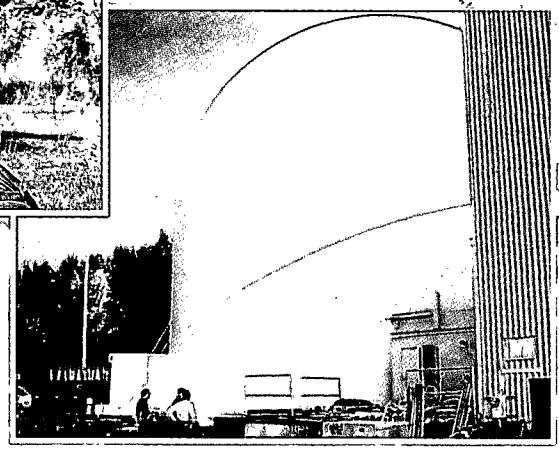
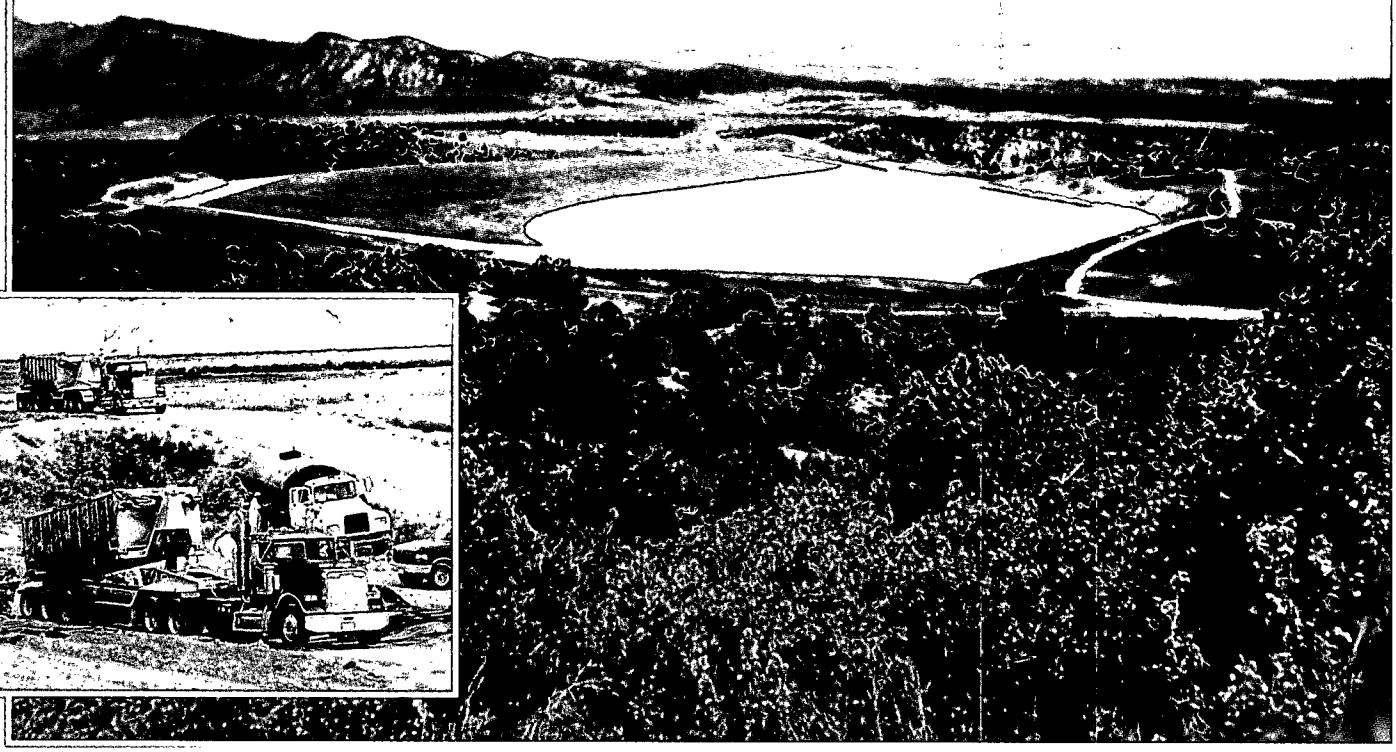
LTSM

Long-Term Surveillance and Monitoring Program

1998 REPORT





U.S. Department of Energy Grand Junction Office
Grand Junction, Colorado

GJO–98–76–TAR

Long-Term Surveillance and Monitoring Program 1998 Report

Long-Term Surveillance and Monitoring Program
U.S. Department of Energy
Grand Junction Office
Grand Junction, Colorado

March 1999

Front cover photographs (top to bottom):

A DOE Grand Junction Office scientist collects water-level information from a monitor well at the Gunnison, Colorado, processing site.

The entombed nuclear reactor at Piqua, Ohio, is cared for by the LTSM Program.

The Bodo Canyon Disposal Site near Durango, Colorado, contains low-level radioactive materials removed from the Durango uranium-ore processing site.

Low-level radioactive material is deposited at the Cheney Disposal Site near Grand Junction, Colorado.

Back cover: The entrance to the DOE Grand Junction Office, Grand Junction, Colorado.

Contents

This report was prepared by MACTEC Environmental Restoration Services (ERS) for the U.S. Department of Energy Grand Junction Office under DOE Contract Number DE–AC13–96GJ87335.

Foreword

Our nation is tasked with the responsibility to protect public health and the environment from low-level radioactive wastes generated as a result of defense and commercial activities. To achieve our goals of safety and to satisfy our obligation to future generations, we have assigned a significant portion of our national resources to remediate these legacy wastes. These wastes will remain hazardous for millennia. Therefore, our task does not end with facility cleanup. The disposed waste materials must be managed.

Remedial action has been completed at many of the nation's sites that were contaminated with low-level radioactive material in support of Federal Government activities. On some sites, radiologically contaminated material remains in long-term storage. Many of these sites have been transferred to the U.S. Department of Energy (DOE) for perpetual oversight and care. For this task, DOE established the Long-Term Surveillance and Monitoring (LTSM) Program in 1988.

The LTSM Program, managed by the DOE Grand Junction Office in Grand Junction, Colorado, conducts stewardship activities for 25 sites. For each site, the LTSM Program ensures that the on-site contaminated materials remain isolated from the environment, that the safety of the public and the environment is maintained, and that all applicable regulations are met. Program scientists, engineers, and specialists conduct inspections, provide maintenance, perform research, and archive records.

DOE has a responsibility to care for these sites to ensure that the public has no concern about harm from these stored materials. This report presents a snapshot of LTSM Program activities, program accomplishments in 1998, and plans for the future. It is our desire that this document will facilitate communication with other entities dealing with long-lived contaminants. If you would like more information about the LTSM Program, please contact me or any of the resources listed on page 22.

Russel Edge
LTSM Program Manager
U.S. Department of Energy
Grand Junction Office

Acronyms

AEC	U.S. Atomic Energy Commission
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980 or Superfund Program (42 *United States Code* [U.S.C.] 9601, *et seq.*)
CFR	*Code of Federal Regulations*
D&D	Defense Decontamination and Decommissioning
DOE	U.S. Department of Energy
EM–40	U.S. Department of Energy Office of Environmental Management
FUSRAP	Formerly Utilized Sites Remedial Action Program
GJO	Grand Junction Office
LTSM	Long-Term Surveillance and Monitoring
NPL	National Priorities List
NRC	U.S. Nuclear Regulatory Commission
NWPA	Nuclear Waste Policy Act of 1982 [42 U.S.C. 101719(c) *et seq.*]
RCRA	Resource Conservation and Recovery Act of 1976 (42 U.S.C. 6901, *et seq.*)
UMTRCA	Uranium Mill Tailings Radiation Control Act of 1978 (88 U.S.C. 7901, *et seq.*)
UMTRA	Uranium Mill Tailings Remedial Action Project

The Obligation for Stewardship

A Legacy of Waste

The exploration and mining of radioactive ores in the United States began in the early 1900s. Radium (contained in uranium ore) was in demand for luminous paint for watch dials and other instruments and for medical and scientific research. Much of the radium was recovered from carnotite, a mineral containing uranium and vanadium oxides that is common in western U.S. sandstones. By the 1920s, demand for vanadium to strengthen steel alloys led to increases in mining and processing carnotite ores. But the uranium component had little value at that time and was usually discarded during the process of recovering the vanadium.

Uranium became important during World War II for defense purposes. In 1943, the Federal Government began processing uranium ore for the Manhattan Project. Because uranium continued to be essential to the national defense in the postwar years, Congress passed the Atomic Energy Act of 1946 (since superseded by the Atomic Energy Act of 1954, as amended), creating the U.S. Atomic Energy Commission (AEC) to administer and regulate the production and use of nuclear power.

