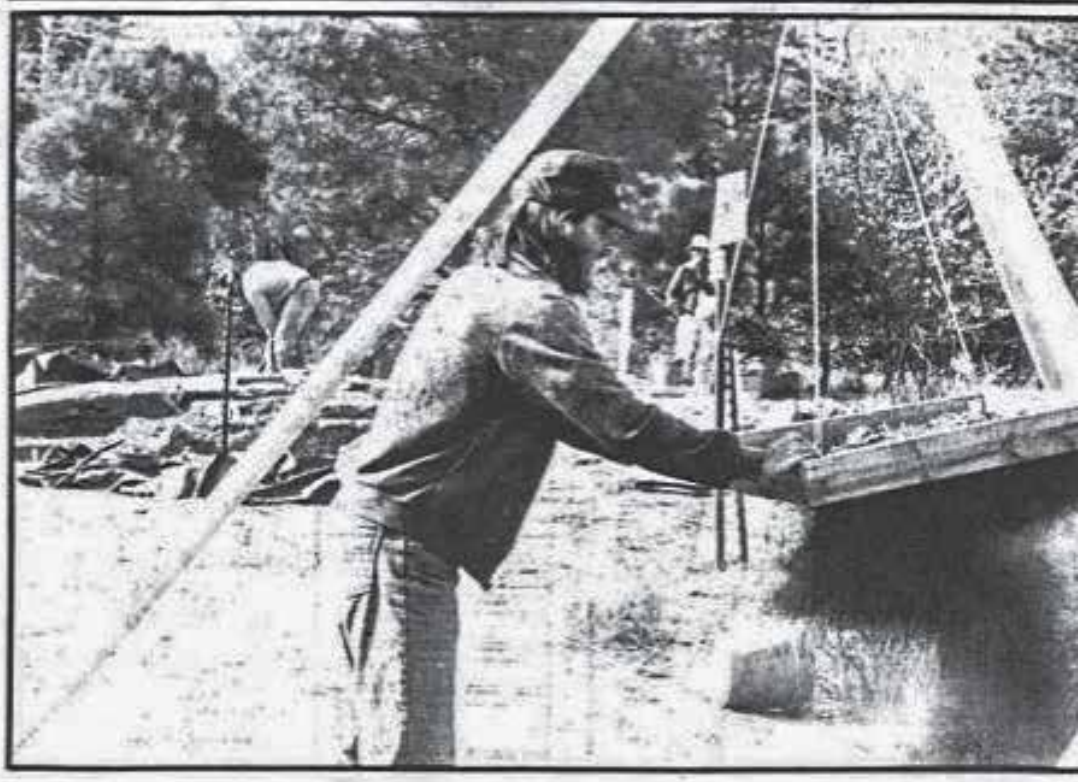
McGehee said that in the course of the project so far, archaeologists have found tin cans, glass, buttons, shoe parts, a deteriorated pendant or medal, partial bottles with embossing, bullets, cartridges, a wrench, and pieces of plates and cups.

She said, "All of these materials are associated with habitation" — with maintenance of a household and with farming.

She said her team also found "a little concentration of oil cans." It's interesting, she said, to see how the remains reflect the changes over time, as homesteaders moved from the era of wagons to the time of automobiles.

Among the fragments are bits of purple glass that are known artifacts of the turn of the century, she said.

(See EXCAVATION, Page 8).



old cabin

An archaeology crew is working on a site across the road from Royal Crest Trailer Park. The photo above shows the site, where a foundation wall has been excavated. The foundation was part of the "Vigil y Montoya Homestead." At left, Mike Schillaci screens dirt, searching for tiny artifacts of the homesteader era. One of the items found during the screening was a small religious medal.

JAMES E. RICKMAN/Monitor

to complete excavation and an artifact analysis, to conduct research into the family's activities, and to determine how long the site was occupied.

The Vigil y Montoya Homestead was initially excavated between 1992 and 1994 in preparation for the installation of a major gas line corridor. But unfortunately, due to the proposed placement of the line, the largest of the eight features, the cabin, had to be fully excavated and quickly bulldozed to extend the utility corridor. Excavation and artifact analysis of the site was then delayed due to lack of funding, and there were still many unanswered questions about what life was like at the time the homestead was occupied.

Luckily, the family left behind many objects that could offer a window into the past. So far, Livesay has reported artifacts like spoons, pots, pans, fine china, soda bottles, tins, glassware, axe heads, keys, and buttons. The Vigil y Montoya family, Livesay found, practiced dryland farming by planting large bean fields, sorghum, and some wheat. Often these plants were sold as cash crops. From animal remains, we know they had livestock such as cows, goats, and sheep.

A local Los Alamos newspaper article on the early 1990s excavations at the Vigil y Montoya Homestead.

One lesson of the Vigil y Montoya Homestead site is that the homesteading period is underrepresented in history. But the Laboratory's Cultural Resources Management group is working to bring students out to these sites in order to teach them that preserving the past creates a meaningful future.

Though the 1990s excavation was unfinished, it enabled the current Laboratory archaeological teams to further research the site and locate descendants of the Montoya family.

In the future, the Laboratory hopes to gain even more information about the site and the people who occupied Los Alamos by collaborating with descendants.

Cultural Resources Management

The Cultural Resources Management program at the Laboratory works to help implement preservation laws, regulations, and policies, including the National Historic Preservation Act. About 90 percent of Department of Energy land in Los Alamos has been surveyed for prehistoric and historic cultural resources, and so far more than 1,800 historic sites have been identified in the Los Alamos area, some reaching back 10,000 years.

Protecting the Jemez Mountains Salamander Habitat

Geologists investigate the timing and magnitude of past seismic events along sections of the Pajarito Fault.

By Aaliya Casados

To accurately calculate the seismic hazard for Los Alamos National Laboratory and to design facilities in a way that keeps workers and the public safe, the Laboratory conducts trenching projects to analyze the local geology of the Pajarito Plateau. But between the last (prior to 2002) and most recent trenching (2016–2018), the Jemez Mountains salamander was listed as an endangered species.

Laboratory geologists performed detailed studies and determined that the best places to dig trenches, which allows them to understand past earthquakes, were in areas deemed critical habitat for the Jemez Mountains salamander. This is where the Laboratory's Biological Resources program partnered with this project.

The Jemez Mountains salamander is lungless and endemic to the Jemez Mountains, with the majority of its habitat in the Santa Fe National Forest. They are small, thin, and often mistaken for earthworms because they live underground in moist areas so they can absorb oxygen through their skin. Research on this salamander is limited, so Laboratory biologists determined that mitigation for working in the critical habitat should include new research focused on the salamander.

The sites where the Laboratory sought to trench are within U.S. Forest Service – Santa Fe National Forest property. This resulted in the Department of Energy National Nuclear Security Administration working closely to obtain the required permits from the U.S. Forest

Service as landowners, and U.S. Fish and Wildlife Service as the regulatory authority for the salamanders.

A Laboratory biologist was on site for all ground-disturbing operations. Often, the operators paused work while a biologist investigated areas. Throughout the excavation, Laboratory biologists watched for movements on the trench wall and within the excavated sediment. The team did not discover any Jemez Mountains salamanders during monitoring of the trenching project. After the trenches were backfilled, the disturbed areas were restored with vegetation that had previously been uprooted.

Biological Resources Program Goals

The goals of the Biological Resources program at the Laboratory are to minimize the impacts on sensitive species and their habitats and to ensure all tasks performed by the Laboratory comply with federal and state laws. Endangered or threatened animals in the area are the Jemez Mountains salamander, Mexican spotted owl, New Mexico meadow jumping mouse, Southwestern willow flycatcher, and yellow-billed cuckoo. To protect these species, Los Alamos National Laboratory complies with the Endangered Species Act through a Habitat Management Plan, which was agreed to by the DOE, the National Nuclear Security Administration, and the U.S. Fish and Wildlife Service.

