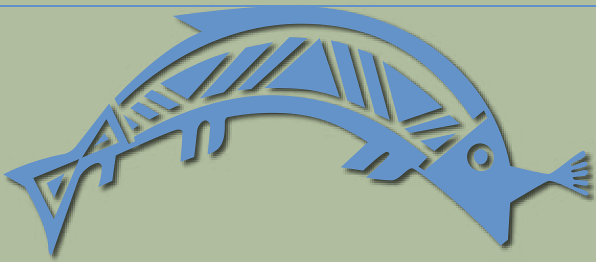
Summary of Environmental Surveillance at Los Alamos during 2007



Los Alamos
NATIONAL LABORATORY
EST. 1943

LA-14385-ENV
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A message from the students...

Growing up in Los Alamos with family members working at Los Alamos National Laboratory (LANL), I always had an idea of what the facility did. After a year at the University of California, Santa Barbara I got pretty good at giving a quick explanation of my historic hometown. Through those conversations, I learned of various perceptions of New Mexico and Los Alamos and I realized how little I knew about the area I grew up in.

I was lucky enough to be hired to familiarize myself with the area, the environmental stewardship of LANL and to compile the information into this Summary Report. Through this report, I hope to give the communities around LANL a better idea of its impacts and to better convey the environmental history of LANL to anyone I meet. After being completely overwhelmed with information at the beginning of the summer, I began to absorb what I was learning and to appreciate the opportunities. I was able to visit the interior of the Valles Caldera; take tours of air sampling systems meteorology towers, and storm water sampling systems; attend public meetings; and interview experts.

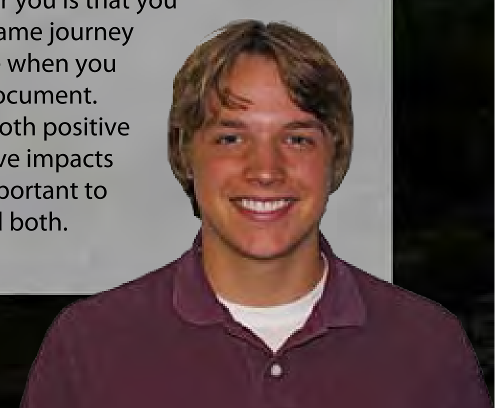
Very rarely does a student get to learn with countless experts at hand, and I found that everyone I encountered was more than willing to help, much to my appreciation. I express my greatest gratitude to my mentors for their help and willingness to let us explore ideas on our own.

Michelle

This summer I was given a wonderful opportunity to write this summary report with Michelle. The experience was entirely new to me. I was born and raised in Kansas and currently attend the University of Kansas. I have a friend who lives in the Los Alamos area, and he told me that LANL was a good place for a student to get a job. I wanted to be adventurous and try something new, so I applied to LANL and ended up working on this Summary Report.

I went through a couple of phases as I learned about the Laboratory. I knew nothing about contamination or radiation, so everything I was learning was new to me. At first I thought LANL did not release any radiation into the environment. As I read documents, I learned that was not true. I have to admit, I was scared by this. For a while I kept thinking about the unseen threat, and it worried me. I kept learning about the radiation and contamination here, and I soon began to put it all in perspective. I realized that the amounts I was learning about were tiny compared to the background radiation that everyone is already exposed to. I also learned about the extensive procedures and monitoring that the Laboratory uses, which again decreased my worry. I went from ignorance to awareness and fear and finally to understanding.

My hope for you is that you make the same journey that I made when you read this document. LANL has both positive and negative impacts and it is important to understand both.



Doug

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What is the ESR and why have a summary report?

Each year, LANL produces an Environmental Surveillance Report (ESR) in compliance with a Department of Energy (DOE) order. The ESR aims to summarize the environmental impacts of the Laboratory, the efforts to minimize these impacts, and LANL's compliance with environmental regulations. This Summary Report presents the methods and results of environmental monitoring done in 2007 in a form that is more understandable and inviting to the public. Though other DOE sites have done Summary Reports in the past, this is LANL's first for the ESR, and the authors were privileged to write this report from the perspective of students.

The former main technical area surrounding Ashley Pond in downtown Los Alamos.

What is LANL and what is its purpose?

Los Alamos National Laboratory (LANL or the Laboratory) is a premier national security institution located in Los Alamos, New Mexico. The mission of LANL is to develop and apply science and technology to;

1. ensure the safety and reliability of the US nuclear deterrent,
2. reduce global threats, and
3. solve other emerging national security challenges.

Since its creation in 1943, LANL has made essential contributions to the world of science in physics, magnetism, chemistry, energy research, and other fields. The idea of a scientific effort to assemble an atomic bomb began in 1939 when Albert Einstein wrote a letter to President Roosevelt informing him of Germany's plan to build an atomic bomb. Roosevelt responded by creating a program for nuclear research, and after Pearl Harbor, the program to build an atomic bomb was made a true priority with the Manhattan Project.

General Leslie Groves was put in charge, and one of his first tasks was to choose a location that was secluded and secure. J. Robert Oppenheimer suggested Los Alamos because of its moderate climate and seclusion in the mountains. Three years later, with the collaboration of all the scientists' work, two atomic bombs called Little Boy and Fat Man were completed and dropped on Japan, ending World War II soon after.

Despite the completion of the original project, the Laboratory continued and eventually became Los Alamos National Laboratory. When the Manhattan Project began, 100 scientists seemed sufficient. By 1945, the Laboratory had expanded to include 3,000. Today it employs over 9,000 people and encompasses much more than weapons design.

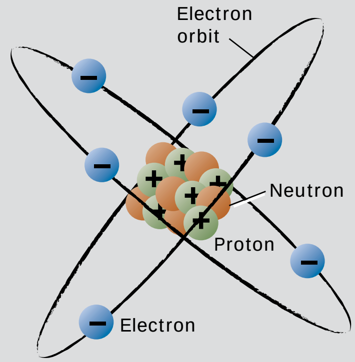
The old main technical area of the Laboratory near Ashley Pond.

Recent achievements include the development of Roadrunner, the world's fastest super computer, and the completion of the Dual-Axis Radiographic Hydrodynamic Test facility (DARHT), which has allowed LANL to better pursue its goal of maintaining the safety and reliability of the US nuclear stockpile without performing nuclear testing. Currently, LANL is working on many other scientific projects involving biomedicine, atmospheric measurements, astronomy, satellites, lasers, magnets, and particle accelerators.

Overview of Radiation

What is radioactivity?

Protons determine what kind of element the atom is, while neutrons determine which isotope it is. If the nucleus of an isotope is unstable, it is radioactive and will release its excess energy through radiation.



An atom is made up of a nucleus of protons and neutrons surrounded by orbiting electrons.

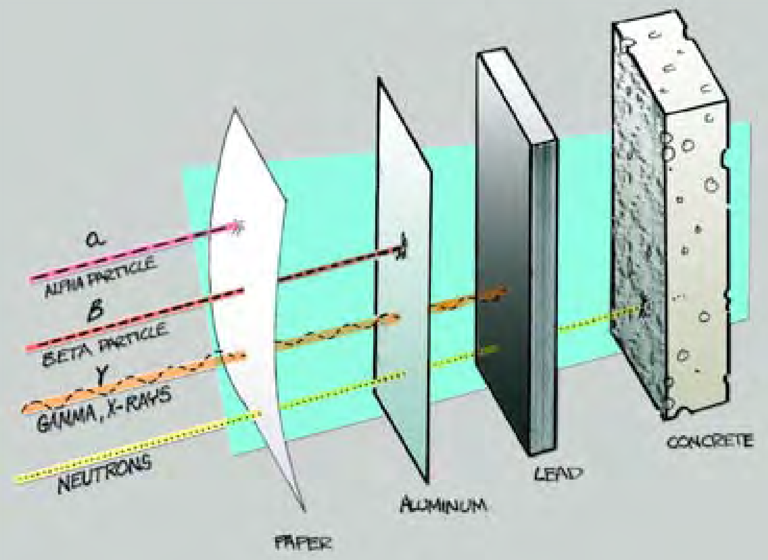
The number of neutrons determines the isotope of an atom.

If the nucleus is unstable (based on the number of neutrons), it releases energy in the form of radiation.

All matter is made up of atoms, as shown.

What is radiation?

Radiation is the energy that a radioactive atom gives off. When radiation is released, it travels at high speeds until it collides with something and passes its energy on to that object. Effects differ based on the type of radiation and how it comes into contact with another object. There are four types of nuclear radiation: alpha, beta, gamma, and neutron. These types can be blocked by different materials. As shown, paper can block alpha particles and thin aluminum can block beta particles. Gamma particles require something denser like lead and neutron particles require something thicker still like a layer of concrete.



Different radiation types are blocked by different substances.

Is radiation natural?

Though it can be man-made, most radiation in the environment is natural. In fact, a human body contains radioactive elements. Radiation even comes from the stars, rocks, and soil.

Is it dangerous?

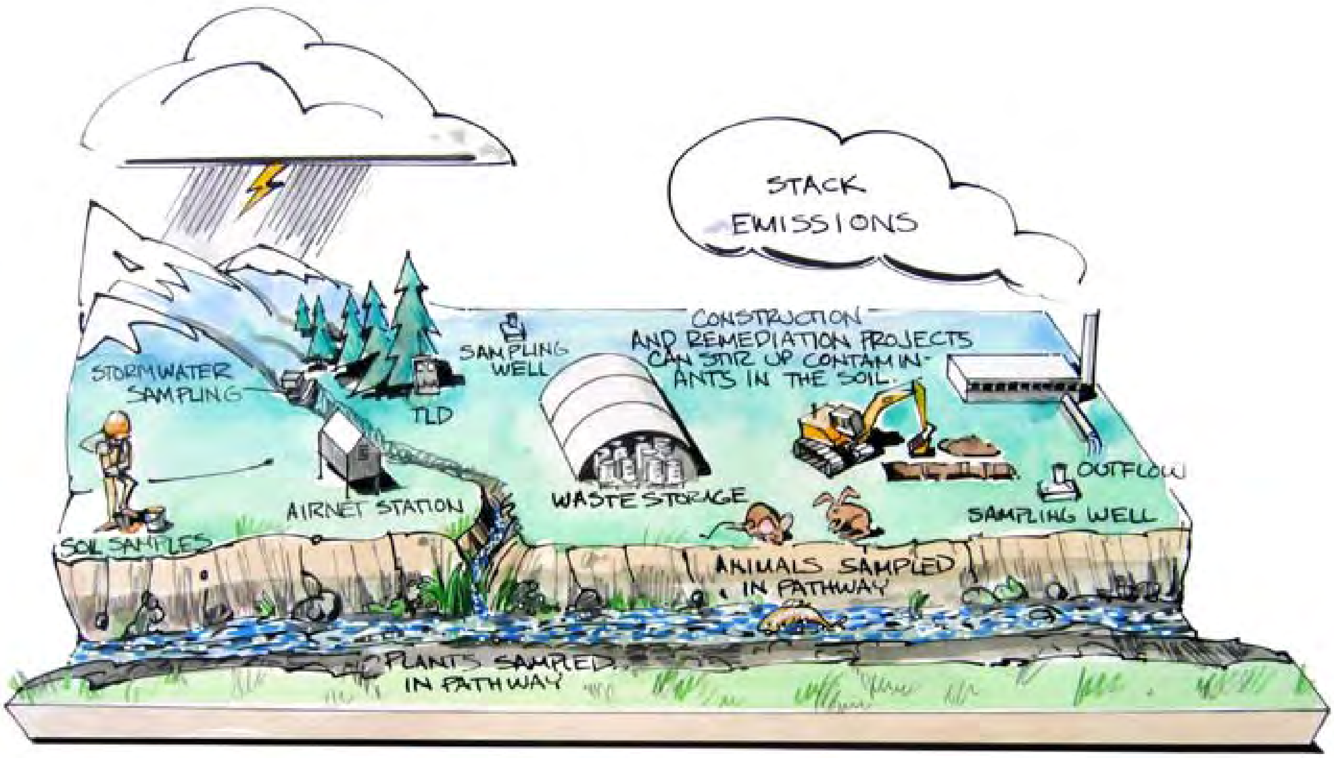
In general, the amount and duration of radiation exposure affects the severity or type of health effect. Cancer is considered by most people to be the primary health effect from radiation exposure. At extreme levels of exposure, radiation burns and radiation sickness can result.

