For the Seventh Generation:

A Report to Our Communities
Environment, Safety, and Health
at Los Alamos National Laboratory

2000–2001, Volume V

For the Seventh Generation

And each generation was to raise its chiefs and to look out
for the welfare of the seventh generation to come.

We were to understand the principles
of living together.

We were to protect the life that surrounds us.

We were to give what we had to the elders and to the children.

What of the rights of the natural world?

Who is speaking for the waters of the earth?

Who is speaking for the trees and the forests?

Who is speaking for our children?

We must stand for these people, and the natural world
and its rights; and also for the generations to come.

Poem based on a statement by Oren Lyons, Iroquois, which appears in
Look to the Mountain—An Ecology of Indigenous Education
by Gregory Cajete, Ph.D., Santa Clara Pueblo.

The indigenous people of North America lived in harmony with the natural environment, protecting and conserving it so their way of life would be indefinitely sustainable. Every decision was examined for its long-term implications, not just for the tribe's children and grandchildren, but for the seventh generation to come. This philosophy is common among the Pueblo Nations of our region and is also to be found in the Great Law of the Iroquois Confederacy.

Cover photos:
Rainbow, Bob Brewer
"Touch the Sky," Gary Warren, *Los Alamos Monitor*
"Touch the Sky," by sculptor Jane DeDecker, was purchased by Los Alamos County Art in Public Places Fund, Los Alamos National Bank, and volunteer contributions. Placed in the center of town near the Municipal Building, the memorial statue is a thank-you to everyone involved in fighting the fire and healing Los Alamos. It is symbolic of the recovery ahead and the promise of generations to come.

Inside *For the Seventh Generation*

These are extraordinary times, times of testing for our government and for our nation. Yet all of us can be proud of the response of our government and the exceptional character of the nation we serve. I've never felt more certain about America's goodness, or more confident about America's future.

Since September 11th, we've seen America more united and resolute than at any point in our lifetimes. We've seen a nation that is generous and patriotic, and a nation that is determined to see justice be done. We've also seen acts of great sacrifice and heroism. Our nation is grateful for all these men and women who have shown the meaning of duty and public sacrifice.

Let's do our duty. Let's hold ourselves to the highest of standards. May God bless your work, and may God bless America.

George W. Bush
President of the United States
October 16, 2001

A Message from the Director of Los Alamos National Laboratory

Welcome to Los Alamos National Laboratory's fifth annual report to our communities on environment, safety, and health. During the past year, we faced many challenges in efforts to support our nation and we look forward to meeting further challenges. The articles in this publication address the Laboratory's progress during the past year and reflect our constant resolve to improve the way we do our work. Our continuing commitment to provide a safe workplace for employees, while safeguarding the environment, is a guiding principle for the operation of the Laboratory.

Performance, progress, partnerships, and commitment to future progress are the common themes among this year's articles. We strive to serve our nation well by applying first-rate science and technology to make the world a better and safer place.

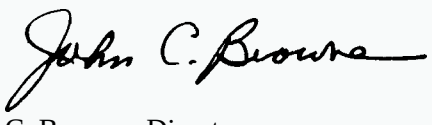
We live and work in difficult times in a rapidly changing world, and in keeping pace with this world, we have adopted six focus areas:

- Values
- People
- Science and engineering
- Customers and stakeholders
- Costs
- Integrated management of safety and security

These focus areas apply directly to our Laboratory's work environment and the overall safety and health of the public and our employees. Such initiatives guide our work and will ultimately determine our success.

As director of the Laboratory, I want to update the people of northern New Mexico on the Laboratory's work. Also, I want to provide people with a way to respond. Please read these articles and take a moment to let us know what you think by returning the enclosed comment card. Our goals are to achieve outstanding performance as a national laboratory and to be responsible to the communities of northern New Mexico, as well as to our nation.

I was in Washington, DC, on September 11, 2001, as the tragic events of that day unfolded. I'm sure that our neighbors in northern New Mexico are experiencing a strong emotional reaction similar to mine—an indescribable mixture of shock, grief, and anger. These events will reverberate through our country for a long time to come, and things may never be quite the same again. However, we at Los Alamos will persevere, working with pride and determination to serve our community and our nation.



John C. Browne, Director
Los Alamos National Laboratory

Progress and Commitment to the Future

I am pleased to present this report to our communities on environment, safety, and health at Los Alamos National Laboratory. Inside, you'll find articles of interest to those of us in northern New Mexico and to our readers nationwide. Overall, we discuss Laboratory performance and safety progress, partnerships, and our commitment to education and future progress. What follows is a sample of some of our efforts to ensure that we operate in harmony with the environment to the greatest extent possible, keeping worker and public safety first.

Our report is divided into two sections—first, Partnerships and Progress, and, second, Environment and Recovery. In all, we feature several programs, projects, and Laboratory workers involved in the day-to-day operations. Sprinkled through the publication, you'll find features on students involved in special projects that exemplify the Laboratory's commitment to education and to the future.

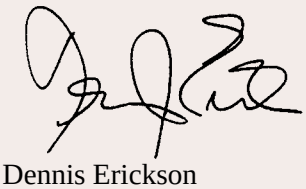
In the first section, we summarize the Laboratory's performance in specific categories of environment, safety, and health that are evaluated every year by the University of California and the Department of Energy. Also, we discuss Laboratory partnerships with Johnson Controls Northern New Mexico, Protection Technology of Los Alamos, and the Waste Isolation Project Plant in Carlsbad, New Mexico.

The next articles in this section focus on a variety of topics: safety and communication issues, a student-initiated archaeological symposium, an overview of some current health research projects in the Bioscience, Theoretical, and Nonproliferation & International Security Divisions, the proposed Biological Safety Level-3 facility, and the human genome mapping project.

In the second section, Environment and Recovery, articles report on the Environmental Restoration Project, the hydrologic cycle, and water sampling in the Nambé region. We also discuss our community's recovery from last year's Cerro Grande fire—both the processes of nature and our continued sampling, mitigation, and restoration efforts. The last article considers the fire's emotional and psychological impact on community mental health.

Again, let me thank all of you who supported the community and the Laboratory during the Cerro Grande fire. Your contributions of goods and services, emergency support, and continuing goodwill bolster our recovery. The Laboratory and surrounding communities sincerely appreciate your efforts.

I look forward to your response and comments. Please read and evaluate our report, take a moment to fill out the enclosed postage-paid response card, and let us know how we can better serve you.



Dennis Erickson
Environment, Safety, and Health Division Leader

Performance and Progress

Laboratory science and technology organizations strive for safety goals and operations that protect workers, the public, and the environment. The Laboratory met an important milestone last April in a two-week review and audit of its implementation of Intergrated Safety Management. The Department of Energy notified the Laboratory that it had met all review criteria and verified the Laboratory's successful implementation.

Here, we highlight safety performance and progress. The five metrics on pages 4 and 5 relate to worker, public, and environmental protection specified by the Department of Energy's contract with the University of California to manage the Laboratory.

Ratings for safety performance came about in 1996 when the Department of Energy established the special contractual provisions in Appendix F to monitor and improve safety at the Laboratory. After a series of accidents during 1994–1995, the Laboratory implemented an integrated safety program in 1996 for all work conducted on the premises.

Like an umbrella, the safety program covers all work activities—from highly technical scientific research in laboratories, radiation protection, environment and waste management, ergonomic safety, and construction projects, to employees' activities, including walking, driving, and climbing stairs. All employees learn about the potential hazards in their work environments and how to conduct their work safely.

The first *For the Seventh Generation* in 1997 reported on the following six Appendix F performance measures:

- Radiation protection of workers
- Radiation protection of the public
- Management of nuclear facilities
- Environmental performance
- Injury and illness
- Waste minimization

Relevant goals were selected for each measure, which included multiyear goals in some instances. Generally, the goals change from year to year for issues that need to be addressed or to make the measures more stringent as performance improves. The degree of success varies from year to year as the goals change. However, over the period of time that the measures have been in place, performance has generally improved (see graphs on next pages).

Each year, the Laboratory reports its performance to the University of California and the Department of Energy for evaluation. At present, Appendix F specifies five of the original six performance measures.

Of the measures originally selected for reporting, the category of Radiation Protection of the Public is no longer a performance measure specified by Appendix F because the Laboratory has consistently achieved goals well above the category's performance targets. However, the Laboratory continues to monitor releases of radioactive materials into the environment and from Laboratory radiation sources. Self-assessment findings are reported quarterly to the University of California Office of the President's Panel on Environment, Safety, and Health at the National Laboratories. These findings appear on page 4. If this category were rated as a performance measure, the Laboratory's overall rating would be Outstanding.

The Laboratory receives a grade ranging from Unsatisfactory to Outstanding for each measure. On the following pages, each grade is explained beneath its dial along with areas of achievement and areas for improvement. Out of a possible score of 100, the performance measure gradients are as follows:

- Unsatisfactory 50%–59%
- Marginal 60%–69%
- Good 70%–79%
- Excellent 80%–89%
- Outstanding 90%–100%

A gauge like the one above shows the overall grade for each performance measure. All targets aim for Outstanding. We provide charts that show four-year trends for self-assessment findings on Radiation Protection of the Public, information on Radiation Protection of Workers, Environmental Performance, and Injury and Illness categories.

Radiation Protection of the Public

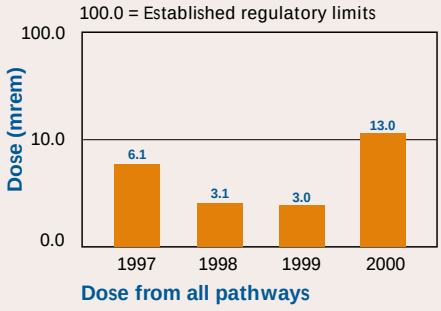
The charts below show human radiation exposures from releases of radioactive materials into the environment and from Laboratory radiation sources.

Radiation Protection of the Public is no longer an Appendix F performance measure and does not receive a rating from the Department of Energy or the University of California. However, the Laboratory continues self-assessment monitoring to meet Department of Energy and Environmental Protection Agency guidelines and regulations.

