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.

Annual Site Environmental Report Summary for 2021
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With record low fuel moisture levels, prolonged drought, and high wind conditions, the threat of wildfire near Los Alamos National Laboratory in 2022 was not a question of if, but when. So, in April, when the Cerro Pelado Fire started burning in the nearby Jemez Ranger District of the Santa Fe National Forest, the Laboratory’s Wildland Fire and Forest Health program was ready to act quickly to protect Laboratory property and personnel.

As the 45,605-acre fire encroached within four miles of Laboratory property, LANL’s Logistics teams from Heavy Equipment, Roads & Grounds, and Hoisting and Rigging thinned trees, cleared brush, and masticated potential fuels along West Jemez Road and New Mexico State Road 4.

Mastication, explains Wildland Fire Program Manager Jim Jones, “grinds potentially flammable biomasses—fallen limbs, dry weeds—into mulch.” That mulch then “goes back into the soil and provides nutrients for future native grasses and flowers.”

The fire mitigation efforts—thinning, clearing, and masticating—reduced combustible materials and created defensible space and a buffer zone along established evacuation routes to slow the spread of fire should it reach Laboratory property. These efforts were necessary to ensure mission continuity and protect valuable Laboratory infrastructure and resources.

The synchronization of efforts among the Emergency Management, Logistics, and Environmental Protection and Compliance divisions led to the successful mitigation efforts. “We have been so impressed with the Logistics Division crew’s attention to detail and commitment to modify their processes in order to maximize the protection of cultural and biological resources, habitats, and the environment,” says Sandi Copeland, Cultural Resources program lead for the Lab’s Environmental Stewardship group.

The Laboratory’s rapid response to the Cerro Pelado fire was, in part, due to interdivision planning and procedures developed because of lessons learned from previous wildland fires, particularly the Cerro Grande fire in 2000 that burned 7,500 acres of Laboratory property.

Responding to wildfire threat is not an easy task, but the Cerro Pelado fuel mitigation efforts at the Laboratory have shown that integrating resources, proper communication, and effective coordination allow for rapid responses to emergencies such as wildfires.
In 2021, and in accordance with the National Emission Standards for Emissions of Radionuclides Other than Radon, the Radioactive Air Emissions Management team continued preparations to vent four flanged tritium waste containers stored at Technical Area 54, the Laboratory’s legacy waste management area.

The venting is necessary to remove any pressure that may have built up in the containers to allow for safe handling and transportation. Tritium may have built up under pressure in the headspace of the containers, so venting releases the pressure. The excess gas then goes through an emissions control system before being released through a monitored exhaust stack. After the flanged tritium waste containers have been successfully released of pressure, the containers will be taken to the Laboratory’s tritium facility for further processing and eventually shipped to an approved offsite disposal facility.

The Laboratory held outreach meetings with local and regional Pueblos, the New Mexico Environment Department, and the Environmental Protection Agency in 2021 and 2022 to discuss the future of the project. The venting will not take place until all safety and formal readiness processes are complete.
Following public input, two new alternative routes for electrical lines through the Caja del Rio were recently proposed as part of the Electrical Power Capacity Upgrade project. In anticipation of the Laboratory’s increased power demands, the National Nuclear Security Administration proposed the Electrical Power Capacity Upgrade (EPCU) project to increase capability, improve reliability, and improve resiliency of the existing electrical transmission and distribution systems at the Laboratory to successfully align with and meet both Department of Energy’s and National Nuclear Security Administration’s strategic plan and mission. This extra electrical power is essential in case of a power outage at the Laboratory so that power can be stored so that integral assets such as the Trinity supercomputer can remain operational.

Part of the proposed Electrical Power Capacity Upgrade project involves installing an external transmission line through the northern portion of the Caja del Rio, an ecologically and culturally significant region in the Santa Fe National Forest for many descendant communities. Managed jointly through the Forest Service and the Bureau of Land Management, the Caja is home to multiple sensitive species, including several species of raptors. The National Nuclear Security Administration is taking this concern about the Caja del Rio and other concerns into account while analyzing impacts and drafting its Environmental Assessment for the EPCU project.

Additional concerns voiced by the surrounding Pueblos on the Caja and the general public center on how the Electrical Power Capacity Upgrade project will impact cultural and recreational opportunities, respectively. Because of the Caja’s long-established history and occupation, DOE has encouraged public engagement with and input to the EPCU Environmental Assessment to ensure that all the environmental impacts are taken into consideration. The National Nuclear Security Administration took the public’s and individual Pueblos’ concerns about potential impacts into account when creating the two newest proposed routes.
**Schematic of public scoping process for EPCU Environmental Assessment**

**Public Notification**
Opening the 30-day scoping period in National Environmental Policy Act (NEPA) process starts public involvement.

**30-Day Scoping Period**
Public can learn more about the proposed project and provide input during the 30-day scoping period and scoping meeting. The scoping meeting will be held a minimum of 15 days after the notice of intent has been published.

**Draft EA**
This document addresses the purpose and need of the project. The document also analyzes the potential impact of the proposed action and alternatives. The draft EA will be published at least 90 days after scoping ends.

**Public Comment Period**
The public has 30 days to provide comments on the content of the draft EA.

**Notice of Availability**
The availability of the draft EA to the public is announced, which initiates the public comment period.

**Final EA/Draft Decision Document**
This document, which includes updates to the draft EA and responses to public comments, is published at least 90 days after the period of public comment ends.

**Objection Period**
Per US Forest Service requirements, this step includes a 45-day timeframe that starts when the final Environmental Assessment is published. This timeframe allows for objections to be filed. If an objection is filed, the objection period is extended for 30 more days.

**Final Decision Document**
If no objection is filed, a final decision document is published — either a Finding of No Significant Impact (FONSI) or notice of intent to prepare an Environmental Impact Statement. With the issuance of FONSI, the project can begin.

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**EPCU = Electrical Power Capacity Upgrade Project**

Map of proposed routes for the new electrical transmission lines. Graphic information from NEPA division.
Compliance at a Glance

Environmental stewardship and compliance are core values of operations at the Laboratory.

Kyla Fugate

Air Quality and Protection

Clean Air Act Title V Operating Permit: The Laboratory is regulated based on its potential to emit air pollutants such as nitrous oxides, carbon monoxide, and volatile organic compounds.