What units are used to measure radiation and radioactivity?

There are several systems for measuring radiation in the environment. The effect of radiation on humans is measured in a unit called a rem, though usually in a smaller unit called a millirem (mrem) which is one thousandth of a rem. Just as teaspoons instead of cups measure smaller amounts of ingredients, millirems can measure radiation in smaller amounts. Similarly, a curie is the unit for radioactivity, but picocuries (pCi) are usually used because of the tiny amounts of radioactivity in natural materials. A picocurie is one trillionth of a curie.

What environmental monitoring goes on at LANL?

Most of the monitoring methods discussed in this report involve at least some monitoring for radionuclides or radiation. To monitor radioactivity, instruments can count the radioactive decays in a sample or a sample can be analyzed for radioactive elements using chemistry. Chemical contaminants are also monitored in many locations. Particles in ambient (in a surrounding area or environment) air, well and surface water samples, ambient radiation measurement with thermoluminescent dosimeters (TLDs), soil samples, and biota (plant and animal) samples are collected for monitoring. Samples are taken around Laboratory property, parts of Los Alamos County, and surrounding areas. These samples allow the Laboratory to understand where contamination needs to be addressed and to observe any changes over time. Much of the monitoring, such as that for groundwater or cleanup at LANL, is directed and scheduled by the New Mexico Environment Department (NMED) through the Consent Order. The Consent Order is a legally binding agreement between LANL and NMED to monitor and remediate specific areas where hazardous materials may have leaked into the environment.



LANL monitors various pathways for contaminants to be sure of locations, concentrations, and trends.

Were there any unplanned releases at the Laboratory in 2007?

There were no unplanned airborne releases or radioactive liquid releases from LANL in 2007. There were 17 spills or releases of potable water, fire suppression water, or domestic waste water, and one spill of a quart of motor oil into a storm drain. All of these liquid releases were reported to NMED. Lastly, smoke was released briefly from a power plant at a higher density than is permitted.

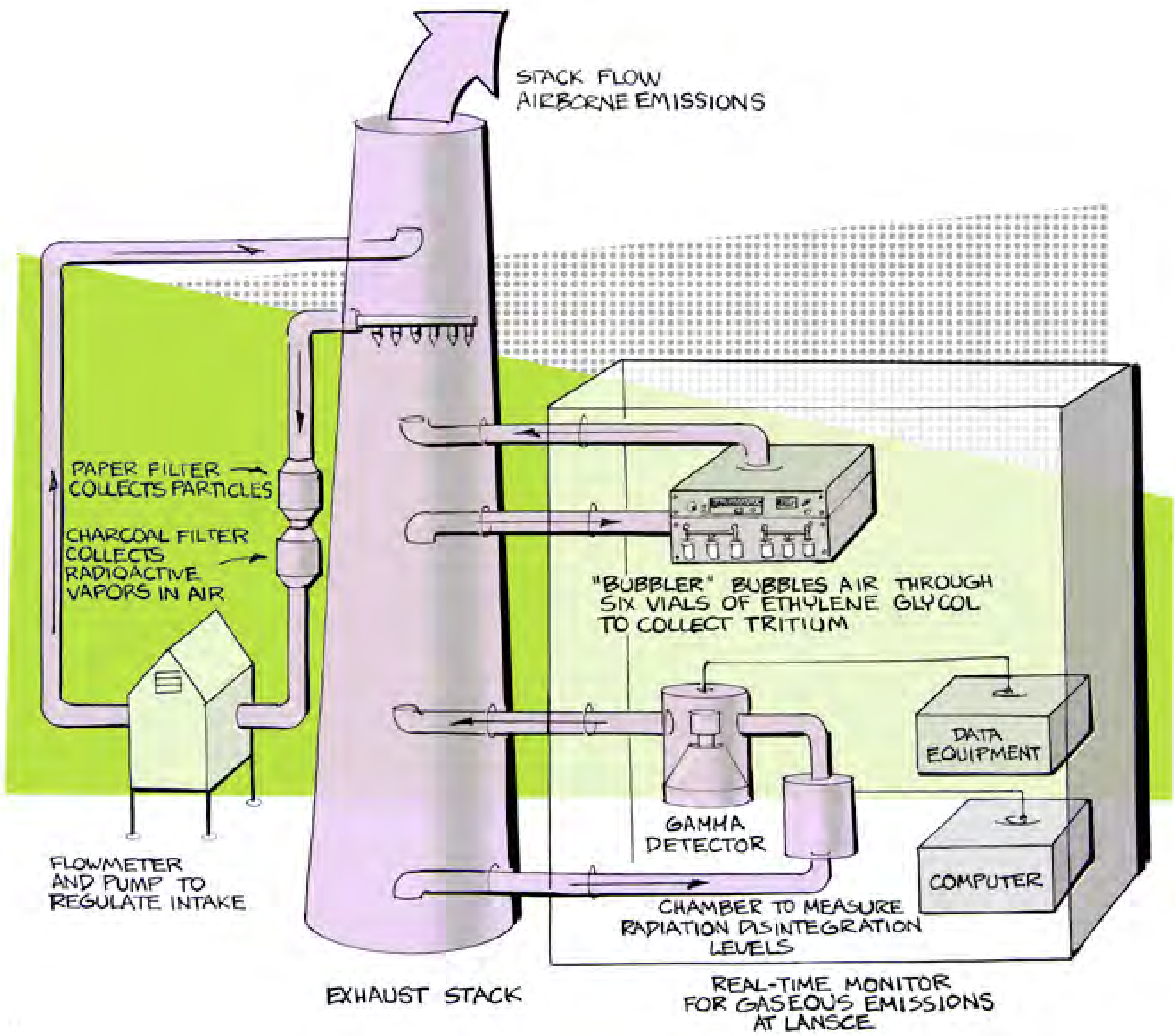
What federal regulations apply to the Laboratory and How well did LANL comply in 2007?

Federal Statute	What it Covers	Status
Resource Conservation and Recovery Act (RCRA)	Generation, management, and disposal of hazardous waste and cleanup of inactive, historical waste sites	▪ Self-assessments showed LANL in compliance 96.29% of the time ▪ Two Notices of Violation: One for not completing groundwater sampling in the permitted time, the second regarding the storage of hazardous waste ▪ Two regional aquifer wells were installed in Sandia Canyon
Clean Air Act (CAA)	Air quality and emissions into the air from facility operations	▪ The Laboratory met all permit limits for air emissions ▪ Several non-radiological air emissions lower than the previous year; many other contaminants similar to the previous year ▪ Smoke from the power plant was denser than allowed for a short period of time, the dose to the maximally exposed individual (MEI) from radioactive air emissions was 0.52 mrem, which is similar to the very low dose for the previous year
Clean Water Act (CWA)	Water quality and effluent discharges from facility operations	▪ Only three of 1,408 samples collected from industrial or wastewater outfalls exceeded wastewater discharge limits because of elevated chlorine levels, which were lowered immediately ▪ LANL continued to implement 15 Storm Water Pollution Prevention Plans to manage pollutants and runoff
Above-ground storage tank compliance program	Liquid storage tank monitoring and compliance	▪ Seven tank systems were closed out with NMED in 2007 leaving a total of 20 regulated tanks
Toxic Substances Control Act (TSCA)	Chemicals such as polychlorinated biphenyls (PCBs)	▪ The Laboratory shipped 46 containers of PCB waste, 60 lbs of capacitors, and 2,795 lbs of fluorescent light ballasts for disposal or recycling
Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)	Storage and use of pesticides	▪ The Laboratory remained in compliance with regulatory requirements regarding use of pesticides and herbicides; used 620 oz of insecticides and 185.5 gal. plus 12 lbs of herbicides
Emergency Planning and Community Right-to-Know Act (EPCRA)	The public's right to know about chemicals released into the community	▪ The Laboratory reported releases, waste disposal, and waste transfers totaling 10,883 lbs of lead and 557 lbs of nitric acid ▪ Chemical Inventory Reports updated to the Los Alamos County fire and police departments for 36 chemicals or explosives
Endangered Species Act (ESA) & Migratory Bird Treaty Act (MBTA)	Rare species of plants and animals	▪ The Laboratory maintained compliance with the ESA and MBTA; conducted annual surveys for Mexican Spotted Owl, Southwestern Willow Flycatcher, Jemez Mountains Salamander, and Grey Vireo
National Historic Preservation Act (NHPA) and others	Cultural resources	▪ The Laboratory maintained compliance with the NHPA and identified four new archaeological sites and no new historic buildings. Fifteen archaeological sites were determined eligible for the National Register of Historic Places
National Environmental Policy Act (NEPA)	Projects evaluated for environmental impacts	▪ During 2007, public comments were incorporated into the final Site-Wide Environmental Impact Statement for continued operation of LANL, the document was released in early 2008 for a final decision in late 2008 on one of three alternatives

How does LANL monitor contamination in the air, and what are this year's results?

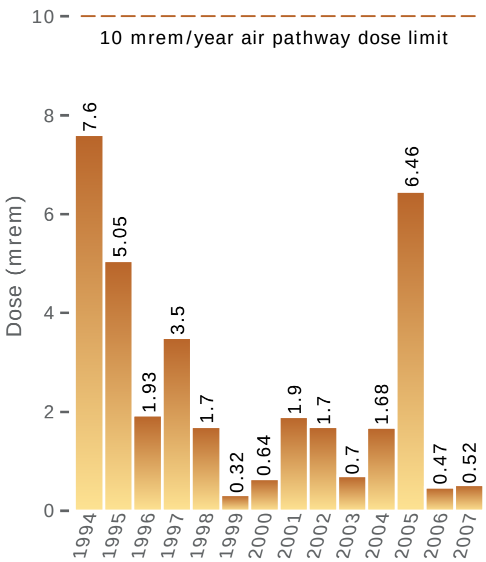
Many sites on LANL property have building stacks that release air emissions from LANL experimental work. Twenty-seven stacks were monitored in 2007, including stacks at the Los Alamos Neutron Science Center (LANSCE) and various chemistry laboratory stacks. If stacks have the potential to result in a dose of 0.1 mrem to any member of the public, then they are monitored. This potential dose is calculated by ignoring any clean-up systems used to reduce emissions. There are four types of filters and monitoring systems for different types of contaminants, but only the methods appropriate to each individual stack are used on that stack.