AEC launched a uranium procurement program that encouraged exploration and production. Consequently, numerous mining and milling facilities were constructed and new and improved processing methods were developed. The Federal Government ended its uranium procurement program in 1970.

The Federal Government also sponsored nonmilitary nuclear research that included test nuclear detonations for civilian purposes and full-scale development of reactor facilities for electricity generation. Commercial use of uranium for electricity generation was encouraged by the passage of the Private Ownership of Special Nuclear Materials Act in 1964. These and other activities within the nation's nuclear research and utilization programs generated low-level radiological contamination.

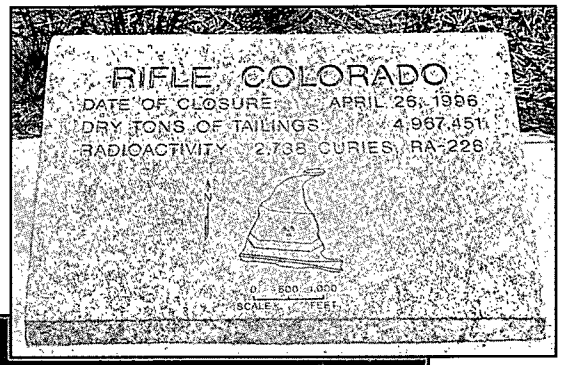
Many of the nuclear production and research sites were eventually decommissioned, leaving uncontrolled or only partially stabilized low-level radioactive waste at those sites. These low-level radioactive materials could potentially expose the public to gamma radiation and radon gas, a radioactive substance produced by the radioactive decay of uranium. Surface water, groundwater, and soils at some locations were contaminated with site contaminants. In the 1970s, the U.S. Congress was made aware of the potential risk to public health posed by these radioactive wastes.

Stewardship—
accepting the responsibility and trust to take all appropriate actions associated with managing and caring for one's property.

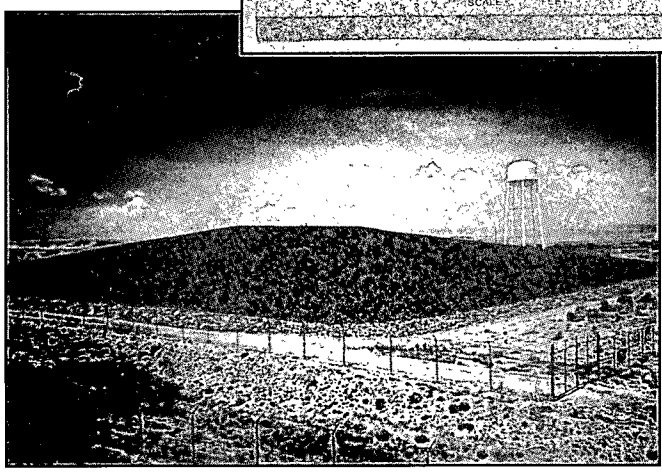
Congress and DOE Respond

In 1978, Congress enacted the Uranium Mill Tailings Radiation Control Act (UMTRCA), which was designed to remove any public health threat caused by mill tailings. Title I of UMTRCA directed the cleanup and stabilization of uranium mill tailings at inactive uranium processing sites. Title II of UMTRCA addressed uranium mill tailings cleanup and stabilization at commercial facilities active in 1978. The U.S. Department of Energy (DOE) created the Uranium Mill Tailings Remedial Action (UMTRA) Project to implement the mandate of UMTRCA Title I. Title II is funded and implemented by the commercial owners of the affected sites. Some commercial sites are eligible for partial reimbursement of reclamation costs under Title X of the Energy Policy Act of 1992 for the portion of uranium milling conducted under contract to AEC.

UMTRCA specified that the Federal Government would become the long-term custodian for all sites remediated under Title I. For sites reclaimed under Title II, the host State could elect to become the long-term custodian; otherwise, the Federal Government would assume that



The site marker provides pertinent information at the Rifle, Colorado, Disposal Cell.



The Green River, Utah, Disposal Cell was transferred to the Long-Term Surveillance and Monitoring Program in 1998.

responsibility. To date, no host State has elected to become the long-term custodian. DOE has been assigned responsibility for long-term custody of all UMTRCA sites.

In 1982, Congress passed the Nuclear Waste Policy Act (NWPA). Section 151 of NWPA addresses the closure of low-level radioactive waste sites. This act authorizes DOE to become the long-term custodian for low-level radioactive waste sites if the U.S. Nuclear Regulatory Commission (NRC) determines that Federal custody is necessary and concurs that stipulated long-term custody and financial criteria are satisfied.

DOE has remediated low-level radioactive contamination under other programs and authorities, including the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA, also known as Superfund), the Defense Decontamination and Decommissioning (D&D) Program (formerly the Surplus Facilities Management Program), and the Formerly Utilized Sites Remedial Action Program (FUSRAP). DOE is monitoring contaminated nuclear detonation sites that were used for research at remote locations through the DOE Nevada Offsite Projects organization.

At all these sites, low-level radioactive materials were either addressed by institutional controls and left in place or isolated in permanent storage. DOE has a mandate to maintain custody of these locations and to provide long-term care to protect public safety and the environment. Responsibilities for these disposal sites are collectively referred to as stewardship.

The Long-Term Surveillance and Monitoring Program

Origins

Many of the missions conducted by DOE have resulted in low-level radioactive contamination at DOE sites. These sites were remediated under different environmental restoration programs, each with its own regulations and standards. All locations with contamination left on site require long-term care. DOE created the Long-Term Surveillance and Monitoring (LTSM) Program in 1988 to establish a central concentration of stewardship expertise to meet this need.

Effective January 1, 1989, the DOE Grand Junction Office (GJO) was designated as the program office for "disposal site long-term surveillance and maintenance."[1] The assignment of this responsibility to GJO has since been reconfirmed on three occasions.[2]

Charter

DOE assumes long-term custody of closed low-level radioactive waste disposal sites. It is DOE's intent to assign all long-term stewardship responsibilities for sites that meet two criteria to the LTSM Program: (1) the site is not physically a part of a major DOE facility and (2) the site does not have a DOE mission after cleanup. Assignment of site responsibility to the LTSM Program ensures cost minimization and uniform compliance with applicable regulations, licenses, and agreements within DOE. Currently, the program is responsible for annual surveillance, monitoring, and maintenance of 25 disposal sites assigned to DOE under UMTRCA Title I and Title II, NWPA Section 151, and the D&D Program. By 2006, more than 50 sites from various remediation programs will be assigned to the LTSM Program at DOE–GJO for stewardship.

Responsibilities of the Long-Term Steward

DOE has put much thoughtful work into defining the role of steward. The primary function of stewardship is to ensure protection of human health and the environment until the managed waste materials are no longer hazardous. LTSM Program responsibilities as the long-term custodian or steward consist of four major elements:

The mission of the LTSM Program is to assume long-term custody of completed DOE remedial action project disposal sites, as well as other assigned sites, and to establish a common office for the operation, security, surveillance, monitoring, and maintenance of these sites.

- **Site Monitoring, Maintenance, and Reporting**—Site monitoring includes periodic inspections to verify that engineered structures and barriers constructed to isolate hazards from the environment are intact. Maintenance activities could consist of repair of structures, replacement of signs and markers, and routine maintenance of security features such as fencing. All site activities must be documented for program archives.

[1]Memorandum to Don Ofte, Manager, DOE Idaho Operations Office, from John E. Baublitz, Acting Director, DOE Office of Remedial Action and Waste Technology, Office of Nuclear Energy, discussing disposal site long-term surveillance and maintenance, November 30, 1988.

[2]The three records of this intention are the memorandum to J.J. Fiore, et al., from R.P. Whitfield, DOE Deputy Assistant Secretary for Environmental Restoration, discussing long-term maintenance of EM–40 disposal sites, January 16, 1992; the memorandum to R. Nace, et al., from James M. Owendoff, DOE Deputy Assistant Secretary for Environmental Restoration, discussing long-term surveillance and maintenance of offsite EM–40 disposal sites, June 14, 1996; and the memorandum to distribution from James M. Owendoff, DOE Acting Assistant Secretary for Environmental Management, discussing transfer of completed sites to the Grand Junction Office Long-Term Surveillance and Maintenance Program, August 31, 1998.