New Mexico Air Quality Control Act: This state law requires evaluation of new or modified sources of air emissions.

Air Quality Facts: In 2021, the Laboratory’s emissions were significantly lower than the permit limits, measuring as low as 5 percent of the limit for particulate matter emissions. In addition, the estimated maximum dose of radionuclide emissions to a member of the public was 0.5 millirem, less than 1 percent of the limit allowed by the Clean Air Act regulations.

In an effort to reduce sources of ozone-depleting chemicals common in refrigerants, 2,380 pounds of refrigerant were sent offsite for disposal. Of that amount, 793 pounds were hydrochlorofluorocarbons, 1,192 pounds were hydrofluorocarbons, and 395 pounds were mixed refrigerants. Additionally, the Laboratory disposed of the last remaining fire-suppression system that used halon.

Natural & Cultural Resources

The National Environmental Policy Act (NEPA): Requires federal agencies to consider the environmental impacts of proposed activities, operations, and projects.

National Historic Preservation Act: Requires federal agencies to identify cultural resources and to consider, minimize, and mitigate any adverse effects their activities may have on historic properties.

The Endangered Species Act: Requires federal agencies to protect federally listed threatened or endangered species and their habitats. The Lab contains habitat for three federally listed species: the Mexican spotted owl, Southwestern willow flycatcher, and Jemez Mountains salamander.

Migratory Bird Act: Prohibits the unlawful hunting, capture, or killing of any migratory birds except those permitted by the U.S. Fish and Wildlife Service.

Natural and Cultural Resources Facts: In 2021, NEPA staff at the Laboratory reviewed approximately 1,060 proposed projects. During surveys performed in 2021, two pairs of Mexican spotted owls were found on Laboratory property in the same nesting locations as previous years.

In fiscal year 2021, Triad archaeologists supported 17 projects by conducting pedestrian surveys or verifying results from previous surveys. Triad historic buildings staff supported 21 Laboratory projects by performing inspections, archival documentation, photography, and research on the historical use of the buildings. Historic buildings staff also participated in surveillance and maintenance evaluations for the most significant historic properties at the Laboratory, including the 17 buildings and structures that are either included in the Manhattan Project National Historical Park or that are eligible to be included.

Other Environmental Protections

America the Beautiful Initiative – Executive Order 14008: Among other goals, this order outlines plans to conserve 30 percent of land and water by 2030. The DOE submitted its first conservation action plan under this initiative in December 2021, which will focus on outdoor recreation, conservation, and restoration.
DOE Order 436.1, *Departmental Sustainability*: Ensures that the DOE carries out its missions in a sustainable manner that addresses national energy security and global environmental challenges.

**Other Environmental Protections Facts**: In 2021, the Interim Implementation Guidance for the Justice40 Initiative, which secures environmental justice initiatives, was released as a new requirement of Executive Order 14008. The Environmental Management – Los Alamos field office was selected as one of five Department of Energy pilot programs to implement this requirement of the Executive Order.

The Sustainability Program completed $2.5 million worth of efficiency improvements across the site including LED installations, steam pit insulation, and building automation system design and installations.

** Radiation Protections**

DOE Order 458.1, *Radiation Protection of the Public and the Environment*: Department of Energy (DOE) facilities are regulated to keep radiological doses to the public and environment as low as possible.

**Radiation Protection Facts**: In 2021, the estimated maximum radiological dose to a member of the public from Laboratory operations was less than 1 millirem, well below annual DOE dose limits. Approximately 68 tons of metal that was potentially radioactive were surveyed, assessed, and then recycled from the Los Alamos Neutron Science Center’s accelerator operations.

**Waste Management**

DOE Order 435.1, *Radioactive Waste Management*: Ensures that all DOE radioactive waste is managed in a manner that protects the health of workers and the public and maintains environmental safety standards.

**2016 Compliance Order on Consent**: Made between the New Mexico Environmental Department and the Laboratory, this order provides the timetable and requirements for cleanup of contaminants released to the environment during past operations.

**Federal Facility Compliance Act**: Requires federal facilities that generate or store mixed radioactive and hazardous wastes to submit a site treatment plan. The plan includes a schedule for developing capacities and technologies to treat all mixed waste.

**Resource Conservation and Recovery Act**: Regulates hazardous waste through all stages of its life cycle: generation, storage, and eventual disposal.

**Waste Management Facts**: During the fiscal year 2021, levels of mixed low-level waste and mixed transuranic waste covered under the site treatment plan decreased because of offsite shipments to the Waste Isolation Pilot Plant and administrative adjustments.

Mixed low-level waste decreased from 285 cubic yards to 200 cubic yards and mixed transuranic waste decreased from 2,059 cubic yards to 1,963 cubic yards.

Four reports on soil vapor monitoring were submitted in accordance with the permit requirements for the Technical Area 63 Transuranic Waste Facility.

**Water Protection**

**Clean Water Act**: Aims to restore and maintain the chemical, physical, and biological integrity of the nation’s waters and requires a permit for effluent and storm water discharges.

**Energy Independence and Security Act**: Section 438 of the Energy Independence and Security Act of 2007 establishes storm water runoff requirements for federal development and redevelopment projects through infiltration, evapotranspiration, and harvest and reuse.

**New Mexico Water Quality Act**: Establishes standards for groundwaters and surface waters in the state by defining designated uses, criteria to protect those uses, and an anti-degradation policy.

**Water Quality Facts**

In 2021, the Laboratory collected 807 water samples at various outfalls on Laboratory property. Only 1.0 percent of these samples exceeded the permit limit and was immediately addressed by correcting the cause or by ceasing discharge until corrective actions could be implemented. In addition, Triad created 35 storm water pollution prevention plans and performed 830 inspections, with 95.3 percent of the sites fully compliant.

In addition, activities during 2021 to comply with the Lab’s Individual Permit included publishing an update to the 2020 Site Discharge Pollution Prevention Plan, completing 1,424 inspections of storm water controls at the 250 site monitoring areas, and conducting storm water monitoring at 138 site monitoring areas.
The Importance of Pollinators at the Laboratory and Worldwide

Los Alamos helps mitigate the decline of pollinator species, which are essential to ecosystem health, stability, and food production.