LANSCE reduces its radioactive emissions by using a long system of circling pipes that allows the radioactive gaseous emissions, which decay very quickly, to decay significantly before being released. In 2005, LANSCE noticed a significant increase in its emissions. After attempting to remediate this with increased pipe lengths, a leak was discovered which had contributed to the higher off-site air pathway dose in 2005. Since the leak repair, emissions and the resulting dose have dropped significantly.

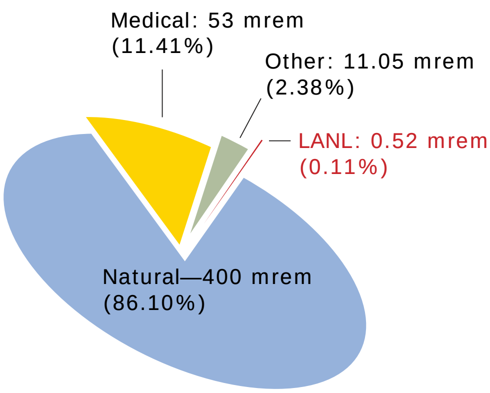


There are four types of monitoring systems for stacks, as shown.

Technician taking measurements from an AIRNET station.



MEI dose level for airborne pathway since 1994.



Sources of radiation to a typical resident of northern New Mexico (black labels) and to the maximally exposed individual adjacent to LANL property (red label).

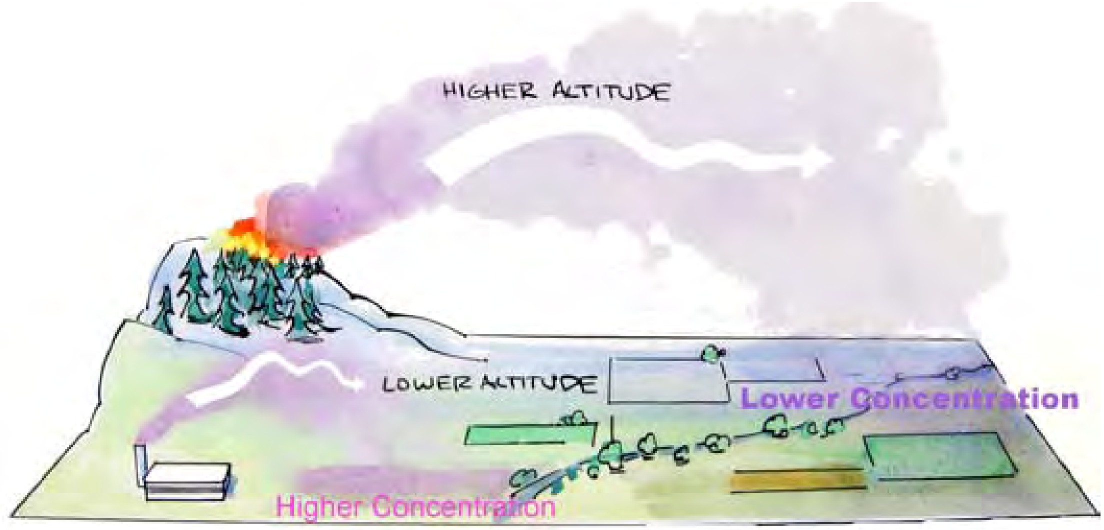
LANL samples ambient air with a network called AIRNET. There are 60 AIRNET stations on or around Laboratory property and a few far away at regional locations. Each station collects particles on a polypropylene filter and collects water vapor in silica gel. The filter and silica gel are changed every two weeks. The filters are analyzed for levels of radioactive contaminants and the water in the silica gel is analyzed for tritium. Tritium can be part of a water molecule and is released from some LANL sites. AIRNET is particularly important because it can detect contaminants that come from sources besides the stacks, such as wind or remediation work that could stir up contaminants.

In addition, LANL uses thermoluminescent dosimeters (TLDs) to monitor direct radiation. Over 90 TLDs are placed around the Laboratory, usually near AIRNET stations. These monitors detect direct neutron and gamma radiation and are analyzed four times a year. While TLDs are particularly useful to detect any significant increases in radiation, it is difficult to distinguish the small amounts of man-made radiation from natural radiation. Many Laboratory employees also wear TLDs while working in areas with potential for radiation exposure so that any dose can be measured. When heated, TLDs emit light that is proportional to the amount of radiation the TLD absorbed.

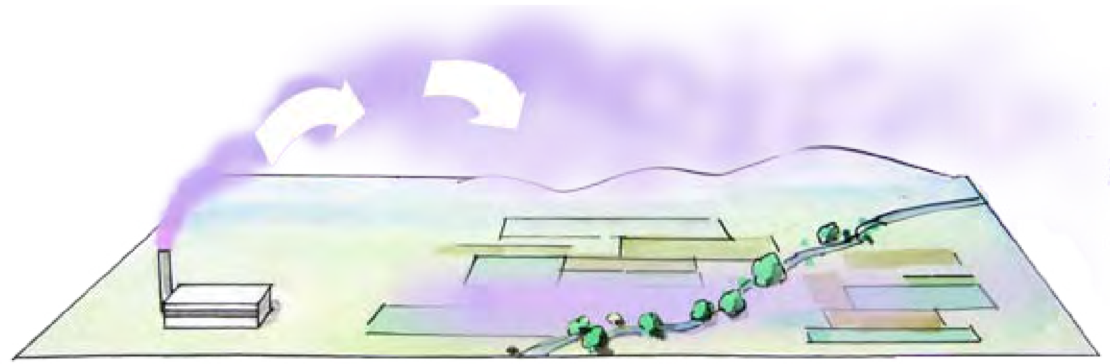
Thermoluminescent dosimeter (TLD) badge, like those carried by employees and used for monitoring outdoors

LANL measures the radiation dose that a person could receive from Laboratory operations at several locations. By using the results from AIRNET stations, stack sampling, and computer models that calculate the direction of dispersion of contaminants, the location with the potential of giving the largest airborne dose to a person is found. This is called the location of the maximally exposed individual (MEI) for air dose. In 2007, the MEI location was along DP Road in Los Alamos with a dose of 0.52 mrem for the year, which is low when compared to the 470 mrem that people in Los Alamos receive from background sources. Using TLD measurements, LANL determined the MEI resulting from direct radiation. The estimated dose from external radiation was 0.8 mrem for 2007 and was on Pueblo de San Ildefonso land north of Area G, LANL's main waste storage and disposal facility. Other measurements determine the dose to the average Los Alamos resident, 0.022 mrem for 2007, and the dose to the average White Rock resident, 0.024 mrem for 2007.

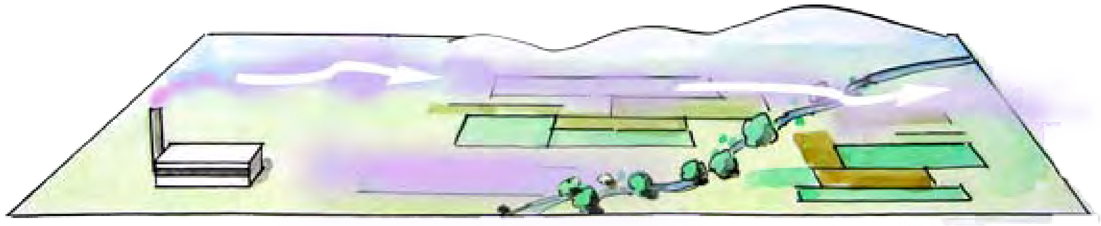
Because of past worldwide, above-ground nuclear tests and the 1987 Chernobyl nuclear reactor accident, low levels of radionuclide contamination are found all over the world. Above-ground nuclear tests lofted radionuclide contaminants into the stratosphere (the level of air above 30,000 feet, essentially above any weather). These radionuclides eventually (from days to years) mix back into the troposphere (the layer of air between the ground and the stratosphere) and settle to the ground through precipitation to become global fallout. Because there is more snow and rainfall at higher elevations in the mountains, increased levels of fallout are expected there. By sampling at different elevations, scientists have verified that fallout generally increases with elevation.



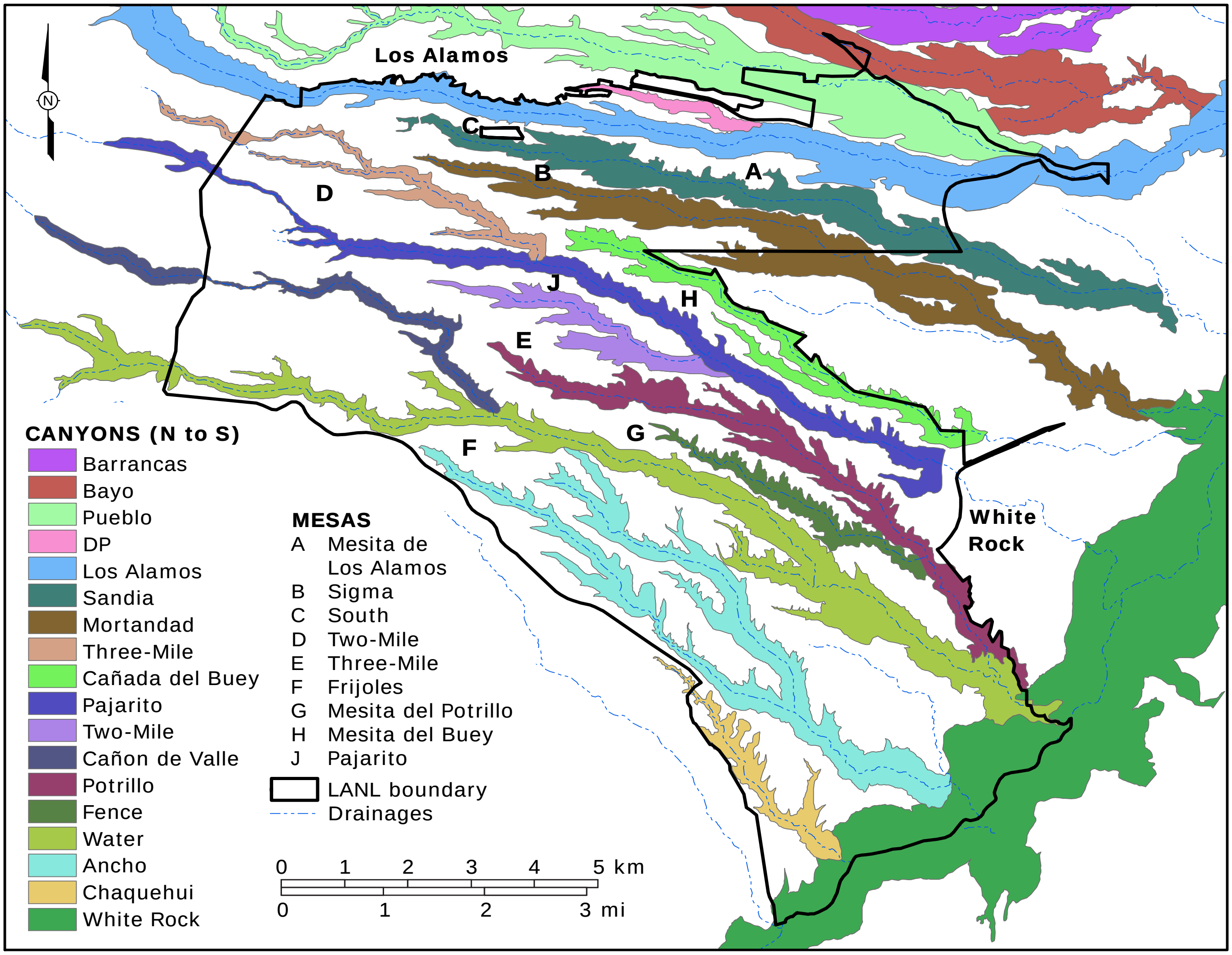
As height of release increases, the contaminants may travel farther but dissipate over more volume so that concentrations are greatly decreased.