Left: The Jemez Mountains salamander is an endangered species whose habitat is primarily in the Santa Fe National Forest near the Laboratory.
Right: Trenching in Santa Fe National Forest

Air Quality

Air Quality at Los Alamos

Using a sophisticated monitoring network, the Laboratory keeps watch on local air quality.

By Sam Menefee

Los Alamos National Laboratory air emissions are well below all U.S. Environmental Protection Agency and Department of Energy limits for radioactive and non-radioactive air emissions. The offsite dose from the Laboratory's radioactive air emissions in 2018 was less than five percent of the allowable emission limit.

Emissions of non-radioactive pollutants such as carbon monoxide, nitrogen oxides, sulfur dioxide, particulate matter, and volatile organic compounds were less than ten percent of permitted allowable emission limit in 2018.

To ensure that emissions stay below allowable limits, the Laboratory monitors stack emissions to assess what is released into the environment.

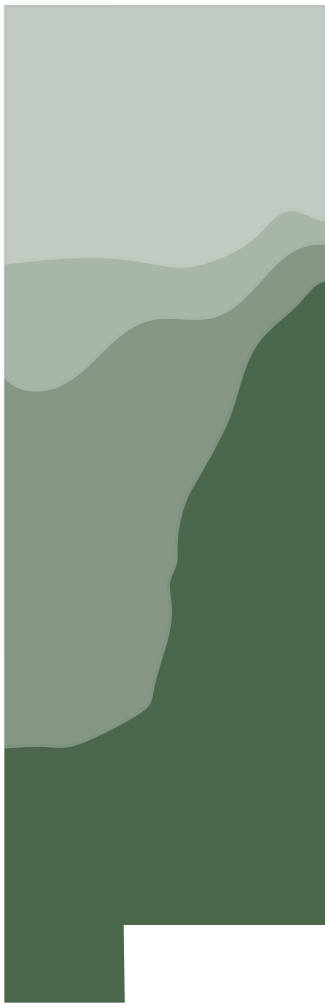
In all, Los Alamos National Laboratory operates a network of 38 ambient air monitoring sites (called Airnet). These provide continuous, real-time data on concentrations of dozens of radiological air pollutants, including uranium, plutonium, and tritium. For example, eight ambient air monitoring stations measure air quality surrounding Technical Area 54, Area G, where radioactive waste is stored. There are also 25 Airnet stations throughout Los Alamos County and nearby communities that monitor the ambient concentrations of radioactive constituents in locations where people live and work.

In 2018, measurements indicated that radiological air materials were below the allowable limits set by the Environmental Protection Agency.

The Laboratory also monitored other materials, like particulate matter, including dust and smoke, which have consistently remained below the Environmental Protection Agency standards.

Trends in Precipitation and Temperature

The Laboratory monitors a continuing drought on the Pajarito Plateau.



By Sam Menefee

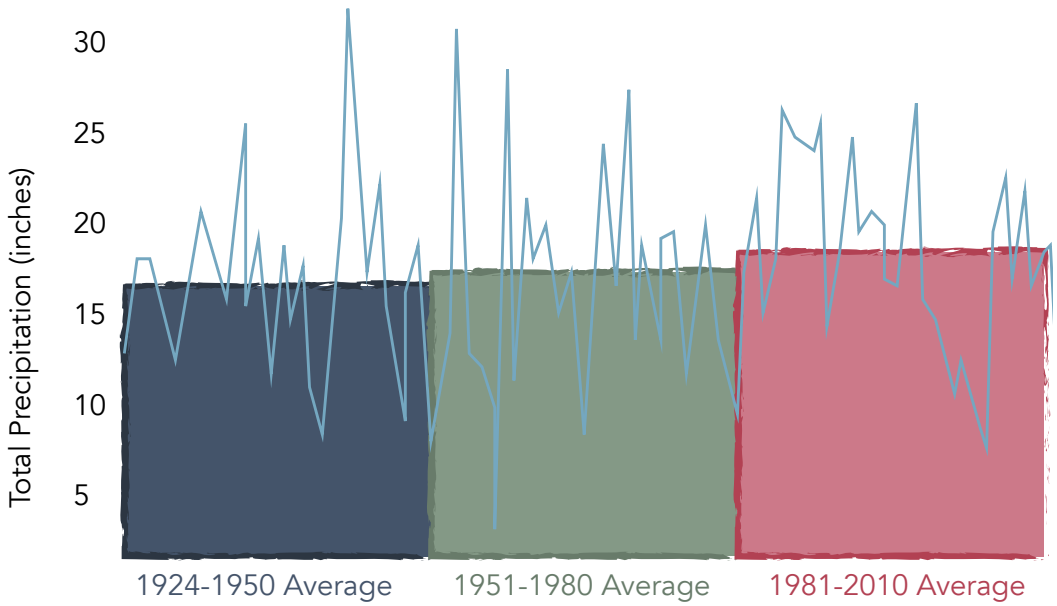
In 2018, rain in Los Alamos was below average for 9 of 12 months, and temperatures were above average for 10 of 12. This drier and warmer trend is consistent with the warming climate predicted across the Southwest. The data also means Los Alamos has, for another year, continued on the path of a now two-decade-long drought.

Meteorologists use several years of data to monitor the local climate. Local weather data is available back to 1910. These data are then used to generate 30-year averages, which give a better representation of historic trends. Below are a few takeaways from this latest data.

