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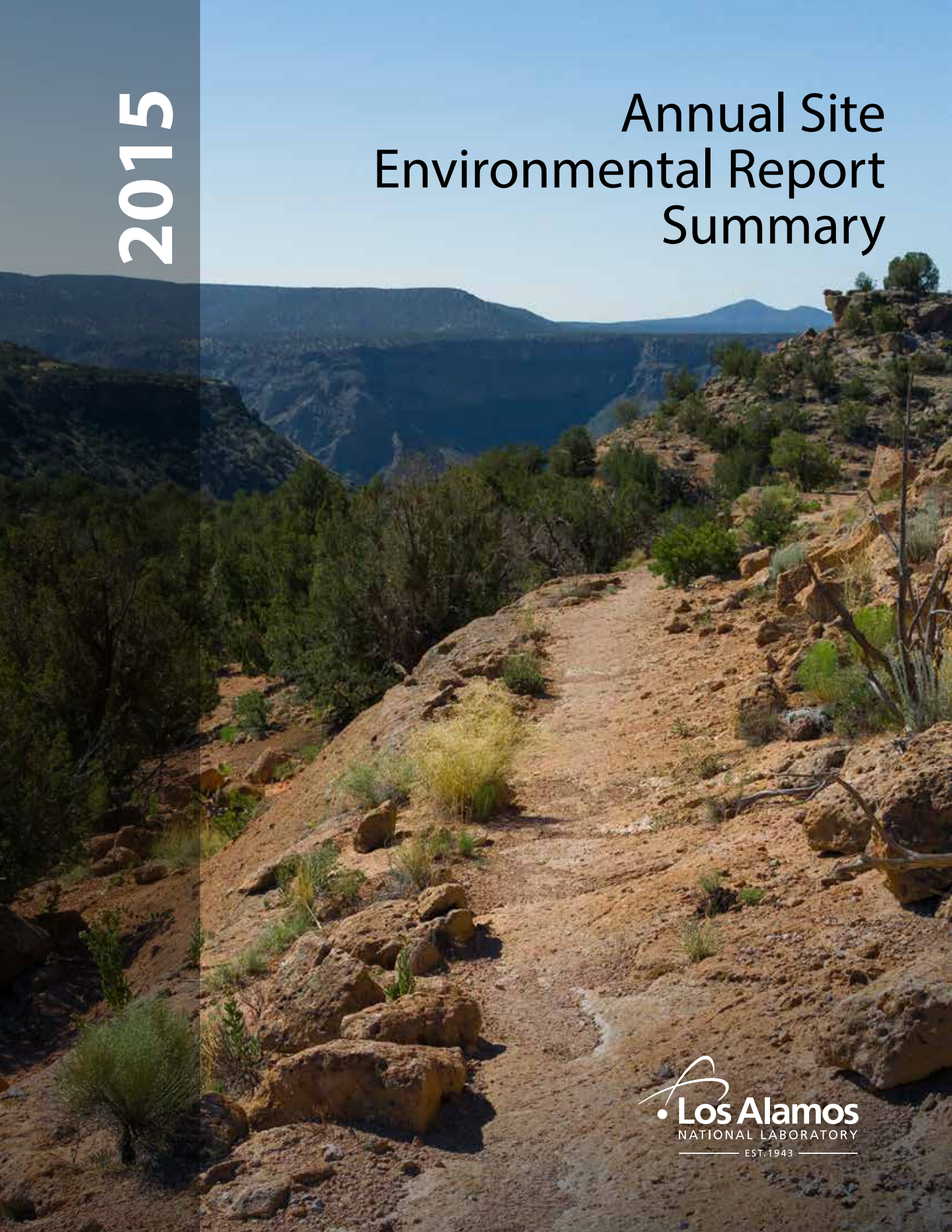
2015

Annual Site Environmental Report Summary



Los Alamos
NATIONAL LABORATORY
EST.1943

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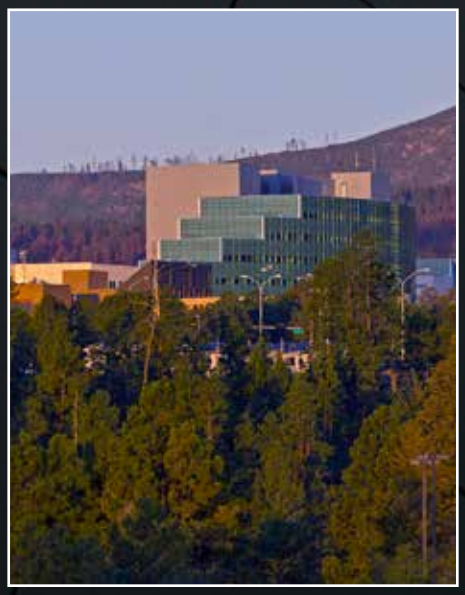
EST. 1943

Los Alamos National Laboratory delivers science and technology that promotes world stability while remaining a good steward of the environment. The Laboratory's mission is to solve national security challenges through scientific excellence. Inseparable from the Lab's commitment to excellence in science and technology is its commitment to environmental stewardship and full compliance with environmental regulations.



What are the Laboratory's goals?

- **Deliver national nuclear security and broader global security mission solutions**
- **Foster excellence in science and engineering disciplines essential for national security missions by:**
  - Attracting, inspiring, and developing world-class talent to ensure a vital future workforce
  - Enabling mission delivery through next-generation facilities, infrastructure, and operational excellence

Commitment to environmental stewardship

Los Alamos is committed not only to excellence in science and technology but also to completing all work in an environmentally responsible manner. Every year, the Laboratory produces an annual site environmental report (ASER) in compliance with U.S. Department of Energy (DOE) Order 231.1b—Environment, Safety, and Health Reporting.

Through the ASER, the Laboratory communicates to the public the impacts its operations might have on the surrounding environment and the approaches used to avoid these impacts. This *ASER Summary* magazine, produced primarily by Laboratory students, provides a nontechnical overview of the ASER and highlights many of the Laboratory's environmental programs. The *ASER Summary* has been organized to recognize efforts made to:

- Create a sustainable future
- Control present processes to minimize impacts
- Clean up past harms to the environment

This publication summarizes data and findings from 2015. Laboratory students and staff hope you find this *ASER Summary* informative and entertaining. Comments are welcome at envoutreach@lanl.gov.

Contents

The *ASER Summary* is a collaboration between students and scientists to deliver environmental data to the public. Above, a group of students collect samples from Laboratory property.

Create a sustainable future

Long-term Strategy for Environmental Stewardship and Sustainability

Environmental stewardship is essential to the mission of the Laboratory. The Long-term Strategy for Environmental Stewardship and Sustainability focuses on potential environmental effects so that the Laboratory operates in a way that protects human health and the environment. To do this, organizations at the Laboratory work together toward common goals set forth in the Environmental Management System (EMS).

What is the Environmental Management System?

Integrated with the Laboratory's commitment to excellence in science and technology is its commitment to complete all work in a safe, secure, and environmentally responsible manner. The Laboratory's EMS provides a unifying framework for:

- Assessing environmental impacts from mission activities
- Identifying and managing necessary controls
- Prioritizing improvements
- Evaluating environmental performance

In 2015, the Laboratory's Environmental Senior Management Steering Committee identified 18 stewardship objectives to control future, present, and past environmental impacts. The EMS program was also externally audited and recertified in 2015, as required every three years. Laboratory organizations evaluated their work to discover potential impacts. A multidisciplinary team from each Laboratory directorate then developed specific controls to manage any activity found to have impacts. The result included 401 actions that were detailed and managed in 15 environmental action plans. ■

Hello there! I'm Wes the bluebird, and I'm here to help "glide" you through the ASER Summary. *My family and many of my friends have lived in and around this area for decades. Together, we know the ins and outs of buildings, canyons, waterways, and have found all the good areas for food. I fly all around the Laboratory, so I can give you answers to important questions such as: Is it safe for me to eat the berries and bugs, nest in the trees, breathe the air, and drink the water in this area? Are there things I can't see that can hurt me?*

More information about the EMS is available at lanl.gov/community-environment/environmentalstewardship/protection/environmental-managementsystem.php.

"Environmental stewardship is essential

Grand Challenges

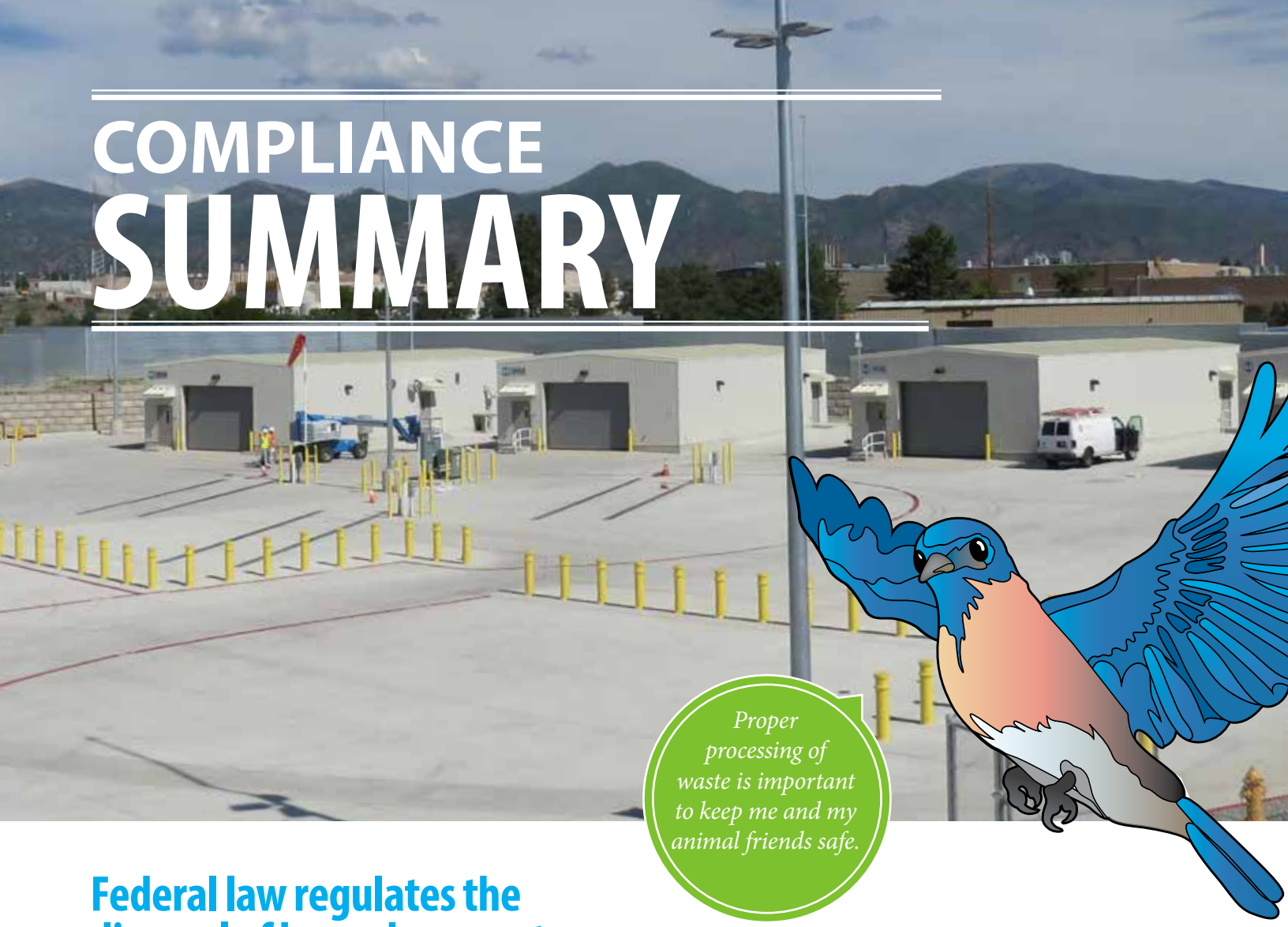
The Long-term Strategy defines seven "Grand Challenges" that are addressed by the EMS as each organization devises annual work plans

GRAND CHALLENGES

The Grand Challenges integrate environmental and operational programs, providing a coordinated approach to environmental stewardship. Each challenge is implemented through an annual set of objectives.

to the mission of the Laboratory."

COMPLIANCE SUMMARY



Federal law regulates the disposal of hazardous waste

Resource Conservation and Recovery Act has been in effect for more than 25 years at Los Alamos

BY FELICIA NARANJO

The Resource Conservation and Recovery Act (RCRA) establishes a federal program that governs the management of hazardous waste and mandates that facilities that treat, store, or dispose of hazardous wastes have a hazardous waste facility permit.

Those permits are issued by the New Mexico Environment Department, which is responsible for implementation of New Mexico's hazardous waste program. The Laboratory's Hazardous Waste Facility Permit, which was initially granted in 1989 and renewed in 2010, authorizes the storage and treatment of hazardous waste at the Laboratory.