Makenzie L. Quintana

The Department of Energy’s Pollinator Protection Plan, finalized in the spring of 2021, is part of a national strategy to protect pollinators and enhance their habitats. Los Alamos, New Mexico, is home to many animal pollinator species, such as ants, bats, beetles, butterflies, birds, and bees. There is increasing evidence that pollinator species are declining all over the world, which will have severe consequences for agricultural areas. Pollinator declines are attributed to pesticide exposure, parasites, loss of habitat, and invasive species.

Invertebrate pollinators such as the monarch butterfly (*Danaus plexippus*) and numerous bumble bee species, including the western bumble bee (*Bombus occidentalis*), Morrison bumble bee (*Bombus morrisoni*), and American bumble bee (*Bombus pensylvanicus*) have been documented in Northern New Mexico and are declining in population. For example, the monarch butterfly was recently warranted for listing by the U.S. Fish and Wildlife Service under the Endangered Species Act but is not yet listed due to higher-priority listing actions. The U.S. Fish and Wildlife Service decided that federally protecting the western bumble bee may also be warranted and is currently conducting a status review of the species with a target listing decision in 2023.

The focused efforts outlined in the Laboratory Pollinator Protection Plan will preemptively inform management actions and compliance practices should any of these species be federally listed in the near future. As a good environmental steward, the Laboratory can help maintain quality habitat for pollinators during new construction, building renovations, landscaping improvements, and in facility leasing agreements. Managing habitat for pollinator species includes providing the basic elements for food, protection, and reproduction to ensure long-term species productivity.

The Laboratory’s Environmental Stewardship group is implementing the Pollinator Protection Plan by working with internal partners, Laboratory programs such as Wildland Fire and Forest Management, Stormwater, and Roads and Grounds. When completing roadside vegetation mowing management—a very important wildland fire protection strategy—crews are aware of and consider the pollinator resources as they are able.

The Pollinator Protection Plan makes mowing management guidelines based on peak pollinator abundance and is one of the many key efforts in the Laboratory’s environmental stewardship for pollinators. Laboratory subject matter experts check milkweed that is slated for mowing for monarch butterfly eggs and caterpillars. Also, the Laboratory has incorporated some pollinator-specific plant species, including host plants for monarchs, into the official LANL reseeding mix that is used after ground disturbances. Ensuring that reseeding with native species occurs after ground disturbance not only provides better storm water control and reduced erosion but also provides food to native pollinators.

Other initiatives have included outreach activities and community involvement to increase public awareness of the importance of pollinators and the steps that can be taken to protect them.
Bees are considered the most dominant species in most ecosystems. More than 500 species of bees have been reported in New Mexico, with the potential of additional species that have either been unnamed or understudied.

Pollination must occur for a plant to produce fruits, seeds, or young plants. Pollinators are organisms that facilitate plant reproduction by moving pollen from the male part of the flower to the female part of the same or another flower. Pollinators are responsible for helping more than 90% of the world’s flowering plants reproduce and are therefore critical to our food supply as well as to the health and resilience of ecosystems.

The White House issued an executive order in 2021 asking federal agencies to assess their environmental impacts, including impacts to pollinators. This order sounded the alarm for pollinator protection, reiterating that the disappearance of bees and other pollinators is reducing crop yields and threatening food security.
Over the past ten years, the Sustainability Program at Los Alamos National Laboratory has decreased energy and water consumption and aims for net-zero carbon emissions by 2050.

Kyla Fugate

Los Alamos National Laboratory’s Sustainability Program celebrated its 10-year anniversary in 2021. The program manages, implements, and tracks various goals set by presidential executive orders and Department of Energy (DOE) policies.

Currently, the Sustainability Program is developing a zero-carbon campus plan to transition the Laboratory’s supply of energy to low- or no-carbon energy sources. Since the Sustainability Program was launched, the Laboratory has reduced water use by 20 percent and energy use by 8 percent.

Some of the program’s current projects include the Sanitary Effluent Reclamation Facility, LED lighting upgrades, solar energy panel installation, and the addition of electric vehicle charging stations. These initiatives have allowed the Laboratory to align new construction projects with initiatives to lower carbon emissions, water use, and energy use initiatives on site.

The Sustainability Program is making important strides for the future sustainability of the Laboratory. But how does the program ensure that these initiatives are compliant with environmental regulations?
As part of the Environmental Stewardship group, the National Environmental Policy Act (NEPA) team ensures the environmental compliance of projects at the Laboratory, including these sustainability initiatives. Every proposed project at LANL is reviewed by NEPA subject matter experts through the Integrated Review Tool to determine if environmental impacts were analyzed in the 2008 Site-Wide Environmental Impact Statement (SWEIS) or other NEPA documents. Potential impacts are also tracked in a SWEIS yearbook on an annual basis. The yearbooks are a testament to the Laboratory’s consistency in meeting environmental standards established by federal NEPA compliance and can be accessed in the Electronic Public Reading Room.

The Sustainability Program has worked across the Laboratory to seek and propose projects that have a cost-effective life cycle, will conserve water and energy, will promote cleaner and safer operations, and have a plan for climate resiliency. The program envisions a Laboratory where resources are managed sustainably, with the hope of the Lab becoming a sustainability leader and model to other DOE sites.
The Importance of Site Cleanup

The Site Cleanup and Workplace Stewardship Program encourages Laboratory employees to be environmentally conscientious.

Beatrice Nisoli

In 2021, the Laboratory’s Site Cleanup and Workplace Stewardship Program partnered with other groups to develop a workplace stewardship section of the Laboratory’s Space Management policy in its procedure regarding proper disposal of unneeded material. The program continues to operate on its belief that segregating, reusing, and recycling items from waste is a sustainable practice that reduces cost because classifying unneeded material as waste is not always the best path.

The Site Cleanup and Workplace Stewardship Program was established at the end of fiscal year 2013 to help rid the Laboratory of excess legacy waste and abandoned material. The initiative has evolved into a coordinated effort to develop an enduring and efficient cleanup process that maximizes efficiency and reduces costs for the Laboratory. Employees in the program evaluate a potential cleanup project before discussing how best to initiate the project and bring it to a successful resolution, both environmentally and fiscally.