Summary of Sites in LTSM Program Custody (March 1999)

Program/Site	1998	1999	2000	2001	2002	2003	2004	2005	2006
UMTRCA Title I	19	19	19	19	19	19	19	19	19
UMTRCA Title II	2	2	9	14	16	16	16	16	16
NWPA Section 151(b) (unknown)									
NWPA Section 151(c)	1	1	1	1	1	1	1	1	1
D&D	3	3	3	3	3	3	3	3	3
Grand Junction Office Remedial Action Project				1	1	1	1	1	1
Monticello, Utah					1	1	1	1	1
Weldon Spring, Missouri					1	1	1	1	1
Nevada Offsite Projects (anticipated)				1	4	6	7	8	8
FUSRAP (unknown)									
Pinellas, Florida					1	1	1	1	1
Total	**25**	**25**	**32**	**39**	**47**	**49**	**50**	**51**	**51**

- **Institutional Controls**—Institutional controls include zoning restrictions, use permits, well-drilling restrictions, and other restrictions administered under local government authority. Institutional controls that can be imposed by the property owner (typically DOE) include deed restrictions, easements, and restrictive covenants that are based on State property law.
- **Information and Records Management**—Information and records management consists of storing, preserving, and providing access to background and design information and to activity reports for long-term stewardship sites. This information is available for use by the site steward, the general public, and other stakeholders and must be maintained for the use of future generations long after the initial custodians are gone.
- **Environmental Monitoring**—Environmental monitoring is conducted to verify continued remedy performance and to provide an early indication of any problems that develop. Environmental monitoring can include air monitoring, surface water and groundwater monitoring, vegetation monitoring, soil and sediment sampling and monitoring, and wildlife assessments.

LTSM Program Activities

The LTSM Program conducts site surveillance and monitoring activities in accordance with approved site-specific plans. LTSM Program personnel inspect each assigned site at least annually. They prepare, distribute, and archive an annual site condition report. The purpose of the annual inspection is to confirm the integrity of visible features at the site, to identify changes or new conditions that may affect site integrity, and to determine the need, if any, for maintenance or follow-up inspections and monitoring.

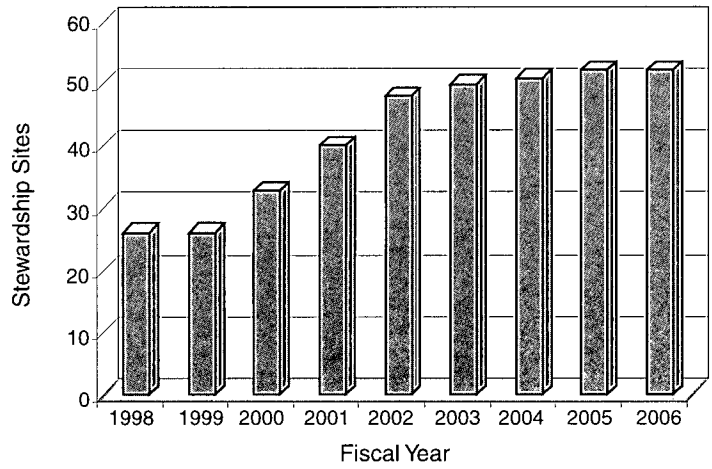
The disposal impoundments were designed to require only minimal maintenance for the duration of their design lives. Because these cells are relatively new, only minor maintenance is required at present. However, as the sites age, they will require routine replacement of wear items such as fencing and signs. LTSM Program activities also include groundwater monitoring and other environmental monitoring, as stipulated in the site-specific surveillance and monitoring plans.

If a disposal site receives severe damage or sustains catastrophic failure, DOE will undertake the necessary corrective action. The LTSM Program maintains contacts with

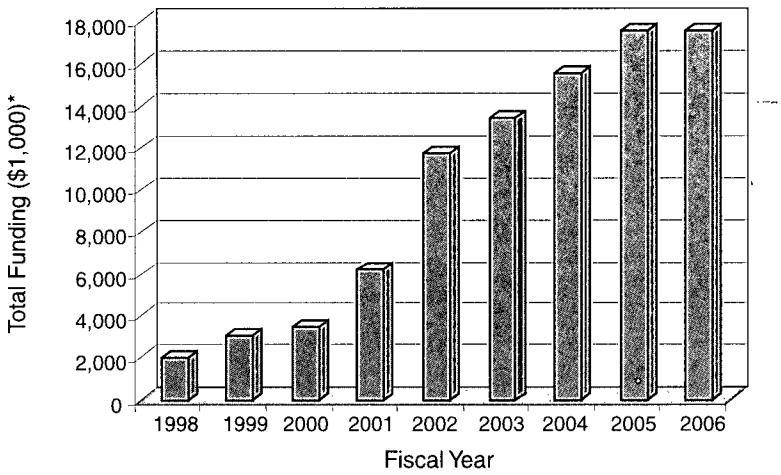
local law enforcement officials at each site, who will notify DOE in case of an incident or emergency. Signs with the DOE–GJO 24-hour phone number (970–248–6070) are maintained at each site.

For UMTRCA Title I and Title II disposal sites in the LTSM Program, DOE becomes a licensee to NRC. Inspections, reporting, and record keeping requirements are defined in *Code of Federal Regulations* (CFR) Title 10, Parts 40.27 and 40.28. These regulations establish the general licenses for long-term custody of Title I and Title II sites, respectively. The general licenses for long-term custody are indefinite in duration (i.e., these licenses will not expire). Usually, title for the land is assigned to an agency of the Federal Government, and the land is administratively withdrawn from public access. Sites located on tribal land revert to tribal control, and DOE obtains a site access agreement with the Tribe.

For disposal sites transferred to DOE under the authority of NWPA, the long-term stewardship requirements are not explicitly defined as under UMTRCA. Similarly, for disposal sites remediated under the DOE D&D Program, stewardship requirements are not statutorily defined. However, DOE conducts long-term custody and care activities to eliminate any risks from potentially hazardous materials under the Department's responsibility. For NWPA and D&D Program sites, the LTSM Program adopts a long-term stewardship approach that is analogous to the program mandated by the NRC license-driven stewardship activities for sites remediated under UMTRCA Title I and Title II. The LTSM Program develops long-term stewardship plans if necessary. When stewardship requirements are not statutorily defined, guidance for these custodial activities is available in the DOE orders system.



Anticipated Number of Sites in LTSM Program



Anticipated LTSM Program Funding

*Source: *Accelerating Cleanup: Paths to Closure, Albuquerque Operations Office,* U.S. Department of Energy, 1998.

LTSM Program Administration

The LTSM Program is administratively responsible to the DOE Office of Environmental Management (EM–40), a unit of DOE Headquarters responsible for the remediation and control of waste materials for which the Department is responsible. The LTSM Program is administered through the DOE Albuquerque Operations Office.

The LTSM Program will take custody of all DOE sites that require long-term care but do not have a long-term DOE mission. The LTSM Program will also take custody of commercial sites such as the UMTRCA Title II sites and, possibly, NWPA Section 151(b) sites when remediation has been completed.

By 2006, the LTSM Program expects to provide stewardship services for about 50 or more sites. These will include two sites remediated under CERCLA (Monticello, Utah, and Weldon Spring, Missouri), Nevada Offsite Projects locations, and, possibly, FUSRAP sites. Negotiations for a Memorandum of Understanding are under way between DOE and NRC for the NWPA Section 151(b) sites and, if accepted by DOE, some of these sites could come into the LTSM Program.

LTSM Program costs will increase from $2,200,000 in 1999 to approximately $17,500,000 in 2006 as the number and complexity of sites increase. Cost savings have been realized by combining maintenance and inspection trips, reducing the number of monitor wells and analytes, and streamlining annual reports. Some of the challenges facing the program in the coming years include operating four or more pump-and-treat groundwater remediation projects, caring for sites in urban areas, and assuming custody of sites remediated by commercial firms.

1998 Program Accomplishments

The LTSM Program inspected and performed necessary sampling at and maintenance of all sites assigned to the program. Visits were made to sites that will likely be transferred to the program, and transition assistance was provided to the owners of those sites.