In addition to establishing general and specific standards for hazardous waste management activities, the permit also establishes standards for closure and post-closure care of the Laboratory's permitted units—which include one storage tank system, one stabilization unit, and 22 container storage units. Nine interim status units at the Laboratory are also being managed under RCRA, including two open-detonation units, one open-burn unit, and six other units that are in the process of being closed.

Compliance with RCRA and the Permit ensures hazardous waste generated at the Laboratory is handled and treated in a manner that protects human health and the environment. ■

The Transuranic Waste Facility was constructed in 2015 and is used to store and characterize newly generated waste.

Compliance Order on Consent keeps an eye on hazardous waste

Los Alamos takes corrective actions at waste management units

BY FELICIA NARANJO

If the Laboratory doesn't clean up after itself, there are consequences. That's the gist of the Compliance Order on Consent, which was issued in 2005 by the New Mexico Environment Department (NMED) and provides requirements for corrective actions at the Laboratory's solid waste management units and areas of concern.

A solid waste management unit is any site at Los Alamos where solid wastes have been placed. Areas of concern are areas that may have had a release of hazardous waste. The Consent Order also addresses remediation of groundwater containing contaminants that resulted from Laboratory operations.

As of 2015, Los Alamos has 965 solid waste management units and 430 areas of concern, all of which are listed in the Laboratory's Hazardous Waste Facility Permit. Of these 1,395 total areas, 155 require no further action by the Lab, 240 sites have been issued certificates of completion of corrective action for cleanup activities under the Consent Order, and 127 sites have been deferred until the operations at the sites are no longer active. The remaining 597 solid waste management units and 276 areas of concern have investigations and/or corrective actions in progress or pending.

Additionally, the Laboratory submitted 13 plans and reports required by the Consent Order to the NMED in 2015. ■

In 2015, the Laboratory removed a small area of mercury-contaminated soil from the rugged, steep slope side of Los Alamos Canyon. The soil was derived from the Manhattan Project and early Cold War era.

Safe disposal of nitrate salt-bearing waste

New treatment methods allow for safe off-site disposal

BY FELICIA NARANJO

On February 14, 2014, a radiological release occurred at the U.S. Department of Energy's Waste Isolation Pilot Plant (WIPP) near Carlsbad, New Mexico. A breached nitrate salt-bearing waste container originating from Los Alamos National Laboratory was identified as the source of the release. The waste container in question was improperly remediated and contained an ignitable mixture of nitrate salt waste and organic absorbent material. As a result, efforts to characterize all nitrate salt-bearing wastes at the Laboratory, as well as the development of treatment paths for the waste, continued in 2015.

Two stabilization treatment methods were examined for their effectiveness in rendering nitrate salt wastes safe for future off-site disposal: the addition of zeolite and cementation. Zeolite addition was evaluated to examine the effectiveness of this process for stabilizing or deactivating nitrate salts. Cementation was assessed because of the prevalence of cementation as a stabilization method for similar wastes.

To eliminate the risk to personnel from the radiological hazards presented by the nitrate salt-bearing wastes, surrogate materials were developed that could be tested at on-site and off-site laboratories. Upon selection of an effective treatment technology, a permit modification will be requested for the Los Alamos Hazardous Waste Facility Permit. ■

Drum-scale testing was performed on surrogate waste to investigate the causes of the WIPP incident.

Laboratory expansion considers environmental impacts

Proposed projects are reviewed in accordance with the National Environmental Policy Act

BY KAREN MUSGRAVE

Whether the Laboratory is constructing a new plutonium facility or simply repaving a parking lot, each new project must be reviewed for its environmental consequences. This mandate comes from the National Environmental Policy Act (NEPA), which has ensured since 1970 that all environmental impacts are considered as activities and projects are planned at Los Alamos.

Those impacts include all aspects of the environment, such as biological resources, socioeconomics, and cultural resources. NEPA staff at the Laboratory review proposed projects to analyze potential environmental impacts and to determine if the activities have existing coverage under current NEPA documents issued by the DOE. If the proposed activities pose no impact to the environment and have been previously evaluated by existing NEPA documents, NEPA staff will approve the proposed activities.

Approximately 1,040 proposed projects were reviewed for NEPA coverage at the Lab in 2015. If projects are not covered under an existing NEPA document, further analysis and documentation are required to obtain NEPA coverage, such as an environmental assessment (EA).

In 2015, for example, an EA was prepared to evaluate an interim measure to control the chromium plume migration and maintain chromium contamination on Lab property. From this EA, the DOE determined the proposed interim measure to control plume migration would not result in any significant adverse effects to the environment. Another NEPA document completed in January 2015 was a supplemental analysis to the Final Environmental Impact Statement for the Chemistry and Metallurgy Research Building Replacement Project. This supplemental analysis evaluated and concluded that no significant environmental impacts would occur from proposed changes to the project. ■

NEPA staff work with Laboratory biologists to preserve habitats such as the juniper woodlands in Mortandad Canyon.

2015 Environmental compliance at a glance

To protect human health and the environment, federal and state laws, regulations, and orders are in place to:

>> Regulate the handling, transportation, and disposal of materials and wastes

>> Regulate impacts to biological and cultural resources, air, soils, and water

>> Require environmental impact analyses of new or changed operations

A LIGHT GRAY BOX INDICATES A FEDERAL REGULATOR; A WHITE BACKGROUND INDICATES A STATE OF NEW MEXICO REGULATOR

HAZARDOUS, SOLID, AND MIXED WASTES

RESOURCE CONSERVATION AND RECOVERY ACT
Regulates hazardous wastes from generation to disposal; mandates a hazardous waste facility permit

2005 COMPLIANCE ORDER ON CONSENT
Process for remediation of solid waste management units

FEDERAL FACILITIES COMPLIANCE ACT
Regulates mixed wastes (radioactive and hazardous)

RADIATION PROTECTION AND RADIOLOGICAL WASTES

DOE ORDER 458.1
Radiation Protection of the Public and the Environment
Establishes limits for radiological releases from DOE facilities

DOE ORDER 435.1 CHG 1
Radioactive Waste Management
Regulates storage and disposal of radioactive wastes

CLEAN AIR ACT
Radionuclide National Emission Standard for Hazardous Air Pollutants
Sets dose limit for air emissions

AIR QUALITY AND PROTECTION

CLEAN AIR ACT
Title V Operating Permit
Sets limits for emissions of regulated air pollutants

CLEAN AIR ACT
Title VI
Regulates ozone-depleting substances

NEW MEXICO AIR QUALITY CONTROL ACT
Requires evaluation of new or modified sources of air emissions

HIGHLIGHTS

>> Corrective actions prescribed by the DOE Accident Investigation Board were performed following the 2014 breach of a Laboratory waste drum at the Waste Isolation Pilot Plant

>> Progress continued on responding to the administrative compliance order concerning treatment and storage of nitrate salt-bearing wastes (see p. 6)

>> Corrective remediation actions were complete or no further action was needed at 395 of sites—about 28 percent of the total 1,395 solid waste management units and areas of concern listed in the Hazardous Waste Facility Permit (see p. 5)

>> The maximum estimated radiological dose to a member of the public from Laboratory operations was 0.13 mrem, about 1.3 percent of the limit (see p. 30)

>> All radioactive waste was generated, stored, and disposed of well within regulatory requirements

>> More than 1,700 metric tons of low-level radioactive waste were processed and shipped offsite

>> No transuranic waste was shipped for disposal due to a hold on all shipping at the Waste Isolation Pilot Plant

>> The highest levels of air pollutant emissions at the Laboratory were significantly below its Title V Permit limits

>> Greenhouse gas emissions from combustion sources remained steady and totaled approximately 46,312 metric tons of carbon dioxide equivalents

>> The Laboratory removed approximately 718 kilograms of Class II ozone-depleting substances from refrigeration and fire-suppression systems

PHOTO COURTESY OF MARK SCHRAAD

OTHER ENVIRONMENTAL STATUTES OR ORDERS

SURFACE WATER QUALITY AND PROTECTION

CLEAN WATER ACT
Requires National Pollutant Discharge Elimination System permits for several types of effluent and storm water discharges; the Act also has requirements for aboveground storage tanks

NEW MEXICO WATER QUALITY ACT
Establishes water quality goals for state surface waters by designating uses and setting standards

GROUNDWATER QUALTITY AND PROTECTION

NEW MEXICO WATER QUALITY ACT
Establishes maximum allowable concentrations of specified contaminants

NEW MEXICO GROUNDWATER DISCHARGE REGULATIONS
Regulates liquid discharges onto or below the ground surface

2005 COMPLIANCE ORDER ON CONSENT
Process for remediation of groundwater contaminant plumes

NATIONAL ENVIRONMENTAL POLICY ACT
Requires federal agencies to consider environmental impacts of proposed actions

MIGRATORY BIRD TREATY ACT
Makes it unlawful to harm any migratory bird, except as permitted by regulation

FEDERAL INSECTICIDE, FUNGICIDE, AND RODENTICIDE ACT
Protects workers using these substances

DOE ORDER 231.2
Occurrence Reporting and Processing of Operations Information
Requires reporting of off-normal events or conditions

NATIONAL HISTORIC PRESERVATION ACT
Requires federal agencies to consider effects of actions on historic properties

FLOODPLAIN AND WETLAND EXECUTIVE ORDERS
Require federal agencies to assess project impacts in floodplains and to wetlands

ENDANGERED SPECIES ACT
Requires federal agencies to protect federally listed species and their habitats

TOXIC SUBSTANCE CONTROL ACT
Addresses the production, use, and disposal of specific chemicals, including PCBs

EMERGENCY PLANNING AND COMMUNITY RIGHT-TO-KNOW ACT
Requires emergency plans for hazardous substances

>> Less than one percent of samples at permitted outfalls exceeded limits in the Laboratory's National Pollutant Discharge Elimination System Industrial Outfall Permit

>> Repairs were completed on five aboveground tank systems, and two tank systems were permanently closed

>> Installation of enhanced storm water controls was completed at 35 site monitoring areas for solid waste management units and areas of concern

>> Two permits currently allow for discharging clean water

>> Sampling of Los Alamos County water-supply wells found no radionuclides or nonradioactive chemicals from Laboratory operations

>> Investigations continue to describe the extent of high-explosives presence in groundwater. The Laboratory is implementing work plans to limit the expansion of a chromium plume in groundwater (see p. 21)

>> Approximately 1,040 Laboratory projects were reviewed for compliance with the National Environmental Policy Act (see p. 7)

>> Robust habitat on Laboratory property and a good rainfall year resulted in two Mexican spotted owl pairs fledging a total of seven young

>> Biologists banded migratory birds in two Laboratory wetland areas as part of nationwide monitoring protocols (see p. 27)

>> The Laboratory shipped 1050.6 kilograms of PCB-wastes off-site for disposal or recycling at a U.S. Environmental Protection Agency–authorized treatment and disposal facility in Veolia, Colorado

ENVIRONMENTAL PROTECTION

I'm happy the Laboratory reads and follows compliance regulations to ensure that my home is safe.

PHOTO COURTESY OF MARK SCHRAAD

Keeping Los Alamos safe, secure, and environmentally responsible

The Environmental Management System sets guidelines

BY EMILY PHILLIPS

An Environmental Management System (EMS) is a set of environmental action plans put forth by different teams within the Laboratory to ensure all work done at Los Alamos is performed in an environmentally responsible manner. These action plans are updated annually and focus on reducing environmental impacts while increasing an organization's operating efficiency. Air quality, surface and storm water, and biological hazards are some of the aspects considered when creating and updating these plans. More than 400 actions in 15 different action plans were tracked in 2015 alone.

Site sustainability

The Laboratory's responsibility is to protect its surrounding natural environment through conservation and sustainable practices. On a day-to-day basis, the Lab acts as an environmental steward, operating under a long-term site sustainability plan. Organizations at the Lab continuously plan, execute, and evaluate operations to improve and maximize the sustainable use of energy and water, as well as to create cost-effective energy through renewable energy projects. The long-term plan focuses on the past, present, and future projects occurring at the Lab.