Such solutions can face challenges, including the expense of varying timeframes and cost outcomes. The program receives a budget through institutional funding and considers proposals from Laboratory organizations interested in having a cleanup project funded. Other groups and divisions can use their own budget to dispose of legacy material and equipment left behind by previous employees and older projects. Site Cleanup staff are involved in the entire cleanup process, including trainings that instruct participants on properly closing out projects and salvaging unneeded materials to avoid future abandoned equipment. On average, the Site Cleanup Program handles thirty cleanup initiatives annually.

A critical program accomplishment involves the segregation of recyclables from waste. Andrea Pistone, who has managed the program since its 2013 inception, says, “Too many people assume everything is waste. If we take the time to segregate recyclables and salvageable items from actual trash and waste, we reduce environmental impacts and waste costs.”

For example, in the past year, the program was tasked with disposing of abandoned refrigerators. Oils and refrigerants are drained from the...
refrigerators. Before being sent to recycling, the fluids are then properly disposed of, rather than treating the entire unit as waste. This method ensures affected sites are still cleaned and recyclable material can be reused while preventing the inadvertent release of greenhouse gasses and environmental toxins.

A project from 2021—the Transportainer 60-192 Cleanup Project—is a continuation of an ongoing effort to clean up storage structures abandoned by the Cerro Grande fire rehabilitation project in the early 2000s. Because of a continuing increase in the cost and liability of maintaining these abandoned materials, the Site Cleanup Program set in motion the effort to clean out and remove old storage structures that are then either salvaged or sent to metal recycling.

Dave Keller, who has been with the program for seven years, advocates environmental conscientiousness when approaching a project: “It is so important to analyze what you’re doing and think about what kind of footprint you’re leaving. Think about the process and address each project’s future environmental ramifications.”

This Cerro Grande–era transportainer will be recycled after the items are removed and the container is cleaned. This photo depicts a transportainer cleaned interior and recycled parts post-project. Items from this transportainer have been safely removed, making this container ready for recycling.
The Laboratory’s location nestled on mesa tops, surrounded by forests and mountains, although beautiful, places the Lab at increased risk for intense wildfires.

In the last century, past efforts to control wildfires by quickly extinguishing them have led to forest overgrowth, which can then cause fires that burn hotter and become uncontrollable. Additionally, hotter temperatures, unpredictable precipitation, and more frequent wind events caused by climate change add to the wildfire risk by creating a longer fire season and drier, more flammable fuels.

In 2021, to help address the increased threat of wildfires, the Laboratory started the Forest Health Program, which partners with the Wildland Fire Program, to plan and implement forest management and restoration projects as one integrated program tackling wildfire mitigation within regulatory constraints.

The main goals of the integrated program are to collaborate with wildland fire and environmental subject matter experts to plan and implement fire mitigation treatments, reduce risk of fire affecting Laboratory infrastructure, and help the forest become healthier. Most recently, this work has focused on thinning trees around Laboratory property to return the forest to a healthier density.

Thinning, the process of removing trees from a forest, is an important fire mitigation treatment. High stand density negatively impacts the available sunlight, water, nutrients, and growing space for each tree. Overgrown forests are also more susceptible to wildfire. The Forest Health Program conducts field work before thinning treatments to gather baseline data on tree density and forest structure. That data inform the number of trees to remove.

Stand density is an important factor for the monitoring and tree marking process because it is related to the space between each tree. Thinning treatments aim for a mosaic of stand densities within the forest, with some areas as low as 10 trees per acre and others closer to 125 trees per acre. By working together, wildfire risk reduction in turn increases forest health and resilience.

The work and planning of forest thinning is designed with input from environmental subject matter experts to ensure that treatments follow Laboratory standards and federal requirements. For example, collaboration with the Biological Resources team ensures forest treatments protect sensitive species habitat, and collaboration with the Cultural Resources team protects important archaeological sites and artifacts during treatments.

With repeated monitoring, the Laboratory observes whether goals are met and uses the data to document changes to the forest over time. This helps guide and improve forest health and resilience in the most effective methods in the face of climate change. The Forest Health Program has become an important addition to the Laboratory to ensure environmental compliance while protecting Laboratory property and habitat.
This photo shows an unhealthy ponderosa pine forest on Laboratory property at a stand density of approximately 500 trees per acre.

A healthy ponderosa pine forest on Laboratory property has a stand density of approximately 45 trees per acre.

Wildfire Mitigation Treatment Cycle

1. Site-wide Fire Risk Assessment
2. Identify & Prioritize Mitigation Projects
3. Project Planning & Pre-treatment Monitoring
4. Project Implementation & Oversight
5. Post-treatment Monitoring & Documentation
6. Inspections & Forest Health Assessments
Finding a New Manhattan Project-Era Site

Cultural Resources staff are sharing new insights on the Manhattan Project.

Keenan Greywolf

This aerial photo shows a section of the Laboratory, in Technical Area 6, where a piece of history was found.

In 2021, the Laboratory’s Cultural Resources team began a resurvey of an area in Technical Area 6 to confirm that proposed development would not impact any cultural resources. Under its project review responsibilities, the Cultural Resources team ensures that the Laboratory complies with federal and state regulations. During the resurvey, the Cultural Resources team found a concrete post base that bore the inscription “Dedicated August 16, 1944,” indicating the post dated to the Manhattan Project. The resurvey resulted in the identification of a new archaeological site.

With more than 1,800 archaeological sites, ranging from pre-Hispanic to historical periods, the Laboratory adheres to the National Historic Preservation Act to preserve the area's cultural heritage. The act requires that federal agencies identify and evaluate all historic properties. To comply with these regulations, LANL’s Environmental Stewardship group implements the Cultural Resources Management Plan, which governs the program’s work in support of the Laboratory’s mission. Routine implementation of the management plan led to the identification of the aforementioned site.

The Manhattan Project National Historical Park uses historical resources to maintain and interpret the Manhattan Project’s legacy. Laboratory staff researched and determined the new historical site is a water-recovery method firing pad site, built during the Manhattan Project to help scientists recover plutonium while building the atomic bomb. It is located less than a mile west of a similar Park-eligible structure known as the Concrete Bowl.
This new site stands as a precursor to the Concrete Bowl. During the era of the Manhattan Project, the scarcity of plutonium majorly hindered scientists’ attempts to create an implosion bomb.