During fiscal year 1998, the LTSM Program

- Inspected 25 sites and prepared reports of site conditions. These inspections evaluated site integrity and identified any needed maintenance.
- Sampled groundwater at eight UMTRCA sites. For some sites, groundwater sampling is required in the site-specific surveillance and monitoring plan to demonstrate that precipitation is not passing through disposal cell contents and carrying leached contaminants into the underlying groundwater system. Groundwater samples are collected from permanent monitor wells or, at some sites, from streams, seeps, or springs downgradient from the disposal cell. This activity was coordinated with the UMTRA Ground Water Project to realize cost efficiencies and to avoid duplication of effort. The LTSM Program is responsible for monitoring groundwater associated with the cell; the UMTRA Ground Water Project is responsible for groundwater contaminated by pre-UMTRA processing operations.
- Conducted initial site inspections at three D&D Program sites transferred to the LTSM Program in 1998. These inspections established baseline conditions against which future performance of the sites will be gauged. The inspections included hand-off meetings with the previous site custodians.
- Conducted inspections at two UMTRA Title I sites that will be licensed in 1999. During these inspections, program personnel met with Remedial Action Contractor personnel and gained knowledge of site histories and issues.
- Performed routine maintenance at nine sites. Maintenance activities included replacing signs that were defaced or stolen, repairing fences, removing debris, cutting encroaching vegetation, and spraying weeds.
- Repaired erosion damage at two sites. Runoff water diversion systems were designed and constructed for the Lowman, Idaho, and Canonsburg, Pennsylvania, sites. At the Lowman site, LTSM Program personnel avoided approximately one half of the bid price by acting as general contractor for the work.
- Conducted the first Long-Term Stewardship workshop in Denver, Colorado. This workshop was attended by 125 managers and specialists representing more than 70 agencies and companies. Presenters from five countries discussed long-term care issues in their nations. The workshop provided opportunities for exchanging information, problem solving, and establishing contacts. A second stewardship workshop will be hosted by the LTSM Program in 1999.
- Assumed custody of and operated the Cheney Disposal Cell near Grand Junction, Colorado. This accomplishment is the result of many years of negotiations among the State of Colorado, local governments, and DOE regarding the disposition of mill tailings in the Grand Junction area that were remediated under supplemental standards and marks the successful completion of the UMTRA Grand Junction Vicinity Properties Project.
- Continued monitoring cell covers and provided summaries on cover design and material properties for UMTRCA Title I covers through the Long-Term Performance Project. This effort furnishes data to support development of more appropriate, less-expensive disposal cell covers for municipal landfills, nonradiologic hazardous waste sites, and other applications.

- Installed a rock drain at the Burrell, Pennsylvania, site to prevent ponding at the edge of the cell.
- Presented technical papers at the Waste Management '98 symposium and prepared draft technical papers for the 1999 symposium.
- Completed the first two phases of a biointrusion risk assessment at the Burrell, Pennsylvania, site and began studies at western U.S. sites to determine if volunteer plant growth affects the water-infiltration barrier properties of cell covers.
- Continued to disseminate inspection results and site status information to the public and other stakeholders.
- Continued studies of the riprap durability at the Lakeview, Oregon, site. Radon flux measurements were also made at this location.
- Prepared the draft long-term surveillance and monitoring plans for the Site A/ Plot M, Chicago, Illinois, and Monticello, Utah, sites and finalized long-term surveillance and monitoring plans for the Hallam, Nebraska, and Piqua, Ohio, sites. Modified the long-term surveillance and monitoring plan for the Lakeview, Oregon, site.
- Hosted a National Academy of Sciences technical meeting at DOE–GJO.
- Presented the technical paper titled *Post-Remediation Monitoring and Maintenance at Former Uranium Mill Tailings Sites in the United States* at the NATO Conference on Contaminated Mill Tailings Sites held in Estonia in October 1998 and chaired the session on stewardship.

Issues/Status

Administrative

The primary issue facing the LTSM Program is maintaining the integrity of disposal cells and engineered features of remediated sites to ensure that contamination remains isolated from the environment. All facilities were constructed to resist degradation from natural processes, such as erosion and biointrusion, but proactive maintenance of most sites can be expected. Currently, LTSM Program data affirm that all disposal sites are in excellent condition and remain protective of public safety and the environment.

The regulatory complexities of sites vary greatly because of the varying requirements of Federal environmental response programs and agreements with individual States and Tribes. Concurrent regulation of groundwater is a potential concern if State-imposed groundwater quality standards require remedies or monitoring at sites where the NRC groundwater regulations are already satisfied. Currently, all sites are in full compliance with applicable regulations.

Adequate funding will be necessary to provide for typical annual inspections and operation of pump-and-treat systems. Changing environmental regulations or possible cell cover repairs may also affect the costs of caring for sites. Out-year funding requirements for the LTSM Program are incorporated in the DOE *Accelerating Cleanup: Paths to Closure* plan.

Lessons learned from the LTSM Program can benefit other environmental remediation programs. This information must be disseminated to have value, and the LTSM Program must maintain funding to perform this function. LTSM information is available from the program office, on the program World Wide Web site (in 1999), at workshops and seminars conducted by the program, through joint projects with other agencies, and through professional contacts and program-sponsored presentations or attendance at symposia and seminars.

A stewardship program must be maintained for the full period that the managed wastes remain hazardous. Complete program records must be archived so that future custodians can obtain the information necessary to make sound stewardship decisions. The LTSM Program maintains a repository of site information. During site transfer, LTSM Program personnel assemble necessary site documentation. Records from different projects are logged into a document database and organized according to a standardized scheme that complies with National Archives and Records Administration requirements. Because of the rapid growth of the program, funding requirements for the resources necessary to manage program records competently have been incorporated in the DOE *Accelerating Cleanup: Paths to Closure* plan.

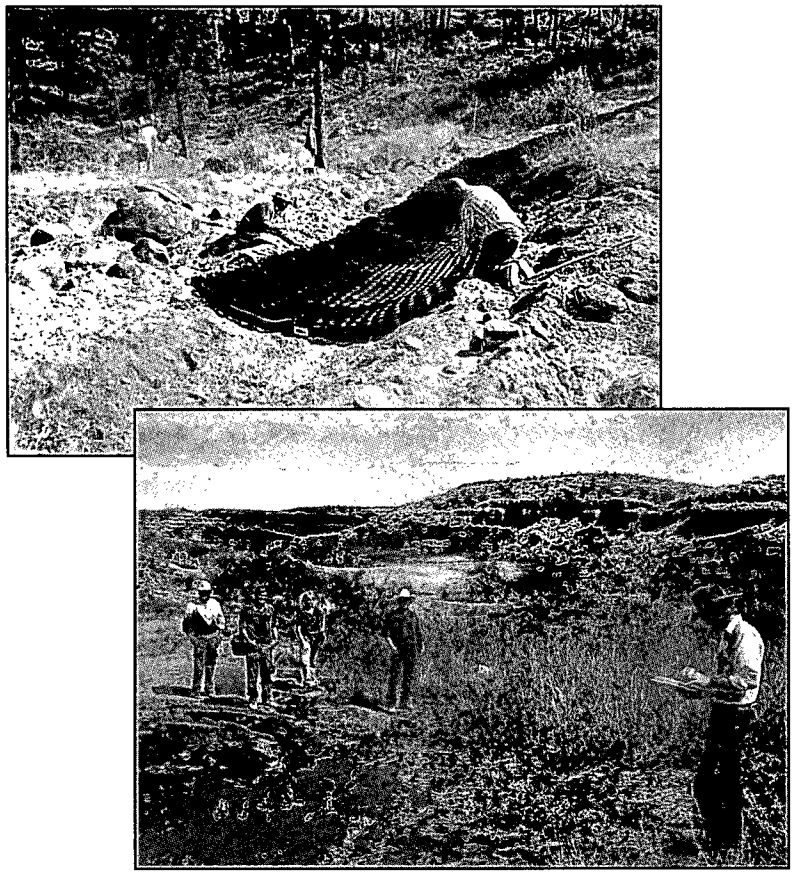
Technical

Reclamation and revegetation have been only partially successful at some arid western U.S. sites. Program range scientists are modifying planting techniques and species selection to improve seed germination and plant growth. Ongoing research continues to address these problems.

The LTSM Program is required to control noxious plant species at its stewardship sites but control of undesirable species is a difficult task. Effective spraying regimens were developed to control salt cedar, an invasive noxious shrub common at western U.S. sites.

Vegetation control on cell covers is expensive and challenging. Program scientists are conducting research to determine if plant growth degrades cover effectiveness sufficiently to present a risk to human health and the environment. Research continues on techniques for plant control at humid locations.

Environmental and human health risk assessments may be necessary to optimize disposal cell maintenance. Risk assessment



Top photo: A geotextile erosion protection grid is installed at the Lowman, Idaho, site.

Bottom photo: Representatives of the DOE Albuquerque Operations Office, the Navajo Nation, and the LTSM Program inspect groundwater seeps at the Mexican Hat, Utah, Disposal Cell.

results for the Burrell, Pennsylvania, Disposal Cell will aid LTSM Program managers to choose between continued mechanical or chemical control of encroaching vegetation or allowing the vegetation to become established on the cell cover.

Disposal sites can affect drainage patterns for surrounding off-site properties in high rainfall environments. As these situations are identified, the program will take appropriate action to remedy any problems. A potential issue at the Falls City, Texas, site is being addressed, and an erosion problem was corrected at the Lowman, Idaho, site in 1998.