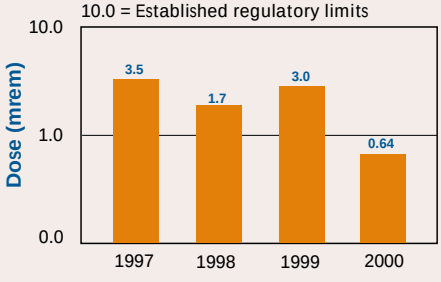
Self-assessment findings pertain to all Laboratory-caused radiation exposures to the public. Data from air-monitoring stations indicate a low level of Laboratory-produced radioactive emissions for 1999 and 2000.

Self-assessment findings for all pathways show safe doses above naturally occurring radiation, such as radon, cosmic radiation, terrestrial radiation, and radiation from radioactive materials naturally found in the human body.

The top lines in each chart, 10.0 and 100.0 mrems, are the established regulatory limits. Limits are depicted in logarithmic, not proportionate, scale.



Dose from all pathways



Dose from air pathway

Radiation Protection of Workers

The Laboratory monitors radiation doses from occupational exposure to radiation.

Overall, the University of California and the Department of Energy gave the Laboratory a rating of Good. However, individual target scores varied.

Target 1—Routine occupational radiation exposures are monitored to assure that individual doses do not exceed specific limits.

Performance—Based on external plus tritium-internal doses and assessed internal doses for 2000, no employee exceeded either the dose target of 2 rem or the lifetime limit*. The Laboratory's performance on this target was rated as Outstanding by the University of California and Excellent by the Department of Energy.

Target 2—Occupational internal exposures caused by intakes of radioactive material and incidents are carefully monitored. Operational incidents are accidental releases from containment systems in which an amount of material is released and taken into the body.

Performance—In March 2000, an incident at Technical Area 55, the plutonium facility, resulted in three worker intakes of greater than 2 rem. Plutonium facility operations account for 95% of the total effective dose equivalent. Performance on this target was rated Unsatisfactory.

*The lifetime limit is calculated at 1 rem per year, based on an individual's age starting at 18 (this lifetime limit calculation does not apply to infants, children, or minors, and there is no age at which the limit is capped). For example, a 30-year-old would have a lifetime limit of 30 rem for that year, and a 60-year-old's lifetime limit would be 60 rem for that year. See rem definition in the box on the right.

Management of Nuclear Facilities

The Laboratory operates its nuclear facilities according to Department of Energy requirements.

The overall performance on this metric was rated Good by the University of California and the Department of Energy.

Target 1—At least 97% of proposed facility changes are made according to Department of Energy procedures.

Performance—Of proposed facility changes, 85% made the goal. Performance is rated Good.

Target 2—There are no violations of operating requirements. However, formal lessons-learned meetings can offset violations.

Performance—There were nine violations of procedures. Eight were offset by formal lessons-learned meetings. Performance is rated Outstanding.

Target 3—Safety documentation for nuclear facilities is completed on schedule.

Performance—The Department of Energy rated performance for this target as Marginal.

What is a Roentgen equivalent man (rem)?

The rem is the most commonly used unit for measuring radiation dose equivalence in humans. The rem takes into account the ionizing radiation energy absorbed (dose) and the biological effect on the body (quality factor) resulting from the different types of radiation.

mrem = 1/1000 rem

Environmental Performance

The Laboratory complies with environmental laws and regulations that apply to operations.

Overall, the Laboratory received a rating of Good from both the University of California and the Department of Energy.

Target 1—No Resource Conservation and Recovery Act violations.

Performance—Self-assessment findings for the Laboratory dropped to 4%, an improvement over previous years.

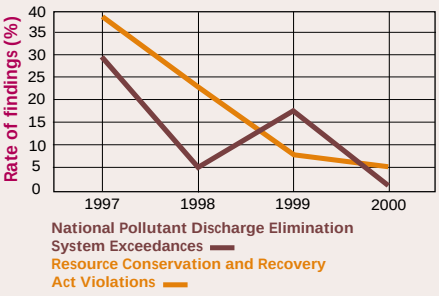
Target 2—No National Pollutant Discharge Elimination System exceedances.

Performance—Two exceedances were recorded during 2000, a decrease from the 17 exceedances for the previous year. Most of the 17 exceedances occurred during modifications to the Laboratory's Radioactive Liquid Waste Treatment Facility. Also, they were accumulated during a five-quarter period because of a change in the definition of performance year.

Target 3—No violation of other environmental laws and regulations.

Performance—No violations were recorded for the Toxic Substances Control Act, the Solid Waste Disposal Act, the Clean Air Act, Underground Storage Tank regulations, or the National Environmental Policy Act.

Environmental findings



Injury and Illness

The Laboratory strives for a progressively smaller number of work-related recordable injuries and illnesses and lost workdays each year.

The University of California and the Department of Energy rated the Laboratory Outstanding for this metric. During 1994–1996, five accidents prompted official improvements to eliminate injury and illness to workers.

In 1996, a series of five-year targets for reduction of injury and illness was established to decrease work-related recordable injuries and illness and lost workdays.

By 2000, the Laboratory had reduced injury and illness lower than the established target goals.

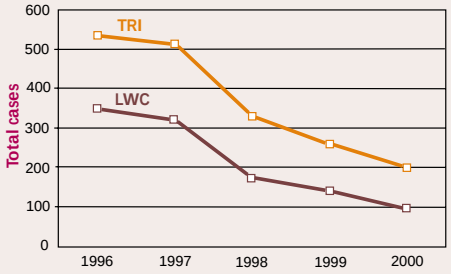
Target 1—A 49% reduction for total recordable injuries and illnesses compared to the 1996 baseline.

Performance—The rate declined in 2000 to 200 people from 258 people in 1999 and from 532 people in 1996, the baseline year.

Target 2—A 64% reduction for total lost workday cases relative to the 1996 baseline.

Performance—The Laboratory's total lost workday injuries and occupational illnesses declined from 140 cases in 1999 to 96 cases in 2000, a reduction of 44 cases for the year and 253 fewer cases than the 349 cases in 1996. The Laboratory's total lost workday injuries and occupational illnesses declined from 349 cases in 1996 to 96 cases in 2000, a reduction of 253 cases.

Site-wide total recordable injury and illnesses (TRI) and lost workday cases (LWC)



Waste Minimization

The Department of Energy determines this target and applies it to all operating DOE sites across the country.

Target—The Laboratory's performance goal for 2000 was a 9% reduction in the generation of low-level waste, mixed low-level waste, and hazardous waste.

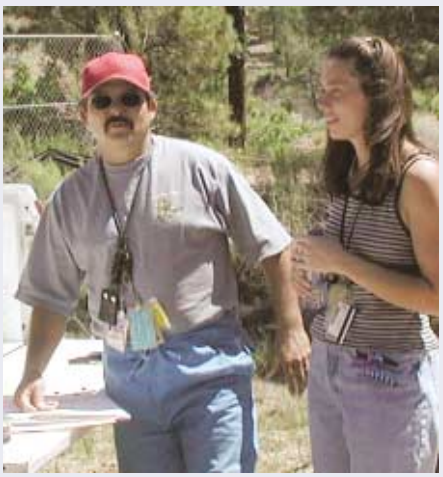
Performance—Performance data show a 12% reduction in the generation of low-level waste, an 8% reduction in the generation of mixed low-level waste, and a 13% reduction in the generation of hazardous waste. This earned an overall performance rating of Good/Excellent.

Tailgate Safety Briefings

Rick Velasquez takes worker-safety briefings to sites around the Laboratory for many activities and projects. For example, a particular team's activity for the day might be sampling and sample processing for soil, vegetation, and wildlife.

Rick prepares to brief workers by reviewing the relevant Hazard Control Plan and Standard Operating Procedures for the planned activity. Next, he reviews the purpose of the specific activity and the proposed work plan. He uses a checklist to ensure such things as equipment availability and viability, required supplies and tools, necessary personnel, and appropriate training completed for personnel.

Once he has a good overall idea of what needs to be done, Rick delivers the worker-safety briefing from his truck tailgate to the personnel at the site of the proposed activity. He goes over the purpose or goal of the activity, the potential risks involved, equipment, supplies, and specific needs, such as plenty of water during hot weather. Personnel have already been trained for their planned activity, so the tailgate meeting reminds them of safety and emergency procedures, reiterates their training, and provides a forum to ask questions about the activity.