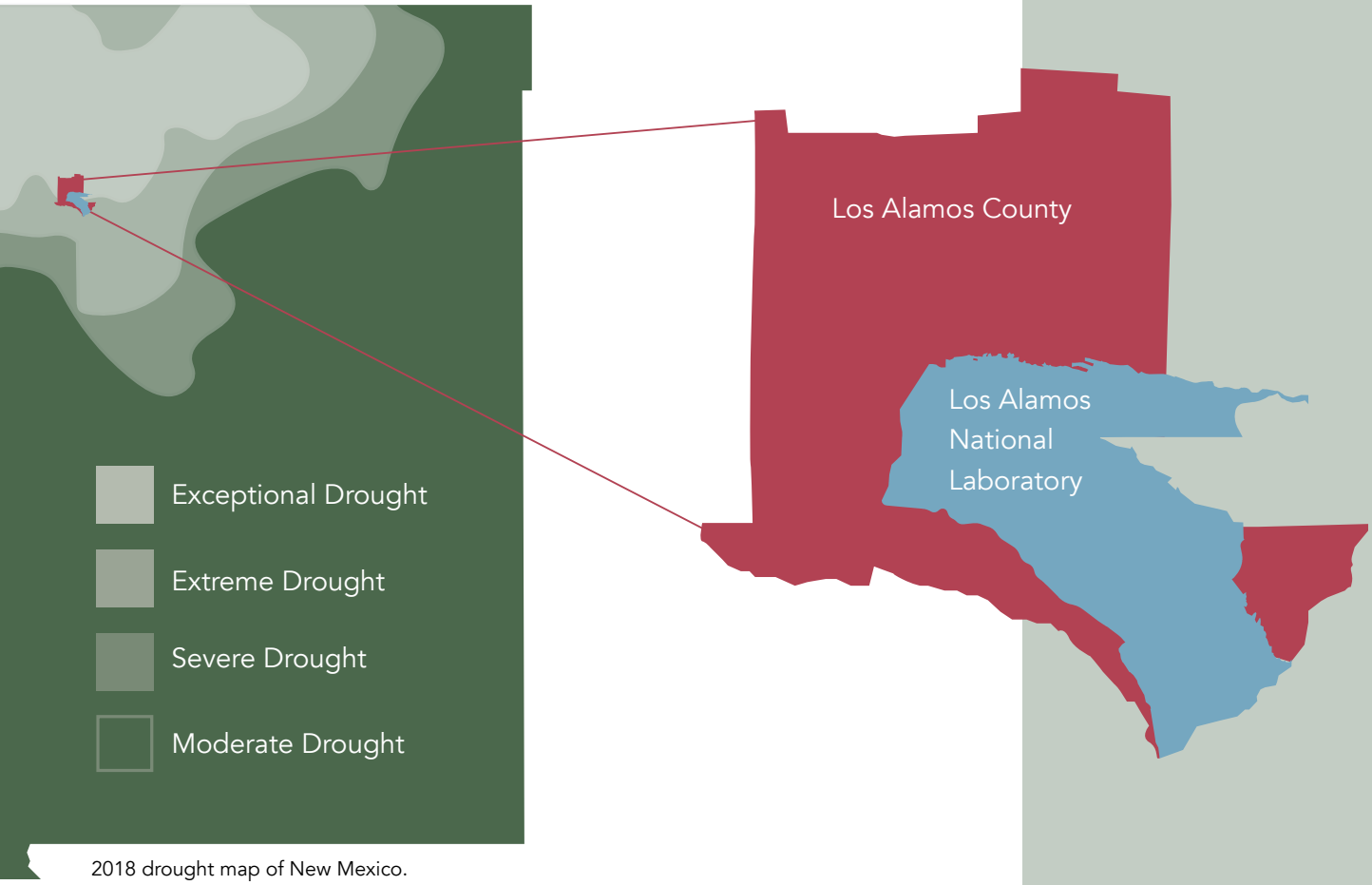
Temperature is increasing

As a whole, the Pajarito Plateau was 3 degrees Fahrenheit above historic averages, and 2 degrees Fahrenheit warmer than 2017. Average temperatures have consistently increased since 2011, which strongly suggests the climate is warming. Meteorologists predict this will only get worse, and its pace will increase in the future.

"Particularly during the fall," says the Laboratory's meteorologist David Bruggeman, "these increasing temperatures are leading to more precipitation falling as rain and a longer wildfire season."



The blue line follows the total precipitation for each year.



2018 drought map of New Mexico.

Precipitation is fluctuating

Los Alamos depends on about 50 percent of its annual precipitation to fall during the monsoon season (June 15 through September 30). During the winter, precipitation can fluctuate with the El Niño-La Niña cycle, giving the Pajarito Plateau relatively more precipitation during El Niño winters compared to La Niña winters.

In 2018, December snowfall on the Pajarito Plateau was 177 percent above average. But the yearly total precipitation was 4.94 inches below average, making 2018 a dry year.

How do we know if we are in a drought?

There is no universal standard for drought. Instead, meteorologists use regional averages to determine if precipitation in an area is below average. Generally, drought conditions are those that are dry enough to have social, environmental, or economic effects—meaning the status of the Pajarito Plateau can change rapidly and be difficult to predict. Meteorologists say the most recent drought in Los Alamos has spanned from 1998 to 2018.

Groundwater Monitoring

Chromium Plume Updates

New advances in controlling a historic chemical plume bring progress.

By Mariah Gonzales

From 1956 to 1972, as part of routine operations, a Laboratory power plant discharged water containing potassium dichromate into Sandia Canyon. The potassium dichromate was used as a corrosion inhibitor in the cooling towers for the plant. The contaminated water flowed into the canyon as surface water traveled through two groundwater zones where it eventually came to rest in parts of the regional aquifer. When these factors were combined with environmental conditions, a hexavalent chromium plume formed.

This process was slow, however, and the plume wasn't discovered until 2005 when data from a new monitoring well in Mortandad Canyon identified the chromium. Following an investigation, the Laboratory found the plume to be approximately a mile in length and half-mile in width and an estimated 50 to 100 feet deep in the regional aquifer.

To prevent the plume from migrating any farther, Los Alamos began to install and use extraction and injection wells. In this process the contaminated water is extracted, treated with ion exchange, and injected back into a nearby area, effectively creating a barrier between the plume and the uncontaminated water. This interim measure is a temporary solution while the Laboratory continues testing and developing a final remedy.

The Department of Energy's Department of Environmental Management is working to control migration of the plume so that it does not move into drinking water wells.

PM-3 (shown on the map on page 23) is a Los Alamos County drinking water well. Upgradient are R-35a and R-35b, wells installed by the Laboratory to monitor for hexavalent chromium.

These wells are used to monitor for potential migration of the plume towards PM-3 and to make sure that it has not reached the county water supply.

A monitoring well was also placed on San Ildefonso property—San Ildefonso Monitoring Regional (SIMR-1)—in order to monitor the plume's progress and determine whether it has migrated onto Pueblo land. The Laboratory has worked hard to make its environmental impact as minimal as possible during the construction of new wells and also took into consideration the cultural sites surrounding the project area.

In the meantime, there has been some progress made in decreasing the extent of the hexavalent chromium plume.

RDX Plume Updates

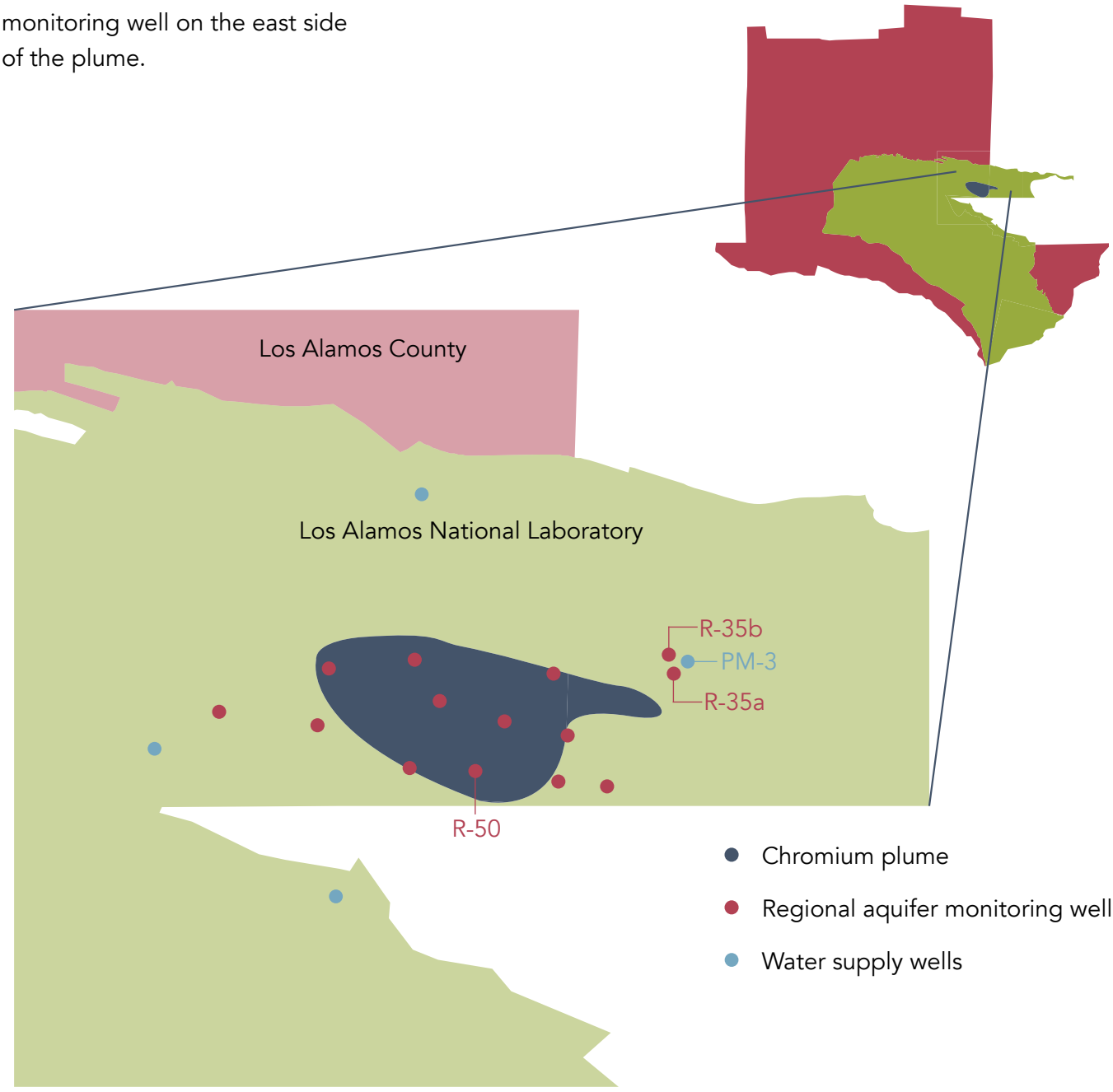
The highly soluble explosive compound Royal Demolition Explosive (RDX) was discharged into Cañon de Valle by Los Alamos National Laboratory from 1951 to 1996 when used in support of the nuclear weapons program. RDX infiltrated through the rock and shallow groundwater zones, and it reached the uppermost layer of the regional aquifer.