In low wind conditions, contaminants are higher closer to the source but decrease rapidly away from the source.



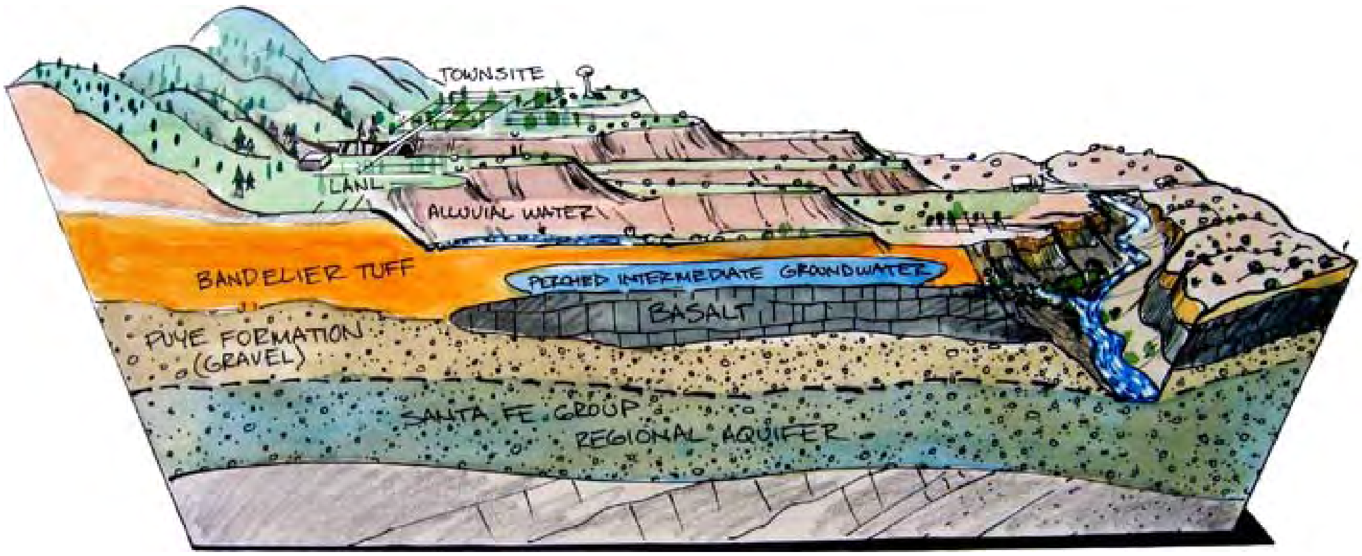
As wind speed increases, the contaminants may travel farther but are dispersed in a greater volume resulting in much lower concentrations.



Canyons and mesas in the vicinity of Los Alamos National Laboratory.

Where does groundwater occur in Los Alamos?

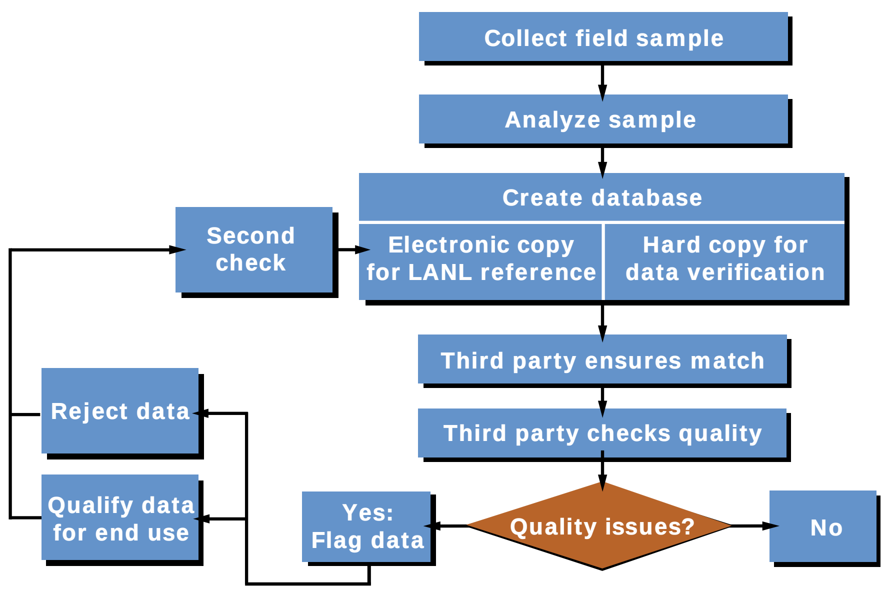
The groundwater in Los Alamos is crucial to the community. It provides all the drinking water and is an important part of the ecology. Of the three groundwater levels, the most shallow is alluvial groundwater which occupies sediments in canyon bottoms. Below canyons, intermediate depth water sometimes settles on top of rocks that it cannot easily travel through, slowing the transport of contaminants to the regional aquifer. The regional aquifer is located 600−1200 feet below the surface beneath several layers of unsaturated rock. Only the regional aquifer is used as a source of drinking water for people.



Levels of groundwater.

What does the Laboratory do to monitor groundwater?

An extensive system of wells around Los Alamos, including more than 40 wells drilled since 1998, is used to monitor the groundwater at varying depths and locations. There are also numerous springs where groundwater reaches the surface, allowing LANL to monitor groundwater without drilling wells. The water quality measured at monitoring wells is compared to regulatory standards. LANL can find contaminants, observe trends, and determine what to look for in specific wells by evaluating sources of contamination and expected pathways. If an outfall is known to have released a specific contaminant, then wells along the path of the contaminant will be monitored for that contaminant.



Flow chart on analytical data process.

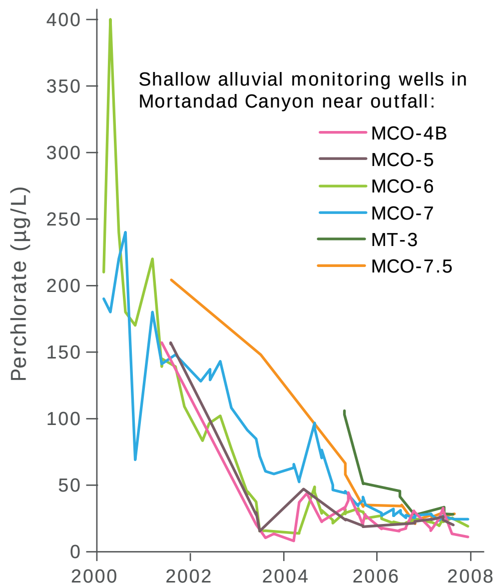
What contaminants are found in Los Alamos groundwater?

Several contaminants have been found in the groundwater around Los Alamos, including tritium, nitrate, perchlorate, and chromium.

Though tritium has been found in Los Alamos groundwater in several canyons, levels have been steady over the past three years and are well below groundwater standards. Tritium was previously released from LANL and moves readily in groundwater, which is why monitoring continues.

Nitrate has also been found in regional groundwater, often within background values but also as evidence of effects from past releases. Nitrate has been detected in several aquifer monitoring wells but is well below standards. It has also been found in alluvial groundwater from past releases from current and former sewage treatment outfalls.

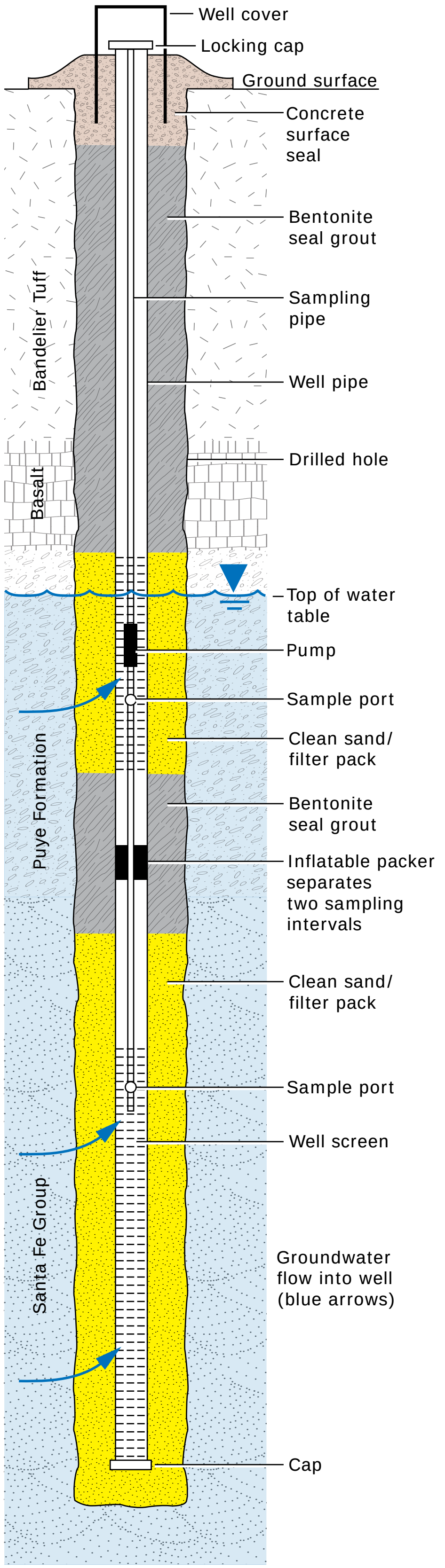
Perchlorate is another contaminant of concern at LANL because it moves readily in groundwater and was previously released from the Radioactive Liquid Waste Treatment Facility in Mortandad Canyon. While small amounts of perchlorate are found naturally, levels have been found well above background in the alluvial groundwater in Mortandad Canyon. Releases of perchlorate since 1999 have been low due to improvement in treatment process, and levels in the monitoring wells have dropped drastically.



Perchlorate in Mortandad Canyon alluvial groundwater, measured in four different wells.

Chromium is another contaminant of concern, mostly beneath Mortandad and Sandia Canyons. The power plant in the main Laboratory technical area used to release chromium which has now been found in the regional aquifer, though it is not present in any drinking water wells. About 36 pounds of chromium were released from the power plant outfall into Sandia Canyon every day from 1956 to 1972. The area around this outfall is a wetland that has converted a potentially large portion (possibly 25 percent) of the hexavalent chromium into trivalent chromium. Hexavalent chromium can potentially cause adverse health effects in humans and is fairly mobile in groundwater. Trivalent chromium is relatively immobile and is an essential nutrient.

Monitoring Well



Typical structure of a monitoring well.