LTSM Projects and Sites

UMTRCA Title I Disposal Sites

UMTRCA specified 24 uranium processing sites for remediation. Of these, two sites in North Dakota were removed from the program. Remediation resulted in creation of 19 disposal cells that contain encapsulated uranium mill tailings and associated contaminated material (see figure on page 12). Almost 43 million cubic yards of low-level radioactive material are contained in UMTRCA Title I disposal cells.

The U.S. Environmental Agency (EPA) sets forth UMTRCA remedial action, cell performance, and groundwater standards in 40 CFR 192. These standards direct DOE to design the cells to endure with minimum maintenance for 1,000 years, or at least 200 years. Upon NRC concurrence that remedial action is complete and acceptance of the site-specific long-term surveillance and monitoring plan, each site comes under the DOE general license for long-term care granted in 10 CFR 40.27. If groundwater at a particular site was contaminated by historical site activities, NRC will allow only the surface improvements to come under the general license; the site will not be fully licensed until groundwater quality meets the applicable regulations. The NRC license mandates annual inspections of the disposal cells.

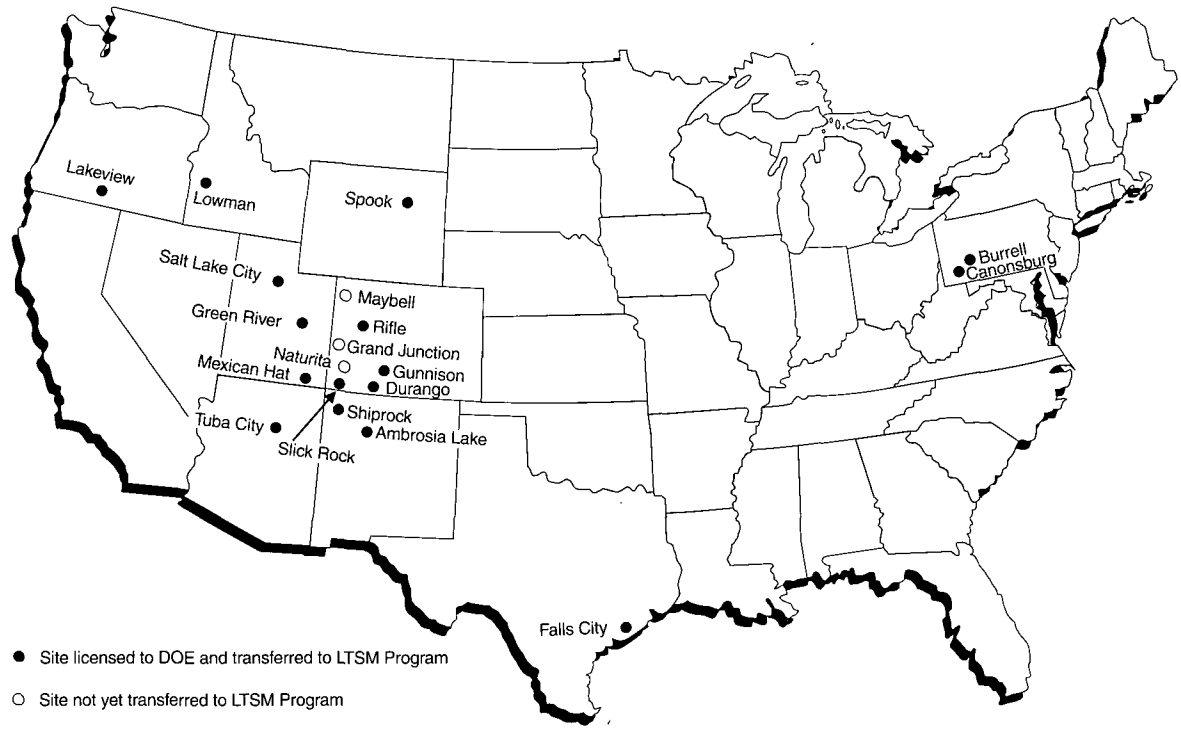
Two UMTRCA Title I disposal cells (Maybell and Naturita, Colorado) will come under the general license in 1999. A portion of the Cheney Disposal Cell near Grand Junction, Colorado, will be left open under the Long-Term Radon Management Project (see page 18) that is managed by DOE–GJO in conjunction with the LTSM Program.

LTSM Program personnel inspected 17 UMTRCA Title I disposal sites during fiscal year 1998. The following summaries provide a brief status report on each site; complete annual inspection reports and fact sheets are available from the LTSM Program office at DOE–GJO.

Ambrosia Lake, New Mexico—Contaminated materials were consolidated and encapsulated on the existing tailings pile. The riprap-armored disposal cell was closed in 1995. NRC has concurred that groundwater quality conforms to the requirements of 40 CFR 192 through the application of supplemental standards. Therefore, groundwater monitoring is not required to determine compliance or cell performance at this location, and NRC fully licensed the site in 1998. A shallow depression on the cell cover was noted during the annual site inspection; this feature is probably an artifact of cell construction and will be monitored for change. Minor vegetation encroachment upon the cell will be monitored.

Burrell, Pennsylvania—Mill tailings were hauled to this location from the Canonsburg, Pennsylvania, site for use as fill. Because of the large volume of tailings on the site, a disposal cell was constructed at Burrell. The disposal cell was accepted under the NRC general license in 1994. Because vegetation encroachment on the riprap-covered cell continues to be a concern, the LTSM Program will remove the volunteer plant growth until the growth can be shown to not affect the integrity of the impoundment. DOE corrected a drainage problem at the site in 1998. Groundwater is monitored annually at the Burrell Disposal Cell.

Canonsburg, Pennsylvania—DOE encapsulated low-level radioactive material from the millsite and 163 vicinity properties in an engineered disposal cell in 1985. NRC accepted the site under the general license, and the site was transferred to the LTSM Program in 1996. This urban disposal cell has a compacted clay liner to prevent the isolated radioactive materials from causing groundwater contamination. The tailings were covered with 3 feet of a clayey soil radon/water infiltration barrier and layers of rock and soil; the cover was seeded with grass. Custodial maintenance at the Canonsburg Disposal Cell includes mowing



Locations of UMTRCA Title I Sites

the grass within the site boundary and preventing the establishment of shrubs or trees on the cell cover, thus ensuring the success of the grass cover and preventing erosion. Limited groundwater and surface water monitoring will continue annually through 2003. Unneeded monitor wells will be abandoned. Canada thistle, a noxious weed, has been identified growing at the site and may require control.

Durango, Colorado—DOE removed tailings, contaminated building debris, and soil from the processing location on the Animas River and vicinity properties. The low-level radioactive material was encapsulated in the Bodo Canyon Disposal Cell southwest of Durango in 1990. NRC accepted the cell under the general license in 1996. The cell cover includes a radon/water infiltration barrier, consisting of multiple layers of compacted clay materials and an overlying bentonite geomembrane mat. Over this layer is placed a sand filter/drainage layer, a rock biointrusion layer, and a frost-protection/rooting medium layer. The top slope of the cell is protected by a planted rock-soil matrix layer; the side slopes were covered with riprap to protect against wind and water erosion. Groundwater is monitored annually to confirm cell performance.

Falls City, Texas—NRC concurred that this site conformed to EPA standards, and the site was brought under the general license in 1997. Tailings from seven deposits were combined in a disposal cell on the original millsite. The cell is grass covered and is mowed twice a year to discourage growth of deep-rooted plants on the cover. Plant encroachment on the riprap-armored side slopes is a concern. Area drainage must be corrected because flooding has occurred on adjacent properties. Because groundwater at this location contains widespread naturally occurring contamination, it is classified as limited use and is not monitored.

Grand Junction, Colorado—Low-level radioactive materials from the Grand Junction, Colorado, area were relocated to the Cheney Disposal Cell. A portion of the cell will remain open until as late as 2023 under the Long-Term Radon Management Project (see page 18). The LTSM Program assumed responsibility for the entire site in

1998, but only the closed portions of the cell will be addressed by the provisions of the site-specific long-term surveillance and monitoring plan. Groundwater monitoring will not be required at this site. Volunteer plant encroachment on the rock-armored cell cover may become a concern.

Green River, Utah—Tailings, contaminated soil, and building debris were relocated to an on-site disposal cell in 1989. NRC accepted the Green River Disposal Cell under the general license for UMTRCA Title I in 1998, and the site was transferred to the LTSM Program. The program conducts annual inspections; no extraordinary repairs or maintenance has been required to date. Groundwater at the site was contaminated by processing operations and is sampled to monitor cell performance. Site groundwater contains naturally elevated levels of selenium and is not used in the region.