RDX concentrations in the regional aquifer, approximately 1200–1400 feet below ground surface, measure at levels below the New Mexico Environment Department tap water screening level of 9.66 parts per billion, except at two wells. The RDX contamination area is limited, and it is three miles away from the nearest public water supply well.

The Laboratory has recently submitted the first annual long-term Monitoring and Maintenance Report, following up on the completion of RDX surface layer cleanup. Los Alamos will also submit a report characterizing RDX in deep groundwater, including regional groundwater.

Recent data are showing that concentrations at R-50 are now below the state standard of 50 parts per billion. To keep track of the progress, the Laboratory has also constructed another monitoring well on the east side of the plume.

Building monitoring and extraction wells is difficult. New wells can cost millions of dollars and the topography varies greatly. At the deepest wells the boreholes extend to 1200 feet.



Layers of Groundwater

Understanding the three underground water layers that support the ecosystem.

By Mariah Gonzales

Alluvial groundwater

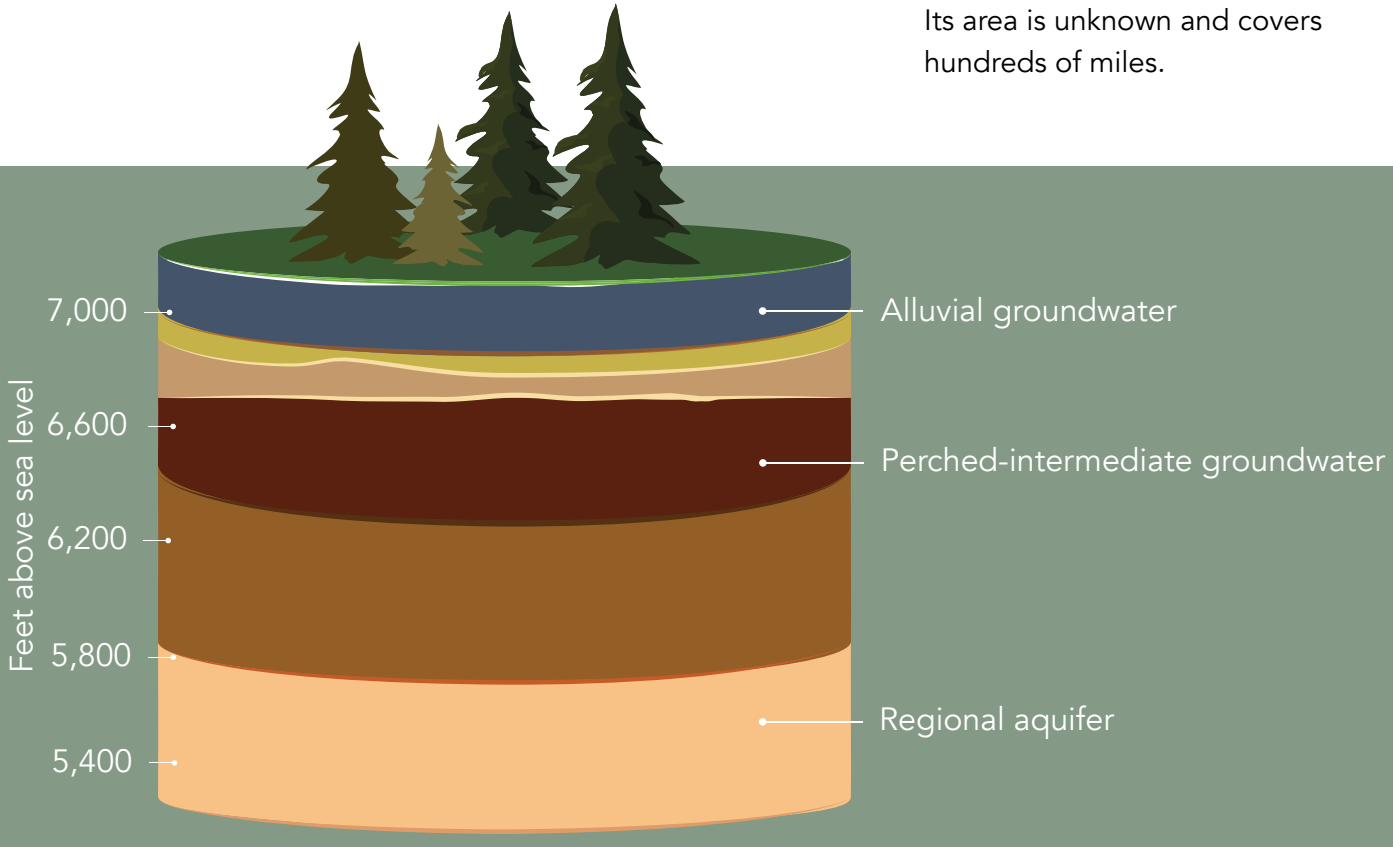
Alluvial groundwater forms in canyon bottoms and drainages in the first 50 feet below the surface when water soaking through sand and gravel reaches a layer of rock that it cannot flow past. This layer of groundwater sometimes is supported by and supports rivers and streams—alluvial groundwater and rivers contribute to one another. The alluvial layer is shallow enough that tree and shrub roots may reach it. In some areas of the Laboratory, outfall discharges support alluvial groundwater.

Perched-intermediate groundwater

Deeper than the alluvial groundwater layer, perched-intermediate groundwater bodies form in some areas of the Laboratory when water seeps to depths of up to 600 feet below the ground, but reaches an impermeable rock layer before it flows into the regional aquifer. From there, the water may travel further down or sideways through cracks in the rock. This groundwater layer sometimes feeds naturally occurring springs in canyon walls.

Regional aquifer

The regional aquifer occurs at depths of 600–1200 feet below the ground surface. It is separated from alluvial and perched-intermediate groundwater by geologic layers that are not saturated with water, including rocks such as tuff and basalt, and low-moisture sediment. This layer of groundwater lies in vast areas of saturated rock and sediment, and it is the source of the municipal tap water that Los Alamos County and the Laboratory use. It is also where private wells get their water. Its area is unknown and covers hundreds of miles.



What is an outfall?

An outfall is the location where a pipe releases the liquids produced from industrial processes to the environment.

Watershed Quality

Natural vs Laboratory Chemicals

Many sources in the Los Alamos area contribute to chemicals found in the environment.

By Caitlyn Cruz

Many of the chemicals found in storm water runoff in or near Los Alamos National Laboratory occur naturally and can be attributed to background sources. These include the natural composition of rocks and soil, wildfire residue, and chemicals deposited from the atmosphere. In fact, the New Mexico Environment Department Surface Water Quality Bureau states that many of the excess levels sampled "may reflect natural sources associated with geology of the region."

However, some of these chemicals can also be attributed to human activities, including historical Laboratory operations. Substances found at levels above New Mexico state standards are listed below.