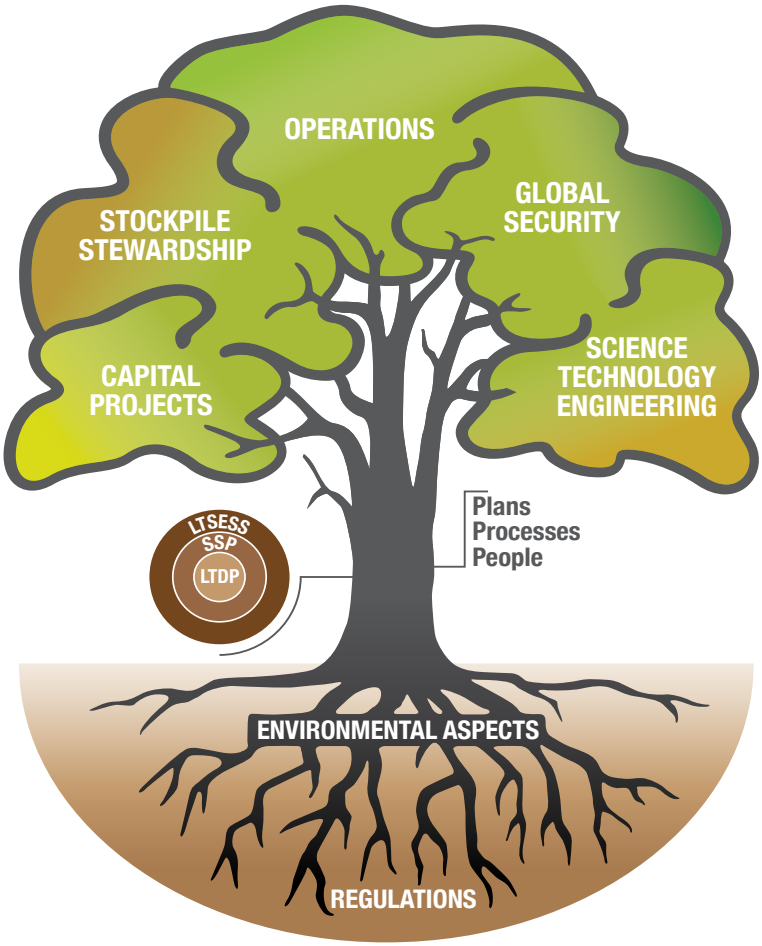
Clean the past

Historic waste sites that date back to the Manhattan Project (1940s) are common at Los Alamos. The Laboratory is continuously making sure these areas are inspected and cleaned based on the data collected in these places. Continuous observations of these sites ensure the protection of human health and the environment.

Control the present

At present, the majority of the environment is monitored to ensure the Laboratory is following regulations through the EMS. The EMS creates a safe work environment while also safeguarding the environment being worked on. Monitoring occurring at the Labs includes wildlife, plants, water quality, and air quality. ■

The tree diagram (below) demonstrates the roots and limbs of the environmental responsibilities at Los Alamos.



The future is source reduction

Pollution prevention eliminates waste before it is produced

BY KASSIDY BURNETT AND MADISON FOLEY

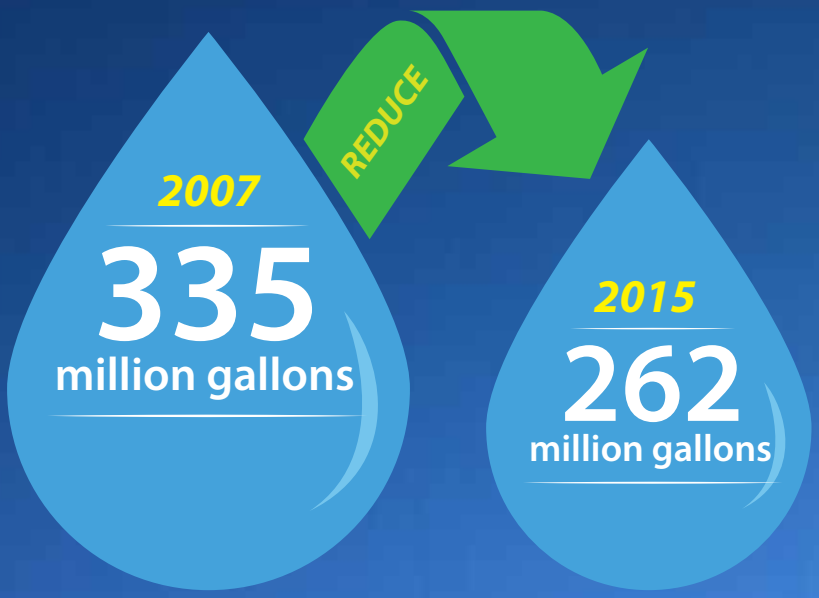
Developed more than 20 years ago at Los Alamos National Laboratory, the Pollution Prevention (P2) program works to create a more sustainable Laboratory while also supporting the Lab's mission.

Source reduction, or producing as little waste as possible by modifying the Lab's daily activities, is the P2 team's primary focus. The team also works to lessen waste by focusing on key areas such as spill prevention, education, green chemistry, sustainable purchasing, and working with generators to prevent unnecessary waste accumulation in the future. During the past year, this work has created a healthier, more sustainable Laboratory and has reduced operating costs by $3.4 million.

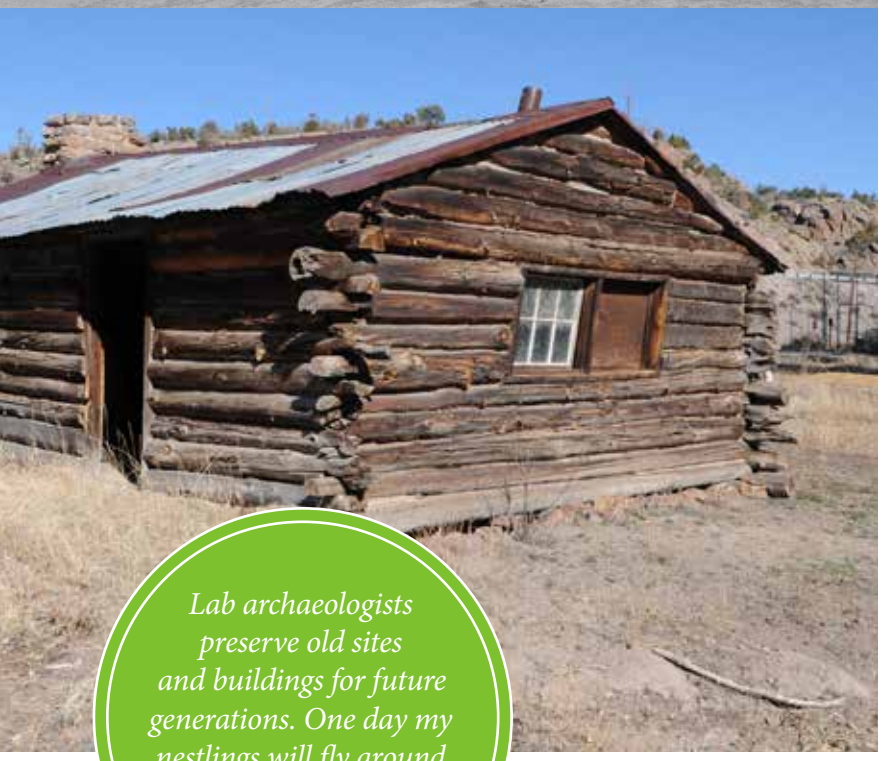
When the P2 team stepped back and ran the numbers for 2015, it was able to list the following accomplishments:

- Reusing more than 3,000 pounds of computer hardware
- Recycling 1 million pounds of metal, 500 cubic meters of sediment, and hundreds of gas cylinders
- Preventing the use of corrosive and dangerous acids through green chemistry
- Enhancing the Laboratory's battery recycling program

With such exciting accomplishments in 2015, the P2 team is looking toward challenges that can be addressed—and successfully met—in the future. ■



The Laboratory's total potable water consumption for the fiscal year (FY) 2007 was about 335 million gallons. Total consumption for FY 2015 was about 262 million, a decrease of 73 million gallons annually.



Lab archaeologists preserve old sites and buildings for future generations. One day my nestlings will fly around and learn about these historical structures.

Above: Pond Cabin, built in 1914, is listed on the New Mexico State Register of Historical Places and is the only surviving log structure at the Laboratory dating to the homestead period.

Manhattan Project National Historical Park includes Laboratory buildings

Los Alamos and the Department of Energy work to admit the public without compromising national security

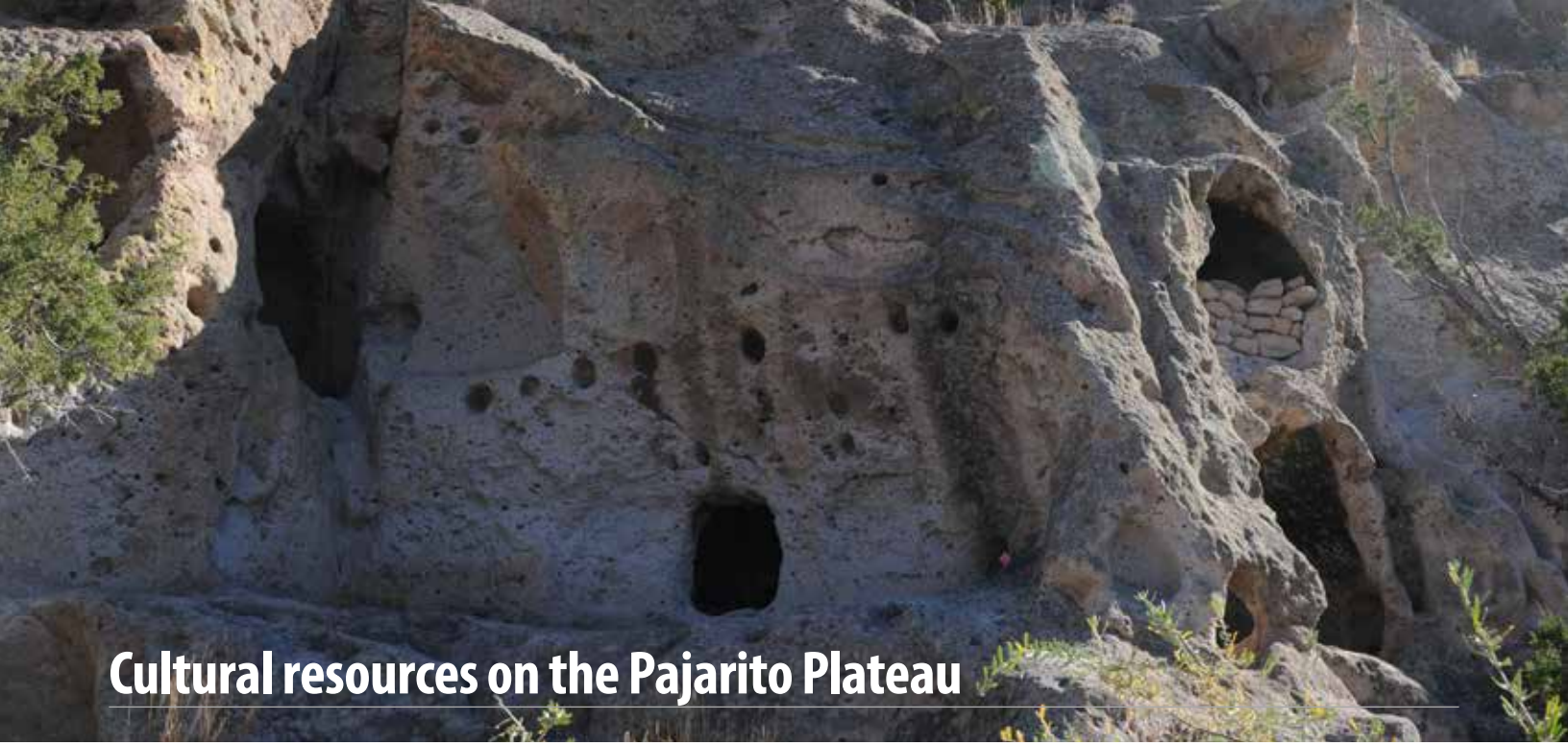
BY JEREMY BRUNETTE

Nine Laboratory properties are included in Manhattan Project National Historical Park, which was signed into law on November 10, 2015, and tells the story of America's nuclear weapons science, technology, and industry during World War II. The Los Alamos site is one of three locations for the park—a multistate endeavor that also includes key Manhattan Project facilities in Oak Ridge, Tennessee, and Hanford, Washington.

However, visitors can't just wander onto Lab property at their convenience; the Park properties are located in active areas that are critical to national security and the Lab's mission. This makes access to the Park more complicated then what one might expect when visiting a National Park; it will likely be several years before the Laboratory, the National Park Service, and the Department of Energy have finalized a plan for visitors to access the park properties.

Technical Area 18 will likely open first, allowing visitors to learn the history of the Pajarito Plateau from prehistoric times, to the homesteading and ranching period, to the Manhattan Project and the Cold War era. Also called the Pajarito Site, the area is home to Pond Cabin, the Slotin Building, and Battleship Bunker.

In the meantime, eager park-goers don't have to wait to experience these sites. A new app, *Los Alamos: The Secret City of the Manhattan Project,* is now available as a free download for both Apple and Android devices and allows visitors to see many of the Laboratory's original buildings. ■



Cultural resources on the Pajarito Plateau

Laboratory archaeologists protect and preserve sites for future generations

BY AMANDA CVINAR

For decades, archaeologists have documented and inventoried cultural and historic sites on the DOE-occupied areas of the Pajarito Plateau. More than 1,800 cultural properties have been identified on Laboratory property and are protected by law under the National Historic Preservation Act (NHPA).

Cultural sites on the Laboratory date from the Archaic period (5500 BC–600 AD) and span into the early Cold War period (1943–1963). These sites include large and small pueblos, rock art panels, trails, and shrines associated with Ancestral Pueblo culture (1150–1600 AD). Other types include agricultural sites, man-made masonry rooms carved into the side of rock faces (known as cavates), water reservoirs, game traps, historic homesteads, and Manhattan Project and early Cold War period buildings.