“The scientists of Project Y were going to use half the world's supply of plutonium on a thoroughly tested, but still unproven, implosion design,” says Elliot Schultz, a historian of science with the Laboratory’s Historic Buildings team.

Failure to find a way to efficiently recover plutonium would undoubtedly have resulted in the collapse of the implosion bomb efforts. Thus, a special recovery group was tasked with testing methods of plutonium recovery, including water recovery, which used water to catch and recover plutonium used in implosion design experiments.

This newly recorded site captures an important historical episode in the creation of a plutonium implosion bomb. The site consists of five features, most of which are related to plutonium recovery via the water method. One such feature, a concrete post base, includes what appears to be several people’s initials who were presumably associated with the experiment or constructed the concrete base. The site’s significance and integrity makes it eligible for listing in the National Register of Historic Places.

This newly identified site offers an important view into the lives of Manhattan Project workers and provides additional context and interpretive opportunities for the Park.

As of 2021, Laboratory staff supporting the Park are working closely with staff education initiatives, such as the Weapons Engineering Study Hall. Created for use in virtual reality environments, photographs of Manhattan Project-era buildings help document Park structures and provide the unique opportunity to virtually visit areas of the Park not normally accessible to the public because of mission-related work.
Pollution Prevention Initiatives

In 2021, the Pollution Prevention Program funded projects that address waste-related risks across the Laboratory.

Caitlyn Cruz

The Pollution Prevention program at Los Alamos National Laboratory works to reduce waste, to fund projects that eliminate or reduce use of hazardous chemicals and other pollutants, and to research and identify emerging contaminants.

Several programs collaborate with Pollution Prevention to reduce the Laboratory’s impact on the environment.

The Chemical Management program, established in 2020, coordinates with Pollution Prevention to optimize the purchase of hazardous chemicals and enforce proper chemical inventory site-wide. In 2021, Chemical Management staff introduced updated barcode scanners to simplify compliance with the annual inventory requirements. Employees scan the barcodes of chemical containers for inventory transfer, and document when chemicals are disposed of. The new system also prevents duplicate scans from being uploaded into the database, which limits the possibility of errors during upload.

The new scanners are a big technological step forward for chemical management at LANL, says Kellan Lamb, the program lead for the Chemical Management program. “Our hope is that the scanners will reduce the administrative burden of the annual inventory process and help chemical custodians get back to their workday faster.”

Through the introduction of new inventory technology, Chemical Management is making it easier for LANL staff to track their chemicals. This tracking will help prevent unnecessary chemicals from coming on site and increase use of chemicals already in the inventory.
Pollution Prevention also collaborates with the Sustainability program to focus on climate issues. In 2021, the programs collaborated on two initiatives related to the Laboratory’s response to climate change. These initiatives include reduction of climate change causing pollutants on site and the creation of a LANL Vulnerability Assessment and Resilience Plan.

Both programs are continuing to reduce sulfur hexafluoride—a potent greenhouse gas commonly used as an insulator in the electric power industry. Although it is colorless, odorless, nonflammable, and nontoxic, sulfur hexafluoride is a potent greenhouse gas because of an atmospheric life span of 3,200 years and a global warming potential that is 22,800 times that of carbon dioxide.

As sulfur hexafluoride is used in Laboratory operations, both Pollution Prevention and Sustainability programs purchased gas recovery systems to reduce the emission of the gas. Pollution Prevention plans to continue reduction and elimination efforts through testing and development of an alternative gas.

The Vulnerability Assessment and Resilience Plan project, a DOE initiative to assess and manage climate related risks, was completed during fiscal year 2022.

Inventoried and stored chemicals on site.

Gas recovery systems that capture sulfur hexafluoride.
Measuring Wind Speed and Fuel Moisture

Recent upgrades to Los Alamos National Laboratory’s meteorological system improve safety and environmental monitoring.

Ashlyn T. Lovato

Every year, the Meteorology program measures and collects data on wind speed and direction, temperature, atmospheric pressure, humidity levels, dew point, precipitation, and solar and terrestrial radiation. These measurements are taken by equipment installed at all eight meteorological tower sites on Laboratory property, including three new towers.

Meteorological towers are sited to provide good exposure to wind and precipitation for accurate data collection. In addition to fuel moisture monitoring, which monitors dead plant matter that could pose a fire risk, three new meteorological towers were built in 2021 (Technical Areas 54, 16, and 63).

Currently, there are eight meteorological towers located throughout Laboratory grounds. Seven of these are located on mesa tops (Technical Areas 06, 49, 53, 54, 54B, 16B, 63) and one is located at the bottom of the Mortandad Canyon.

Meteorological monitoring in Los Alamos has been conducted since 1910. When the Manhattan Project began at Los Alamos in 1943, the previous data were compiled to assist with recording weather trends.

Today, meteorological monitoring is crucial for Laboratory activities and supports many programs, such as emergency management operations, the Lab Safety Basis group, environmental surveillance, engineering, regulatory compliance, and a host of other programs.

Safety Basis, an internal customer to the Laboratory, collaborated with the Meteorology program to fund the three new towers. The purpose of the new towers is to eliminate the location and data gaps between the existing towers. The three new towers can monitor and analyze meteorological data for safety operations specific to that location. As David Bruggeman, of the Meteorological Program says, “There is complex terrain across the Laboratory, so the more observations, the better.”

The fuel moisture instrument monitors moisture content on six out of the eight meteorological towers. The purpose of monitoring fuel moisture is to record the percent of moisture in fuel (dead vegetation) that contributes to the levels of moisture content on the ground surface. Monitoring fuel moisture is crucial data to inform wildfire land mitigation practices and to compare trends before and during monsoon season. “All three new towers have fuel moisture instruments to help cover the whole Laboratory with fire mitigation data for better coverage and detail overall,” says Kenneth Waight of the Meteorological program.