Naturally Occurring

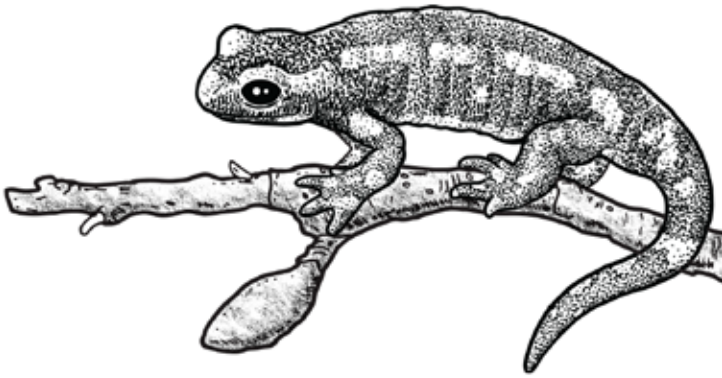
- Aluminum (Bandelier Tuff)
- Copper (forest fires/developed areas)
- Manganese (Cerro Grande fire in 2000)
- Selenium (Cerro Grande fire in 2000)

Natural and Human Derived

- Lead (developed areas/lead-based paint)
- Zinc (vehicle tires/motor oil)

Related to Los Alamos National Laboratory Operations

- Cadmium (fossil fuel combustion)
- Cesium-137 (nuclear reactor/weapon testing)
- Chromium (cooling towers)
- Dioxins and furans (municipal and private waste)
- Mercury (forest fires/fossil fuels, such as coal and petroleum)
- Polychlorinated biphenyls, known as PCBs (older construction materials and electrical components, including transformers)
- Polycyclic aromatic hydrocarbons (former Sandia Canyon asphalt batch)



Storm Water Sampling

Each year, Los Alamos National Laboratory checks for chemicals in water upstream and downstream and in local watersheds.

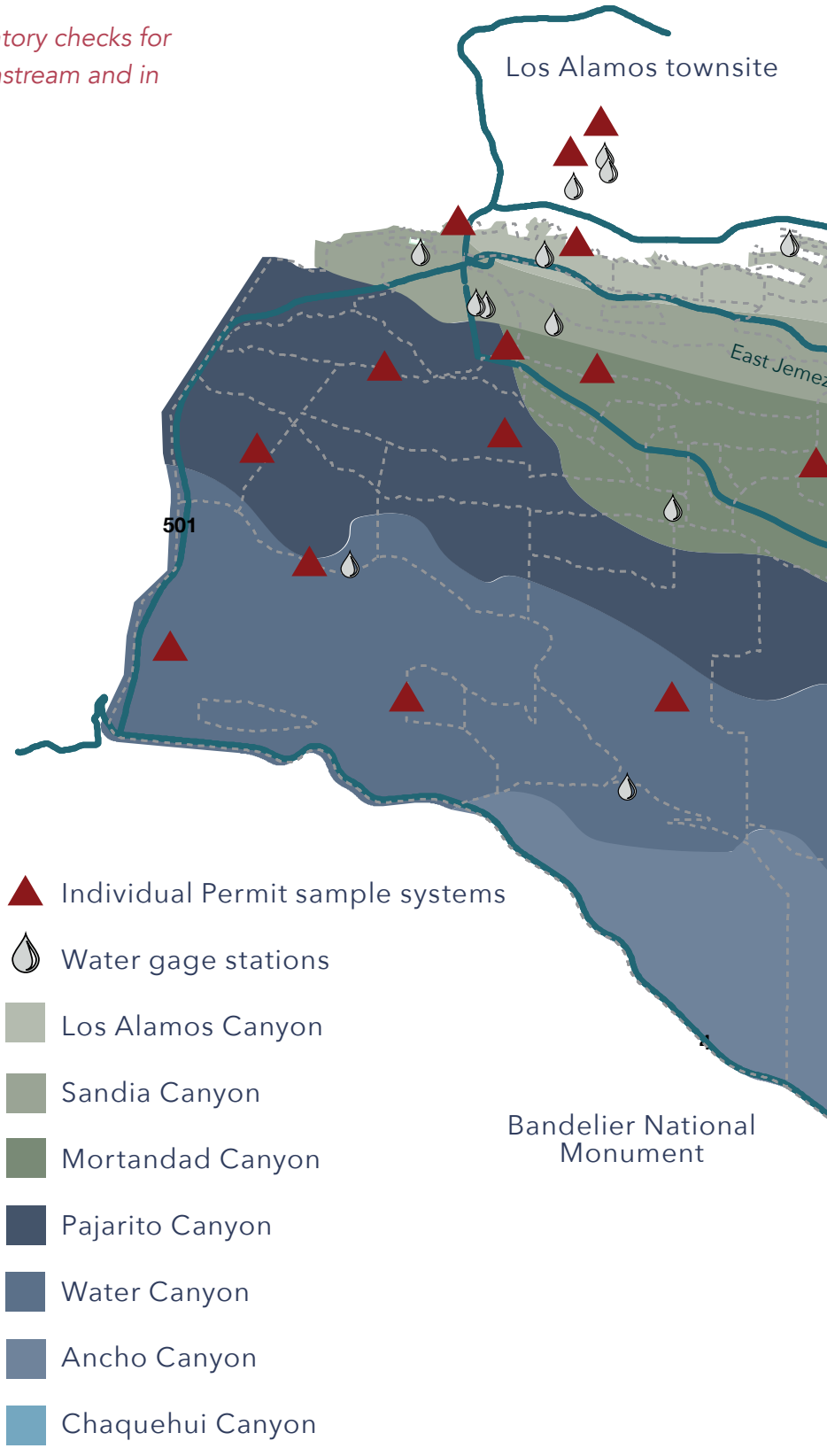
By Caitlyn Cruz

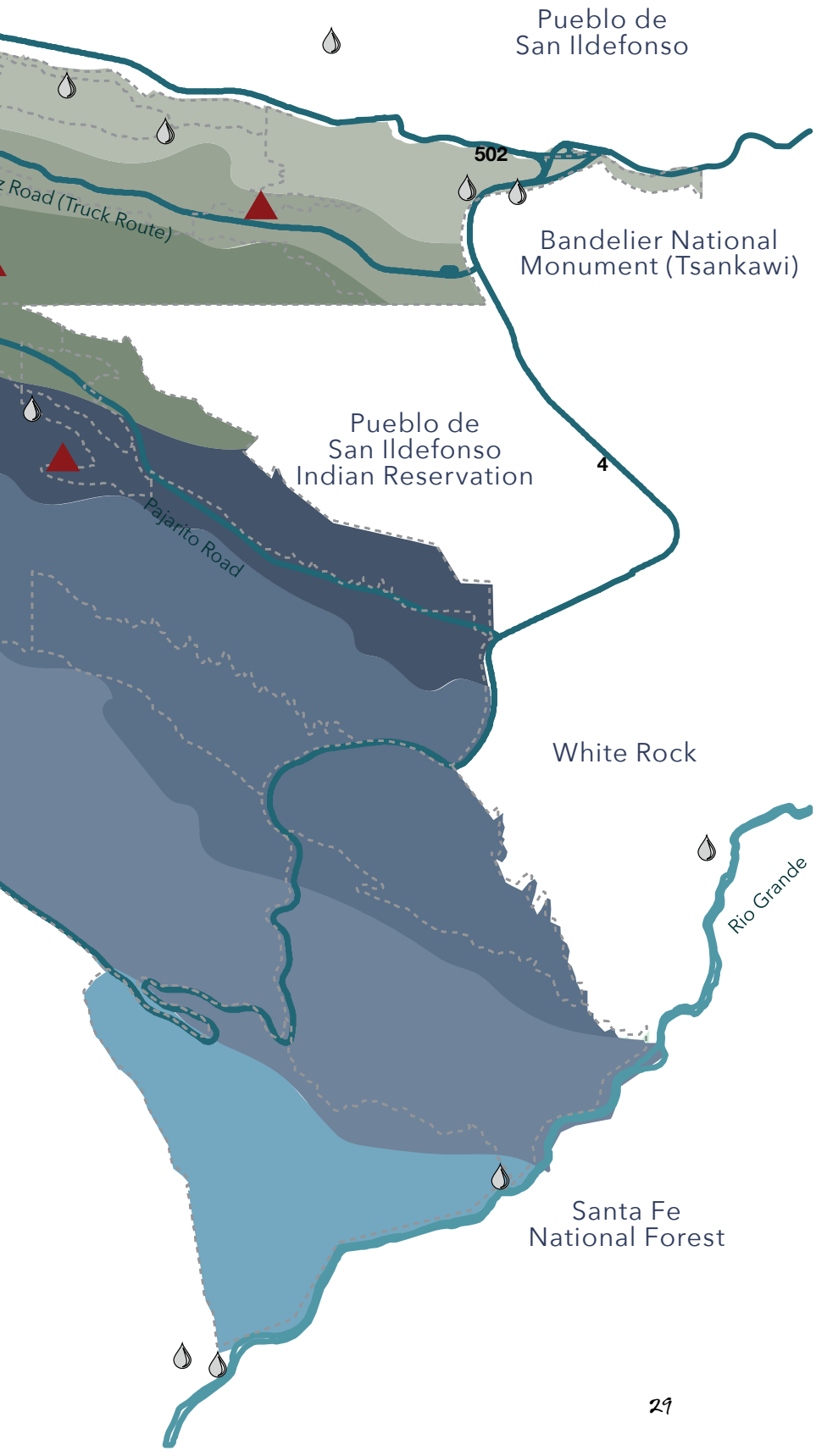
The Los Alamos National Laboratory is located within seven of the Rio Grande's primary watersheds. Each year, the Laboratory evaluates the quality of water upstream, within, and downstream of its property in order to measure levels of chemicals used in past operations that might impact the health of people or the ecosystem.