The goal of the NHPA is to have federal agencies act as responsible stewards of the nation's cultural resources. Archaeologists work under this law to identify, evaluate, and protect cultural resources eligible for the National Register of Historic Places (NRHP). Archaeologists use four criteria to help determine which sites should be considered eligible for inclusion to the NRHP.

Consultation with Native American communities regarding archaeological sites and traditional cultural properties is also required by law. The DOE continues to consult with the pueblos of Cochiti, Jemez, Santa Clara, San Ildefonso, and other affected area tribes with respect to identifying and protecting traditional cultural properties, human remains, and sacred objects.

Why does cultural preservation matter?

Many sites that might appear unremarkable to the untrained eye are significant to New Mexico's native people. These sites were the homes of their ancestors. The Laboratory's Environmental Stewardship Services Group assists the DOE in its stewardship responsibilities, such as sharing knowledge concerning the cultural resources and public outreach initiatives to dissuade looting and vandalism of cultural properties. Looting includes digging, excavating, or collecting artifacts, architecture, and human remains and can be prosecuted as a felony under laws governing burial grounds.

To learn more about cultural resources and preservation at the Laboratory, visit lanl.gov/environment/protection/cultural-preservation, or stop by the resource management exhibit at the Bradbury Science Museum. ■

Above: Cavates in Mortandad Canyon. Below: Rock art (petroglyphs) at Tsirege Pueblo. Petroglyphs are images that have been pecked, incised, or abraded into tuff cliff faces or boulders.

Lab recycles more than 1.2 million pounds of metal in 2015

Metals recycling program supports Laboratory cleanup and stewardship initiatives

BY ELIZABETH RUEDIG

Recycling of scrap metal is a fiscal and environmental stewardship issue for the Laboratory. Excess metal has accumulated across the Lab since 2000, when the DOE issued a moratorium on the release of potentially contaminated metal from certain facilities licensed to have and use radioactive material. Across the DOE complex, the total value of excess metal is estimated to range from $67–$192 million.

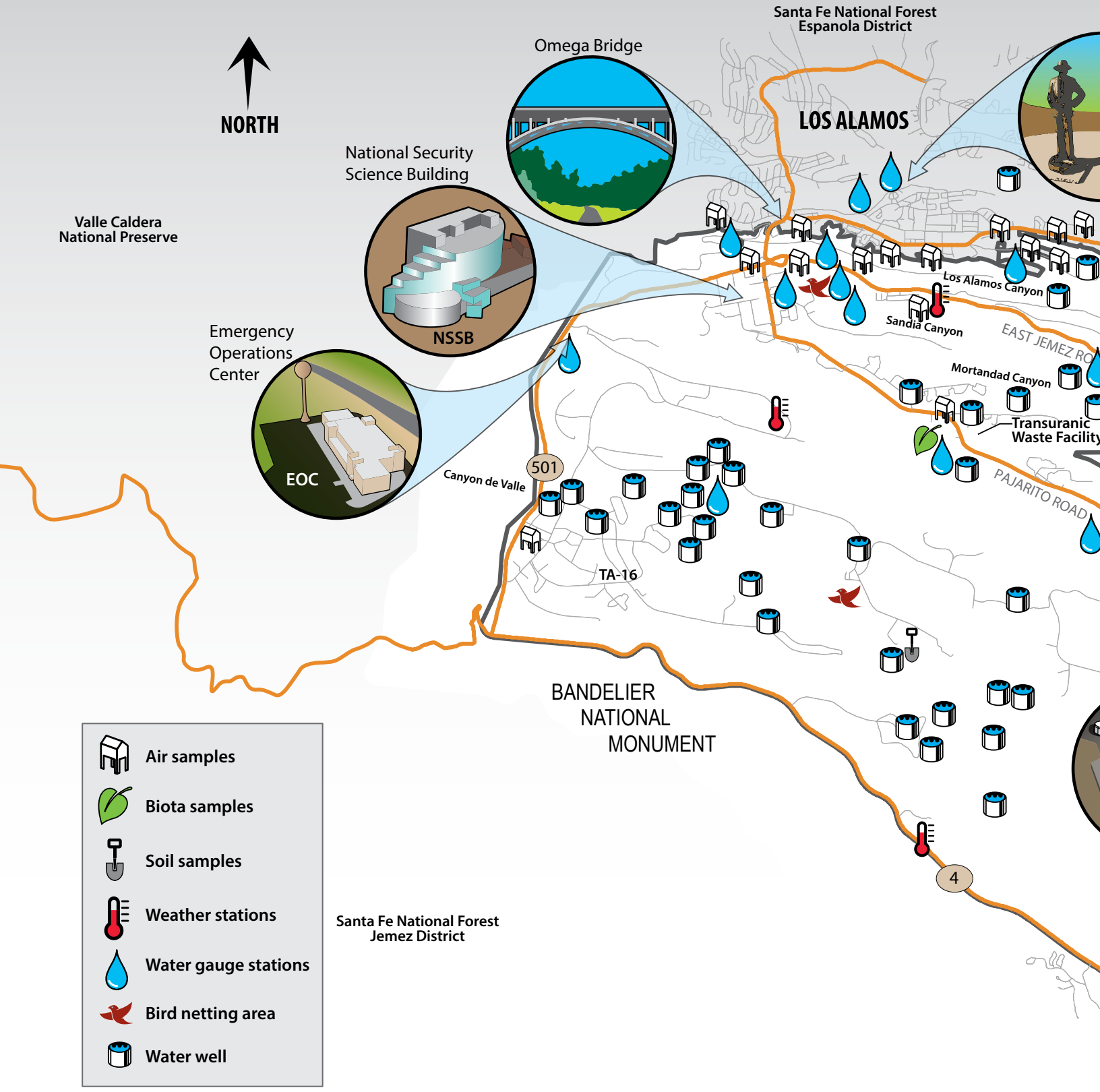
Leaving excess metal on concrete pads throughout the Laboratory also creates a site stewardship issue. "Proper disposition of unwanted, legacy, or abandoned material and equipment across the Lab is crucial to reducing environmental and safety risks," says Andrea Pistone, who oversees the Laboratory's metal recycling program. "Another perk of cleaning up the site is increased pride in our workplace. If it looks better, we feel better about it."

In 2011, recycling of some metals began after Energy Secretary Steven Chu authorized DOE program offices across the country to clear some metal for public release; since then the Laboratory has developed policies and procedures to ensure that the released metal is safe for reuse by the public.

The Laboratory has an ongoing pilot project at the Los Alamos Neutron Science Center and other facilities to identify, dismantle, physically assess, and recycle metals similar to those covered by the moratorium. In 2015, the Laboratory's pilot metal recycling program released more than 1,246,600 pounds of metal. ■

Scrap metal that qualifies for the recycle program at Los Alamos.

One of the goals of the Laboratory's Pollution Prevention program is source reduction, or stopping waste before it's made. Other Laboratory projects have included recycling a million pounds of metal.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NSSB
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EOC
Los Alamos Canyon
Sandia Canyon
EAST JEMEZ RO
Mortandad Canyon
Transuranic
Waste Facility
PAJARITO ROAD
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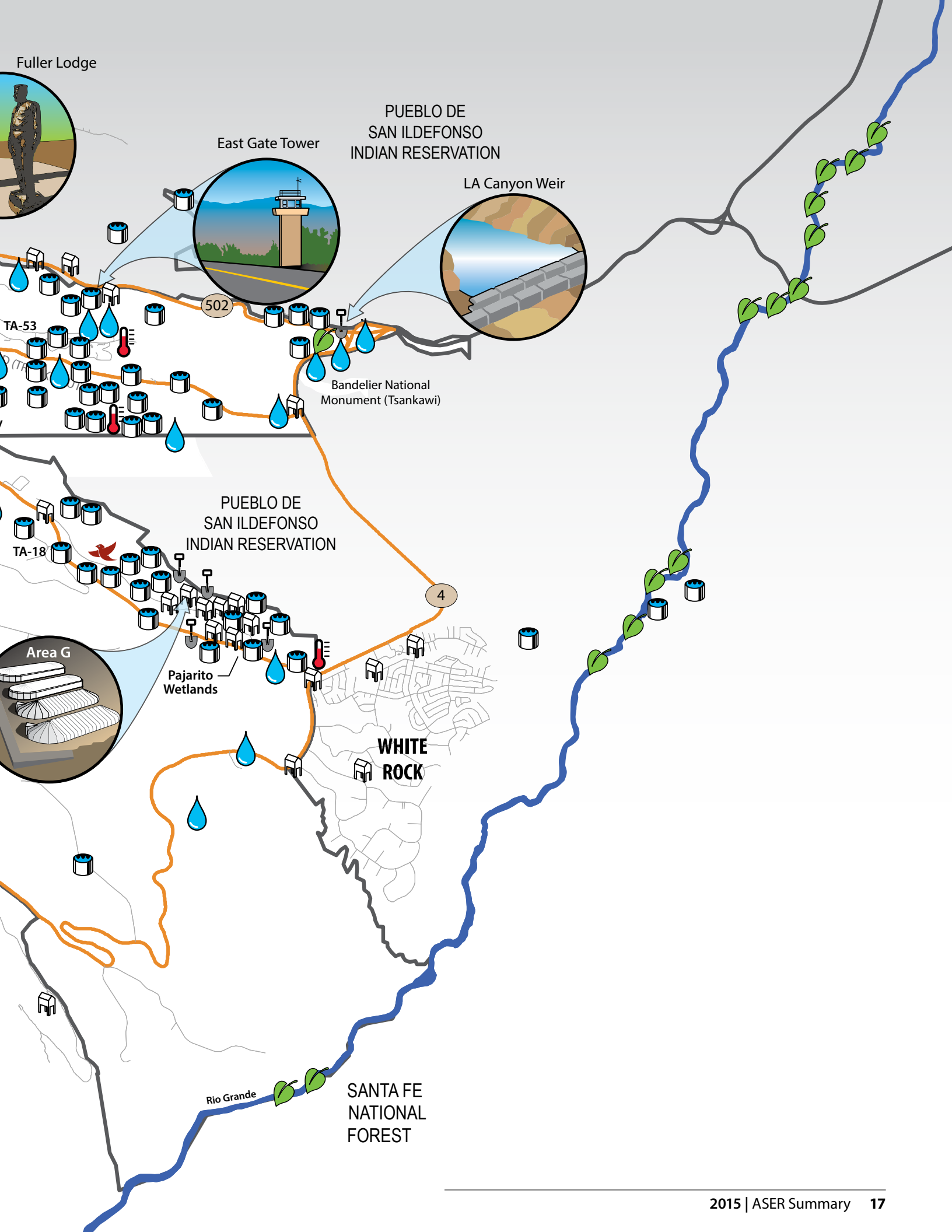
Canyon de Valle
TA-16
BANDELIER
NATIONAL
MONUMENT
4
Santa Fe National Forest
Jemez District
Air samples
Biota samples
Soil samples
Weather stations
Water gauge stations
Bird netting area
Water well

SITE MAP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NATIONAL
FOREST

AIR QUALITY & METEOROLOGY

Meteorological monitoring

Rising temperatures have negative long-term effects

BY DAVID BRUGGEMAN

The topography of Los Alamos creates multiple weather conditions in a small area. At the Laboratory, six meteorology stations effectively capture this variability. The weather data is available at weather.lanl.gov.

2015 weather at a glance

Compared with the 30-year average (1981–2010), temperatures were 2.5 degrees Fahrenheit warmer and precipitation was 23 percent higher in 2015. The summer monsoon produced 46 percent of the annual precipitation. Snowfall totals in Los Alamos were below average for the fifth winter in a row.