The three new meteorological towers and the fuel moisture instruments will help researchers and the Laboratory gain a greater understanding of weather trends and changes in the Los Alamos area, in addition to improving the day-to-day safety operations of the Laboratory as a whole.
Wind Speed Monitor

Fuel Moisture Monitor

- Fuel Moisture Sensor
- Temperature Probe
- 10-Hour Fuel Temperature Stick
- Ponderosa Pine Dowel
Los Alamos National Laboratory is monitoring a legacy hexavalent chromium plume, and has implemented an interim measure to control the spread of contamination.

Danielle Huerta

As of April 2021, the Interim Measure developed by Los Alamos National Laboratory to reduce a chromium plume was fully operational along the plume’s southern and eastern edges.

Today, there are no active sources of chromium at LANL, but from 1956 to 1972, the Laboratory’s power plant released potassium dichromate that had been used to control scaling. The wastewater effluent discharge from the power plant, which was released into Sandia Canyon, contained potassium dichromate, a chemical compound containing hexavalent chromium, now known to be a carcinogen. After many decades, the chromium made its way into the regional aquifer beneath Sandia and Mortandad canyons, and is now at concentrations above the New Mexico groundwater standard of 50 micrograms per liter.

In an effort to control migration and reduce the footprint of the chromium plume, the Interim Measure was proposed and approved by the New Mexico Environment Department. Implementation of the Interim Measure began in 2018, and today consists of a network of 31 monitoring, 5 extraction, and 5 injection wells that have been installed in and around the chromium plume. The extraction wells allow the contaminated groundwater to be pumped from the regional aquifer. It is then piped to a centrally located treatment system that removes chromium from the groundwater via a process called ion exchange. The treated water is then pumped back into the aquifer through injection wells placed at the downgradient edge of the plume.

The idea is that, over time, the treated water will help to decrease chromium concentrations and reduce the size of the plume, which has, along the southern edge of the plume, already shrunk approximately 500 feet from where it was when the Interim Measure was first implemented in 2018.

In 2021, monitoring efforts focused on characterization of the chromium plume and understanding the fate and transport of the contamination in the regional aquifer. Monitoring work is still being carried out, and additional wells may be constructed to determine the vertical extent of the contamination and to further characterize the chromium plume.

Fortunately, 2021 data indicate there are no impacts to public water supplies by the chromium plume and water-supply wells are being monitored and sampled quarterly for chromium. A final, long-term strategy to characterize and treat the chromium plume is being developed by the Department of Energy and N3B, its cleanup contractor. The final plan for remediation will be presented to and approved by the New Mexico Environment Department (NMED) before implementation.
“We’re eager to better understand the plume’s full extent so together with NMED, we can transition to a final remedy. The entire groundwater remediation team is committed to cleaning up the chromium plume and protecting the region’s water supply.”

- Vicky Freedman, Program Manager for the Chromium Project

For more information see the ASER report.
The Laboratory Will Soon Apply More Protective Water Quality Standards

Los Alamos National Laboratory worked with New Mexico state officials to increase surface water quality protections for intermittent reaches on the Plateau.

Mariah Gonzales

In 2021, Laboratory representatives attended the Triennial Water Quality Review hosted by the Water Quality Control Commission (WQCC), otherwise known as New Mexico’s water pollution control agency. In accordance with the Clean Water Act, states are required to hold public hearings (“Triennial Reviews”) at least once every three years to review, amend, and adopt water quality standards, as applicable.

Because of Covid-19 pandemic restrictions, the Triennial Review Public Hearing was held virtually, with the Laboratory attending along with other experts and stakeholders. Under the Clean Water Act, states and state agencies are responsible for developing updated water quality standards that are based on the data provided during the commission hearing. The updated rules and regulations that come from the triennial review are adopted by the Environment Protection Agency (EPA) and are then implemented by the Laboratory.

The Laboratory presented data taken from various stream reaches on Laboratory property. The data presented to the panel included stream gage flow data, water chemistry data, macroinvertebrate (bug) data, and data from hydrology field assessments conducted in recent years in collaboration with the New Mexico Environment Department (NMED).

The Laboratory’s EPC program then reviews and implements these changes as they relate to water quality on the Plateau.

How Water Quality Standards Are Implemented (Triennial Review)

WQCC deliberates NMED and other party proposals and makes decisions based on the information from the hearing—WQCC approves or disapproves for state water quality standards. NMED and the WQCC then send these to EPA for consideration and approval.

EPA reviews the information and makes a decision.

Decision is finalized and added to the water quality standards of the State of New Mexico. The Laboratory’s EPC program then reviews and implements these changes as they relate to water quality on the Plateau.
Once approved by the EPA, these new standards will apply to the Laboratory and water quality monitoring will continue under this regulatory framework.

The Laboratory continues to collect high-quality data to make informed decisions about protecting surface water bodies within its boundaries. With the addition of Section 140, the state will be able to assign appropriate protections for surface water reaches and consider future assignments of water quality protections.

In the summer of 2022, Laboratory water quality scientists embarked on an extensive data collection effort in four canyons at the Laboratory: Ancho Canyon, Water Canyon, Mortandad Canyon, and Effluent Canyon. The data collected will be evaluated and used to make recommendations that will ensure the most protective standards are applied to surface water reaches at the Laboratory.

### Types of stream flows:

- **Perennial streams** consistently flow throughout the year, while **ephemeral streams** flow in direct response to rainfall, and **intermittent streams** flow in response to snow and rainfall.
Samples from large animals allow environmental scientists to monitor the effects of potential contaminants in the environment.

Jessica C. Johnson

Despite Los Alamos National Laboratory’s location in Los Alamos County, which has a relatively low population, cars still collide with and kill animals. But rather than discard the deceased animal, the Environmental Protection and Compliance Division at the Laboratory turns these incidents into learning opportunities. By using the roadkill specimens to support important environmental health monitoring efforts, in 2021, the Laboratory confirmed that the ecosystem in and around the Laboratory remains safe.

The Soil, Foodstuffs, and Biota program, which is administered by the Environmental Stewardship group, leads an effort to monitor biota, or living organisms such as large mammals, throughout the Laboratory and surrounding areas. This program makes use of specimens collected opportunistically, typically from roadkill. Most roadkill collected are larger species, primarily elk and deer, which have high population numbers in this area.