Gunnison, Colorado—Uranium mill tailings along the Gunnison River and contaminated materials from demolished mill structures and vicinity properties in Gunnison were relocated to the Gunnison Disposal Cell in 1995. NRC licensed the site in 1997. Groundwater monitoring is required at point-of-compliance wells to confirm cell performance. Potential concerns at this location include freeze-thaw degradation of the riprap and changes in drainage patterns that could be caused by future expansion of the adjacent Gunnison County Landfill. Unneeded monitor wells will be abandoned.

Lakeview, Oregon—Remedial action was completed at the Lakeview site in 1989, and NRC placed the site under the DOE general license in 1995. The disposal cell side slopes are armored with riprap; the top slope is covered with a rock-soil matrix and planted with native grasses. The olivine basalt armor rock is monitored annually for signs of accelerated weathering and consequent reduction in size. Other LTSM Program activities include groundwater monitoring to verify that contaminants are not leaching from the disposal cell and radon monitoring.

Lowman, Idaho—In 1992, DOE consolidated radioactive materials from the processing operations and vicinity properties onto existing radioactive sand tailings piles and encapsulated the material beneath an engineered cell cover. NRC licensed the disposal cell in 1994. Groundwater monitoring is required to confirm cell performance. In 1998, a water diversion system was designed and installed to prevent erosion on adjacent property. Plant encroachment upon the cell cover will be monitored to determine if vegetation will compromise the integrity of the cell. Otherwise, the site is in excellent condition, without any other maintenance needs.

Mexican Hat, Utah—Mill tailings from the UMTRCA Title I processing site in Monument Valley, Arizona, were hauled to the Mexican Hat Disposal Cell and co-disposed with tailings left at this location. In 1997, NRC accepted the disposal cell under the general license for UMTRCA Title I, and the site was transferred to the LTSM Program. The Navajo Nation will retain title to the land. The program conducts annual inspections; no extraordinary repairs or maintenance has been required to date. Groundwater at the site was contaminated by processing operations and is sampled at downgradient seeps and monitor wells by the LTSM Program and the UMTRA Ground Water Project. The shallow aquifer is naturally unsaturated and is expected to drain empty of contaminated water.

Rifle, Colorado—In 1996, DOE relocated wastes from two uranium and vanadium processing sites near the Colorado River and waste from decontaminated vicinity properties to the Estes Gulch Disposal Cell, located north of Rifle. NRC granted DOE a general license for custody and long-term care of the Estes Gulch Disposal Cell in 1998. Ongoing maintenance concerns include abandoning monitor wells that are no longer used and reseeding several disturbed areas adjacent to the cell. The perimeter fence was extended to prevent grazing on reseeded areas at the site. Minor site-related groundwater contamination would not pose a risk to local water supplies

or human health; therefore, postclosure groundwater monitoring at the Estes Gulch site is not required.

Salt Lake City, Utah—Mill tailings and associated contaminated materials were relocated from the Salt Lake City processing site to the South Clive Disposal Cell in 1988. NRC licensed the disposal site in 1997. The cell is located adjacent to a commercial low-level radiologic waste disposal operation. Remedial action was conducted by the State of Utah under the direction of the UMTRA surface project. The existing groundwater is classified as limited use because of poor ambient water quality; therefore, groundwater monitoring is not required.

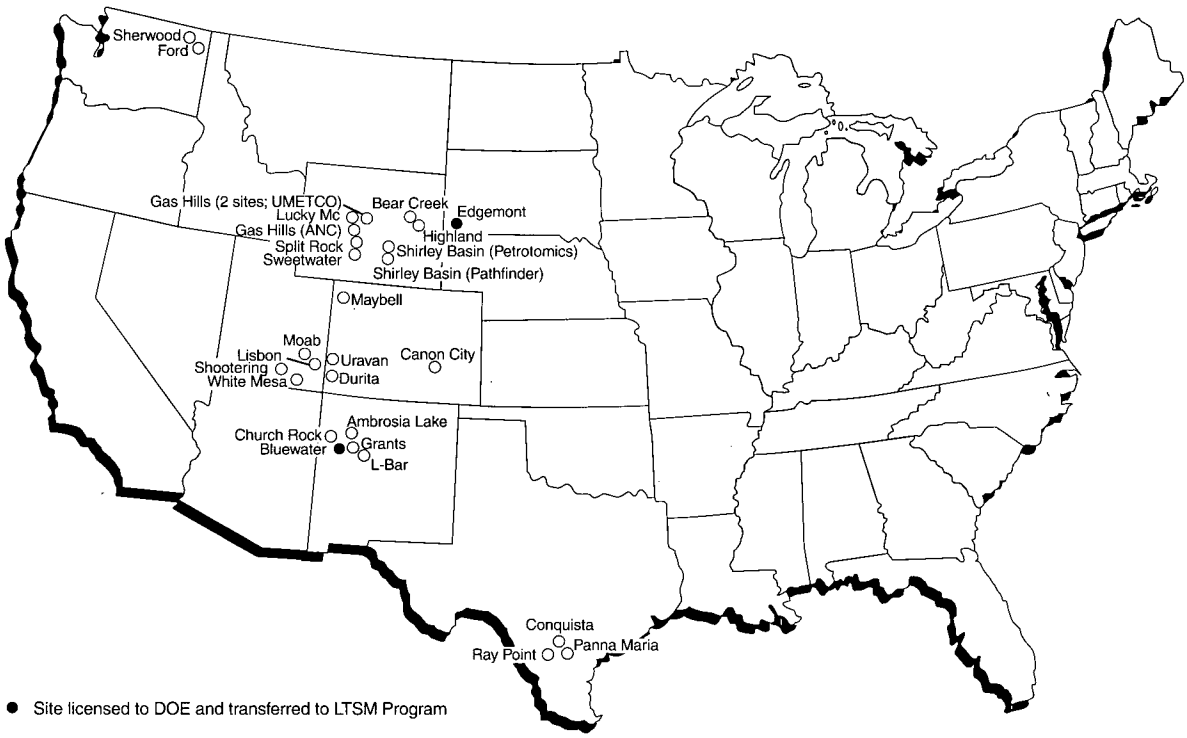
Shiprock, New Mexico—Cleanup of the Shiprock site was completed in November 1986 by consolidating and stabilizing the mill tailings in an on-site engineered disposal cell. NRC licensed the Shiprock Disposal Cell in 1996. The Navajo Nation will retain title to the land. Maintenance activities include controlling annual deep-rooted weeds and salt cedar, a noxious shrub. The UMTRA Ground Water Project is characterizing groundwater contaminated by historical processing operations and may conduct active groundwater remediation in the adjacent San Juan River floodplain.

Slick Rock, Colorado—Tailings from two processing sites on the Dolores River were relocated to the Burro Canyon Disposal Cell in 1996. This site was accepted under the NRC general license in 1998 and was transferred to the LTSM Program. The cell contains tailings, contaminated debris, and soil from the demolished mill structures and vicinity properties. The riprap-armored cell is sited on a small mesa on unsaturated sedimentary rock. No groundwater monitoring is required at the disposal cell location. The Remedial Action Contractor reseeded the site in September 1998 after the initial restoration failed because of dry weather.

Spook, Wyoming—This site consisted of a small, open-pit uranium mine, with associated tailings, ore piles, mine adits, and processing structures. DOE placed all contaminated materials in the pit on a low-permeability soil layer and constructed an engineered cover over the waste. The stockpiled overburden was compacted over the disposal cell under the Surface Mining Control and Reclamation Act and graded to provide drainage. As much as 60 feet of earthen material covers the encapsulated tailings at this site. Groundwater monitoring is not required at this site; the existing groundwater is classified as limited use because of widespread naturally occurring uranium contamination. Monitor wells will be abandoned; Canada thistle, a noxious weed, may require control.

Tuba City, Arizona—DOE encapsulated mill tailings in place over the existing tailings pile in 1990. NRC granted DOE a general license for custody and long-term care of the surface impoundment at the Tuba City Disposal Cell in 1996, and the site was transferred to the LTSM Program. The Navajo Nation will retain title to the land. LTSM Program personnel are conducting arid land revegetation studies at the site; test plots and a greenhouse are located on the property. Minor volunteer vegetation growth on the rock cover has been studied to assess if the plants are affecting the water barrier properties of the cover system.

Under the provisions of the long-term surveillance and monitoring plan, the LTSM Program will monitor groundwater quality and levels at the cell boundary to demonstrate the effectiveness of the cell in isolating the encapsulated wastes from the underlying groundwater system. However, milling activities at the site caused groundwater contamination that must be cleaned up before cell performance can fully be evaluated. The UMTRA Ground Water Project plans to conduct active groundwater remediation to reduce contaminant levels to below applicable standards. This activity will include regular sampling and analysis of site groundwater, which will satisfy the requirements of the long-term surveillance and monitoring plan. The need for groundwater monitoring will be re-evaluated after groundwater cleanup goals are achieved.