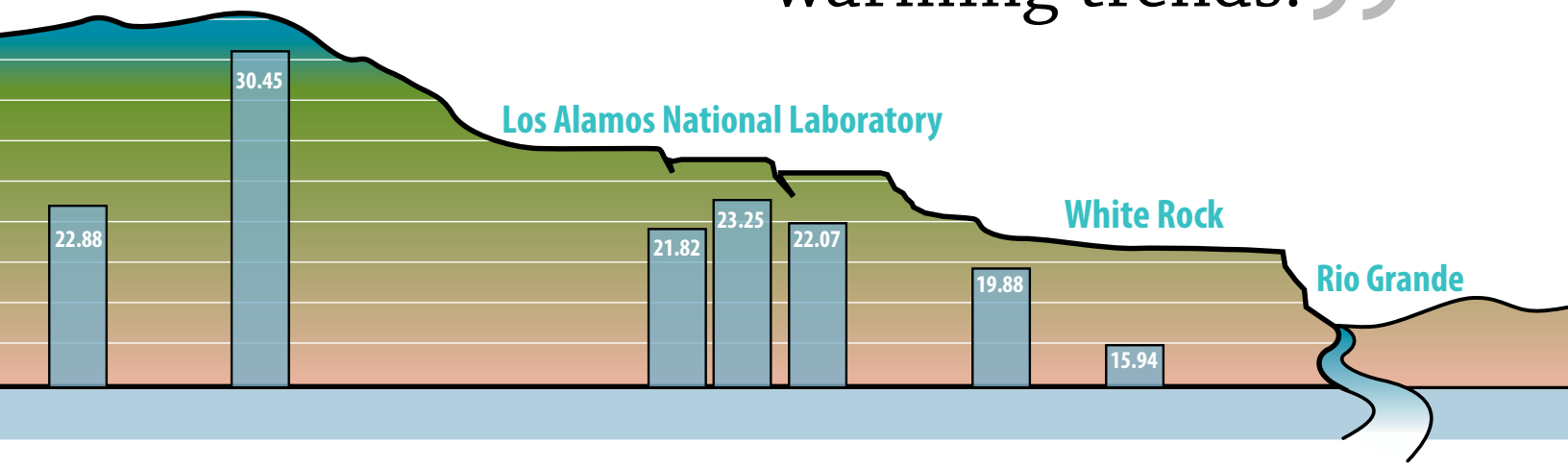
Temperatures are increasing

The current warming trend in Los Alamos is consistent with national warming trends. The most recent data show the annual average temperatures in Los Alamos during the past seven years are warmer than the previous 30-year averages.

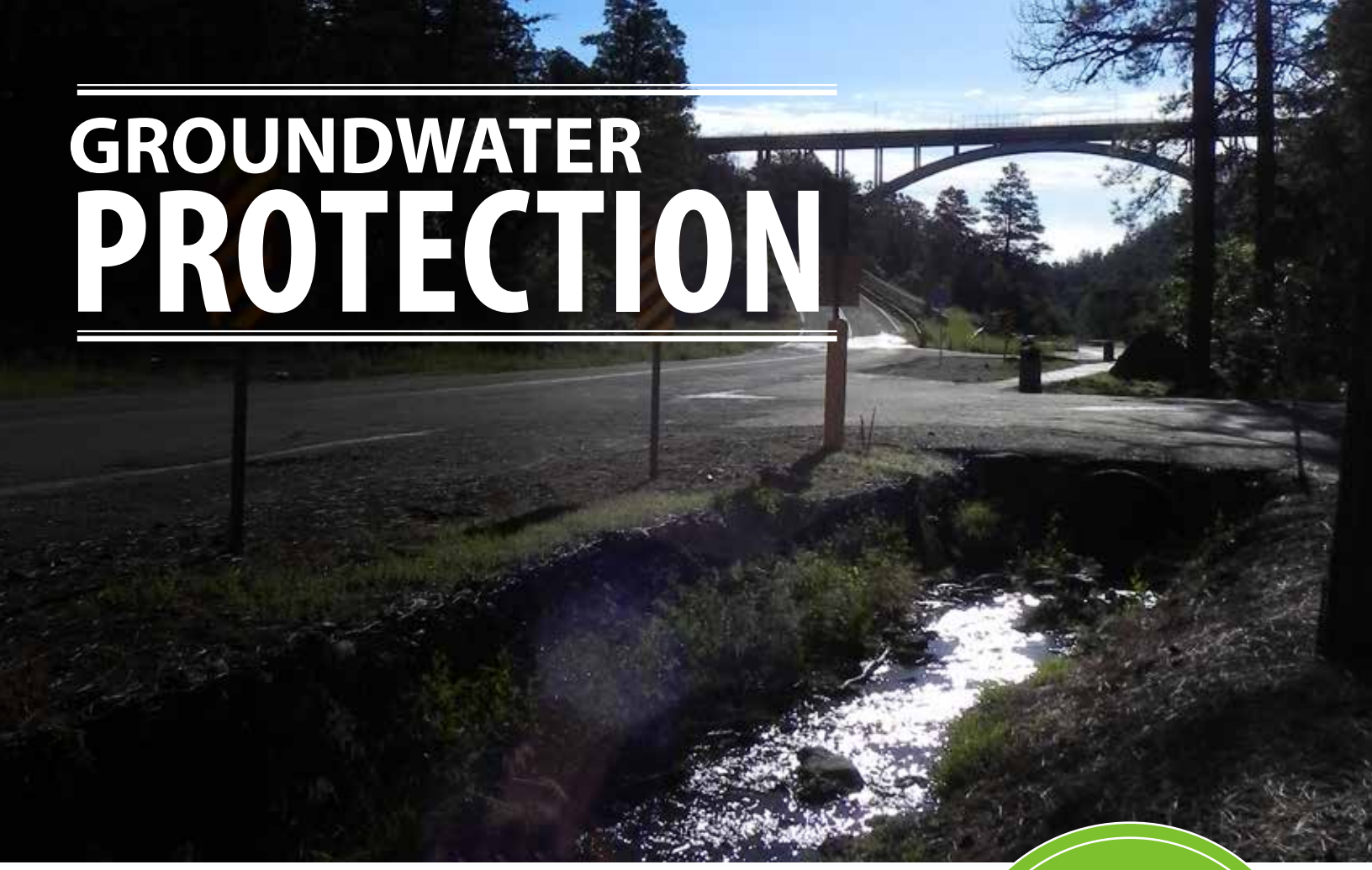
The potential long-term effects of global climate change include warmer temperatures and more extreme weather events. At the Laboratory, warmer temperatures could increase air conditioning costs, and more frequent extreme heat waves could lead to an increase in employee illnesses and deaths. ■

Weather data is available at weather.lanl.gov.

> "The current warming trend in Los Alamos is consistent with national warming trends."



GROUNDWATER PROTECTION



Science on tap

Lab scientists monitor area groundwater

BY NEAL GAFFIN AND HANNAH SMITH

The Laboratory monitors groundwater on-site and in surrounding areas to gather information and to comply with institutional, state, federal, and local requirements. Monitoring information is used to protect public health and the environment.

Groundwater occurs at three depths—alluvial, perched-intermediate, and regional aquifer—and all depths are sampled. The regional aquifer is the area's primary source of drinking water. The different depths of groundwater depend on the intricate geology of the area. The Laboratory is located on the Pajarito Plateau, an area formed from millions of years of volcanic activity and subsequent erosion. The geological layers of the Pajarito Plateau include the Bandelier Tuff, the Tschicoma Formation, the Puye Formation that interfingers with the Cerros del Rio basalt, and the sediments of the Santa Fe Group.

The County's water, supplied to homes and buildings, is safe to drink! The Laboratory is cleaning pockets of contaminated groundwater to ensure that the County's water remains safe.

How do contaminants get into groundwater and move?

Non-dissolvable materials, such as most radionuclides, attach to soil particles and only move if the soil moves and don't readily contaminate groundwater. However, easily dissolvable materials can contaminate groundwater. These materials can trickle from the surface through different rock layers at rates up to 100 feet per year depending on the rock type.

Groundwater standards

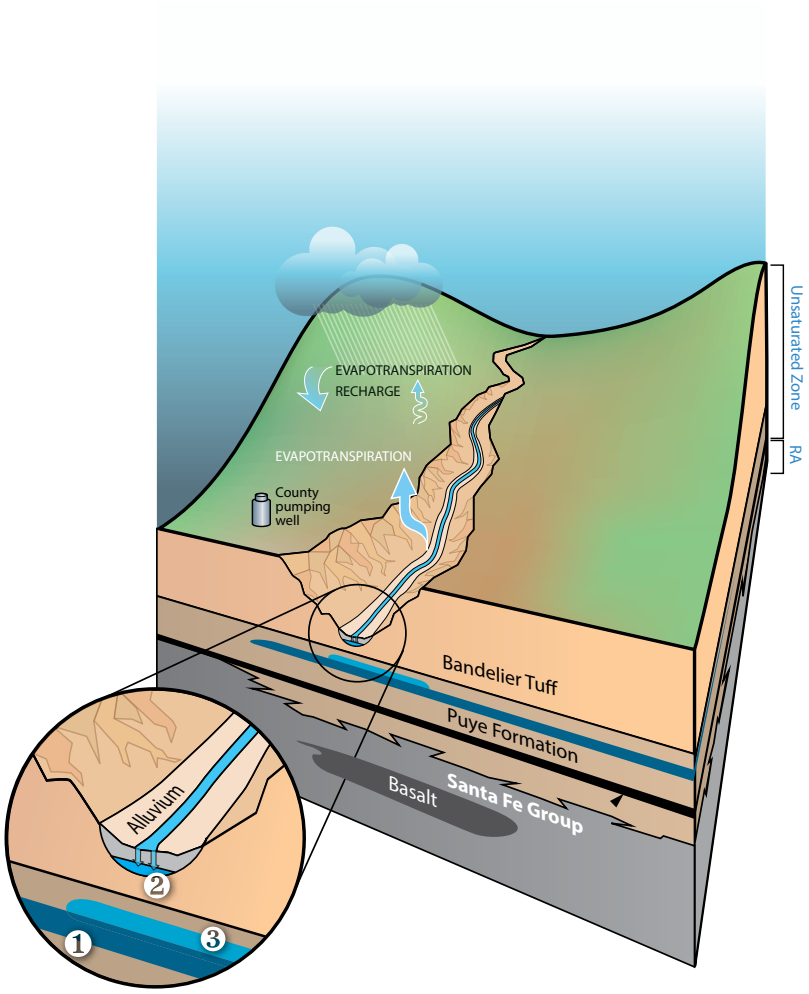
Groundwater standards are established by the U.S. Environmental Protection Agency and New Mexico Water Quality Control Commission. These standards are established to protect the population from unacceptable levels of exposure to contamination in drinking water. For chromium, the U.S. Environmental Protection Agency standard in public drinking water is 100 parts per billion (ppb), and the New Mexico groundwater standard is 50 ppb. The U.S. Environmental Protection Agency royal demolition explosive (RDX) standard for tap water is 7 ppb.

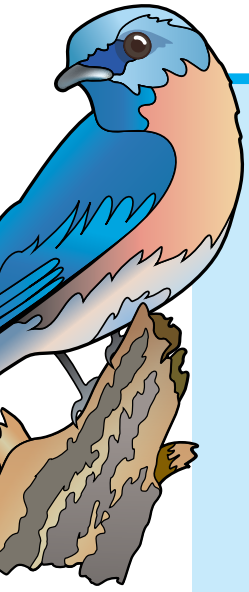
Is our drinking water safe?

Yes, according to the Los Alamos County Department of Public Utilities 2015 Annual Drinking Water Quality Report. All drinking water produced by Los Alamos County met federal and state drinking water standards. The Laboratory supplements the County's sampling program to ensure safety of water-supply wells. ■

Depths of groundwater

1. **REGIONAL AQUIFER:** *the water table within the regional aquifer is located 600–1200 feet below the ground surface within sands and gravels and is used as the source of drinking water*
2. **ALLUVIAL:** *the shallowest layer of groundwater found down to approximately 50 feet below the surface of the sediment that occurs in a canyon floor*
3. **PERCHED-INTERMEDIATE:** *typically 30–200 feet thick flowing around less permeable rocks and is located approximately 350–900 feet below the ground surface*





Groundwater corrective actions

Chromium

From 1956–1972, a Lab power plant at the head of Sandia Canyon discharged large quantities of water containing potassium dichromate, which was used as a corrosion inhibitor in the plant's cooling tower system. Chromium-contaminated water flowed through Sandia Canyon and penetrated the underlying rock layers below Sandia and adjacent Mortandad Canyons. In 2005, a new regional aquifer monitoring well in Mortandad Canyon found chromium levels above the New Mexico groundwater standard of 50 ppb in the regional aquifer approximately 900 feet below ground surface. After further investigation, the Laboratory determined that the chromium plume was nearly a mile long and a half-mile wide. The chromium currently rests within the top 50 feet of the aquifer.

In 2016, the Laboratory began the process of implementing an interim measure to control migration of the plume. Additional work is underway to determine approaches for remediation of the plume.

Royal demolition explosive (RDX)

From 1951–1996, the Laboratory discharged the chemical RDX into Cañon de Valle in Technical Area 16. Used in explosive research and development, RDX is dissolvable in water and moves easily with groundwater. RDX is found primarily within the perched-intermediate groundwater, the zone above the regional aquifer, at depths ranging from 650–1200 feet. The Laboratory is currently conducting studies to evaluate potential remediation strategies for the RDX contamination.

WATERSHEDS & WATER QUALITY PROTECTION

Scientists at the Laboratory diligently monitor storm water coming off of Laboratory property. They have planted wetlands and built structures to keep the water cleaner!