Throughout the year, ecologists from the program collect samples of both muscle tissue and bone from the animals to submit for chemical analysis. These analyses help determine if these animals may have absorbed from the environment surrounding the Laboratory, either through eating local foliage or drinking local water. Large mammals have been collected since the 1970s, with the program analyzing a total of 63 deer and 61 elk. In 2021, Laboratory staff collected four mule deer, one feral cow, one gopher snake, two great horned owls, and two turkey vultures from on site and perimeter locations.

Photograph collected by Biological Resources Program using game cameras to monitor elk movement through Pajarito Corridor
Samples are submitted for a suite of chemical analyses including radionuclides, inorganic elements such as various metals, and polychlorinated biphenyls (PCBs). Since the program began, no radionuclides, metals, or PCBs have been detected in amounts that exceed federally set screening levels.

Consistent with results that have been observed over time, the levels of radionuclides found in the roadkill samples from 2021 are far below levels that can cause adverse effects, as determined by thresholds known as biota dose screening levels. PCB concentrations in deer and elk were also far below the United States Food and Drug Administration recommendation for red meat consumption. The 2021 analyses also confirmed that PCB levels are no higher among biota sampled at the Laboratory than biota from the surrounding community.

Additionally, the program has recently begun testing for per- and polyfluoroalkyl substances (PFAS), which are man-made chemicals that are found in a variety of consumer and industrial products and do not easily break down. Of the PFAS results, deer and elk have the lowest levels of all the animals tested in terms of total number of chemicals detected and the lowest concentrations observed.

“Our observations show that the levels of radionuclides, metals, PCBs, and PFAS are low and below levels that are associated with adverse effects to the animals themselves or to the people who consume their meat,” says Shannon Gaukler of the Soils, Foodstuffs, and Biota program. “Deer and elk that roam Laboratory property and are hunted off site are safe for human consumption.”

The donation of these deceased animals enables the Soils, Foodstuffs, and Biota program to safely monitor biota near the Laboratory. This sampling causes no impact to the environment. In fact, it helps the Laboratory verify that animal populations are healthy so that the Laboratory can help ensure that the environment and local ecosystem are properly managed.
Wildlife Biology Monitoring

The Laboratory monitors native and threatened or endangered species to evaluate environmental and anthropogenic impacts over time.

Zavier T.S. Avery

Biologists at Los Alamos National Laboratory perform surveys and collect data on migratory birds and threatened or endangered species to ensure compliance and site stewardship of these species and their habitat. By avoiding or minimizing impacts of Laboratory activities on migratory bird populations and federally protected species, the Laboratory facilitates compliance with the Migratory Bird Treaty Act and the Endangered Species Act.

The three threatened or endangered species that biologists monitor at Los Alamos are the Mexican spotted owl, the Jemez Mountains salamander, and the Southwestern willow flycatcher. All three species are federally listed and protected by the Endangered Species Act.

Biologists working in the Environmental Stewardship group conduct presence/absence surveys annually during breeding season for the federally threatened Mexican spotted owl. In 2021, two breeding pairs of Mexican spotted owls were detected in the Mortandad and Three-Mile canyons of the Laboratory. The primary threats on Laboratory property to the Mexican spotted owl include disturbances during breeding season (for example, noise and heavy machinery near a nest), habitat loss, and fragmentation.

Similarly, wildlife biologists conduct presence/absence surveys for the federally endangered Jemez Mountains salamander as needed for specific projects. These surveys are completed during the monsoon season, July through September. This species of salamander respires through its skin, so they require a cool wet habitat. Habitat loss caused by climate change, wildfire, and development are the biggest threats to Jemez Mountains salamanders on Laboratory property. No salamanders were detected based on the one survey that could be conducted in 2021.

The Southwestern willow flycatcher is also listed as a federally endangered species under the Endangered Species Act. Surveys for their presence on Laboratory property are conducted annually from May 15 to July 17. Although none have been observed at Los Alamos to date, the Southwestern willow flycatcher could be attracted to the wetland vegetation at the Laboratory. The biggest threat to this species is the degradation of riparian habitat.
Under the Migratory Bird Treaty Act of 1918, Los Alamos monitors populations and mitigates risks to migratory birds like ash-throated flycatchers by integrating conservation measures into all operational activities. The Laboratory prioritizes installation of avian-safe power poles and transmission lines, schedules vegetation removal outside of migratory bird nesting seasons, and installs caps on any open pipes, bollards, or fence posts that have the potential to trap birds. In addition, there are several long-term monitoring projects that monitor birds over time and ensure they are not being impacted by Laboratory operations.

Collectively, these monitoring efforts ensure the health and safety of migratory birds and threatened or endangered animals on Laboratory property while ensuring compliance with federal laws.

“The diverse biological resources monitoring at the Laboratory not only supports the mission by ensuring compliance, but the long-term data sets are used to advance the scientific literature, provide management recommendations, and most importantly ensure species are protected.”

Audrey Sanchez, program lead for Biological Resources Management
Radiation Monitoring at the Laboratory

To ensure public safety, Los Alamos National Laboratory monitors for ionizing radiation.

Carina Echave

Possible ways people can be exposed to radiation, or exposure pathways, include being near direct penetrating radiation, inhaling particles containing radioactive atoms, or ingesting food or water containing radioactive atoms. The Laboratory monitors these pathways to ensure that the public does not receive an unsafe amount of radiation exposure from Laboratory activities.

Ionizing radiation is radiation with enough energy to ionize molecules, or remove electrons from molecules, including molecules in human cells. This can cause damage to those cells. A “radiation dose” is a measure of the amount of damage caused to cells and is usually measured in units of millirem.

Maximally exposed individual (MEI)

Each year, the Laboratory calculates the maximally exposed individual’s (MEI) dose from ionizing radiation. The dose to this hypothetical individual is the highest possible dose that a member of the public could receive from Laboratory operations.

This MEI calculation is useful because if the MEI dose is safely below regulatory limits then every member of the public also has a dose safely below regulatory limits.

To find the MEI location, the Laboratory considers publicly accessible sites both on and off Laboratory property and cumulative radiation dose amounts from all pathways at each site.