In 2018, the Laboratory maintained 37 gaging stations to measure the quantity and rate of stream flow.

Automated samplers were also used to collect storm water runoff in bottles when activated by stream flow. Additionally, to comply with the National Pollution Discharge Elimination System Individual Permit requirements, the Laboratory installed samplers in 250 sites to monitor runoff from solid waste management units and other areas of concern.

All automated samplers collect a "first flush" sample, which is water collected at the highest point of the storm, to ensure that samples contain the maximum concentrations of chemical constituents. Sampling usually occurs from June 1 to December 1 of each year.





Some of the chemicals tested for include copper, lead, zinc, mercury, and polychlorinated biphenyls, as well as radionuclides like cesium-137. The Laboratory also monitors naturally occurring chemicals like aluminum, arsenic, manganese, and selenium.

In 2018, storm water and base flow water samples were collected at 22 locations (shown on the map). Watershed quality samples contained traces of both organic and inorganic chemicals, as well as radionuclides. Some were above state or federal screening levels, but these were consistent with previous years and are in part owed to naturally occurring factors. For example, arsenic comes from both human-derived and natural sources. It exists in local volcanic rock, but can also be attributed to coal-fired power plants, which the Laboratory once operated. Copper, too, comes from human activities and can be found near explosive firing sites. But it is also a byproduct of forest fires.

All of the monitored chemicals and radionuclides fell in or below the ranges recorded in previous years, with the exception of mercury from Ancho Canyon. There is relatively little data for this watershed, which makes it hard to draw trends.

Ecosystem Health

Soil and Vegetation Monitoring

Through rigorous environmental testing, the Laboratory keeps an eye on chemicals and radionuclides.

By Raven Alcott

As environmental stewards, Los Alamos National Laboratory monitors chemicals and radionuclides in soil and vegetation to determine whether the Laboratory is affecting chemical concentrations or causing impacts on the environment. This monitoring is done in two ways: site-wide and facility-specific.

The site-wide evaluations measure radionuclides and chemicals within the Laboratory and its perimeter. Researchers compare these results to those from regional background locations 20 or more miles from the Laboratory. The facility-specific surveys, meanwhile, allow the Laboratory to measure the effect of specific buildings or operations.

In 2018, the Laboratory collected soil and understory vegetation from 19 onsite locations, 12 perimeter locations, and six regional background sites.

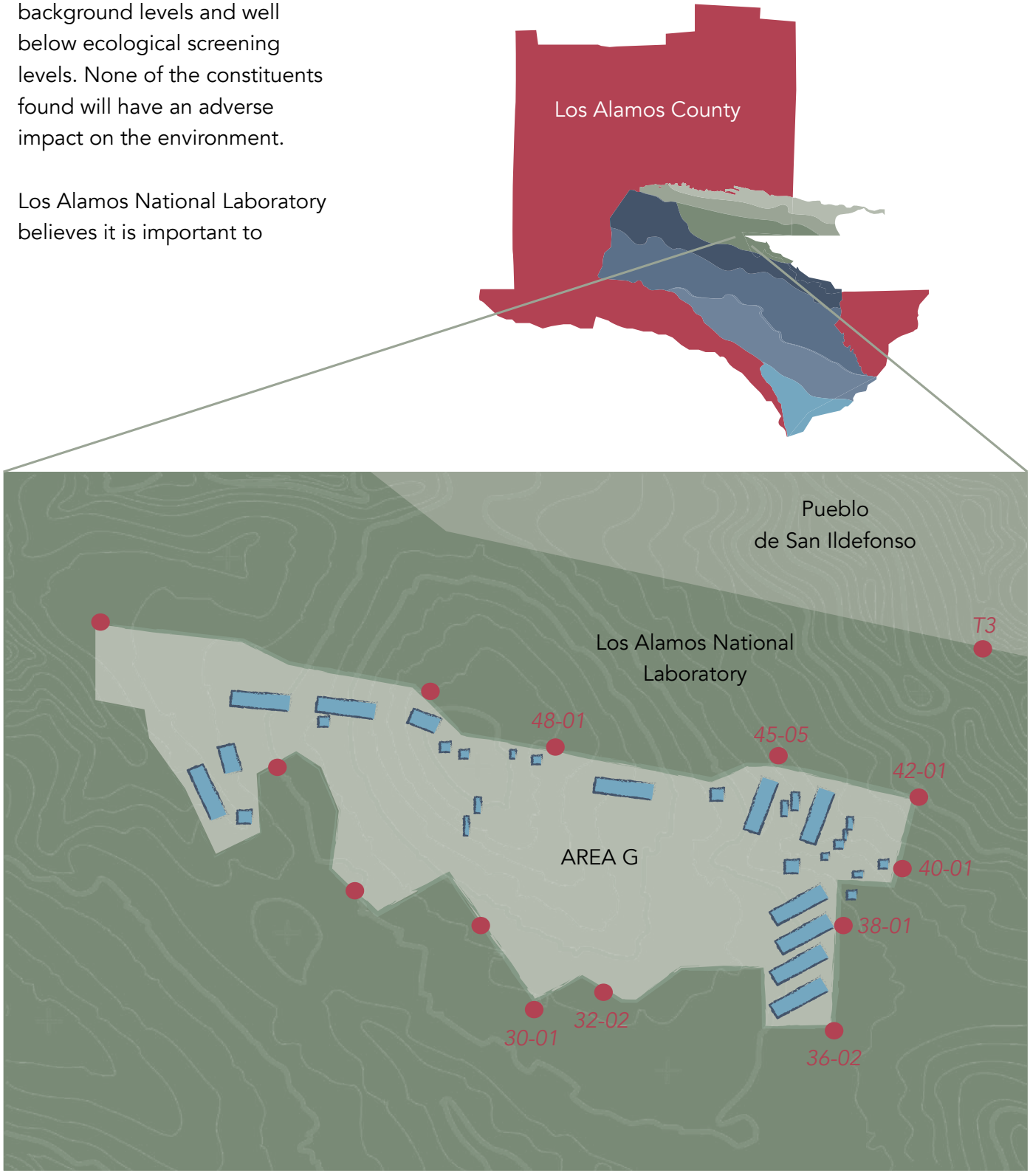
The vegetation was tested for radionuclides and metals, and soil was tested for radionuclides, metals, polychlorinated biphenyls (PCBs), high explosive compounds, dioxins, furans, and volatile and semi-volatile organic compounds. Vegetation samples were collocated with soil sampling locations.