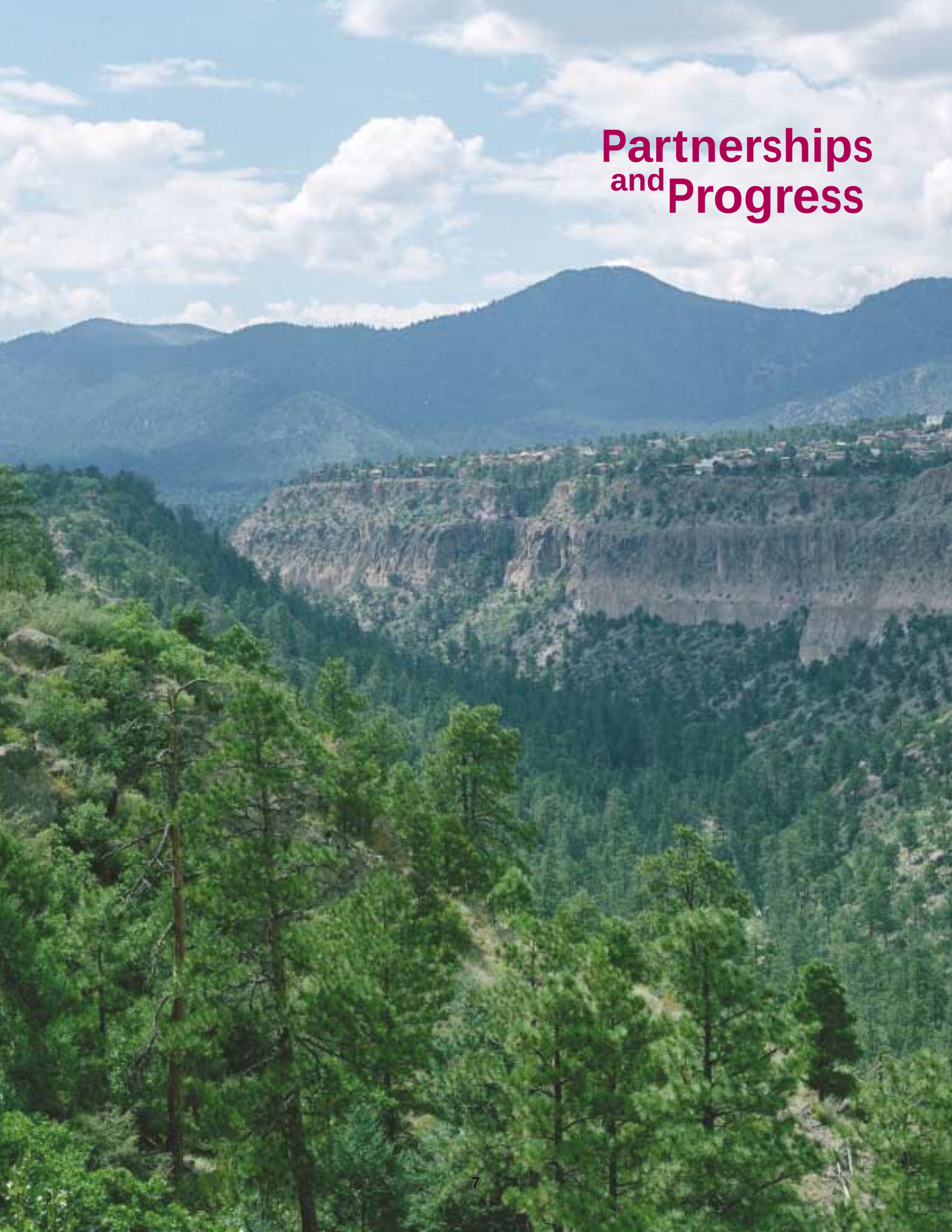
Rick prepares for a tailgate worker-safety briefing while student employee Christine Nathanson looks on. When he's away from work, Rick says, "I have a small farm where we mostly grow alfalfa and sweet corn, and I've been commissioner on the La Mesilla Community Ditch Association for five years. I've learned quite a bit about politics and people!"

The entire worker-safety briefing usually takes less than 15 minutes—time well spent to review and reinforce important safety and emergency information and to prevent injuries and accidents.

New Calibration Facility

A new radiation instrument calibration facility, which opened in 2001, improves the process for calibrating more than 7,000 Laboratory radiation-detection instruments. These instruments detect levels of radiation that range from environmental levels to levels around accelerators and nuclear criticality assemblies. Some instruments are sensitive enough to detect a millionth of a curie (a unit of radioactivity) during environmental monitoring.

The new facility works with a variety of radioactive calibration sources, including very large sources used to calibrate detection instruments for criticality experiments. The facility addresses concerns about radiation exposures to workers and to the public. Shawna Eisele of the Health Physics Measurement Group says, "This new radiation-instrument calibration facility will serve the Laboratory well in the years to come. The building and the state-of-the-art calibration equipment have been designed to substantially reduce both worker and public radiation dose."



Partnerships and Progress

Johnson Controls: A Great Partner, A Great Neighbor

Johnson Controls Northern New Mexico is not only a partner with the Laboratory, but a great neighbor to northern New Mexico communities. As a partner, Johnson Controls provides Laboratory services, such as operation and maintenance of facilities, utility systems and infrastructure, custodial duties, waste removal, roads and grounds maintenance, construction, and engineering. As a neighbor, the company promotes community outreach and economic development.

For example, the company constructed a new business park at Northern New Mexico Community College in Española. The facility has 7500 square feet of office space and a 3000-square-foot commercial kitchen. Entrepreneurial food producers rent time in the state-of-the-art kitchen and avoid capital investment while establishing their businesses. After 'incubation,' companies relocate into the community and set up their own kitchens. Many entrepreneurs continue mentoring new food producers. The kitchen helps sustain the agricultural economy of the Española valley.

Options Services, Inc., is another business park tenant. Started by Johnson Controls subcontractor Kleen-Tech, Options Services provides personal assistance to elderly and disabled Medicaid-eligible area residents who need assistance with daily living. Caregiving is a tradition in the local extended-family ethic.Options has generated approximately 100 new jobs by hiring and training family members and others as caregivers. Started in 2000, Options will bring over $2.5 million each year to the local economy.

Johnson Controls Northern New Mexico employee Willie Cordova offers his views on safety to a film crew from the Northern New Mexico Community College.

The Laboratory partnership with Johnson Controls extends to other institutions to stimulate the local economy, support education, and benefit workers. For example, students in a filmmaking class at Northern New Mexico Community College produce high-quality safety training films for Johnson Controls workers. "Our Story," last year's film, won the Communicator Award for Distinction in two categories—Student Produced and Company Orientation. The training films help launch careers for student producers, writers, and directors, and, at the same time, Johnson Controls personnel receive excellent training from coworkers who participate in the films.

Also, Johnson Controls provided $350,000 to construct the Nambé Recycling Facility, which has contracts with the Laboratory, Los Alamos County, and City of Española, to sort material for recycling. Plans are to add an ecology component so that recycled materials can be made into end products. Johnson Controls continues to provide technical assistance and advice.

Recently, Johnson Controls has partnered with Regional Development Corporation, Siete del Norte, Greater Española Valley Community Development Corporation, and others to create *Otra Vez* "Retraining while Refurbishing." Slated to open in the fall 2002, *Otra Vez* will train at-risk residents, rehabilitation graduates, and school dropouts to refurbish Laboratory surplus computers, office furniture, and equipment for resale. As they learn employment and business skills, students will be paid and be able to obtain a GED. The facility will be self-sustaining in three years.

A traditional Hispanic saying is *pansa llena, corazón contento,* translated "with a full stomach, comes contentment." Johnson Controls advocates this philosophy—not only by establishing programs to meet local needs, but also by creating hundreds of new jobs to provide income to fill local cupboards and pantries with favorite foods.

Right
Northern New Mexico Community College filmmakers work with Johnson Controls and Laboratory personnel to produce a training film. From left, student Roberto Valdez holds the sound boom and film instructor Roger Salles runs the camera. Laboratory radiation control technician Robert Cox simulates monitoring of Johnson Controls employee Luis Romero.

Below
From left, NNMCC student Luis Rivera holds the sound boom while Johnson Controls employee Donald Thymes answers questions for Kevin Valdez and Maia Brown at the wastewater treatment plant. Kevin and Maia, children of Johnson Controls employees, participated in the filmmaking process by posing questions to Donald.

Donald says, "I feel like a public servant—like a fireman or policeman protecting public safety. I would feel bad if someone got sick from the water I treated."

Who Ya Gonna Call? PTLA!

Who does the Laboratory call in an emergency? Protection Technology of Los Alamos, or PTLA, is the Laboratory security and protection organization. When Los Alamos National Laboratory is closed for the winter holiday or when winter weather delays the Laboratory's opening, the 500 trained security professionals at PTLA are still on the job. PTLA is a Laboratory organization that works around the clock.

PTLA does more than check badges and dispatch 911 calls. Since 1992, PTLA has protected the Laboratory 24 hours a day, 365 days a year. PTLA employees provide routine security services, such as controlling access to Laboratory facilities, patrolling Laboratory property, and responding to and maintaining the security alarm system. They also assist with Laboratory emergencies, such as the Cerro Grande fire. PTLA maintains continuous coverage of every Laboratory security post to protect the Laboratory from theft, sabotage, and malicious destruction.

When they have spare time, PTLA employees coach various sports, serve on volunteer fire departments, run small businesses, and raise money for the charities of northern New Mexico. To maintain Laboratory security, however, they are always on call, often work overtime, endure rigorous physical training daily, and are prepared to risk their lives protecting the Laboratory. They are ready for action, even when the rest of the Laboratory is closed.

PTLA personnel provide routine security services and are prepared to respond to any potential threat to the Laboratory. The photos at right show how PTLA employees train daily to meet weapons and protective technology qualifications.

Top
A shipment of transuranic waste heads towards Carlsbad.

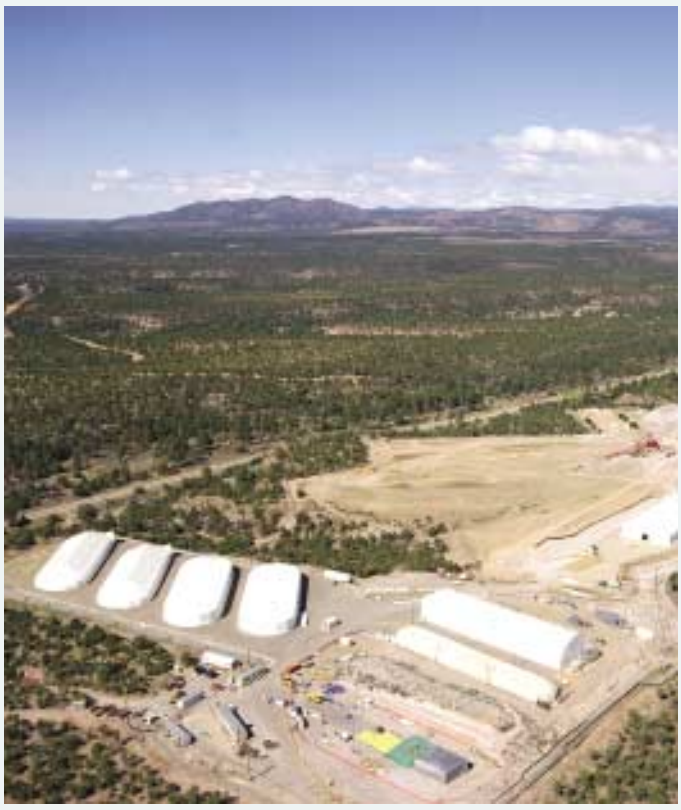
Bottom
Technicians inspect a waste drum as part of the waste inspection program at Area G (bottom right).