Locations of UMTRCA Title II Sites

UMTRCA Title II Disposal Sites

Uranium processing sites addressed by UMTRCA Title II were active when the act was passed in 1978. These sites were commercially owned and are regulated under NRC license. For license termination, the owner must conduct an NRC-approved reclamation of any on-site radioactive waste remaining from uranium ore processing operations. The site owner also must ensure full funding for inspections and, if necessary, ongoing maintenance. The sites are then transferred to DOE for custody and care. DOE administers the sites under the provisions of a general NRC license granted in 10 CFR 40.28. To date, the LTSM Program manages two Title II sites; this number is expected to increase to 16 sites by 2006 as ongoing site reclamations are completed (see figure above). Ultimately, as many as 26 Title II sites may be managed by the LTSM Program.

Bluewater, New Mexico—ARCO Coal Company stabilized mill tailings in place and completed engineered covers in 1995. NRC licensed the site in 1997. The radon barrier covering the wastes varies in thickness from 2.4 to 3.4 feet and is protected by rock armor. All surrounding disturbed areas were regraded and reseeded with indigenous species. The Bluewater site also contains other stabilized disposal areas, including a small riprap-armored disposal cell containing polychlorinated biphenyl-contaminated uranium mill tailings that was permitted by EPA and is in compliance with the Toxic Substances Control Act. Several years of active groundwater treatment did not succeed in returning groundwater contaminant levels to background concentrations. Subsequently, alternate concentration limits were granted for the site. DOE conducts groundwater monitoring at the Bluewater site to verify continued compliance with the approved limits.

Edgemont, South Dakota—The Tennessee Valley Authority relocated tailings from the millsite to an engineered disposal cell in 1989. Material from Edgemont vicinity properties, remediated by the UMTRA surface project, was co-located with the

Locations of Non-UMTRCA Sites in the LTSM Program

material from the millsite. NRC concurred with placing this disposal cell under the general license for long-term custody in 1996. The 9-foot-thick radon/water infiltration barrier, consisting of 3 feet of compacted clay, 5 feet of clean compacted fill, and 1 foot of topsoil material, was revegetated with native grass species to prevent soil erosion. Groundwater monitoring is not required for this site because the closest confined aquifer lies below an impermeable bedrock layer. Controlled livestock grazing of the grassed site cover is administered by the LTSM Program to promote the long-term health of the turf.

NWPA Section 151 Sites

Certain sites with low-level radioactive contamination remediated by the owner under the NRC Site Decommissioning Management Program can be transferred to DOE under NWPA Section 151. This law allows DOE to assume title and responsibility for the long-term custody and care of these sites. Because these sites are not addressed by an NRC license after transfer, DOE long-term surveillance and monitoring activities are self-regulated. As with the UMTRCA Title II sites, the owners of these sites must obtain NRC concurrence with the results of the implemented remedial action and must ensure future funding for long-term stewardship before NRC will terminate the site license.

At present, the LTSM Program manages one site transferred to DOE under NWPA Section 151. In 1994, the Parkersburg, West Virginia, site was transferred to DOE under NWPA Section 151(c). DOE may transfer additional sites to the LTSM Program under Section 151(b). This action depends on the successful implementation of a Memorandum of Understanding between NRC and DOE and the acceptance of the candidate sites by DOE.

Parkersburg, West Virginia—At this site, radioactive zircon ore was processed under contract to AEC from 1957 to 1968, resulting in waste accumulation and soil contamination. Some of the waste was pyrophoric, or capable of causing fires and explosions. Remediation of the site

was completed in 1982 when the NRC-approved disposal cell was closed. The grass-covered, gently sloping stabilized mound covers an area of approximately 12 acres and is surrounded by a posted security fence. Custodial maintenance for the Parkersburg site includes discouraging the establishment of shrubs or trees to ensure the continued success of the grass cover. The LTSM Program initiated annual inspections at this location in 1994. Site groundwater complies with the Federal Safe Drinking Water Act and State of West Virginia groundwater standards. However, as a best management practice, DOE will monitor the groundwater at approximately 5-year intervals.

CERCLA Sites

DOE is the responsible party at two sites that were placed on the National Priorities List (NPL) by EPA. These sites were remediated in accordance with CERCLA guidance. Neither site has yet been deleted from the NPL. Because these sites cannot be released for unrestricted use, DOE is required by statute to conduct 5-year remedy performance reviews.

Weldon Spring, Missouri—The Weldon Spring, Missouri, Superfund site was operated as the Weldon Spring Uranium Feed Materials Plant from 1955 until 1966. Previous use of the site included manufacture of trinitrotoluene (TNT) by the U.S. Army from 1941 to 1945. The Army reoccupied the property in 1966 and began decontamination of structures to allow the production of defoliants, but the project was canceled before new equipment was installed. The site was placed on the NPL in 1987 because of contamination in a rock quarry that had been used for waste disposal. Raffinate ponds and the former chemical plant were added to the NPL in 1989. Contaminated plant buildings were removed by 1994, and bulk removal of contaminants from the quarry was completed in 1995. Significant LTSM Program activities at Weldon Spring will begin in 2002 as the site begins transition to DOE custody by 2003. The LTSM Program will likely conduct postclosure activities at the Weldon Spring facility.

Monticello, Utah, Sites—EPA listed the Monticello, Utah, Mill Tailings Site and the Monticello Vicinity Properties Site on the NPL in 1989. Monticello mill activities generated approximately 2.5 million cubic yards of low-level radioactive waste as a result of uranium and vanadium processing activities. Contaminated materials were distributed by wind and water and were used for construction, resulting in contamination of approximately 400 vicinity properties. These materials will be placed in a disposal cell, which is scheduled for closure in 1999. Supplemental standards were applied to limited occurrences of radioactive material that was left in place because the material posed no risks and remediation would be technically unfeasible, unjustifiably expensive, or harmful to the environment. According to the long-term surveillance and monitoring plan proposed for Monticello, annual inspections of the cell and the supplemental standards areas will be conducted in perpetuity. The LTSM Program will assume stewardship responsibility for the cell and may conduct groundwater remediation beginning in 2002.

Pinellas Site

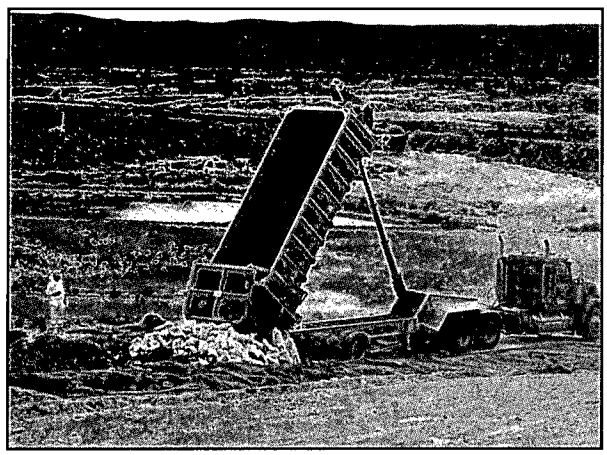
The Pinellas Science, Technology, and Research Center in Largo, Florida, was contaminated with low-level radioactive materials created during the manufacture of neutron generators and other devices for DOE. Facility remediation at Pinellas was completed in 1997 by DOE under the EPA Resource Conservation and Recovery Act (RCRA) Corrective Action Program. The facility was transferred to local government ownership in 1995, but DOE continues to conduct pump-and-treat groundwater remediation. Responsibility for the Pinellas facility is scheduled for transfer to the LTSM Program in 2002.

D&D Program Sites

The LTSM program has custody of three DOE D&D Program sites: Piqua, Ohio; Hallam, Nebraska; and Site A/Plot M located near Chicago, Illinois. These sites were transferred from the custody of the DOE Chicago Operations Office in 1998. No additional D&D Program sites are expected to be transferred to the LTSM Program.

Hallam, Nebraska, and Piqua, Ohio—The Piqua, Ohio, and Hallam, Nebraska, sites are former nuclear reactor facilities that were part of the AEC Power Demonstration Program during the mid-1960s. In both cases, the reactors were operated in cooperation with, and on the property of, area electric utilities. Both reactors were decommissioned in the late 1960s, and both reactor vessels were sealed with concrete and steel during decommissioning after removal of spent fuel and other removable contamination. Annual inspections and monitoring are conducted by the LTSM Program to verify encapsulation integrity.