For more information see the ASER report.
**MEI offsite**

In 2021, the offsite MEI location was at 132 DP Road, which is at Fire Station number 2 on DP Road. The total dose to the MEI from all exposure pathways at this location was 0.50 millirem.

Interestingly in 2020 and 2021, previously buried and undetected radioactive waste from the time of the Manhattan Project was found at Middle DP Road near the 2021 MEI site. Michael McNaughton, a health physicist at the Laboratory, says, “The ratio of uranium to plutonium in air data and pattern of results from air monitoring stations indicate possible dose contributions from Middle DP Road site dust, in addition to probable contributions from routine construction dust on DP Road.”

**MEI onsite**

The onsite MEI location in 2021 was East Jemez Road near Technical Area 53. It was calculated that the onsite MEI would receive a dose of 0.02 millirem.

What does the MEI dose indicate about public safety?

**BY THE NUMBERS:**

10 mrem/year air pathway dose limit

Note mrem = millirem

1990 = 10 mrem

MEI dose since 1990 when the 10mrem air pathway regulation took effect.

1995 = 5.7 mrem
2000 = 1.7 mrem
2005 = 0.7 mrem
2010 = 0.55 mrem
2015 = 0.21 mrem
2021 = 0.43 mrem

The Department of Energy limits the annual Laboratory radiation dose to each member of the public to 100 millirem. In addition, the Environmental Protection Agency limits the airborne radiation dose to 10 millirem.

Both the onsite and offsite MEI doses were safely below these limits, indicating that the Laboratory workers and the surrounding communities are safe from radiation.
Allison Cunningham
Hometown: Los Alamos, NM
Education: BS in ecosystem science and sustainability, Colorado State University
Favorite food: Huckleberry salmon with garlic asparagus and mashed potatoes

I’ve learned a lot from working at the Lab, such as proper field measuring techniques for forestry, how to write a professional document, and the various difficulties with finding the right organization and communication strategies. The Lab is a great place to hone skills you didn’t know were hidden inside you.

Ashlyn T. Lovato
Hometown: Santa Clara Pueblo, NM
Education: MA in American studies, Brown University
Favorite food: Grapefruit

Because of my work at the Lab, I am able to connect the history of ancestral sites that are now under Los Alamos National Laboratory to my research around language and culture.

Beatrice Nisoli
Hometown: Los Alamos, NM
Education: BS in pure mathematics and BA in philosophy (pre-law concentration), University of New Mexico
Favorite food: Focaccia

Among other tasks, working within the National Environmental Policy Act (NEPA) has allowed me to sift through public comments to NEPA analyses of various Laboratory projects and, in general, shift my perspective to value the input and individual concerns of my local community. Learning and prioritizing the knowledge that environmental concerns vary in type and intensity across diverse backgrounds and income levels is an exposure I can utilize when approaching environmental sustainability as a community member.

Bridget Bloodwood
Hometown: Barnegat, NJ
Education: PhD in forest resources, Clemson University
Favorite food: Mango salsa

The mission of the Laboratory’s Forest Health Program is to promote wildland fire mitigation treatments that maintain healthy forests—those resilient to climate-related disturbances. Our program works alongside biologists, environmental compliance experts, and the Wildland Fire program to ensure forest treatments are creating that more resilient landscape. My role at the Lab, much like my role as a graduate student in forestry, is to conduct evaluation monitoring of the forests before and after treatments. I am assessing the general health of the forest and determining whether we need to adapt our management techniques.

Carina Echave
Hometown: Los Alamos, NM
Education: BS in psychology, University of New Mexico
Favorite food: Crab wontons

At the Lab, I am working with code that uses the computer program Visual Basic for Applications, and that work has increased my ability to use computer programs in order to analyze data. This skill easily transfers to other programming languages and can be useful in analysis of quantitative psychology data as well.

Danielle Huerta
Hometown: Dallas, TX
Education: PhD in anthropological archaeology, University of California, Santa Cruz
Favorite food: Butter chicken and veggie samosas

Since 2014, I have been training as a New Mexico archaeologist. Currently, I am finishing my doctoral dissertation on Rio Grande Glaze Ware pottery from the seventeenth century. Since 2019, I have been living and working in the state, employed by the Bureau of Land Management, Forest Service, and private firms to conduct archaeological surveys and compliance work. At the Lab, I feel like all my expertise has culminated, and I get to work on a variety of projects with our Environmental Stewardship team, ensuring the protection and management of important cultural resources on Laboratory property.
design, University of New Mexico
Favorite food: Strawberries

So far, I have been fortunate enough to work closely with several environmental experts at the Lab, both in the office and in the field. However, as an intern in the Site-Wide Environmental Impact Statement (SWEIS) office, my hope is to better understand the community needs and environmental impacts that will inform the creation of a new SWEIS document. Taking this experience, I plan to help the New Mexico community by actively finding solutions to combat environmental injustice experienced by at-risk communities.

Makenzie L. Quintana
Hometown: Pojoaque, NM
Education: BS in fisheries and wildlife conservation ecology, New Mexico State University
Favorite food: Frito pies

My work at the Lab connects with my studies because I am on the Biology team, and I am also majoring in wildlife biology. I was lucky to get this opportunity: I started while I was in high school, and it led me to this passion. It has been helpful because many of the things I am learning in school, I have either done or heard of at my job. Now that I am starting my last year at NMSU, I am excited to see what I can learn and accomplish when I return next summer as a graduate student.

Rachel Greenwood
Hometown: Los Alamos, NM
Education: BS in ecology, Northwest Nazarene University
Favorite food: Spaghettis

While I first learned about environmental management practices during my undergraduate studies, my work at the Lab has helped me understand what those practices look like when used in the field. For example, while writing about the Electrical Power Capacity Update project, I learned about how the National Environmental Policy Act can offer suggestions and mitigations for a project prior to beginning it. I had first learned about balancing the needs of people and wildlife in the classroom; however, my work at Los Alamos has allowed me to see how that balance plays out in real time.

Zavier J. S. Avery
Hometown: Rolesville, NC
Education: BS in environmental studies, North Carolina Agricultural and Technical State University
Favorite food: Mac and cheese

Working at the Lab gives me the opportunity to talk to and interact with multiple environmental specialists, which is ideal for being an environmental studies major.