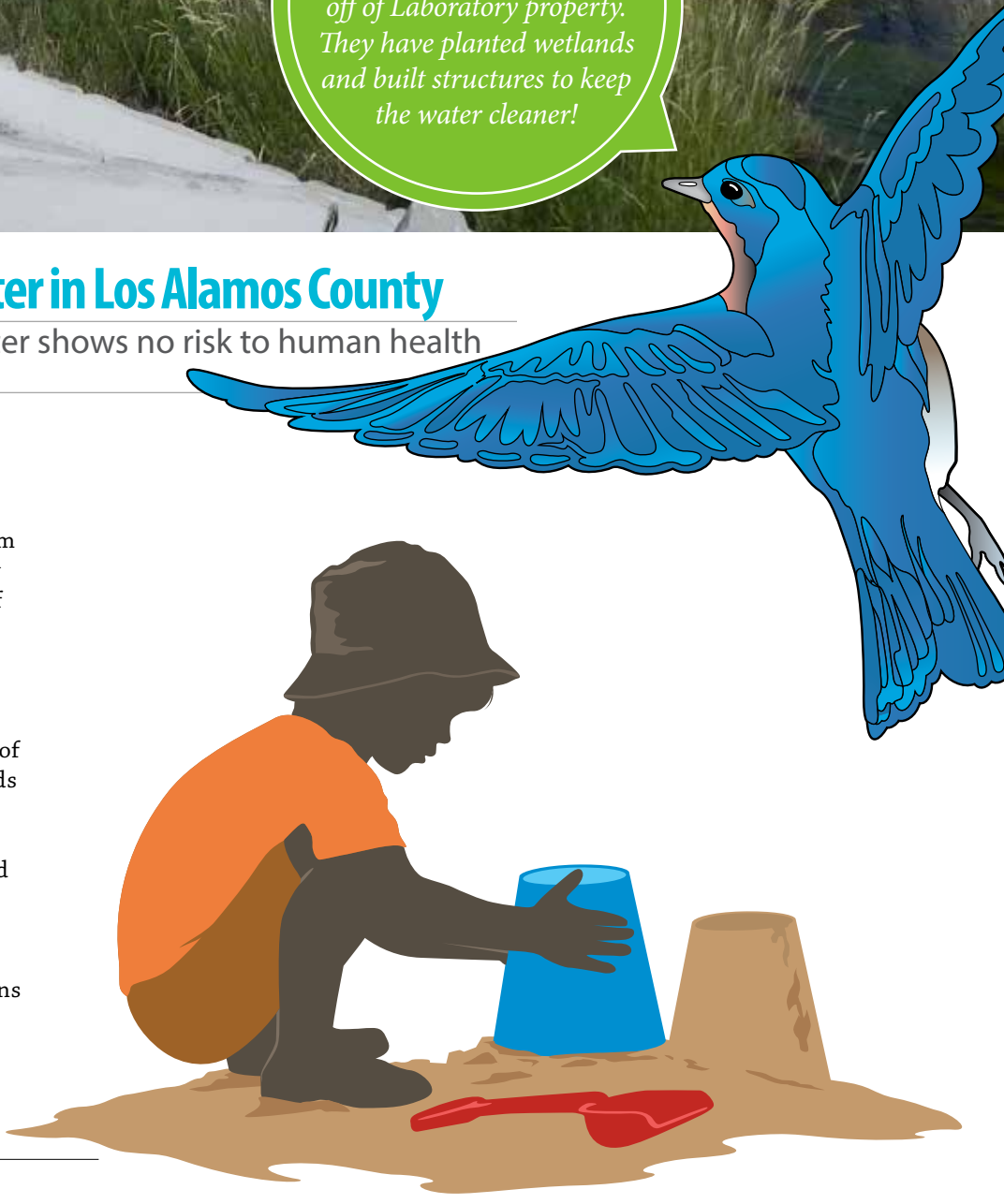
Protecting surface water in Los Alamos County

Continued monitoring of water shows no risk to human health

BY SHANNON BLAIR

During the initial years of the Manhattan Project, liquid wastes were released into Los Alamos watersheds and canyons. Discharge from the Laboratory was reduced in the early 1950s, and by 1978, with the passing of the EPA's groundbreaking Clean Water Act and Clean Air Act, the Laboratory began monitoring and remediating the canyons and water run-off in the Los Alamos area. Although the process of sampling and monitoring the watersheds has changed and progressed during the past 40 years, the missions of the watershed quality programs have stayed the same:

- Monitor historically contaminated Laboratory sites
- Monitor current Laboratory operations and prevent contamination
- Evaluate risk to human and environmental health



Currently, the Laboratory monitors seven watersheds that drain into Northern New Mexico's main source of water and recreational fun: the Rio Grande.

How is surface water monitored and protected?

Monitoring surface water around Los Alamos County requires multiple experts including engineers, hydrologists, chemists, and field scientists all working together under various permits to ensure strict goals are met.

The Laboratory follows four permits in conjunction with the National Pollutant Discharge Elimination System:

- Industrial and Sanitary Permit (outfall permit)
- Individual Permit for Storm Water (individual permit)
- Construction General Permit
- Multisector General Permit

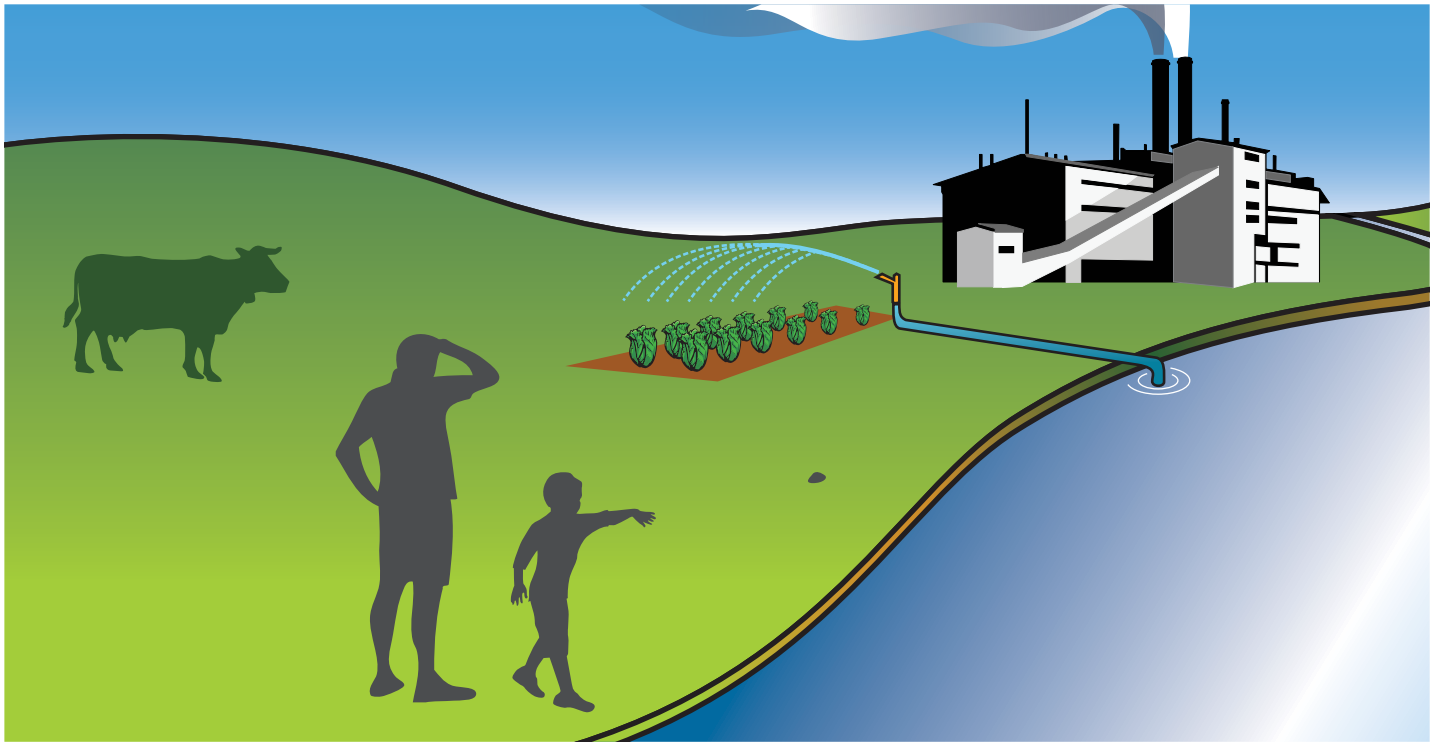
Watershed monitoring

Although watershed monitoring occurs year-round, the busiest time for collecting water samples is the summer monsoon season (June to September) when rain is frequent. Surface water, storm water, and sediment samples are collected in canyons, active stream channels, floodplains, springs, and other sources by samplers. Samplers are also placed in areas beyond Laboratory property (including the Santa Fe National Forest, Jemez and Española Ranger Districts, and Bandelier National Monument) to establish background levels. Field crews collect water following a flow event (rain or snow melt). In areas that have known historical contamination, extra monitoring occurs to ensure water resources are protected to Environmental Protection Agency and New Mexico Environment Department standards.

Samples are analyzed for potential pollutants that include suspended sediment concentration, metals, organics including polychlorinated biphenyls (PCBs), and other select analytes based upon known or potential contaminants. Results are then compared with screening criteria based on the protection of human and environmental health.

Watershed controls

Engineers design ponds, weirs, grade-control structures, wetlands, berms, and riparian vegetation to slow down water that might otherwise erode potentially contaminated sediments. These controls, along with efforts to reduce contamination directly from the Laboratory, ensure the continued safety of the watersheds. ■



Whether using water for irrigation or for recreation, members of the community need to know if the water is safe.

ECOSYSTEM HEALTH

The Laboratory's healthy ecosystem

Samples are evaluated to assess environmental health

BY KASSIDY BURNETT

As an institution with a large presence in Northern New Mexico, the Laboratory has a responsibility to be an environmental steward and good neighbor to its surrounding communities. The Laboratory's past and current activities should not negatively affect area plants and animals, which are collectively known as "biota" and comprise the larger ecosystem. Soil, sediment, vegetation, small mammal, and avian data are collected to assess biota health.

Laboratory scientists work hard to monitor soil, sediment, my small mammal friends, and vegetation for dangerous chemicals or radionuclides. So far, so good, and I can fly free from any worries!

Dirt, mice, and trees: What are they saying?

Certain areas on and off the Laboratory provide critical data for soil, sediment, vegetation, and small mammal analysis. The radiological and chemical concentrations of these samples can be compared to tell us if Laboratory activities are affecting the ecosystem.

In 2015, soil, vegetation, and small mammal (depending on location) samples originated from 22 on-site, 11 perimeter, and six background locations. Background locations were sites with a similar elevation to the Laboratory and more than 20 miles away. Perimeter locations are those from near Laboratory property such as from the communities of Los Alamos, White Rock, and Pueblo de San Ildefonso.

The areas sampled on Laboratory property each have unique reasons for being evaluated. Los Alamos Canyon weir, for example, is important because Los Alamos Canyon receives water from other canyons across the Laboratory before eventually emptying into the Rio Grande. The sediment (soil carried by water) that gets washed up to the base of the weir, the surrounding vegetation, as well as the small mammals that eat and live within the sediment can be tested.

What is looked for in these samples? An independent Laboratory test monitors for PCBs, radionuclides, and inorganic elements such as mercury and lead. In 2015, all radionuclides and most chemical concentrations from on-site and perimeter locations were either not detected, similar to background levels (naturally occurring levels), or below screening levels (those levels that are known to cause no adverse effects or low effects). Although this is great news, the Los Alamos Canyon weir will continue to be monitored to ensure that sediment washed off of Laboratory property is safe. ■

Testing biota samples gives Los Alamos scientists clues about the health of its environment.

Los Alamos' endangered animals

Scientists keep tabs on five species

BY MARIA MUSGRAVE

MEXICAN SPOTTED OWL

YELLOW-BILLED CUCKOO

JEMEZ MOUNTAINS SALAMANDER

SOUTHWESTERN WILLOW FLYCATCHER

NEW MEXICO MEADOW JUMPING MOUSE

Of the 41 threatened or endangered animal species in New Mexico, five live—or have potential habitats—within or near the boundaries of the Laboratory. These species are the Mexican Spotted Owl, the Southwestern Willow Flycatcher, Jemez Mountains Salamander, and the newly listed New Mexico Meadow Jumping Mouse and Yellow-billed Cuckoo.

Each spring, Mexican Spotted Owl surveys are completed by Laboratory wildlife biologists in six canyons on Laboratory property. When the owls are confirmed during these surveys, the canyons are checked later in the season to determine if nestlings are present. In 2015, two breeding pairs and seven nestlings were confirmed.

Los Alamos biologists perform Jemez Mountains Salamander annual surveys from mid-summer to the beginning of fall in the hopes that the summer monsoons will create wet enough conditions for the salamanders to be above ground. In 2015, two salamanders were found.

During bird breeding season, Southwestern Willow Flycatcher surveys are conducted as biologists walk through two wetland habitats at the Laboratory and play the unique call of the flycatcher. Through these surveys, Willow Flycatchers of unknown subspecies have been detected, but none have been confirmed as Southwestern Willow Flycatcher. Similar surveys will begin for the Yellow-billed Cuckoo in 2016, but there are no surveys for the New Mexico Meadow Jumping Mouse.