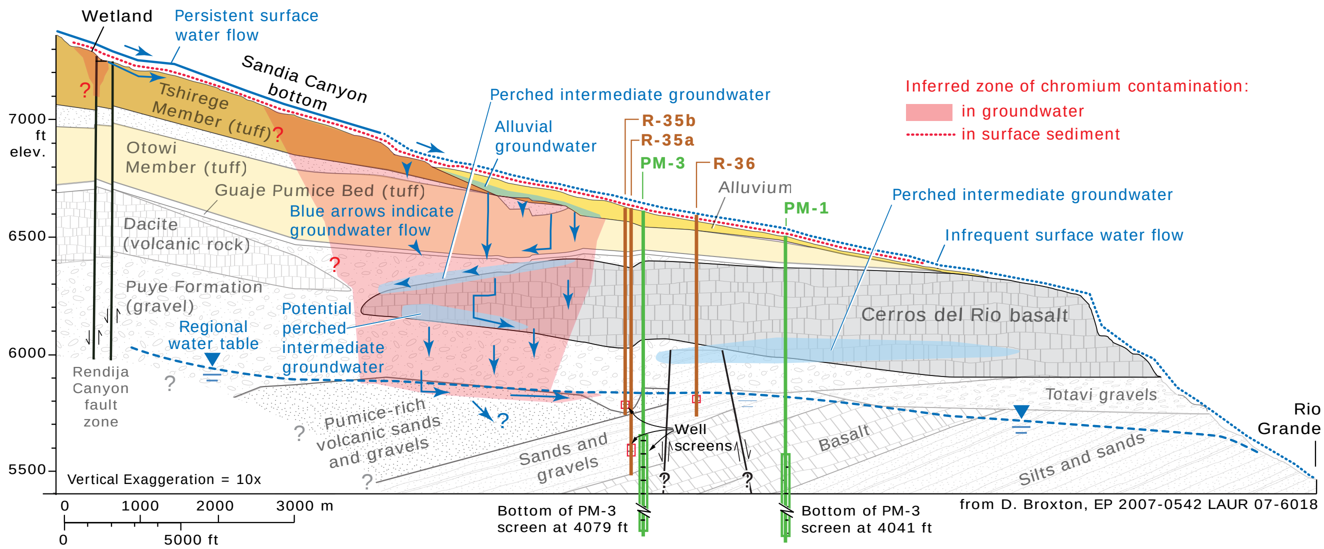
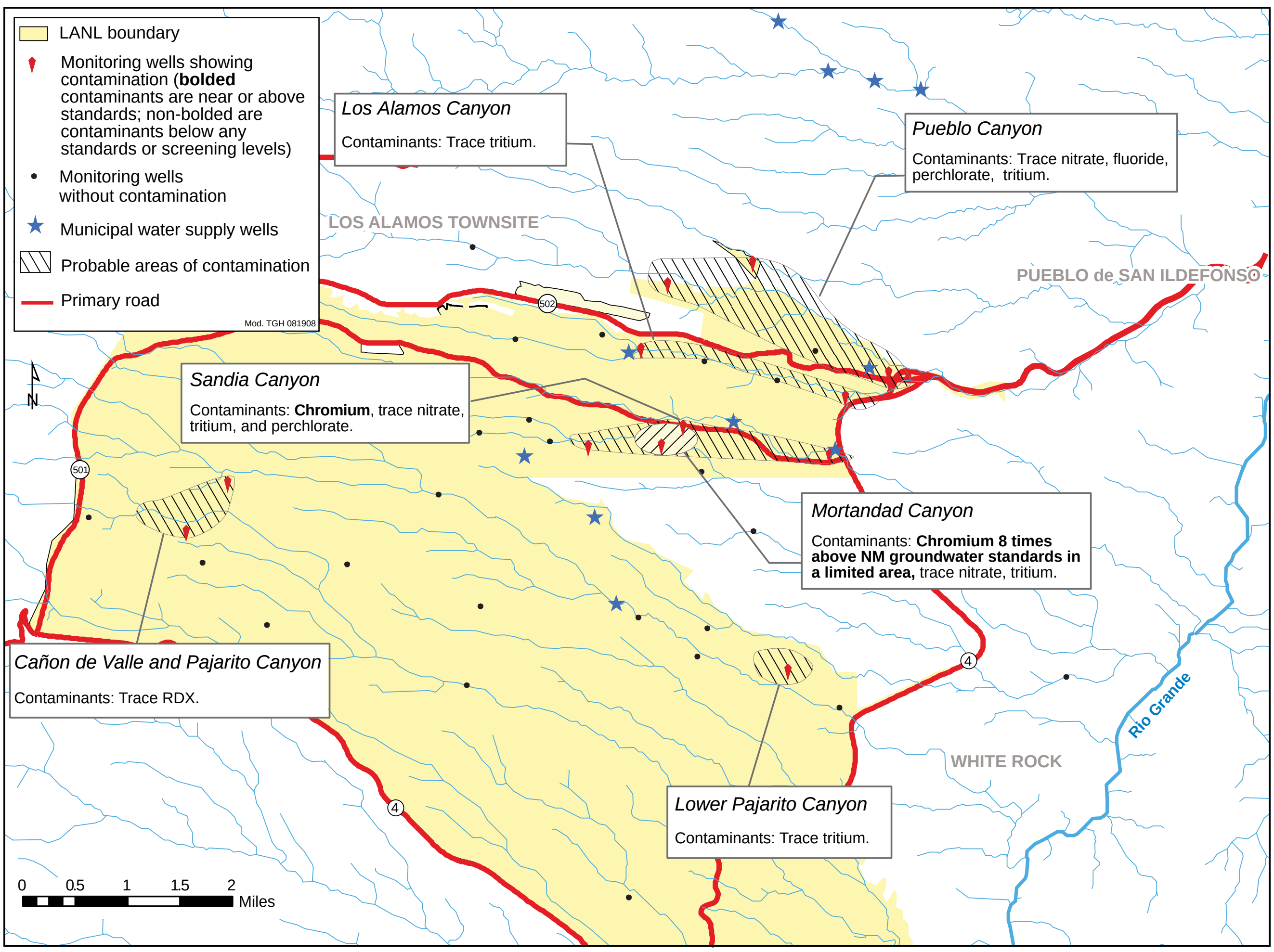


Diagram showing probable pathways of chromium movement into the regional aquifer.

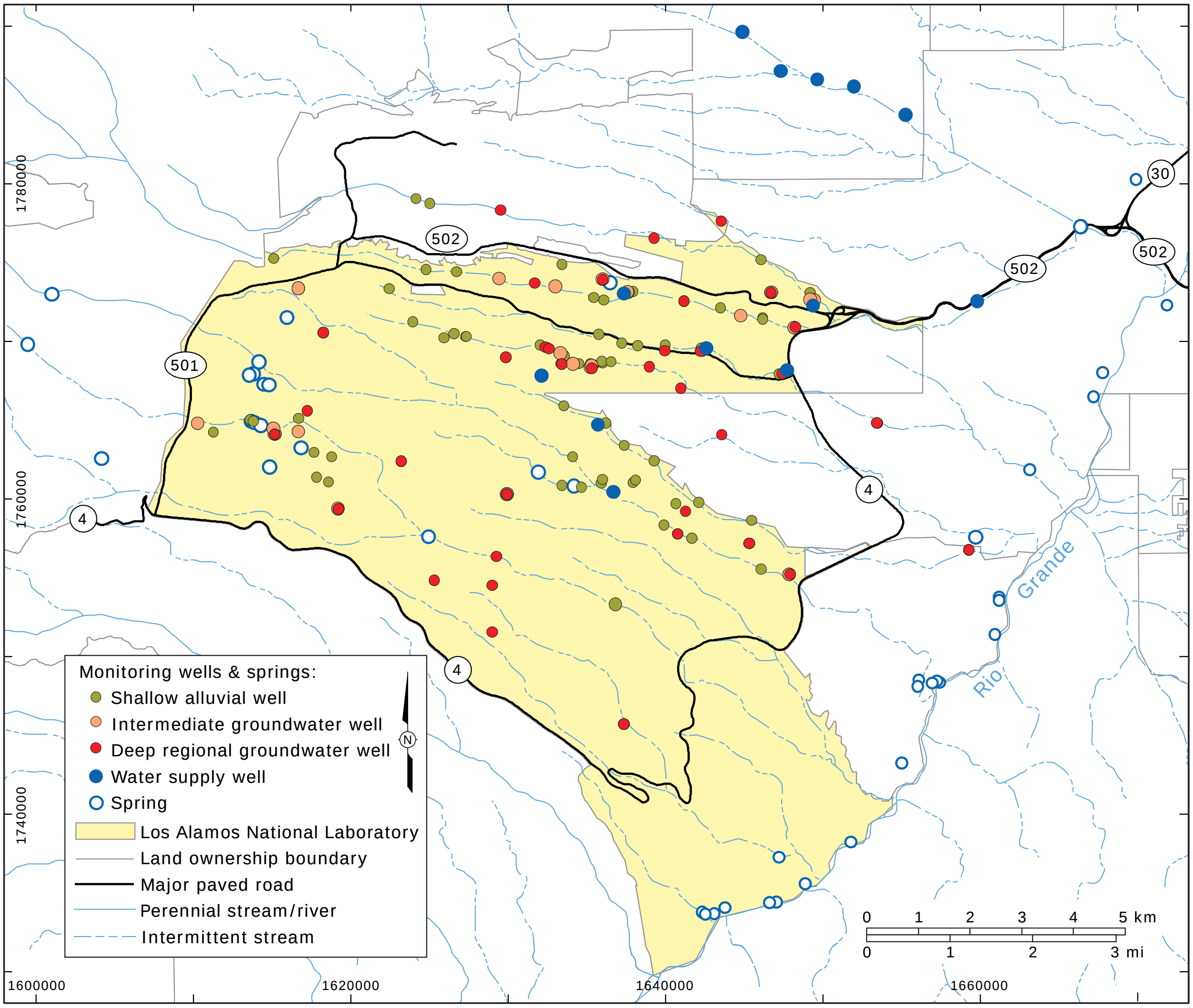
From the outfall the hexavalent chromium traveled down Sandia Canyon where it moved downward towards the regional aquifer. Just down the canyon, a drinking water well, PM-3, lies in the potential path of the chromium. In 2007, LANL installed two additional monitoring wells, R-35a and R-35b, between the known chromium contamination and PM-3 to detect any contamination before it reaches the drinking water well. More wells are being installed in 2008.



Summary of regional aquifer groundwater quality issues at the Laboratory.

Where can we see LANL impacts on groundwater that result in values near or above regulatory standards, screening, or risk levels?