Update: Laboratory Shipments to the Waste Isolation Pilot Plant

The Laboratory made seven shipments to the Carlsbad, New Mexico, Waste Isolation Pilot Plant between October 2000 and September 2001. Shipments from the Laboratory are deposited at the plant in salt formations almost a half-mile underground.

The Laboratory plans to ship approximately 4000 truckloads of transuranic waste to the Waste Isolation Pilot Plant during the plant's expected 35 years of operation. Transuranic waste includes clothing, tools, rags, debris, residue, and other disposable items contaminated with radioactive elements, primarily plutonium.

The Transuranic Waste Inspection Project continued ahead of schedule. The operation has recovered 4315 cubic meters of transuranic wastes from underground pads. More than 5800 drum equivalents have been retrieved since October 2000. The Transuranic Waste Isolation Project plans to retrieve all 4700 cubic meters from underground pads by December 2004.



Profile of a Social Scientist: Postdoctoral Appointee Ben Sims

Meet Ben Sims, a Postdoctoral Research Associate in the Environment, Safety and Health Division. Ben holds a Ph.D. in sociology, specializing in science and technology issues. He recently moved from San Diego to Los Alamos with his wife, who is an experimental scientist at the Laboratory. They are the proud parents of a ten-month-old daughter. For relaxation, Ben says, "I enjoy music and play the guitar."

Currently, Ben is assessing the Laboratory's new safety program from a sociological perspective. In recent years, this program has reduced workplace accidents and improved Laboratory compliance with safety and environmental regulations.

The program integrates safety into all scientific research at the Laboratory. However, scientists and safety experts need to learn to work together more effectively to make sure that increased safety does not mean reduced scientific productivity.

Ben's job is to evaluate the Laboratory's safety program in different research areas, to recommend ways to improve trust and communication about safety issues, and to make recommendations for continuing progress.

Ben describes the purpose of his work: "Social scientists use the term 'culture' to describe a group's traditions, beliefs, and ways of working and socializing. The culture of the Laboratory shapes the way we respond to internal issues and to public concerns.

"Social scientists have an important role to play in helping the Laboratory understand its own culture, and how that culture may have to change to meet current and future challenges. I hope we can also give other social scientists and the general public some insight into what goes on inside the Laboratory."

Ben is organizing a discussion group as a forum for social scientists and other Laboratory researchers and managers to discuss cultural issues.

Ben, on the right, talks with staff member Martin Taccetti. Ben says, "In a typical day, I might observe people at work, interview people, or dig through some documents. I recently spent several months in a physics laboratory to get first-hand experience with safety issues facing researchers. I take a lot of notes to record what I see and hear."

Students Organize Archaeological Symposium

Jennifer Nisengard, from the University of Oklahoma, and Kari Schmidt, from the University of New Mexico, are graduate research assistants working towards doctorate degrees with the Cultural Resources Management team.

With Steve Swanson, from Arizona State University, Jennifer and Kari organized a symposium at the Society for American Archaeology annual meeting in New Orleans. The symposium, "Mogollon Settlement Ecology and Landscape Use," focused on the desert borderlands—including southern portions of Texas, New Mexico, and Arizona and northern Chihuahua and Sonora in Mexico, known as the Mogollon region.

The symposium goal was to expand baseline knowledge about early human use of this area. Papers presented in the symposium highlighted recent research from professors, contract archaeologists, and other graduate students. Rather than expound on the sociopolitical issues that make up most of the earlier literature, Jennifer, Kari, and Steve sought research related to ecological issues, landscape use, and settlement histories. Topics included subsistence issues, natural resource availability, tool technologies, community formation, and social organization.

Jennifer reports, "Attendance was great even though our session was scheduled for 8:00 on a Sunday morning in New Orleans! With the focus more toward environmental issues, we provided information not usually reported. In fact, the University of Arizona Press has approached us about publishing this information."

Jennifer (left) and Kari help survey and record cultural resources on Laboratory lands.

Petroglyphs and pueblo ruins at archaeological sites.

Disease Detectives

You have chills, fever, aches, and congestion. Is it a cold or maybe the flu? You remember cleaning out the shed last weekend and found no signs of mice, but still—could it be hantavirus? Many illnesses begin with similar symptoms. Early diagnosis enables treatment to begin sooner, which, for serious diseases, can greatly affect a patient's chances for full recovery.

The Laboratory is involved with a variety of projects aimed at improving the diagnosis, treatment, and prevention of disease. With the goal of speeding diagnosis, some of the Laboratory's work focuses on the development of tools, such as a hand-held biosensor, doctors can use to instantly pinpoint the cause of an infection. The detector screens for the presence of particular disease-causing organisms, allowing doctors to diagnose diseases with common symptoms much more quickly than is otherwise possible.

The prevention and treatment of disease may depend on a better understanding of the "mechanisms" involved—exactly how bacteria and viruses invade cells or tissues and how this invasion leads to illness. Some Laboratory scientists are working to gain that knowledge, and they are optimistic that their work will lead to the development of new vaccines or new treatments for disease.

Researchers are taking many different approaches to investigating the factors that contribute to the development of disease. Some approaches focus on the bacteria or viruses themselves. For example, to gather clues about the development

Karen Grace works on a biosensor.

of tuberculosis, the Laboratory studies the structure of individual proteins produced by the bacterium that causes tuberculosis.

Proteins are found in all cells. They are the workhorses that carry out life's essential processes—for example, they provide mechanical strength and enable movement, they convert and store energy, produce substances the cells need, and they help cells put those substances to use. These workhorses likely hold a key to unlocking the secrets of disease. Scientists hope more knowledge about the proteins involved with infection will lead to new drugs that latch on to the proteins and make them inactive. More knowledge may lead to vaccines that help the immune system better ward off infection in the first place.

Other approaches focus on the interaction of bacteria or viruses with their host. One Laboratory project involves the bacterium commonly known as staph. Staph causes a wide range of diseases from skin infections to toxic shock syndrome, and it is a common cause of food poisoning. Many of the unpleasant and potentially dangerous symptoms of a staph infection are actually the result of the body's immune response to a toxin produced by the bacterium. The toxin binds immune cells and triggers an immune overreaction that actually interferes with the body's ability to fight the infection. Untreated, the immune overreaction can lead to shock and even death.

Researchers in the Laboratory's staph project have developed a new antitoxin that can block the effects of a staph infection. After analyzing the sites on the immune cells where the toxin binds, Laboratory researchers designed a decoy molecule that mimics these sites. The decoy molecule binds to the toxin, preventing it from binding to the immune cells. Similar decoys may be effective for blocking other bacterial toxins or other proteins involved with bacterial or viral infection.

From detecting disease-causing organisms to finding new ways to stop them, the Laboratory is looking for new ways to help everybody stay healthier.

Using Computers to Fight Disease

In their quest to understand how life works, biomedical researchers around the world are producing millions of encyclopedias worth of genetic information. Even in the late 1970s, Laboratory scientists recognized that information was accumulating faster than researchers could use it. To solve this problem, they developed one of the first genetic sequence databases and new types of computational tools to help researchers search for, compare, or otherwise analyze gene sequence data. This early database became known as GenBank, which is now managed by the National Institutes of Health, and contains more than 11 million gene sequences from many different living things.

Since GenBank, the Laboratory has focused on developing Web-based databases containing information on bacteria and viruses that have a significant impact on public health, such as the influenza virus and Human Immunodeficiency Virus (HIV). These databases, available to scientists worldwide, contain gene sequences, information about what individual genes are believed to do, summaries of significant research, and other information that scientists can use to better understand disease-causing organisms and to develop vaccines and new drug treatments.

Researchers can use the databases to discover similarities between different bacteria, for example, or to identify targets for new drugs. The databases are also useful for tracking evolutionary patterns—how a particular type of bacteria or virus has changed over time—which can help scientists predict new patterns and perhaps help them to develop preventive vaccines. The gene sequence databases can also be used to trace a particular strain. For example, in 1991, Laboratory scientists used the HIV gene sequence database to trace a mysterious cluster of AIDS cases to a Florida dentist who had infected six patients with HIV.

The Laboratory's databases are internationally recognized by scientists as an invaluable data bank of key information—the HIV sequence database, for example, receives an average of 50,000 "hits" each week from scientists investigating ways to foil the virus.

Complementing the nuts-and-bolts approach of laboratory experiments, the databases are invaluable to worldwide efforts to understand—and more effectively battle—the bacteria and viruses that threaten public health.

A Biosafety Posse for Biovillains

Our bioscience research is aimed at strengthening our ability to protect people against emerging infectious disease as well as the effects of biological agents that might be introduced into an environment.

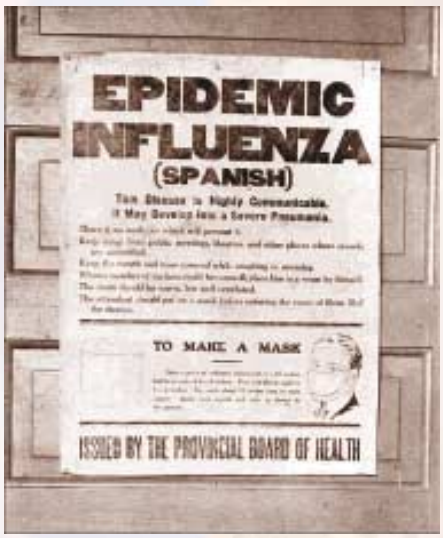
Jill Trewhella, Bioscience Division Leader

Public health and safety are the primary reasons for considering whether to build a Biosafety Level-3 (BSL-3) facility within the Bioscience Division. Formed in 1999, the division brings together biologists, chemists, physicists, and computer scientists to create and discover frontier bioscience. The proposed facility raises many questions in the community: What is a BSL facility? What scientific research would be conducted? What are the public health and worker safety risks?