Documenting these animals on Laboratory property ensures that the Lab adheres to two federal laws that protect wildlife, the Endangered Species Act and the Migratory Bird Treaty Act, and ensures these species will continue to have a home at Los Alamos for years to come. ■

Below: A fledgling Mexican Spotted Owl was found on Lab property in 2015. Baby owls are easily identified by their fluffy, downy feathers.

Lab wildlife biologists monitor and protect migratory birds and threatened and endangered species, such as my bird friend forever (BFF) the Mexican Spotted Owl.

Monitoring provides a bird's eye view of avian populations

Biologists work to document Los Alamos' feathered friends

BY MARIA MUSGRAVE

Long-term avian monitoring programs give an idea of the diversity and abundance of animal species on Lab property throughout the year. These programs include: mist netting and banding during bird breeding and migratory periods, winter and breeding bird surveys, threatened and endangered species surveys, and an avian nest-box network.

Mist netting allows researchers to safely catch and band birds that are either breeding or migrating in an area. At each of the two banding stations found at the Laboratory, 12–14 fine "mist" nets are set up shortly before sunrise and checked every 30 minutes for five to six hours. These nets are difficult to see and easily—and safely—catch birds that try to fly through them. Any birds found in the nets are carefully removed so that they can be banded or marked as a recapture (if they've already been banded). Then, data is collected, including sex, age, weight, tail length, and wing length. Finally, the birds are released unharmed.

Winter and breeding bird surveys are conducted as point-count surveys along straight lines in three habitat types. This means that scientists walk or drive for 250 meters before stopping at a point and listening and watching for birds. Each point lasts five minutes, and there are nine points total in each survey.

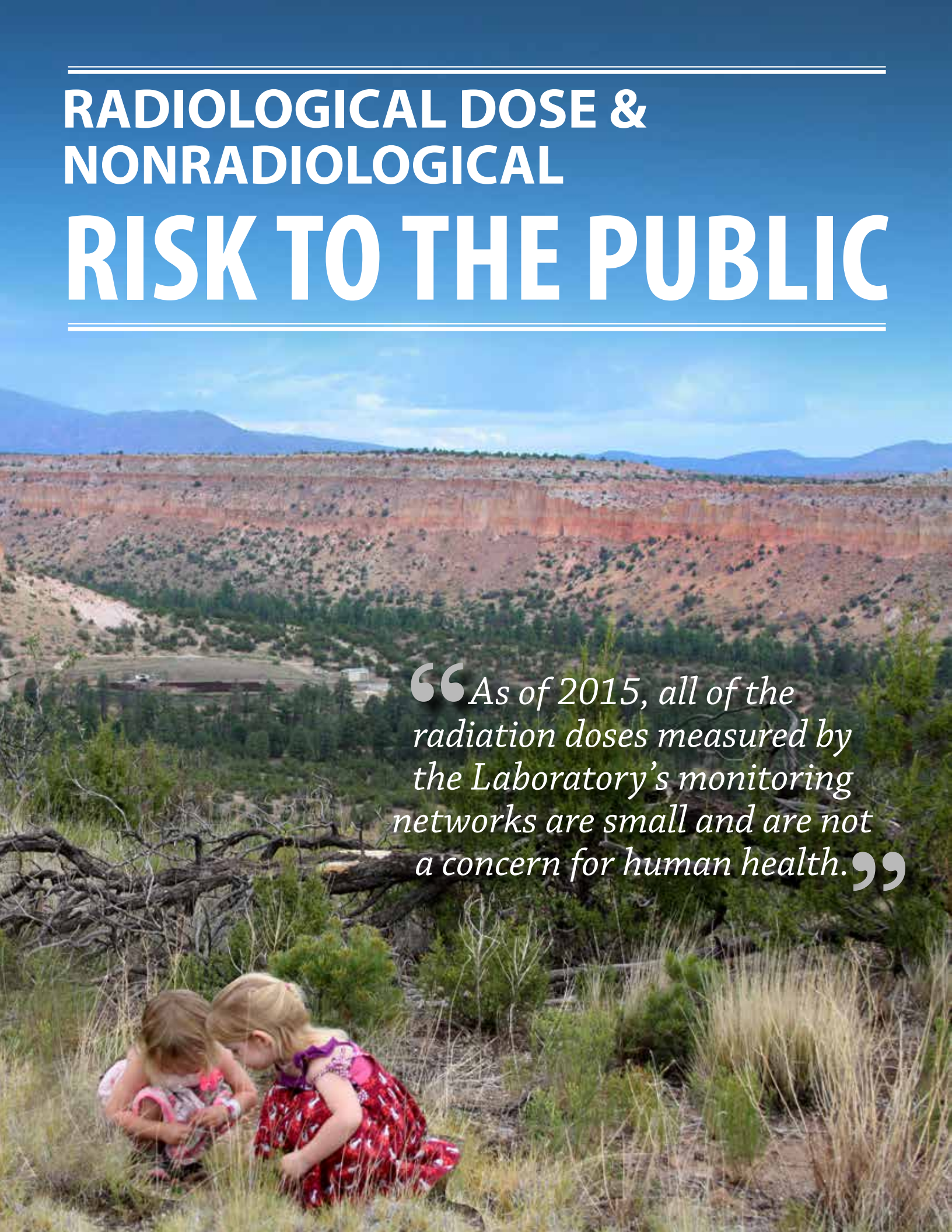
Likewise, information gathered in surveys of the endangered Mexican Spotted Owl, Southwestern Willow Flycatcher, and Yellow-billed Cuckoo can be used to infer information about habitat, climate, human disturbances, and other factors relating to these birds.

The avian nest-box network is a collection of more than 500 nest boxes (essentially birdhouses) that spans the Laboratory and several off-site locations that act as controls. The project has two target species: the Western Bluebird and the Ash-throated Flycatcher. During the breeding season, the boxes are checked regularly for occupation. Any resident nestlings are banded and sexed once they reach the proper stages of development.

Each of these programs is an important part of understanding wildlife populations and possible effects on them. In addition to these programs, the Lab's biological resources management team reviews projects from other areas of the Lab to help ensure that no adverse effects to biological resources occur from Laboratory operations. ■

Above: This Plumbeous Vireo, caught in a mist net, was banded during fall migration banding at Pajarito Wetlands.

RADIOLOGICAL DOSE & NONRADIOLOGICAL RISK TO THE PUBLIC



"As of 2015, all of the radiation doses measured by the Laboratory's monitoring networks are small and are not a concern for human health."

Radiation 101

It's not all bad

BY ELIZABETH RUEDIG

One might think that a nuclear weapons laboratory emits a lot of radiation. But that's not the case at Los Alamos National Laboratory, which ensures that the public's radiation exposure is well below the regulatory limit of 100 millirem per year and far, far less than the natural background radiation dose in Los Alamos County of 450 millirem per year.

To understand what those numbers mean, and how the Laboratory measures its radioactive emissions, one must first understand what radiation is.

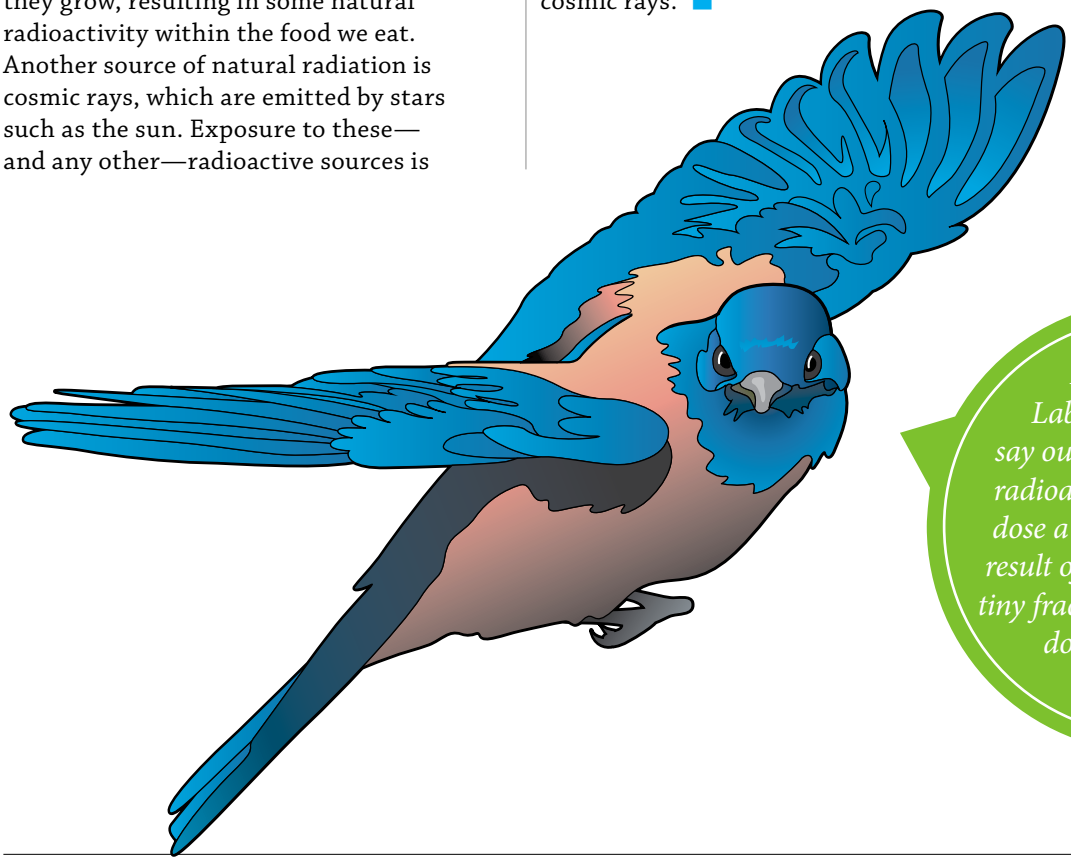
There are two types of radiation: non-ionizing and ionizing. Non-ionizing radiation includes, for example, radio waves and visible light. On the other hand, ionizing radiation (often shortened to simply "radiation") includes four basic types: alpha, beta, gamma, and neutron radiation.

All humans are continuously exposed to naturally-occurring radiation, both non-ionizing and ionizing. Soils naturally contain radioactive uranium and other radioactive elements: these radioactive elements are taken up by plants as they grow, resulting in some natural radioactivity within the food we eat. Another source of natural radiation is cosmic rays, which are emitted by stars such as the sun. Exposure to these—and any other—radioactive sources is called radiation dose, and its unit is the millirem. The sum of all the radiation doses received by an individual from natural sources is called background dose.

Each type of ionizing radiation has distinct characteristics that can affect the radiation's hazard. One important property of a radioactive material is its half-life: as a radioactive element emits energy, that element transmutes into a different, often non-radioactive element. The radioactive material's half-life describes how quickly this process occurs. Materials with a short half-life transmute very quickly, while materials with a long half-life may persist for eons.

Health physicists calculate the radiation dose to humans, plants and wildlife living near the Laboratory by analyzing how radionuclides move through the environment and expose individuals through air, water, food, and other media. This process is called pathway analysis. The Laboratory also measures doses from direct exposure to radiation sources, which is the sum of both radiation emitted by the Laboratory and natural radiation sources such as cosmic rays. ■

Data collected from air sampling stations allow Lab scientists to analyze air quality.



I overheard a Laboratory scientist say our world is naturally radioactive! The radiation dose a person receives as a result of Lab operations is a tiny fraction of the radiation dose from natural radioactivity.

What's the risk from the Laboratory's radiological emissions?

Monitoring data shows no health risks from radiation releases to residents of Northern New Mexico

BY ELIZABETH RUEDIG

The Direct Penetrating Radiation Monitoring Network measures the direct radiation emitted as a result of Laboratory operations via a network of roughly 80 thermoluminescent dosimeters located in key areas throughout Laboratory property. Thermoluminescent dosimeters are the same radiation monitoring devices worn by some Laboratory employees; they are roughly the size of a credit card and monitor beta, gamma, and neutron radiation.