Chemical	On-site	Off-Site	Significance	Trends
Tritium	Intermediate groundwater beneath Mortandad Canyon	No	Not used as a drinking water supply	Insufficient data to define trend
Strontium-90 and total beta	Alluvial groundwater in DP/ Los Alamos and Mortandad Canyons	No	Not used as a drinking water supply; has not penetrated to deeper groundwater	Mainly fixed in location; some decrease due improved quality of liquid release
Chromium	Regional aquifer beneath Sandia and Mortandad Canyons, intermediate groundwater in Mortandad Canyon	No	Found in regional aquifer above groundwater standards; not affecting drinking water supply wells; source eliminated in 1972	Insufficient data to define trends
Perchlorate	Alluvial and intermediate groundwater in Mortandad Canyon	No	Not used as a drinking water supply; source eliminated in 2002	Decreasing in Mortandad Canyon alluvial groundwater as quality of liquid release improves; insufficient data for intermediate groundwater
Nitrate	Alluvial and intermediate groundwater in Pueblo and lower Los Alamos canyons, regional aquifer in Sandia Canyon, intermediate groundwater and regional aquifer in Mortandad Canyon	Pueblo Canyon	In Pueblo and lower Los Alamos canyons, result may be due to Los Alamos County's Bayo Sewage Treatment Plant; otherwise due to liquid discharges	Insufficient data in Mortandad Canyon, values in Pueblo Canyon are variable, values in Sandia Canyon rising
Fluoride	Intermediate groundwater in Pueblo Canyon, alluvial groundwater in DP and Mortandad Canyons	Pueblo Canyon	Result of past effluent releases; not affecting drinking water supply wells	Slow decrease in concentration due to liquid release quality improvement
Dioxane[1,4-]	Intermediate groundwater in Mortandad Canyon	No	Not used as drinking water supply; limited in extent	Insufficient data for trends
Dichloroethene[1,1-] Dioxane[1,4-], Trichloroethane[1,1, 1-], Trichloroethene	Intermediate groundwater below former warehouse in main technical area	No	Not used as drinking water supply; limited in extent	Generally stable, seasonal fluctuations
Tetrachloroethene, Trichloroethene	Alluvial and intermediate groundwater in Cañon de Valle	No	Not used as drinking water supply; limited in extent	Generally stable, seasonal fluctuations
Boron	Intermediate groundwater in Cañon de Valle	No	Not used as drinking water supply; limited in extent	Generally stable, seasonal fluctuations
Barium	Alluvial groundwater in Cañon de Valle and Water Canyon	No	Not used as drinking water supply; limited in extent	Generally stable, seasonal fluctuations
RDX explosive	Alluvial and intermediate groundwater in Cañon de Valle, intermediate groundwater in Pajarito Canyon	No	Not used as drinking water supply; limited in extent	Generally stable, seasonal fluctuations
Chloride, TDS	Alluvial groundwater in Pueblo, DP, Sandia, Mortandad, Pajarito canyons, intermediate groundwater near SM-30 and in Sandia Canyon	Pueblo Canyon	May be caused by road salt in snowmelt runoff, except intermediate groundwater in Sandia Canyon	Values highest in winter samples
Fluoride, uranium, nitrate, TDS	No	Pine Rock Spring, Pueblo de San Ildefonso	Water quality apparently affected by irrigation with sanitary effluent at Overlook Park	Steady over several years



All the monitoring wells and springs in and around LANL.

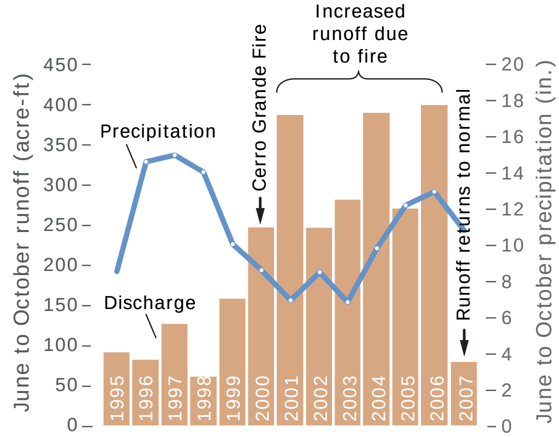
What about the wells that have data issues?

In 1998, LANL began the Hydrogeologic Work Plan by drilling about 30 deep groundwater wells to characterize the geology and the location of and quality of the groundwater in the region. The characterization was successful and because these wells are very difficult and costly to install, a decision was made to continue their use by bringing them into the monitoring well network. However, construction techniques (most notably the use of drilling fluids to prevent the sides of the well from caving in during drilling) sometimes prevent the converted monitoring well from fully detecting potential contaminants because the fluids may adsorb potential contaminants or introduce new ones to the system.

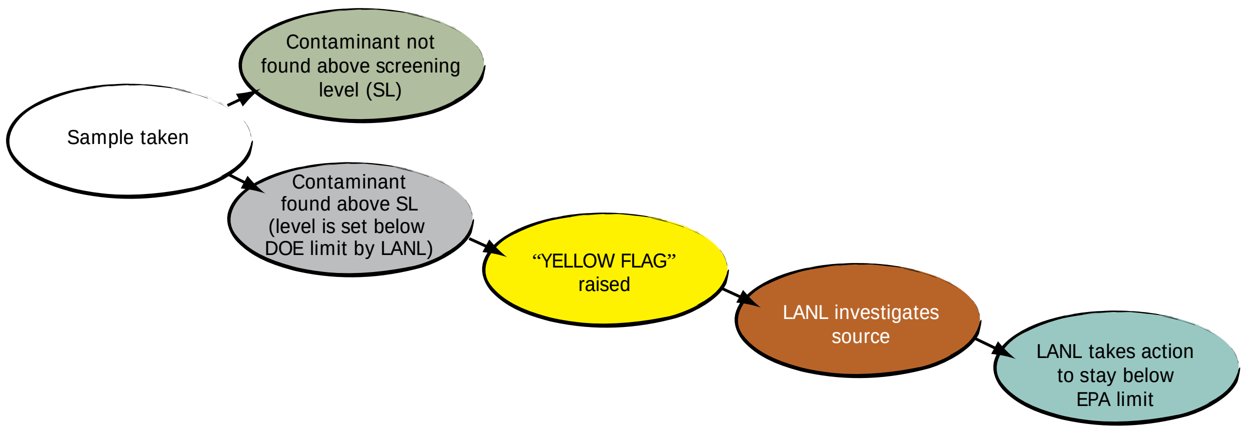
Additionally, some of the wells were installed with multiple sampling screens at different depths in order to get data from more than one layer of water. Wells with multiple screens often cannot be easily purged to remove the residual drilling fluids from each level or (because the wells were originally for characterization) the purging was not done soon enough after completion. To address this problem, LANL performed several detailed network analyses to evaluate the ability of each well to detect potential contaminants in the regional aquifer. The evaluation considered the physical, hydrologic, and geochemical properties of each well. Some wells were rehabilitated, some were plugged and abandoned, others were determined to be satisfactory, and several new wells have been installed. Overall, the network can confidently detect contaminants from the evaluated potential source areas.

What impacts does LANL have on surface water?

The surface water in Los Alamos comes from active outfalls, snowmelt, storm water, springs, alluvial groundwater, and effluent discharge. The County does not use surface water as drinking water but wild animals may. Since the early 1990s, LANL has decreased the number of active outfalls from 141 to 17 and decreased the volume of water released by more than 80 percent. Now, Mortandad Canyon is the only canyon that receives treated radioactive effluent, which comes from the outfall at the Radioactive Liquid Waste Treatment Facility. This facility has met all DOE standards for the last seven years regarding this discharge in all but two months. These two occurrences were due to elevated chlorine, which was immediately lowered.



Estimated June through October runoff in LANL canyons (Pueblo Canyon to Ancho Canyon) and precipitation at TA-6, 1995-2007.



Screening level flow chart that shows the process of determining if something is above a screening level, limit, etc.

What are the screening levels LANL uses?

LANL uses the term "screening level" to refer to both regulatory limits and levels of contaminants that could cause health effects. In some cases, the screening level is set below these limits. Depending on the regulatory authority and the type of contaminant, these regulatory standards or limits are set by the State of New Mexico, the US EPA, or the DOE. In the case of groundwater, the Laboratory uses federal and state drinking water and human health standards as "screening levels" to evaluate radionuclide concentrations in all groundwater, even though many of these standards only apply to drinking water. For example, the drinking water standards apply to water supplied from drinking water wells but do not apply to water from the alluvial and intermediate aquifers in Los Alamos County because this water is not used for drinking, but we still use the drinking water levels for comparison purposes. For radionuclides, the DOE has established dose concentration guides that establish the level of a radionuclide in water or soil that could cause a dose exceeding the DOE's limits. We often set a screening level well below those limits so LANL can see in advance which contaminants may be approaching a level of concern. All data review processes look for sudden increases in the level of an analyte, even if the concentration is well below any screening level.

Most of the canyons that carry water from LANL property are dry most of the year. In fact, none of the streams on Laboratory property average more than 1 cubic foot per second (cfs) during the year and all the streams combined are still generally less than 10 cfs. The highest daily flow rate in 2007 was in December when the combined stream flow reached 22 cfs. At the same time, the Rio Grande at Otowi Bridge was flowing at more than 35 times this rate.

The total runoff at the Laboratory increased significantly after the Cerro Grande Fire in 2000. However, in 2007 runoff levels returned to normal for the first time since the fire.

Where can we see LANL impacts on surface water that result in values near or above regulatory standards or risk levels?

LANL Impact	On-Site	Off-Site	Significance	Trends
Specific radionuclides	No	No	Exposure potential is limited. Los Alamos Canyon surface water at 40% of DOE biota concentration guide for year; dose mainly from radium-226 that is of natural origin	Steady
Gross alpha radioactivity	Mortandad, Pueblo, and Los Alamos Canyons	No	57% of surface water results greater than screening level; major source is naturally occurring radioactivity in sediments, except in Mortandad, Pueblo, and Los Alamos Canyons where there are LANL contributions	Steady in Mortandad; downward in fire-affected canyons as stream flows recover to pre-fire levels
Copper	Multiple watersheds	No	Over screening level in Pajarito, Threemile, and Twomile canyons. Origins uncertain; probably several sources	Steady
Lead	Threemile and Water Canyons	No	Elevated in two samples collected at site monitoring locations in Threemile and Water Canyons	Steady
Mercury	Various canyons; highest in Sandia Canyon at a site monitoring station	Yes	Above screening level only in unfiltered samples; above standards in canyons near residential areas; not all sources from LANL	Steady
Antimony	Several canyons	No	Source is developed areas; highest in storm water from TA-3	Steady
Barium	Cañon de Valle	No	Source related to high explosive research in Cañon de Valle area; subject of focused investigations on barium and high explosives	Steady
Silver	Cañon de Valle	No	Above screening level. From known former photography processing laboratory	Steady
Polychlorinated biphenyls (PCBs)	Many canyons	Yes, particularly in Los Alamos and Pueblo Canyons	Above screening level. Wildlife exposure potential in Sandia Canyon	Steady
RDX explosive	Cañon de Valle	No	Confined to LANL; subject of focused investigations	Steady

How is storm water monitored and why is it important?

Storm water has the potential to move Laboratory contaminants much faster than normal even though flow from storms is generally short-lived, often lasting less than one hour. 2007 was dominated by snowmelt rather than storm water flow. In fact, storm water flow was the lowest it has been since the Cerro Grande Fire. Because of the ability of storm water to spread contamination, it is monitored at various gauging stations in streams, on mesa tops, and in canyons. When flow is present, samples are automatically collected by either gravity flow into a bottle or by an automatic sampler with a water sensor.

Over the last four years, the Laboratory has used a "first flush" system which monitors for only the first 30 minutes of a storm water flow when concentration is expected to be highest. This allows for more accurate monitoring of the highest concentrations of contaminants in storm water. Many of the sampling locations have rain gauges to continuously measure the increase in stream water levels. This first flush system data allows calculation of flow volumes past the sampling location. Samples collected in 2007 for one runoff event at two storm water monitoring locations contained uranium isotopes at levels higher than the DOE guidelines that are set to protect animals and plants. However, the dose that could be received from these levels is still only about one percent of DOE limits.