What is a BSL facility?

The National Centers for Disease Control and Prevention (CDC) defines four categories of BSL facilities, beginning with Biosafety Level-1 and ending with Biosafety Level-4. The levels designate an ascending order of the degree of protection needed for personnel, the environment, and the community. The BSL-1 category is for work with microorganisms that do not cause disease in healthy humans and that present minimal risk to people and the environment. BSL-1 facilities are places such as municipal water-testing laboratories, high-school science laboratories, and community colleges with introductory microbiology classes.

BSL-2 facilities work with agents that present moderate risk to personnel and the environment. These agents include microorganisms that workers may have been exposed to, often as children, and to which they have developed immunity. Access to a BSL-2 facility requires appropriate immunizations, potential hazard awareness, and special practices and procedures proficiency. For example, eating, drinking, smoking, handling contact lenses, and applying cosmetics are not permitted in



the work areas, and food is stored outside the work area in cabinets or refrigerators designated for this purpose.

More stringent practices and procedures are in effect at BSL-3 facilities. For example, all procedures involving the manipulation of infectious materials are conducted within biological safety cabinets or other physical containment devices, or by personnel wearing appropriate personal protective clothing and equipment. A BSL-3 facility has special engineering and design features (discussed below). The proposed facility under consideration at the Laboratory is a BSL-3 facility.

The BSL-4 designation is for centers that research diseases with no known cure, such as smallpox and the Ebola virus. BSL-4 facilities handle the most deadly agents, have exceptional engineering controls, are highly specialized, and operate in only a few locations.

What, exactly, is a BSL-3 facility?

Employees at a BSL-3 facility work with infectious agents that may cause serious or potentially lethal diseases from exposure by inhalation, such as some strains of tuberculosis, encephalitis, and *B. anthracis*. BSL-3 facilities require specific barriers, such as a high-containment building, double-door entry, and single-pass air movement (exhaust air is not recirculated). BSL-3 facilities also use special protections, such as vaccinations for the workers, engineering controls, negative air pressure, and waste sterilization. At the present time, the nation has at least 250 BSL-3 facilities. The University of New Mexico in Albuquerque has two BSL-3 facilities.

What kind of research would be done at Los Alamos?

The BSL-3 facility proposed at Los Alamos would allow researchers to develop better ways to detect and identify microorganisms, seek better ways to understand and manage diseases, and detect the origins of particular microorganisms. Researchers might be considered a biosafety posse, rounding up biovillain microorganisms and averting disaster.

For example, in 1918, the Spanish flu pandemic swept around the

world in a few short months. Six hundred thousand Americans—and 20 million people worldwide—died of this strangely potent strain of influenza. Often, people contracted the disease and died the same day. Whole families perished from this mysterious disease. But now, researchers at the CDC work to understand the epidemic and why it was so virulent—their work is possible because tissue samples were recently recovered from victims buried in the Norwegian permafrost during the influenza epidemic.

A case of detecting the origins of a particular microorganism recently occurred. In Ekaterinburg (formerly Sverdlosk), Russia, a 1979 outbreak of anthrax killed an unprecedented number of people. The Soviet Union claimed the anthrax bacteria came from infected meat; however, tissue samples showed four different strains of anthrax bacteria—evidence that the outbreak could not have been natural. Researchers used technology developed at Los Alamos to learn about the extent and sophistication of the former Soviet Union biological weapons program. Authorities eventually admitted the anthrax outbreak followed an accidental release of anthrax-causing spores produced at Ekaterinburg.

What are the risks and will the facility be safe?

All BSL-3 facilities are designed, approved, and overseen by the CDC. Research projects at the Laboratory would also require local approval from the Institutional Biosafety Committee (IBC) that includes members from outside the Laboratory. IBC committee meetings are open to the public.

Bioscience Division Leader Jill Trewhella says, "A BSL-3 facility would greatly benefit our researchers working with detection and protection technologies. These scientists need to have daily access to a laboratory specifically designed to safely handle small amounts of organisms that, while infectious, can be vaccinated against or treated to prevent or eliminate infection."

Infectious diseases can destroy lives, strain community resources, and even threaten nations. In the global environment, new diseases could spread around the world in days, or even hours, making early detection and action important. The Department of Energy will decide whether to construct a BSL-3 facility at Los Alamos sometime after the National Environmental Policy Act analysis is complete.

Top
Members of the Institutional Biosafety Committee Dina Sassone, James Fryer, and local physician Dr. Richard Honsinger discuss a research project.

Above and at right, photos show work done at a typical BSL-1 laboratory.

Mapping the Human Genome: Undergraduate Student Wendy Thompson

Wendy Thompson is a senior undergraduate student at the University of New Mexico majoring in biology with a minor in anthropology. Since 1998, she has worked at the Health Research Laboratory of the Bioscience Division on the human genome-mapping project. The goal of this Department of Energy project is to create a physical map of the sequence of nucleotides—basic consituents of DNA and RNA—in every chromosome of human DNA.

As the mysteries of the human genome are unraveled, new knowledge will yield better pharmaceuticals, forensic tools, predictors of disease susceptibility, and clues about our genetic past.

Wendy displays a captive bug.

Several laboratories and research institutes across the nation are working on different parts of the human genome project. Los Alamos National Laboratory's assignment is to map chromosome number 16 and the short arm of chromosome number 5.

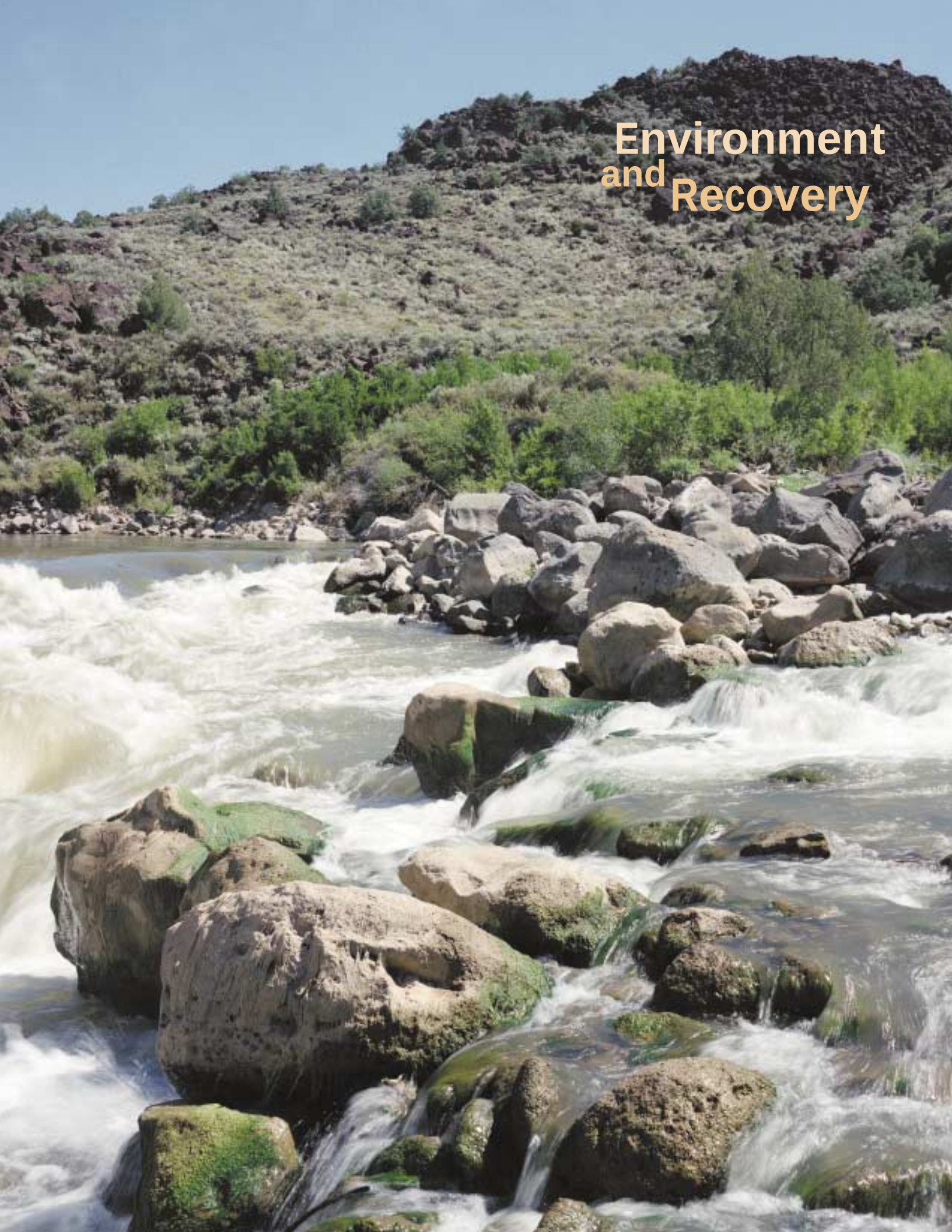
Wendy supports the Laboratory's assignment by using various laboratory results and external research data to make a graphic interpretation of chromosome 16. She works with a computer database, where each piece of the human genome-mapping project may be compared to making the first map for an unknown city.

"Calling me a cartographer wouldn't be far off the mark," she says, "The only difference is, instead of placing streets and rivers on a city map, I place genes and other elements on a chromosome map."

The genome city is microscopic, which makes the mapping project challenging and computer databases necessary. The map of chromosome 16 will eventually show all the genes on the chromosome with the relationships and distances to other genes, and the map of the entire human DNA will bring all the chromosome cities and their landmark genes together.

As the heroine in a local theater melodrama production, Wendy perfected the damsel-in-distress gesture of "hand-to-the-forehead and sigh." Photos at left and above show her and other members of the cast in their melodrama costumes.

In addition to her interest in local community theater, Wendy enjoys camping, hiking, and collecting bugs.