In soil, the majority of radionuclides, metals, PCBs, high explosive compounds, dioxins, furans, and volatile and semi-volatile organic compounds were not detected, were similar to or below background, or were below screening levels, which are protective of the environment. The understory vegetation monitoring results for radionuclides and metals were similar to the soil results. Results of the sampling were of no ecological concern and proved to have no detrimental impacts to plant or animal life.

At Area G, a radioactive waste storage area in Technical Area 54, soil and vegetation were analyzed for radionuclides. Radionuclides in vegetation were below the biota dose screening levels.

In soil, plutonium-238 displayed an increasing trend at one location around Area G, but overall concentrations are below background levels and well below ecological screening levels. None of the constituents found will have an adverse impact on the environment.

Los Alamos National Laboratory believes it is important to continue monitoring the ecosystem to ensure that Laboratory impacts, if any, are not detrimental or causing harm to nature.



Biota Monitoring

Chemical and radionuclide testing show no harm to local plants and animals.

By Raven Alcott

Los Alamos National Laboratory pays close attention to the potential for storm water runoff to transport chemicals and radionuclides in the sediment downstream—especially after the 2000 Cerro Grande fire, which destroyed vegetation and increased erosion.

Following the fire, the Laboratory constructed sediment and flood retention structures in Los Alamos and Pajarito canyons to help control runoff and floods downstream.

The Laboratory monitors small mammals and vegetation upstream of these structures for adverse effects on plants and animals—collectively called biota.

Additionally, small mammals were monitored downstream of the Los Alamos Canyon weir on land belonging to Pueblo de San Ildefonso, as well as at the Dual-Axis Radiographic Hydrodynamic Test Facility, a primary firing point at Los Alamos.

Mice are good indicators for potential contamination because they're omnivores that live and feed close to the ground. Due to drought conditions this year, though, not enough mice were captured for radionuclide analyses at some of the locations monitored.

The upstream vegetation results at both retention structures showed that radionuclides were below biota dose screening levels—created to protect animals and plants—and were not changing over time. Several metals were detected in both vegetation and small mammals, though many metals occur naturally and levels were indistinguishable from regional background levels, which are used as a baseline measurement.

The majority of metals concentrations in mice observed at all monitoring locations were below regional statistical reference levels. Polychlorinated biphenyl (PCB) concentrations in the mice collected above the retention structure in Los Alamos Canyon were higher than regional statistical reference levels but lower than levels associated with adverse effects. However, PCB concentrations in small mammals collected downstream of the weir in Los Alamos Canyon on Pueblo de San Ildefonso land are decreasing over time, which suggests that the weir is successful at retaining Laboratory-derived PCBs.

At the Dual-Axis Radiographic Hydrodynamic Test Facility, mice were analyzed for metals, dioxins, furans, and radionuclides, and while the results showed that most metals were detected, all were below the regional statistical reference level. Only strontium-90 and all uranium isotopes were found to be above background levels; however, they persist at levels that will not harm the vegetation or animals. Dioxins and furans were evaluated, but only one was detected at minimal amounts. Operations conducted at this facility are shown to have no negative impact based on these results.

Although elements released from operation of the Laboratory as well as naturally occurring elements were detected in biota, Los Alamos monitors the concentrations of these constituents over time.

Thus far, none of the findings have suggested a detrimental impact to the ecosystem and the Laboratory intends to continue its monitoring.

Birds at Los Alamos National Laboratory

How do Laboratory operations impact the local bird population?

By Raven Alcott

Each year, the Los Alamos National Laboratory studies the richness, abundance, and diversity of the area's migratory bird population. To do this, the Laboratory set up a nest box network in 1997, has documented songbirds in the Pajarito wetlands for nine years, and in 2014 it opened a banding station in Sandia Canyon. By using these systems the Laboratory is able to monitor changes in the health of the local bird population as part of its requirement to do no harm to local species and to follow conservation laws like the Migratory Bird Treaty Act.

The Laboratory oversees more than 500 nest boxes, which target the western bluebird and the ash-throated flycatcher.

Beginning in April, the boxes are checked every week, or every other week, throughout the breeding season. Researchers count eggs, and they also collect those that are nonviable to test for radionuclides, inorganic elements, and organic chemicals. When the nestlings reach 12 days or older, they are banded, as well as some parents.

Common yellow throat

During 2018, the overall bird population remained constant; however, due to access restrictions put in place to prevent wildfires, researchers weren't able to visit as many boxes as in the past. Chemical analyses found low levels of radionuclides, metals, polychlorinated biphenyls (PCBs), and organochlorine chemicals in western bluebirds and ash-throated flycatchers, but these were determined not likely to cause adverse health effects in breeding birds. To better understand what impact the chemicals might have, researchers set up 96 nest boxes south of the Laboratory to serve as a reference.

At the bird banding station in Sandia Canyon, the Laboratory captured 264 birds representing 46 species and documented age, sex, weight, and fat to determine their health. In the Pajarito wetlands, researchers banded 342 birds representing 42 species.

Violet-green swallow

From 2010 to 2018, there was no noticeable change in the diversity of birds banded. But there was some change in the makeup of the bird community. While some species were more abundant than in the past, some insectivores like Virginia's warbler saw large declines in the area. Throughout this bird's national range, it has declined in population by 46 percent since 1970.

This is thought to be related to shifting climate factors, one of which in the Southwest is increased drought.

Western bluebird

Endangered and Threatened Species

In addition to an abundance of migratory bird species are the threatened or endangered species like the Mexican spotted owl and the Southwestern willow flycatcher.

However, researchers weren't able to conduct nest checks for Mexican spotted owls because wildland fire restrictions limited access. Although nest success was not determined for 2018, the Laboratory has documented active young in the past and is dedicated to protecting these species.

Public Dose and Risk Assessment

MEI Trace Radiation

A calculation of the worst-case scenario for radiation exposure shows no ill effects.

By Sam Menefee

Each year, Los Alamos National Laboratory calculates the Maximally Exposed Individual (MEI) for radiation. Rather than being an actual individual, the MEI is a hypothetical member of the public whose dose is measured by identifying the location with the highest concentration of radioactive material and calculating exposure as if that member were to stand in the same location, without leaving, for a year.

The Laboratory uses ambient air monitoring stations, exhaust stack sampling, and meteorological data paired with its air quality program to model the spread of radioactive material from Laboratory operations. The Laboratory then models this information to find both onsite and offsite areas with the highest concentrations of radioactive material, which are then used to determine the MEI.

Offsite MEI

In 2018, the offsite MEI was identified at 2470 East Road, generally near the East Gate area. A hypothetical individual standing at this spot would have received 0.35 millirem per year of radiation dose, which is less than 1 percent of the dose limit allowed by DOE regulations.

Onsite MEI

In 2018, the onsite MEI was East Jemez Road, near Technical Area 53. If a person were to spend an entire year standing in one spot at this location, that person would receive 0.8 millirem per year of radiation. However, joggers and hikers who pass through the area spend less than 1 percent of their time on East Jemez Road, meaning individuals receive true doses of less than 1 percent of 0.8 millirem per year.

What it means

On average, radiological dose to the public from Laboratory operations is under .001 millirem per year. Diligent air monitoring ensures that problems are solved in a timely manner, further reducing risk to the public. But even at the highest dose, radiation as a result of Laboratory operations is smaller than background radiation in Los Alamos County (approximately 800 millirem per year) by a factor of 0.00043.

With limited sources of radiation, emissions from

Laboratory activities are not only low, but also easily identifiable. For example, Los Alamos Neutron Science Center emissions and other significant stack emissions are the main contributors to radiation at MEI locations.