What is the Laboratory doing to reduce the spread of contamination from storm water?

The Cerro Grande Fire raised concerns about increased flow of sediment from the Laboratory in storm water down canyons. The Los Alamos Canyon Weir (a low dam) was built to slow the flow of water through Los Alamos Canyon. LANL samples sediments, plants, and field mice from behind the weir to determine whether contaminants have spread as the sediments build up. The Laboratory found that most radionuclides and metals in the sediments were within background range. However, levels of cesium, plutonium, americium, zinc, cadmium, lead, silver, and mercury were slightly above the background levels, though still below screening levels. In plants, several radionuclides (plutonium, strontium, and americium) were found above background range, but these were also below screening levels.

The Los Alamos Canyon Weir.

PCBs were found in mice and sediments behind the weir, though there has not yet been enough sampling to determine background for PCBs. To check for potential effects in the Rio Grande, LANL has historically sampled fish both upstream (Abiquiu Reservoir and areas above the Otowi Bridge) and then downstream (areas below the Otowi Bridge to Cochiti Reservoir) to measure PCB levels. This was last done in 2005 and the levels of PCBs in fish both upstream and downstream of LANL are similarly elevated, which implies that LANL is not the major source of PCBs.

The Pajarito Canyon Flood Retention Structure located in Pajarito Canyon was constructed to slow storm water runoff. Plants and small mammals were collected above this structure, and most showed no elevated levels of contaminants. In sediments there were slightly elevated levels of some radionuclides and metals, and mice were found with small amounts of uranium, but all were below screening levels.

What monitoring is being done for soil contamination?

Major soil sampling is done on a rotating basis every three years and the last soil sampling was done in 2006. In other years, biota, edible plants, fish, and other specimens are collected. Results of the samples collected in 2006 showed that for off-site samples, radionuclide and metal concentrations were consistent with previous years, and are mostly within background range but all well below screening levels. For on-site locations, most radionuclides were within background range, and those samples that were above background were in areas with expected contamination. All were below screening levels.

In addition to the triennial sampling, LANL annually collects samples from Pueblo de San Ildefonso land downwind of Area G and extra samples around DARHT and Area G. The results of the samples from Pueblo de San Ildefonso were within or near background range and correlated with previous years. Other samples taken in 2007 from around Area G did show elevated levels of plutonium, americium, and tritium, but all were below screening levels. DARHT receives extra monitoring, and samples showed some elevated levels of uranium, though still below screening levels. In addition to these samples, in 2007 LANL took special samples between the Valles Caldera area and a site on LANL that performs open air explosions, called Minnie site. These samples were taken to test for high explosive residues; there were no detections of any of the high explosives.

What is Area G?

Area G is the Laboratory's main radioactive waste storage and disposal facility. Domes that protect the stored drums have a ventilation system that pulls air inward at all times and no air leaves the building without first going through a high efficiency particulate air, or HEPA, filter. These precautions prevent the potential release of radioactive material to the environment and prevent workers from becoming contaminated if one of the storage drums leaks.

Waste types at Area G:

Low-level

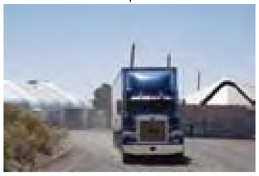
Waste such as paper, building rubble, and soil that is contaminated with radionuclides (but is not transuranic or high-level waste)

Disposed of in pits and shafts which are then covered with soil and planted with native grasses on top

Mixed Low-level

Waste that is contaminated with both radionuclides and hazardous components as defined by the EPA

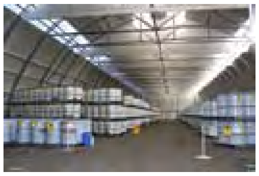
Stored in drums and then large domes to protect them from the weather



Shipped off LANL property to commercial disposal facilities

Transuranic

Waste that contains more than 100 nanocuries per gram of a man-made element whose atomic number is greater than uranium (such as plutonium or americium) and has a half-life over 20 years



Stored in drums and then large domes to protect them from the weather

Shipped off LANL property to Waste Isolation Pilot Plant (WIPP) if it meets requirements; if not, contents of container are processed to meet requirements

Where can we see LANL impacts on mesa-top surface soil that result in values near or above background or screening levels?

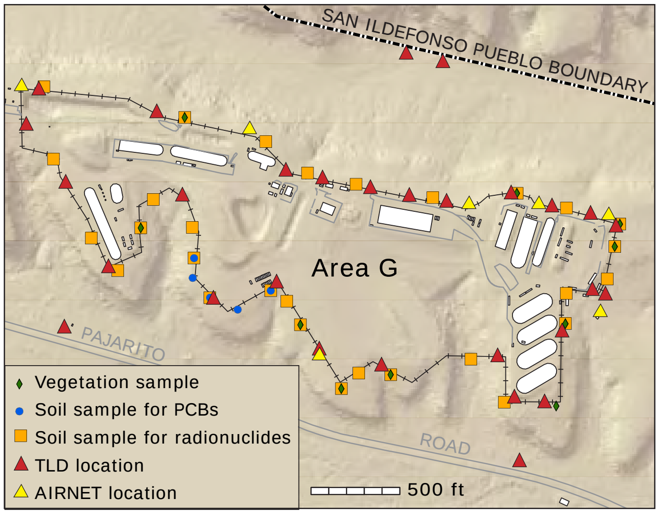
LANL Impact	On-site	Off-Site	Significance	Trends
Tritium	Yes, above background at some sites	No	Far below residential screening levels	Consistently detected but not increasing in the south sections of Area G
Plutonium-239/240	Yes, above background along State Road 502 downwind of TA-21 and at TA-54, Area G	Yes, above background along State Road 502 on the west side of the airport (downwind of TA-21) and at LANL/Pueblo de San Ildefonso boundary and Sacred Area northwest of Area G	Far below residential screening levels	Plutonium-239/240 downwind of TA-21 varies but is generally not increasing; consistently detected on the north, northeast, and eastern sections of Area G, mostly not increasing for the eastern side
Other Radionuclides	Mostly depleted uranium at DARHT	Mostly no	Far below residential screening levels	Uranium-238 at DARHT increased through 2006 but decreased in 2007 likely because of the use of steel containment vessels
Inorganic Chemicals	Few detections: beryllium at DARHT is just above background	Few detections	Far below residential screening levels	Steady
Polychlorinated biphenyls (PCBs)	Most samples below detection limits. Aroclor-1260 detected at Los Alamos Weir	No	Far below residential screening levels	Re-sampling around a positive PCB soil result in 2006 at Area G showed no PCB amounts; steady at Los Alamos Canyon weir
High Explosives	All below detection limits	No	Minimal potential for exposure	None
Semi-volatile Organic Compounds (SVOCs)	One sample along State Road 502 in 2006 detected SVOCs	No	Far below residential screening levels; from asphalt (not a LANL source)	None

What sites get extra monitoring?

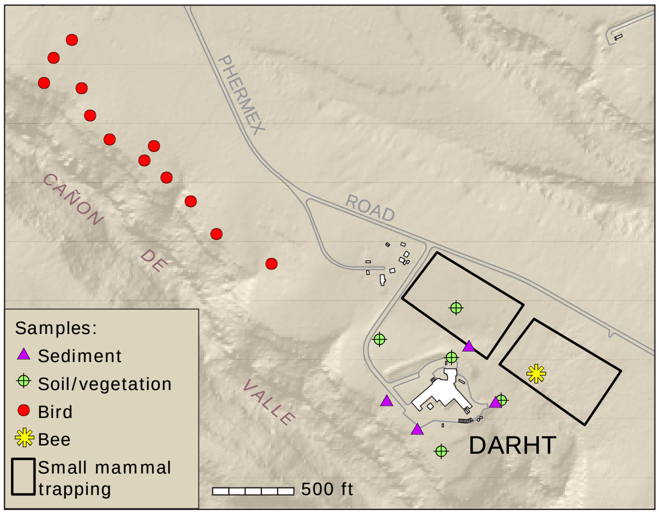
Storage of waste in barrels.

Because Area G stores much of the Laboratory's waste, extra precautions are taken to ensure that no contamination is released from the area. There are six wells surrounding Area G so that the Laboratory can detect any contaminants that may have leaked. Samples are also taken from nearby storm runoff stations, and sediments are collected from several areas around the site. There are several forms of monitoring around Area G: TLDs, eight AIRNET stations, soil samples, and vegetation samples. Some of these results have already been discussed.

DARHT consists of two electron accelerators positioned at a 90-degree angle and focused on the same point. Mock nuclear explosions occur at this point, and the electron accelerators capture four images of the explosion. This testing allows LANL to make progress in efforts to keep the nuclear arsenal safe without doing nuclear tests. Beginning in May 2007, the experiments at this location were fully contained in steel vessels to better protect the environment. Similar to Area G, soil and biota sampling is done around DARHT since the experiments were not always fully contained. Many of these results have already been discussed.



Locations of soil and vegetation samples collected at Area G in 2007.



Locations of soil, sediment, and biota at DARHT in 2007.

How does LANL ensure that plants, animals, and crops are not contaminated?

Because contamination can be transferred to people through edible plants, milk, or hunted game, the Laboratory also monitors edible plants and wild animals in Los Alamos, White Rock, Pueblo de San Ildefonso, and Cochiti Pueblo. Non-edible plants and small animals are also monitored in these areas to evaluate ecosystems. For edible biota, LANL samples fruits, vegetables, and wild edible plants on LANL property as well as in perimeter and regional areas. The fruit and vegetable samples (10 from each local community and eight from on-site) did not show elevated levels of radionuclides except for one that showed tritium from a Laboratory site that used to process tritium. Samples from regional areas were within background range. In 2007, a sample of goat milk in White Rock was also analyzed and showed no contamination.

Non-edible biota samples were also collected, including around Area G, around DARHT, above the Los Alamos Canyon Weir, and above the Pajarito Canyon Flood Retention Structure. Around Area G, tritium and plutonium were detected near known sources of these contaminants. DARHT showed depleted uranium just above background range, but well below screening levels and below levels from previous years. Mice and bees in the area showed slightly elevated levels of barium and copper but birds in the area showed no contamination effects. Above the Los Alamos Canyon Weir, plutonium, strontium, and americium were found in plants, as well as PCBs in mice and sediments. All these were still well below screening levels.

What is LANL's approach to endangered species?

The Endangered Species Act is one of many laws that the Laboratory must comply with. One of LANL's primary objectives is to avoid harming the habitat or potential habitat of an endangered or threatened species. If a known habitat is in the area of a LANL project, habitat alteration is restricted.