Environment and Recovery

The Environmental Restoration Project: No Easy Solution, No Quick Fix

Some people say the Environmental Restoration Project—an effort by the Department of Energy to clean up the facilities involved in its weapons production program—spends too much time and money conducting studies and writing reports and too little time and money in actual cleanup. However, more cleanup has been accomplished in the last three years than in the project's previous history; much of this work was accomplished ahead of schedule, saving the taxpayers millions of dollars.

The project's mission is to correct environmental problems caused by nearly 60 years of Laboratory operations by bringing together the best science, engineering, and management practices. The corrective actions prescribed in the Resource Conservation and Recovery Act and numerous other laws and regulations (see box on next page) govern the program. While adherence to regulatory requirements protects workers and the public, it may result in a time-consuming process that frustrates a public eager for speedier cleanup.

For example, the project must comply with statutes that protect endangered species. So, because high-noise levels might disturb the Mexican spotted owl, the project may not conduct disruptive activities within the owl's potential or known habitat at certain times of the year. Regulatory compliance benefits the owls, but may interfere with the project's tight sampling and cleanup schedule.

To help ensure objectivity, the project uses outside laboratories to analyze soil and water samples for contaminants, such as metals, high explosives, organic compounds, and radionuclides. Project scientists assess the significance of the findings, write detailed reports, and make recommendations to the state and federal agencies that ultimately are responsible for approving those recommendations.

No touching! A radiation control technician holds a water bottle for a worker standing inside the exclusion zone. After air monitoring determined that radioactivity was not airborne, workers are allowed to drink from the bottle but may not touch it to avoid spreading radioactive contamination. Both workers wear protective clothing, which, with the drinking straw, will be disposed of along with all other waste removed from the site, following Code of Federal Regulations guidelines.

Traditionally, the project followed a multistep investigative process that determined the nature and extent of contaminants; evaluated contaminant fate and transport; identified, evaluated, and implemented corrective action alternatives; and implemented control and monitoring requirements. To streamline this effective but time-consuming and sometimes cumbersome approach, a new framework was adopted in 1999—a more streamlined, natural-watershed approach that allows multiple sites to be investigated, assessed, and, if necessary, restored together.

However, both the traditional and watershed approaches to corrective action are lengthy processes that must follow numerous state and federal regulations. The same regulations that protect public health and safety and ensure environmental cleanup cannot provide a quick fix to almost 60 years of Laboratory operations. Fortunately, those requirements do ensure an environment in which historic contaminants can be addressed effectively and safely.

So where should the public, the ultimate and most important beneficiary of these cleanup and restoration activities, put its trust? The answer is that both sides of this issue are important: strong governmental regulations together with an interested, involved public ensure responsible environmental cleanup.

Above
Program Manager Julie Canepa (on left) discusses a cleanup with concerned citizens at a public meeting. At meetings like this, project scientists interact with the public, explaining the progress and significance of project remediation/ restoration activities. The project holds at least four public meetings each year and maintains year-round communication with neighboring pueblos and communities.

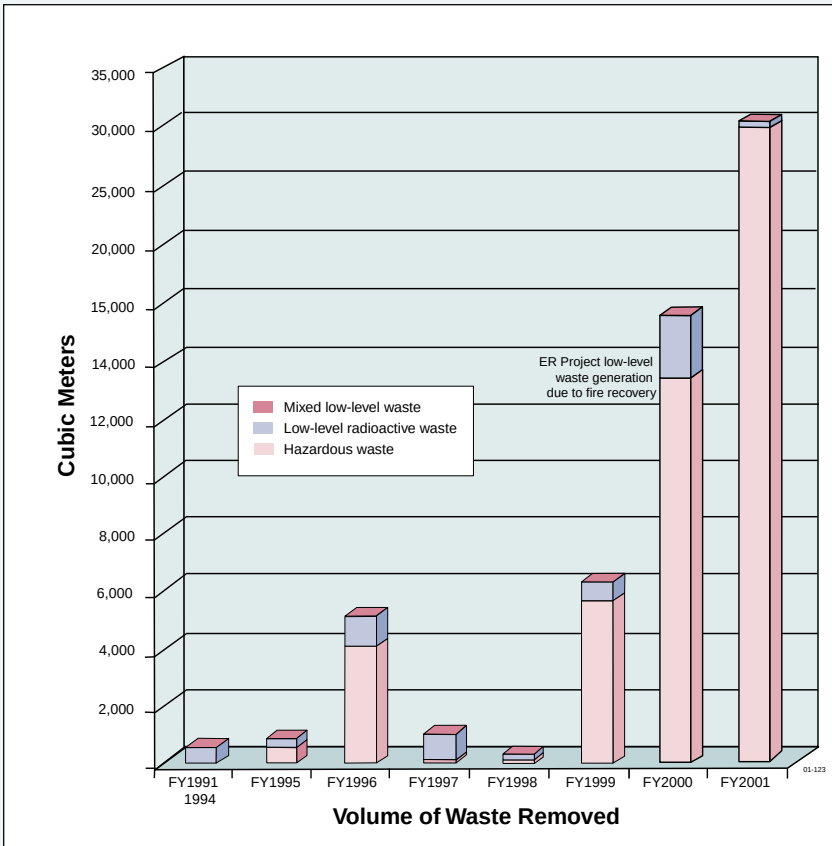
Primarily the project must comply with the following:

- Resource Conservation and Recovery Act regulations
- Module VIII of the Laboratory's Hazardous Waste Facility Permit
- National Environmental Policy Act
- Applicable Department of Energy directives, policies, and Executive Orders
- Fourteen federal statutes, such as the Clean Air and Water Acts, the Endangered Species Act, the National Historic Preservation Act, and the Safe Drinking Water Act
- Numerous state statutes, including the Air Quality Control Act, the Hazardous Chemicals Information Act, and the Radioactive and Hazardous Materials Act

Left
Some contaminated soil and water must be removed by hand, using shovels and vacuum equipment. Workers wear protective clothing and are monitored frequently for radiation and other potential contaminants.

Center
An Environmental Restoration Project scientist identifies sediment layers in an Acid Canyon stream bank. Taking samples from sediment deposited since the beginning of the Laboratory helps scientists focus the cleanup on soil that contains the contaminants.

Below
The Environmental Restoration Project has completed cleanups at many sites around the Laboratory. By the end of 2000, the Environmental Restoration Project had reduced the original 2124 potential release sites to only 880. More waste has been removed from the environment in the last three years than in the project's previous history.



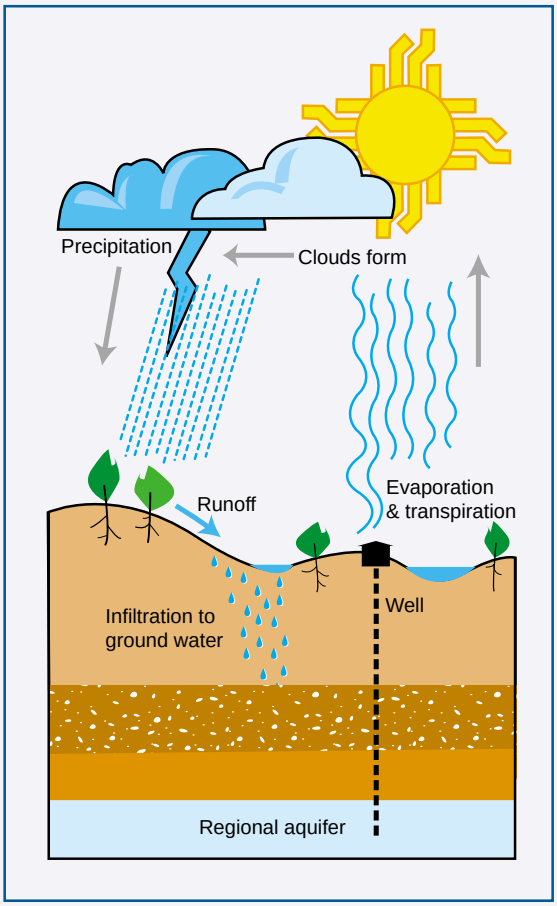
The Hydrologic Cycle

The hydrologic cycle begins when water evaporates or transpires from the earth into the atmosphere. This release of moisture happens in two ways—first, by evaporation from bodies of water and the ground, and second, by transpiration from green plants. As the cycle progresses, condensation gathers moisture from the atmosphere into cloud formations. Precipitation then brings the moisture back to earth as rain, sleet, snow, or hail. Moisture once again flows into lakes, streams, and the ground itself, only to be released again into the atmosphere. The cycle is necessary and perpetual.

Consider the deep, fingerlike canyons carved into the Pajarito Plateau. These canyons are narrow, but steep, products of centuries of rain falling onto the soft volcanic rock formations and eroding the weakest portions. On the plateau, geologic conditions affect the hydrologic cycle, making possible seasonal monsoons with daily thunderstorms and tremendous amounts of water.

Under certain conditions, rainstorms can unleash awesome power and streams of runoff water, which may carry some potentially harmful elements. For instance, some atoms called radionuclides are released into the air from natural minerals. Fallout from past multinational nuclear testing has settled worldwide on trees, shrubs, and the ground around the world.

The Laboratory's early operations released industrial wastewater containing radioactivity and chemical compounds. In some Pajarito



Hydrologic cycle

Plateau canyons, this legacy contamination remains. And, finally, there is insecticide residue from many decades ago in the national forest above the plateau.

Runoff water moves things as small as a radioactive particle of cesium suspended on a tree leaf and as large as a ponderosa branch or a two-ton rock. Movement starts with single raindrops falling onto plants, buildings, and the ground, each droplet merging into another. Falling rain quickly fills creeks and streambeds.

Streamlets expand, carrying microscopic particles along with rocks, dead wood, leaves, and loose dirt. The moving water gains volume and power. The harder the rainfall, the greater the water movement through the canyons.

Eventually, the water fills pools and ponds in the floodplains, seeps underground into the ground water, or flows into the Rio Grande. As time passes, silt and sediment accumulate, trapped in low-lying areas or around large trees and boulders. Silt and sediment sometimes contain radioactive and chemical elements hazardous to environmental health.