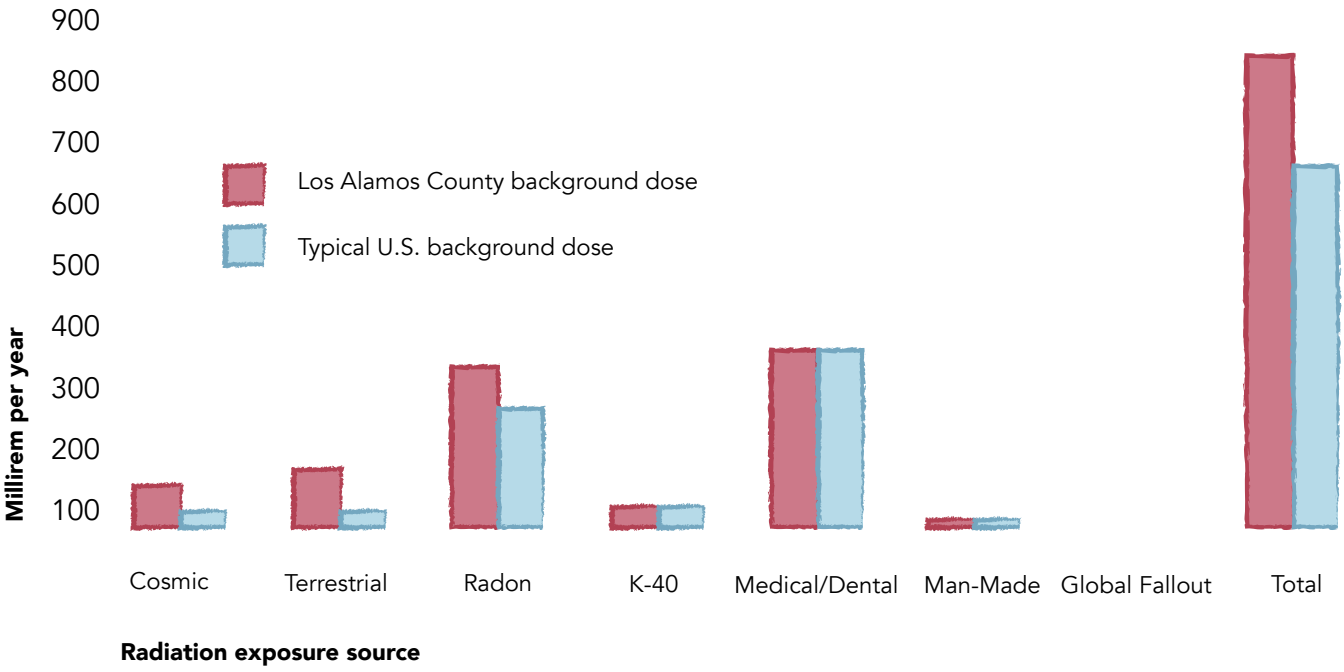
And even though the onsite MEI is larger than the offsite MEI, the difference between the two is not a result of fewer precautions taken on Laboratory property for limiting radiation.

Instead, the farther that person is from a source of radiation, the smaller dose that person will receive. As a result, surrounding land in Los Alamos and White Rock naturally has a lower MEI because of its distance from operations that would create radiation.

In conclusion, it is highly unlikely that a member of the public would be negatively affected by radiation as a result of Laboratory operations.

In fact, individuals on the Pajarito Plateau receive hundreds of times less radiation from Laboratory operations than they do from background sources such as medical x-rays, naturally occurring radon gas, and solar UV radiation.

Students visit the Vigil y Montoya excavation site.



Contextualizing trends

Due to the extremely low exposure individuals receive from Los Alamos National Laboratory, even small increases in dose can change trend data. This can be a result of alterations in radiation management, activity at Los Alamos Neutron Science Center, and procedures, all of which can result in relative increases but do not pose additional threat to the public.

For example, starting in 2015 and ending in 2018, collective dose to the population within 80 kilometers increased each year. Doses did not increase by more than a few tenths of a millirem per year, yet this change still caused the collective dose to increase even though it poses no public health risk.

Radiation Protection

Where do sources of radiation in Los Alamos come from?

By Ashlyn Lovato

According to the 2018 data, the estimated maximum possible radiological dose to the public by Los Alamos National Laboratory was less than 1 millirem, a measure of radiation energy absorbed by living tissue.

Under Department of Energy orders, the Laboratory is required to protect the public and environment from undue risk of radiological releases regarding any activity conducted on its property. Also, the Laboratory must not exceed 100 millirem of radiation dose a year, although for any exposure pathway, like food or water ingestion or the storage of waste, doses must not exceed 25 millirem.

Los Alamos National Laboratory

Doses from Laboratory operations are much smaller than those received from natural sources such as radon, terrestrial radiation, and cosmic radiation—all of which are natural sources that contribute to background, non-Laboratory radiation.

Synthetic

Background radiation can come from common man-made sources, like concrete, bricks, and granite slabs. But they also occur naturally.

Natural

Naturally occurring radon is high in Los Alamos because of its geographic location on the Pajarito Plateau beside the Jemez Mountains. Here, there is a higher than average uranium concentration in the soil, and uranium decays into radon.

Soil

Another form of background radiation comes from terrestrial radiation that originates from natural elements found in the ground and that have existed since the creation of Earth. For instance, potassium-40 naturally occurs within the human body and all living creatures.

Cosmic

Cosmic radiation, an energetic process in the sun and stars, also contributes to background radiation. The stars obtain energy from nuclear fusion, which emits energy in the form of radiation. Because of Los Alamos' high elevation, the area receives a higher dose of cosmic radiation.

But for the most part, the majority of background radiation received by any person in the United States comes from medical or dental appointments, which can produce as much exposure as 300 millirem per year.

Contributors

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Academic focus
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My summer at the Laboratory
"I have a deep passion for the environment because it correlates intricately with my culture. I am thankful to have been given the opportunity to explore that at the Laboratory."

Future ambitions
"After college, I want to have a job that allows me to take care of my family and people. I have the intentions to take care and give back to as many people as my capacities allow me to."

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Why the Laboratory
"I work with environmental protection and compliance at the Laboratory because it is my generation's responsibility to ensure tomorrow by improving today and preserving yesterday."

My summer at the Laboratory
"I have been given further insight into my home state with regard to endangered species and the history of where I call home."

Caitlyn Cruz

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Environmental science

Why the Laboratory
"I worked at the Laboratory because I wanted to gain skills and experiences that may influence my career path."

My summer at the Laboratory
"The internship helped me discover my passions for environmental professions and their significance."

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My summer at the Laboratory
"It was an amazing experience to work with people in different fields and expose myself to different careers that the Laboratory has to offer."

Future ambitions
"I am passionate about reading and writing and hope to someday work as an editor in a publishing house."

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Why the Laboratory
"I work at the Laboratory because it is a highly respected and cutting-edge facility that allows burgeoning young professionals to experience a wide range of different fields."

My summer at the Laboratory
"The Laboratory's student program has helped me to become better acquainted with how the Laboratory and other affiliated government entities operate, which will be vitally important for future employment."

Ashlyn Lovato

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Santa Clara Pueblo,
New Mexico

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Academic focus
Ethnic studies

What I learned
"I have a connection with the land, and working with the Cultural Resources Team allowed me to see ancestral pueblo sites and understand the process of protecting these sites."

My summer at the Laboratory
"My passions are Native American education, my culture, and law. This summer, I was able to see where my passions may play a role within the Laboratory."

Sam Menefee

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Why the Laboratory
"Working at the Laboratory for the summer was an amazing opportunity where I could do meaningful and interesting work without leaving my hometown."

My summer at the Laboratory
"My internship at the Laboratory provided me with a greater appreciation for the water, air, and land I interact with at all times."

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NNSA
National Nuclear Security Administration