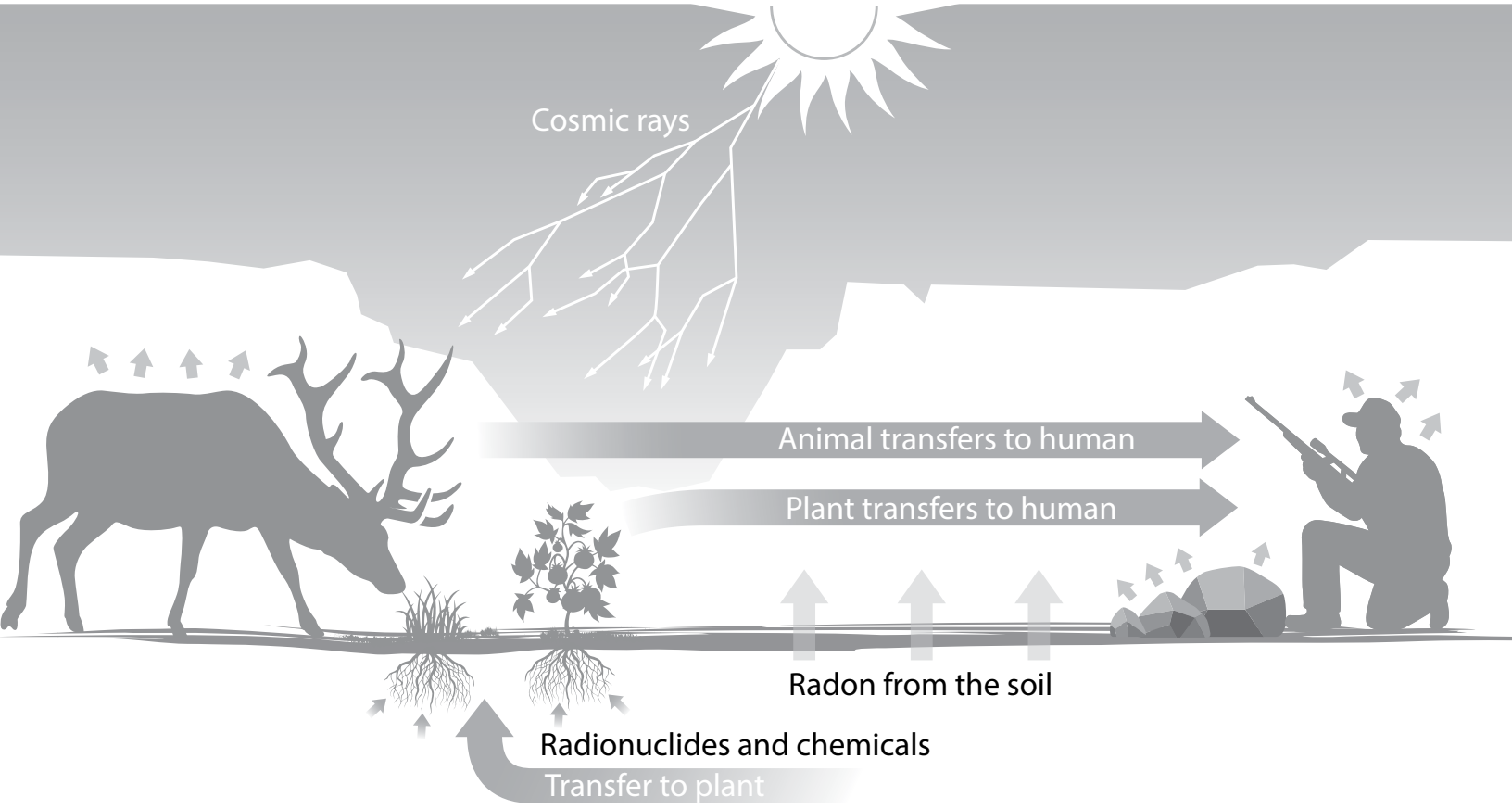
In 2015, the highest dose to a member of the public from direct-penetrating radiation was less than 0.1 millirem.

The Laboratory also maintains a network of air-monitoring stations; these stations continuously pull air through a filter, which is analyzed for its radionuclide contents. Radionuclide concentrations in air can be related back to a radiation dose by assuming a typical person's breathing rate. Usually radiation doses from the air-monitoring network are too small to measure and must be calculated by a health physicist. In 2015, the calculated radiation dose from the Laboratory's air emissions was less than 0.001 millirem.

In addition to the air-monitoring network, the Laboratory monitors facility stack emissions on a weekly basis. Stacks are similar to chimneys and are designed to disperse gases after passing them through a high efficiency filter. Stack monitoring is conducted to ensure that radionuclide emissions from stacks are as low as reasonably achievable. In 2015, the radiation dose to the public as a result of stack emissions was below the U.S. Environmental Protection Agency's standard of 10 millirem.

As of 2015, all of the radiation doses measured by the Laboratory's monitoring networks are small and are not a concern for human health. ■

Animals cannot be hunted on Laboratory property, but they may migrate into areas where hunting is permitted. The Lab monitors radiation release to be sure these animals do not have an unnatural level of radiation.



In search of the Maximally Exposed Individual

How much radiation might one person be exposed to at the Lab and surrounding areas?

BY ELIZABETH RUEDIG

What is the highest potential radiation dose received by a member of the public as a result of Laboratory operations? This person is called the Maximally Exposed Individual, and his or her radiation dose is calculated under the assumption that an individual is continuously exposed at the most radioactive location(s) and consumes only locally sourced food and water. The calculation is performed both on Laboratory property (on-site Maximally Exposed Individual), and also off Laboratory property (off-site Maximally Exposed Individual).

This calculation represents the highest potential radiation dose. When corrected for a hypothetical individual's behavior, such as time spent in one area and actual food sources, the radiation dose to any real individual will be much lower than the Maximally Exposed Individual calculation suggests.

During 2015, the off-site Maximally Exposed Individual was located at 2470 East Road (East Gate). A person who spends 24 hours per day and 365 days per year at this location—in addition to consuming locally sourced food and water—would receive 0.13 millirem, or less than 0.1 percent of background dose.

The 2015 on-site Maximally Exposed Individual was located on East Jemez Road near Technical Area 53. An individual at this location, with the same occupancy and food restrictions as the off-site individual, would receive less than 0.1 millirem, or less than 0.1 percent of background dose.

Both of these doses are the result of airborne radioisotope emissions from the Los Alamos Neutron Science Center stacks. Many of the radioisotopes from these stacks disperse and decay very quickly, and the expected dose for most real individuals is less than 1 percent of the Maximally Exposed Individual dose.

The radiation dose to which the Maximally Exposed Individual is hypothetically exposed is very small and is not a risk to human health. ■

The location of the off-site maximally exposed individual is East Gate tower on East Jemez Road, which dates back to the early Cold War era.

2015

ANNUAL SITE ENVIRONMENTAL REPORT SUMMARY

CONTRIBUTORS

Shannon Blair

Post-baccalaureate student for Environmental Remediation and Environmental Services

Blair graduated from Whitman College in 2015 with a degree in environmental studies-geology. After living in Colorado for a year, she decided to move home to Los Alamos and work with the Laboratory's storm-water team, which collects field samples and ensures the continued safety of the area's watershed.

David Bruggeman

Graduate student for Compliance Programs Group

At Los Alamos, Bruggeman works as a meteorologist to provide weather data to support a broad range of projects and programs. Bruggeman received a master's degree in meteorology from San Jose State University and bachelor's degrees in meteorology and earth science from Metropolitan State University of Denver and Minnesota State University Mankato, respectively.

Jeremy Brunette

Post-master's student for Environmental Stewardship Services

Brunette arrived in Los Alamos in May 2015 after completing a master's degree at the University of Nebraska-Lincoln (Go Big Red!). Working at Los Alamos has afforded him the opportunity to raise his family in a stunning natural environment with safe communities while managing remarkable cultural resources.

Kassidy Burnett

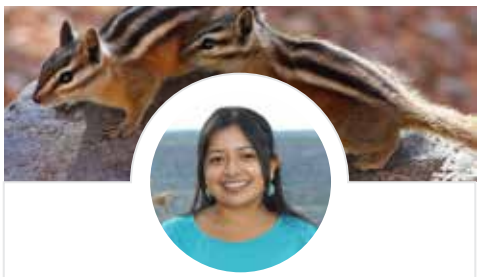
Post-master's student for Environmental Stewardship

A Los Alamos native, Burnett began working at the Laboratory in October 2015 after living on both coastlines for a few years. During her time at the Lab, she's learned a great deal about environmental monitoring, the pollution prevention program, and even a little bit about NEPA compliance.

Amanda Cvinar

Graduate research assistant for Cultural Resources Management

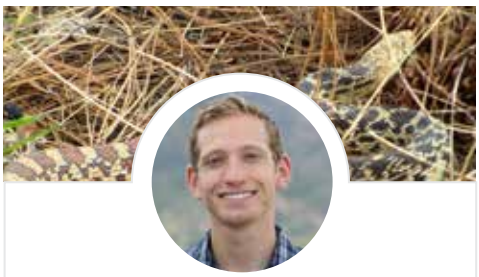
Cvinar graduated from the University of North Carolina-Chapel Hill with degrees in archaeology and anthropology. She is currently pursuing a master's degree in cultural resource management from Adams State University while working full time at the Laboratory. Her master's project documents an archaeological site on Lab property that she hopes will become a National Historic Landmark.



Tatiana Espinoza

Graduate research assistant master's student for Environmental Stewardship

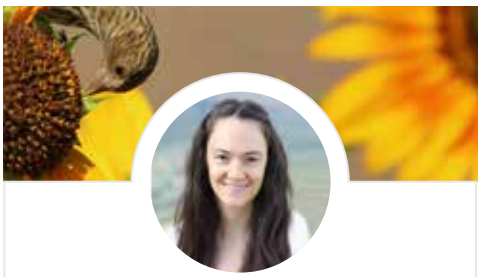
Espinoza is pursuing a master's degree in natural resources stewardship at Colorado State University She began working at Los Alamos as an undergraduate in 2013. Her mentors were supportive of her educational goals and encouraged her to pursue a graduate degree while doing field work.



Neal Gaffin

Undergraduate student

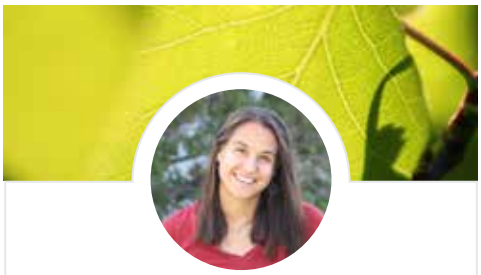
Gaffin studies chemical engineering at Brigham Young University and has decided to further his education after spending a summer at the Laboratory. After participating in cutting-edge engineering projects at Los Alamos, he hopes to dedicate his career to research and scientific advancement.



Karen Musgrave

Post-master's student for Environmental Stewardship Services

Musgrave earned a bachelor's degree in psychology from the University of Oregon in 2012 and a master's degree in behavioral ecology from the University of Exeter. At the Laboratory, she has expanded her knowledge of environmental policy, biological and cultural resources, and environmental stewardship.



Maria Musgrave

Post-bachelor's student for Environmental Stewardship Services

As an undergraduate student, Musgrave worked with the Laboratory's biological resources team during the summers. After graduating from the University of Redlands in 2015 with a degree in environmental science, she returned to Los Alamos as a full-time student.

Felicia Naranjo

Post-master's graduate research assistant for Environmental Protection and Compliance

Naranjo graduated in 2015 with a master's degree in environmental science from New Mexico Highlands University. At Los Alamos, she assists the RCRA Permitting and Compliance team with permit and permit modification submittals to maintain regulatory compliance at all of the Laboratory's units that treat, store, and/or dispose of hazardous and mixed waste.

Emily Phillips

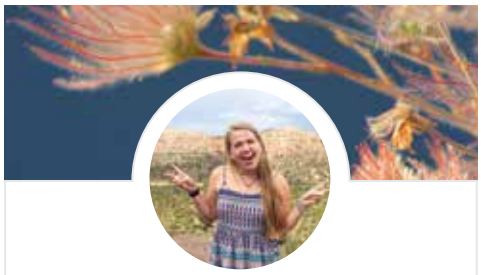
Post-bachelor's student for Environmental Stewardship Services

Phillips graduated from New Mexico State University with a degree in conservation ecology before beginning a post-bac position at the Laboratory in January 2016. Phillips has been able to conduct her own research, and she plans to bring what she's learned at Los Alamos to a graduate program in fall 2017.

Elizabeth Ruedig

Postdoctoral research associate in Environmental Stewardship Services

Ruedig, who earned a Ph.D. in radiation health physics from Oregon State University, has worked for the Laboratory since 2015 as an environmental health physicist. She wants to ensure that the environment is safe for all Northern New Mexicans and is preserved for future generations to enjoy.



Hannah Smith

Undergraduate student in Environmental Remediation and the Environmental Protection and Compliance Divisions

A Georgia native, Smith studies environmental engineering at Mercer University. During the summer of 2016, she interned in the Environmental Remediation and the Environmental Protection and Compliance Divisions–and learned to love green chile. Smith has since decided to pursue a master's in engineering management.

Brenda Fleming

Graduate student for Communication Arts and Services

Fleming discovered her passion for design after studying abroad in France, Spain, and Mexico. After receiving a degree in foreign languages, she continued to pursue an education in graphic design. She is currently obtaining a master's degree in graphic information technology at Arizona State University. She is the graphic designer for this magazine.

Westerfield Montoya

Western Bluebird for Environmental Management at Los Alamos

When not looking for bugs or seeds, Westerfield, aka Wes, is usually busy advocating for his homeland. He spends his days educating people about his environment and how to keep it safe. Wes lives down West Jemez Road with his wife and two eggs.

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Lorrie Bonds Lopez *Editor*

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A special thanks to Mark Schraad for donating several photographs for use in this magazine. Schraad is a program manager in the Lab's nuclear weapons program; on weekends he is an amateur, but avid, nature and wildlife photographer.


Los Alamos
NATIONAL LABORATORY
EST. 1943