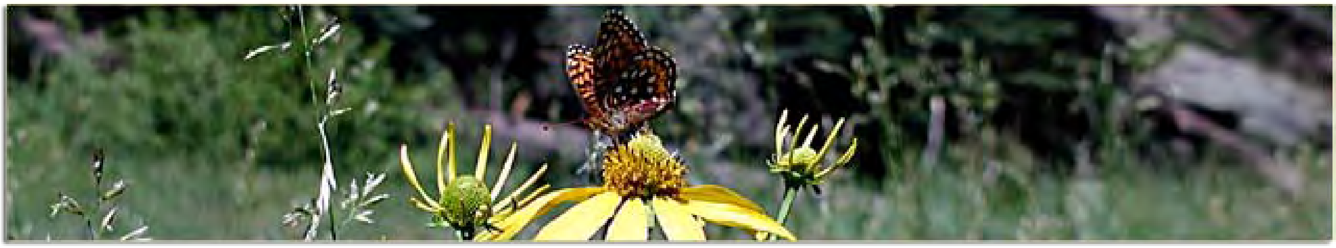
Mexican Spotted Owls.

The animal of most concern in the area is the Mexican Spotted Owl. The owl is known to nest in canyons in Los Alamos, and its breeding season is from March 1 to August 31. During this time, LANL follows additional restrictions. For instance, in a known habitat during owl breeding season, the following activities are restricted: entry of more than three people and two vehicles to the area, noise generation over six decibels above background levels, high levels of artificial light, and tree removal. If a LANL project does require work that would not comply with these restrictions in a known habitat of an endangered species, LANL consults with the US Fish and Wildlife Services before beginning the project.

LANL also monitors species listed as sensitive within the state so that if they were to become federally endangered or threatened, appropriate restrictions could immediately be applied. LANL avoids affecting the habitat of these state-listed species.

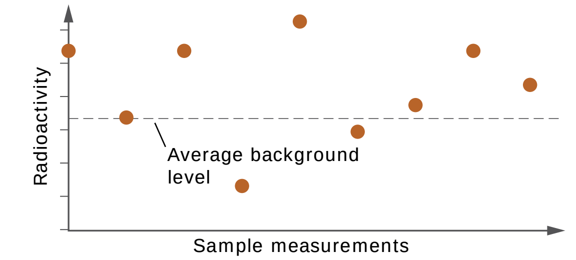
Where can we see LANL impacts on biota that result in values near or above regulatory standards or risk levels?

Media	LANL Impact	On-site	Off-Site	Significance	Trends
Wild edible plants	Radionuclides	Tritium in plants from Cañada del Buey	Above background concentrations for strontium-90 in Mortandad Canyon on Pueblo de San Ildefonso land in 2006	Far below screening level. Higher strontium-90 in wild plants is a function of low calcium in the soil and not to increased contamination levels	Steady
	Inorganic chemicals	No	No	No	Steady
Native vegetation	Radionuclides	Mostly tritium and plutonium-239/240 at Area G; and depleted uranium at DARHT	Few detections	Far below screening levels	Tritium and plutonium-239/240 are steady at Area G, Uranium-238 in trees at DARHT increased through 2006, decreased in 2007
	Inorganic chemicals	Few detections: arsenic in one plant sample at DARHT	No	No	Steady for most metals
Small mammals, bees, and birds	Radionuclides	Depleted uranium at DARHT; some radionuclides in biota upstream of the Los Alamos Canyon Weir and the Pajarito Canyon Flood Retention Structure	None collected	Far below screening levels	Steady for most radionuclides
	Inorganic chemicals	Some detections in a bird at DARHT	None collected	One sample out of two	Insufficient data
	PCBs	Detected in mice at the Los Alamos Canyon weir	None collected	Toxicity levels were comparable with the control	Insufficient data
	Species diversity	Abundance and species diversity of birds at DARHT during operations are similar to baseline	None collected	No stress to birds at DARHT	Steady

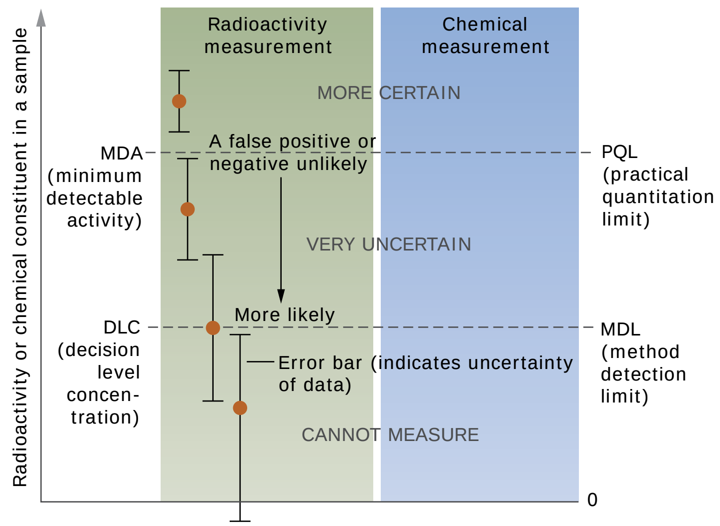


What is a False Positive?

Measuring radioactivity or chemical contaminants in the environment may involve detecting very small amounts where it is often difficult to distinguish the values from zero. Knowing the smallest concentration of an analyte that can be reliably distinguished from zero is critical to determining if an analyte is present. In radioactivity detection, this is called the minimum detectable activity (MDA) and in chemical detection this is called the method detection limit (MDL). These values are not used alone to determine if an analyte is present but can help decide if the decision about the presence of the analyte is correct. Above these are levels that define the smallest concentration of an analyte that can be measured with confidence. On occasion it is either incorrectly determined that there is an analyte present (false positive) or incorrectly determined that there is not an analyte present (false negative) because of the uncertainty in the measurement.



With radioactivity samples, negative data can occur when an instrument measures a sample at a level lower than the background average was determined to be. By running blank samples, the analytical laboratory determines the average background level radiation from the instruments, the room, the lights, and so forth, and subtracts this from the sample levels to determine amounts in the sample. If the sample level reads at a value lower than the background, the result is negative.



One way to think of a false positive is to think of looking at a very small spot on paper with tiny text. At first glance, the spot may look like a word. But if the spot is looked at more closely with a magnifier, it turns out to be a flaw in the page with no significance. What the person thought they saw was not there.

For example, when measuring radioactivity, the measured amount (minus the average background value from a blank sample) is compared to a specific level where detections can confidently be found. In between this level and the MDA there is a chance that a detection could be a false positive because of the very high uncertainty in the measurement. Another way a false positive can occur is if there is another substance in the sample that causes detections to be too high or low, such as a chemical cleaner that masks other contaminants or introduces new ones.

What environmental remediation is going on at the Laboratory?

Corrective actions at LANL are directed and scheduled by NMED through the Consent Order. However, if an urgent issue arises, such as planned construction over a site suspected of containing contamination, then the schedule may be accelerated for early remediation. The Laboratory manages the Consent Order activities under three programs: the Water Stewardship Program, the TA-21 Closure Program, and the Corrective Actions Program.

The Water Stewardship Program at LANL determines the presence and severity of contamination in water that could affect ecosystems or drinking water, such as the chromium contamination in Mortandad Canyon. This program also encompasses all of the canyon investigations that sample around potential sources of contamination, rather than the entire length of the canyon.

The TA-21 Closure Program samples and remediates sites such as septic systems, outfalls, and five material disposal areas (MDAs) around TA-21 near DP Road. The goal of the program is to investigate and close TA-21, including the removal of all structures.

The Corrective Actions Program investigates and, if necessary, cleans up solid waste management units (SWMUs) and areas of concern (AOCs) which are areas in and around Laboratory property where LANL may have previously released contamination.

In 1989, there were 2,124 SWMUs and AOCs, which LANL has since reduced by more than 40 percent. Though the number of sites is high, they vary in the severity of their condition from a few spots on the ground to an MDA where contaminants were disposed for years.

What "green" programs does LANL implement?

In 2005, LANL established the Environmental Management System (EMS), which then received third-party certification to the International Organization for Standards (ISO) 14001:2004 in 2006. This is the international standard for environmental management systems, and LANL was the first DOE/National Nuclear Security Administration (NNSA) Laboratory to achieve it.

The Laboratory has implemented a Pollution Prevention Program into the EMS, which works toward the goal of reducing waste to reduce cost and impact. By 2005, this program made the following reductions to LANL waste: 90 percent reduction in hazardous waste, 50 percent reduction in radioactive liquid waste, 45 percent reduction in transuranic waste, 80 percent reduction in low-level radioactive waste, and an 80 percent reduction in mixed low-level waste.

Under the Pollution Prevention Program, LANL also administers the Generator Set-Aside Fee Program, which collects a small fee from solid and radioactive liquid waste generators based on the quantity of waste generated and invests the collected funds in projects to reduce waste or pollution. In this way, LANL encourages waste reduction.

Since the Laboratory monitors and works in many of the canyons in the area, there is a need for a certain number of large vehicles that can handle the terrain, despite their fuel inefficiency. For situations where off-road vehicles are not needed, such as driving to meetings on-site, LANL began to replace these vehicles and upgrade to more fuel efficient cars, including several hybrid vehicles. LANL has also begun to promote programs such as the Student Sustainability Challenge in which employees and students can submit ideas for environmental impact reductions. LANL plans to replace the Chemistry and Metallurgy Research Facility (CMR) with a Leadership in Energy and Environmental Design (LEED) silver-certified facility that will drastically decrease its environmental impacts. To continue these improvements, any facility costing $5 million or more will be required to achieve LEED certification.

Tent rocks in Pueblo Canyon are composed of welded volcanic ash spewed from a massive eruption of the Valles Caldera about 1.2 million years ago.

How can I get involved?

- Check LANL's environment outreach web site (http://www.lanl.gov/environment/outreach/involvement.shtml) and calendar (http://www.lanl.gov/environment/calendar/index.htm) for environmental meetings, workshops, and for scheduled meetings that the Laboratory holds for the public to provide an opportunity for the public to give input and learn more about the Laboratory.

- Join the Northern New Mexico Citizen's Advisory Board (http://www.nnmcab.org) or attend its meetings as a non-member. The DOE has chartered this board to learn about issues at LANL and provide its input. Each year the board provides recommendations to the DOE concerning LANL's operations.
- Learn more by visiting the Laboratory's Public Reading Room located at J. Robert Oppenheimer Study Center and Research Library where you can read many of the Laboratory's environmental investigations and reports.
- If you require any additional information, you may contact Lorrie Bonds Lopez at (505) 667-0216 or electronically at envoutreach@lanl.gov.

Helpful web sites:

Department of Energy	www.energy.gov
DOE/NNSA Los Alamos Site Office	www.doeal.gov/laso
LANL	www.lanl.gov
LANL'S Public Reading Room	www.lanl.gov/environment/outreach/prr.shtml
LANL'S Environmental Surveillance reports and supplemental data tables	www.lanl.gov/environment/all/esr.shtml
Department of Energy	www.energy.gov
LANL's air quality group	www.lanl.gov/environment/air
LANL's water quality group	www.lanl.gov/environment/h2o
LANL's waste group	www.lanl.gov/environment/waste
LANL's biological resources group	www.lanl.gov/environment/bio
LANL's risk reduction group	www.lanl.gov/environment/risk
LANL's clean-up group	www.lanl.gov/environment/cleanup

The following Los Alamos National Laboratory organizations perform environmental surveillance, ensure environmental compliance, and provide environmental data for this report:

- Waste and Environmental Services Division (Terry Morgan, Coordinator)
- Water Quality and RCRA Group (Luciana Vigil-Holterman and Robert Beers, Coordinators)
- Air Quality and Ecology Group (Sonja Salzman, Coordinator)

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