At the Laboratory, the Water Quality and Hydrology Group keeps tabs on possible contaminant levels in water and sediment on Laboratory lands. Constant monitoring, shown in the photos on the next page, provides information about the accumulation of harmful elements downstream and on the Pajarito Plateau.

The hydrologic cycle produces powerful thunderstorms in the area's unique canyons every summer. The Laboratory monitors the rainwater, runoff water, silt, and sediment, takes action to prevent flooding, and conducts constant sampling.

Water Quality and Hydrology personnel perform a constant variety of sampling.

Left
Graduate research assistant Amanda Bissell collects streambed sediment.

Center
Personnel from the New Mexico Environment Department prepare boats before sampling open water.

Below
(Left) A Laboratory employee monitors runoff sediment; (right) Mike Alexander checks a stream gauge.

Studying Uranium in Well Waters of the Nambé Region: Graduate Student Audrey Hakonson-Hayes

In the past few years, high concentrations of natural uranium have been discovered in well waters of the Nambé region of New Mexico. These elevated concentrations are associated with a low-grade underground uranium deposit in the area. In fact, concentrations of natural uranium above the Environmental Protection Agency's proposed safe limits have been found in half of the region's wells that are used for drinking water.

Natural uranium is both a radiological (affecting bones) and toxicological (affecting kidneys) agent. The toxic action of uranium resides more in its chemical action on the kidneys, rather than in its radiation effects.

As part of her master's thesis, Colorado State University graduate student Audrey Hakonson-Hayes wanted to answer the question: How much of this water can area residents safely use?

She explains, "The purpose for this study was to estimate radiological and toxicological doses from three pathways: drinking the well water, eating the vegetables grown with this water, and inhaling airborne soil that has been irrigated with this water."

When Audrey began her research, she found very little information about plant uptake of soluble uranium. The information that did exist was specific to other regions or to vegetable species not grown locally. Audrey's new data would help to fill a gap in the common knowledge related to uranium and plant uptake.

Audrey planted an experimental garden of tomatoes, squash, lettuce, and radishes—vegetables that are common to home gardens in northern New Mexico. She watered distinct sections of plants with water from different Nambé area wells. Each water source contained a specific concentration of uranium. Throughout the growing season, Audrey and her assistants gathered the vegetables and sent them to be analyzed at New Mexico State University.

Results indicated that uranium concentrations in plants increased in direct proportion to increased uranium concentrations in the water. Lettuce and radishes absorbed more uranium than squash and tomatoes, and tomatoes absorbed the least.

"People probably think that the radioactivity of the uranium in the human body would be most significant. However, we found the radiological dose from the three pathways to be insignificant; even if an individual were to consume water and vegetables containing the highest uranium concentrations for a period of 70 years," she says, "it is the toxicological effect that uranium has on the kidney that could cause problems."

"Even so, the same 70-year consumption of water and vegetables and the inhalation of airborne soil would result in a kidney burden well below damaging levels. Finally, the study showed that consumers get most of the uranium dose from drinking the water, not from eating the vegetables or inhaling suspended soil."

Audrey arranged four groups of plants on elevated platforms separated from each other by walkways to prevent cross-contamination. She irrigated each section with well water containing a specific concentration of uranium. The concentration was measured in micrograms of uranium per liter of water—a microgram is one-millionth of a gram.

Audrey and her crew harvested the vegetables and brought them to the laboratory for processing. Processing meant rinsing all of the vegetables with tap water, scrubbing the radishes to remove as much dirt as possible, quartering tomatoes, and slicing squash before placing the vegetables in labeled paper bags for oven drying. Samples were then sent to New Mexico State University in Las Cruces for analysis.

This project attracted media attention because many people were interested in the results. Audrey gave interviews on television news programs, and she reported her work in several area newspapers, national symposiums, and international journals.

Contact Phil Fresquez at (505) 667-0815 for the Laboratory report related to this project, or access the report online from the Laboratory's Library without Walls at

http://lib-www.lanl.gov/la-pubs/00393703.pdf

Containers of well water for irrigating the experimental garden.

Audrey grew up in Los Alamos and graduated from Los Alamos High School. She joined the army after high school, spending most of her time in Fort Benning, Georgia. She represented the United States in international pistol-shooting competition and trained military personnel and civilians in marksmanship.

After her army duty, she earned her bachelor of science degree in biology at the University of Wyoming before moving to Colorado State to earn her masters degree in radioecology.

Forest Recovery, Naturally

More than a year has passed since the Cerro Grande fire. Most of the burned trees are still standing, but somehow, up on the hillsides they do not seem quite as stark as they did last summer or as they did against the whiteness of last winter's snow. Maybe more trees have fallen. Or maybe all of the new-growth colors have muted the blackness. Or maybe peace of mind has returned because rehabilitation efforts have dealt with many of the post-fire environmental dangers.

Those dangers came in many forms. Thirty-four percent of the 43,000 acres burned by the Cerro Grande fire—almost 15,000 acres, mostly on National Forest land—had severe damage. Everything in the area that could burn did, leaving some areas completely denuded with hardened soil unable to absorb moisture. After the fire, the summer monsoon season was just around the corner. Since much of the severely burned land was on the slopes above Los Alamos and the Laboratory, flash floods and severe erosion were immediate concerns.

The Interagency Burned Area Emergency Rehabilitation Team responded with a plan of action to guard against flooding and soil erosion. Hundreds of community volunteers made this rehabilitation effort the largest of its kind. Workers placed straw bales and wattles on the burned slopes to slow fast-moving water and trap sediment. They spiked grass seed into the burned ground, removed dangerous smoldering trees, and reinforced runoff channels. Seed and hydromulch were dropped onto burned areas from helicopters and airplanes. Storm water runoff and erosion controls were soon established in many of the burned areas close to the town and the Laboratory.

Ash produced by the fire caused other concerns. Did the ash contain harmful chemicals or radioactive elements from burned vegetation and soil? How would these concerns be addressed?

Even before the fire, monitoring plans had been in place. For example, the Environmental Surveillance Program keeps tabs on the natural environment on Laboratory land, around its borders, and miles away. Technicians constantly check air and water quality. They gather biological samples to analyze for radioactive or chemical contamination. However, after the fire, many citizens were concerned about contaminants getting into the air, water, and food sources.

Program staff began supplemental sampling, especially in areas where citizens had specific interests. For instance, organic farmers downwind of the fire were concerned about harmful elements in the smoke and ash settling on their garden produce. Within days after the fire, samples of fallout ash and soil were collected and analyzed. Safe levels were found and reported to the public.* To monitor uptake of dangerous substances, fish samples were taken where runoff from the burned area and the Laboratory flows into the Rio Grande.

Summer rain and heavy winter snowfall primed the burned ground for the next growing season. Wildflowers and grass grew profusely in the spring.

Recovery after a wildfire is a slow process that takes years and years, but nature promises growth and renewal. A recent publication by

Teralene Foxx—*Out of the Ashes, A Story of Natural Recovery*—explains the role of fire in forestland and the natural processes that follow.** Artist renditions by Dorothy Hoard are included below and on the next page that show her vision of future environmental recovery.

* For analysis results, see Fresquez et al., *The Effect of the Cerro Grande Fire (Smoke and Fallout Ash) on Possible Contaminants in Soils and Crops Downwind of Los Alamos National Laboratory.* This report can be accessed on the internet at http://lib-www.lanl.gov/la-pubs/00818191.pdf or contact Phil R. Fresquez at (505) 667-0815.

** *Out of the Ashes, A Story of Natural Recovery* can be accessed on the internet at http://lib-www.lanl.gov/la-pubs/00367049.pdf or contact Carey M. Bare at (505) 667-3349.

Right
Surveys to assess fire damage of cultural artifacts, such as this pottery shard, began immediately after the fire.

Below center
In the spring, wildflowers and grass grew profusely after the winter snowfall.

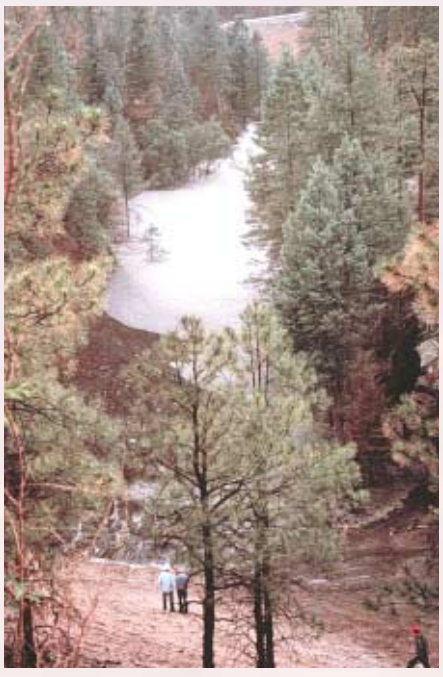
Bottom left and right
Previously obscured, the Mitchell Trail arch could be seen from the trail after the fire. Artist Dorothy Hoard's rendition illustrates how the arch will look after the burned trees fall over.

Left
The mountains above Los Alamos after the fire. The burned trees will fall down in about 5 to 8 years while aspen, oak brush, and grass grow in.

Left
Artist Dorothy Hoard's conception of how the mountains will look in about 20 to 25 years.

Below left
A debris catcher for fallen trees and other large objects that might wash down in heavy rains.

Below
An accumulation of flood water in Pueblo Canyon before the culvert was enlarged after the fire.



Feeding Habits of Rocky Mountain Elk and Mule Deer

What plants do Rocky Mountain elk and mule deer nibble on? Do they compete for food on the Pajarito Plateau? Why ask these questions? Leonard Sandoval is a graduate research assistant from

New Mexico State University working towards a master's degree in range science. His work expands baseline knowledge about the grazing habits of Rocky Mountain elk and mule deer on the Pajarito Plateau.

On the plateau, the Laboratory covers over 27,000 acres of land, and most of this area is restricted to general public access. A large part of the area is undeveloped and serves as a sort of a wildlife refuge for many northern New Mexico animal species. Another closeby animal refuge is Bandelier National Monument with over 32,000 acres, which shares a common border with the Laboratory. Much of the rest of the plateau is managed by other agencies, such as the US Forest Service, the Bureau of Land Management, and Native American pueblos.

Even though the various agencies manage their lands according to different plans, a common theme is the maintenance of a healthy wildlife population. Elk and deer, in particular, are high-profile, high-maintenance species that require specific attention. To this end, land stewards of this area formed the East Jemez Resource Council. Their charter is a formal agreement to "promote understanding and coordination of natural and cultural resources management in the east Jemez Mountains."

In concert with this council, the Laboratory is developing a long-term wildlife management plan. To develop this management plan, three types of information are needed—resource use patterns, movement patterns, and food habits analysis. Work is progressing in all three areas—not only at the Laboratory, but at Bandelier, in the national forest, and on pueblo lands—and Leonard's focus is on food-habits analysis.

To area residents and government agencies, elk and deer pose a number of concerns that include wildlife management issues, property damage, radioactive contamination, automobile accidents, and habitat degradation. Another concern is the impact of the Cerro Grande fire on population dynamics.

Leonard studies questions such as what plants the two species prefer to eat. Are the preferred plants similar? Is there competition between species, and how does this affect population dynamics?

He says, "Understanding food habits is fundamental to interpreting an animal's behavior, physiology, ecology, and morphology. More importantly, it is essential in the management of large ungulates for evaluating diet quality, preference, and competition."

Leonard has spent over two years collecting and analyzing elk and deer pellets to learn which plants the animals graze on most. Preliminary data indicate that elk graze on a wider variety of plants than do deer, and that there is no significant overlap of preferred plant species.

Rocky Mountain elk cow

Up Close and Personal: Life after Cerro Grande

We needed psychological first aid.

—Mike Barnes

After the Cerro Grande wildfire Mike Barnes thought, "We need everything and have nothing." He chronicles his experience during this crisis, unique to him, but at the same time, mirroring the experiences of others. Mike was part of the Laboratory's Emergency Response Team during the fire. He worked around-the-clock and slept in his car. When the residents of Los Alamos—and his wife Ivy—evacuated, Mike remained on the emergency team. Sleep and meals were erratic. He ran out of clean underwear and broke his glasses. The darkest moment came when he learned that his house was burning—he could do nothing and had no way of telling Ivy.

Los Alamos residents—including the children, the elderly, people in the hospital and the nursing home, business owners, even pets—had been evacuated. No one could know how extensive the fire would be or how their lives would change.

No wonder anxiety and fear reigned. Laboratory psychologist Tom Locke explains, "None of us should underestimate the psychological impact of our experiences in May 2000. Laboratory staff worked diligently for long periods without relief and away from their families. Some emergency workers directly risked their lives."

The fire smoldered, but when the evacuation was lifted, people returned.

For Mike and Ivy Barnes, the ups and downs of life after Cerro Grande were extreme. People's generosity was heartwarming—within days, they had at least twenty offers of places to live—but their problems were immense, the result of "needing everything and having nothing."

"Touch the Sky" is the commemorative statue for the Cerro Grande fire.

They faced painful uncertainties about what to do next. Should they rebuild, rent, buy another house in Los Alamos, or move away? They struggled with sleep difficulties, nightmares, diet and appetite fluctuations, and cash flow problems. Their initial need, says Mike, was "psychological first aid."

With their faith and spiritual community as emotional mainstays, the couple decided the fire disaster could be a new beginning, a time to examine values, establish new habits, and redefine their lives. They channeled their energies into new enterprises. They were active in the Cerro Grande Fire Survivors Association, Mike began a new job at the Laboratory, and Ivy started a new business. Friends, disaster aid, and community support helped them through the rough times. The Art Center, which raised money for the entire community, buoyed Mike and Ivy's spirits with new art supplies. An interfaith organization surprised them with handmade Christmas ornaments.

As the first anniversary of the Cerro Grande fire came and went, supportive community activities continued. A parade down Central Avenue honored the firefighters and the many others who had helped the community cope. Townspeople gathered at the Municipal Building around the "Touch the Sky" commemorative statue to remember the anniversary with a moment of silence. Several neighborhoods held potluck dinners to renew ties and show camaraderie.

The Family YMCA, Los Alamos County, the Laboratory Bioscience Division, and other community sponsors coordinated the first annual "Renewal Run." Proceeds went to a fire unit that traveled to Los Alamos during the fire. Los Alamos National Bank and the Laboratory made generous contributions to produce a

Teralene Foxx, a retired Laboratory ecologist and fire-recovery expert, has been busy educating the community about environmental recovery. Besides presentations to Laboratory workers and community people, Terry has worked with teachers and children, encouraging youngsters to write stories, draw pictures, and engage in creative activities to cope after the fire. Here, students show a quilt they made in school. Youngsters expressed their sentiments on the quilt.

special publication, *Cerro Grande: Canyons of Fire, Spirit of Community,* which is to provide scholarship money for children who lost homes.

Laboratory psychologist Tom Locke says, "Everyone's life has been affected, not just those who lost their homes."

Tom Locke says, "Certainly, individuals and families who lost their homes cope daily with what it means to reestablish a home. Everyone's life has been affected, not just those who lost their homes. Most of us live with the reality that the world is not as safe as we once thought it was; but all of us can be strengthened by the knowledge that we experienced a disaster and are recovering from it. Oliver Wendell Holmes, U.S. Supreme Court Justice, once said:

What lies behind us and what lies before us are tiny matters compared to what lies within us.

"Knowing what we can do when faced with adversity is one of the very important lessons we can take from all that this fire has taught us."

Much recovery, restoration, and rebuilding lies ahead. Thanks to the support of neighbors, volunteers, professionals, and the outpouring of generosity from New Mexico, the nation, and the world, many people have a new sense of community and an appreciation for their lives and families—a sense of having weathered the crisis.

But for many people, recovery is still emotionally painful and stressful. Mike and Ivy are acutely aware of their own situation and the losses sustained by their neighbors in northern New Mexico. Mike sums up, "My hope for the community is that they examine their values and make something out of the test of fire."

Last July, Mike and Ivy settled into a new home in Santa Fe, named *Casa del Fuego (*house from the fire). Mike wrote "Fire Prayer" to express his experience:

Fire Prayer

Thank you for cleaning my life of worldly things. Thank you for the man that gave me clean underwear, the woman that fed me fish, the 4th graders that sent lunch, and the officer that kept me from danger. Let me not slip back into the materialism of this world. Let my light, my love, burn bright so that I do not lose this baptism of spirit, baptism by fire. In the dark hours let me see past the fear and be open to your light.

For information about *Cerro Grande: Canyons of Fire, Spirit of Community*, contact
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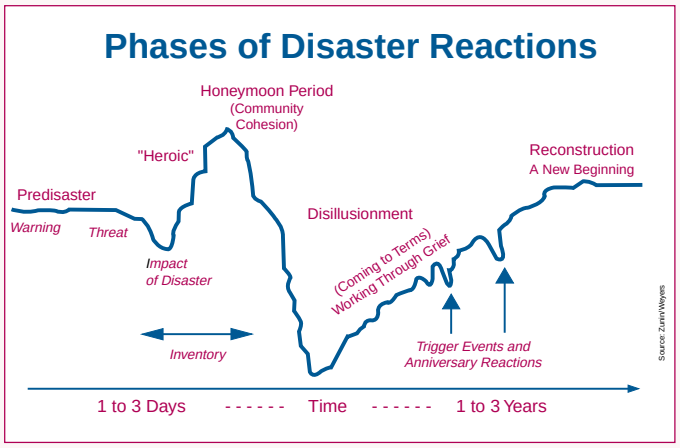
Right
Mike and Ivy survey the ruins and rubble of their former home. Only bits and pieces of their belongings remained, but Mike's vintage car was not burned.

Below
A fallen tree almost crushed the sign on Highway 4 close to the Laboratory and Bandelier National Monument.

Project Recovery



Below
Project Recovery staff and children at the Health Fair in October 2000 and in the Los Alamos County Fair parade, August 2001.

Project Recovery opened, staffed with counselors and outreach workers, almost immediately after the Cerro Grande fire. Project Recovery delivered services to more than 10,000 northern New Mexico residents and to the Los Alamos community. Recovery services included post-disaster service, support, education, and information.

In the days, months, and even years after a disaster, people normally experience an up-and-down roller coaster of reactions and emotions (see chart at left).

Often, the roller-coaster emotions and reactions cause confusion as people work to put their lives back together after a disaster. The recovery process includes periods of stress, sadness, anger, frustration, depression, sleep disturbance, nightmares, and despair— interspersed with feelings of gratitude, courage, energy, determination, compassion, and a desire to help others.

Project Recovery has supported the community process of recovery by offering the following:

- Support, information, and education on the recovery process to individuals and groups
- Disaster counseling for youth, families, and individuals
- Training for service providers
- Distribution of educational materials
- Disaster counseling for a variety of groups, including sports teams, church groups, and businesses

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Los Alamos National Laboratory was established in 1943 as Project Y of the Manhattan Engineer District. Under the leadership of J. Robert Oppenheimer, the Laboratory developed the world's first atomic bomb. Today, Los Alamos is a multidisciplinary, multiprogram laboratory whose central mission still revolves around national security.

Managed by the University of California for the US Department of Energy, the Laboratory maintains a commitment to its tradition of free inquiry and debate, which is essential to any scientific undertaking. Located on the Pajarito Plateau about 35 miles northwest of Santa Fe, the capital of New Mexico, Los Alamos National Laboratory is one of 28 Department of Energy laboratories across the country.

The Laboratory covers more than 43 square miles of mesas and canyons in northern New Mexico. As the largest institution and the largest employer in the area, the Laboratory has approximately 7000 University of California employees plus approximately 3400 contractor personnel. Our annual budget is approximately $1.5 billion.

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