Site A/Plot M, Illinois—The Site A/Plot M area is the former location of Argonne National Laboratory and its predecessor, the University of Chicago Metallurgical Laboratory. Site A contains buried contaminated building debris and the biological shield for the CP–3 reactor. Plot M contains radioactive wastes from the mid-1940s to 1949 buried in trenches. Both Site A and Plot M were decommissioned in 1956. The LTSM Program is responsible for air, surface water, and groundwater monitoring at Site A/Plot M.



Low-level radioactive material contaminated with polychlorinated biphenyls from the DOE Grand Junction Office Remedial Action Project is delivered to the Cheney Disposal Cell.

Long-Term Radon Management Project

Radioactive material from the Climax millsite in Grand Junction, Colorado, and tailings and tailings-contaminated material from more than 4,000 Grand Junction vicinity properties were relocated to the UMTRCA Title I Cheney Disposal Cell under the DOE UMTRA surface project. Contaminated material from the Grand Junction Office Remedial Action Project at the DOE–GJO site was co-located with the UMTRA waste. The 360-acre site is located 18 miles south of Grand Junction in Mesa County, Colorado. A 60-acre disposal cell was constructed on the site to contain 4,600,000 cubic yards of low-level radioactive material. A portion of the cell was left open to accept up to 250,000 cubic yards of tailings from Mesa County, other UMTRCA locations, and the Monticello, Utah, Superfund sites. This action was taken to provide a disposal location for incidental low-level radioactive material, such as might be removed from utility trenches and from beneath streets as those structures are rebuilt. The cell will not remain open past 2023. The LTSM Program operates the cell and provides long-term care for the facility.

Nevada Offsite Projects

The DOE Nevada Operations Office has monitored environmental conditions at two locations in Nevada, two in Colorado, two in New Mexico, and one each in Mississippi and Alaska. Nuclear explosive tests were performed at these sites for various purposes, including stimulating natural gas production and detecting nuclear weapons testing. Responsibility for monitoring these sites is expected to be transferred to the LTSM Program beginning in 2001. Long-term monitoring will consist primarily of sampling groundwater for radionuclides.

Grand Junction Office Remedial Action Project

The DOE Grand Junction Office was established as part of the Manhattan Project to purchase uranium ore concentrates. DOE conducted pilot uranium milling studies at the site between 1953 and 1958. Mill tailings, contaminated soils, and most of the contaminated buildings have been removed or decontaminated. The remaining contaminated buildings will be decontaminated or removed by 2002, when the site will be transferred to the LTSM Program for monitoring. Groundwater monitoring will be necessary for 60 to 80 years until the aquifer is remediated through natural flushing.

FUSRAP Sites

The U.S. Congress directed the U.S. Army Corps of Engineers to remediate contaminated sites designated under FUSRAP. DOE is negotiating a Memorandum of Understanding with the Corps of Engineers to transfer responsibility for the sites to the LTSM Program for long-term care after remedial action is completed. Some sites may become the responsibility of the LTSM Program, but the actual number of sites is not known at this time.

Cover Monitoring and Long-Term Performance Project

DOE designed and constructed engineered soil and rock covers on uranium mill tailings disposal cells to contain contaminants for 1,000 years. The LTSM Program initiated the Cover Monitoring and Long-Term Performance activity in 1998 to evaluate how changes in disposal cell environments, both observed changes and projected changes over hundreds of years, may alter cover performance. Research results improve LTSM Program site inspections and benefit UMTRA Ground Water Project remediation tasks, long-term cover design initiatives at DOE weapons sites, and preparation of new cover design guidance by EPA.

Performance Assessment Framework—Development of a decision framework is under way to provide a consistent approach for evaluating cover performance. The goal is to produce a step-wise guideline for the LTSM Program (1) to project the performance of individual covers for the design lives of disposal cells and (2) to identify appropriate monitoring parameters and instrumentation to track leading indicators of long-term performance as part of routine inspections. The framework links performance and monitoring criteria with potential exposure pathways and risks. It also emphasizes methods for evaluating possible changes in contaminant levels, cover environments, regulatory drivers, exposure pathways, and risks during the design life of disposal cells.

The proposed framework consists of three parallel paths and six phases. The Constituency Outreach and Technology Foundation paths provide data input and feedback to the Performance Assessment Process, the primary path. The Constituency Outreach Path incorporates ongoing regulatory, interagency, and stakeholder interaction into the framework. The Technology Foundation path incorporates existing and new science and technology, as needed, to fill data gaps in the Performance Assessment Process. The six phases of the Performance Assessment Process are Justification, Characterization, Release Pathway Analysis, Risk Assessment, Cover Performance Evaluation, and Stewardship.

EPA Alternative Cover Assessment Program—LTSM Program scientists participated in EPA's Alternative Cover Assessment Program in 1998. The goal of this program is to develop new guidance for cheaper, more effective covers for municipal and hazardous waste landfills in arid and semiarid western States. EPA hopes to revise cover design guidance for municipal and hazardous waste landfills within 3 to 5 years. Researchers will use field studies, modeling, and natural analog studies to acquire data needed to evaluate alternative covers. UMTRCA Title I disposal

An LTSM Program researcher measures the saturated hydraulic conductivity of the compacted soil layer at the Lakeview, Oregon, Disposal Cell.

cells and the lysimeter test in Monticello, Utah, are on a short list of candidate sites for field studies. The LTSM Program submitted a funding request to the Alternative Cover Assessment Program to install monitoring instrumentation during construction of the Monticello, Utah, Disposal Cell cover in 1999.

Hydraulic Conductivity Field Tests—Most UMTRCA Title I disposal cell covers contain a compacted soil layer that acts as a barrier to radon diffusion and water infiltration. The UMTRA Program adopted a design goal for saturated hydraulic conductivity values for this layer, ranging from 1×10^{-7} to 1×10^{-8} centimeter per second. In 1996, the LTSM Program began conducting field tests of the hydraulic conductivity properties of compacted soil layers at Title I sites, starting with the Burrell, Pennsylvania, site. Air-entry permeameters were used to estimate in situ hydraulic conductivity and preferential flow in the compacted soil layers.[3,4] Field tests continued in 1998 at the Lakeview, Oregon; Tuba City, Arizona; Shiprock, New Mexico; and Durango, Colorado, sites. The results show that hydraulic conductivity values for compacted soil layers at these sites are highly variable and mean values can be greater (i.e., the compacted soil layers are more permeable) than the design criteria. Elevated hydraulic conductivity values can be attributed to plant root intrusion, inadequate compacted soil layer materials or construction, and desiccation cracking that possibly occurred as a consequence of seasonal drying and freezing.

Monticello Cover Lysimeter—The cover designed for the tailings disposal cell at the Monticello, Utah, Superfund site is an innovative alternative to conventional UMTRCA and RCRA designs. The Monticello cover relies on a thick topsoil layer and a capillary barrier to retain precipitation and on soil evaporation and plant transpiration to seasonally dry the topsoil and limit water movement into the encapsulated tailings. The LTSM Program teamed with EPA Region 8 to conduct a controlled field test of the design in a drainage lysimeter at the Monticello site. The lysimeter test facility consists of two caissons buried in the ground—a full-scale vertical profile of the cover was constructed in one caisson, and instrumentation for automated monitoring of the soil-water balance is accessed in the other caisson. Monitoring data are continuously recorded and are available by remote access using an integrated modem.

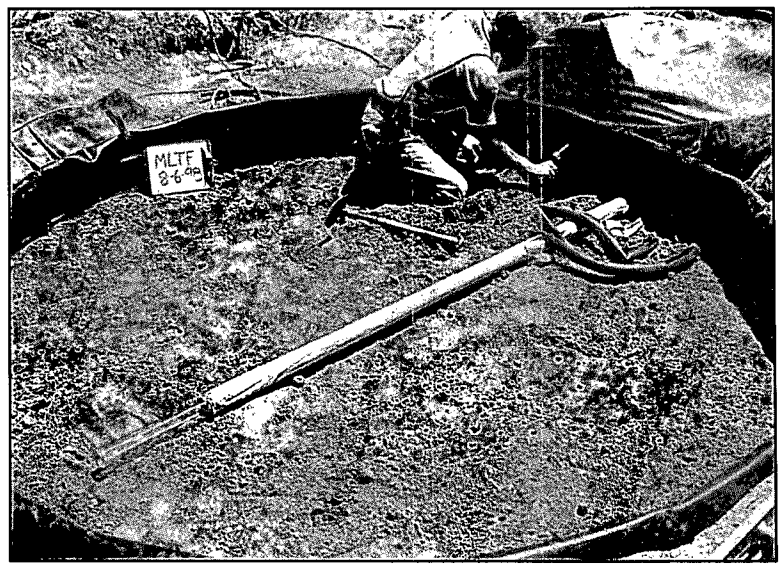
Gravel Admixture Ecology—The unique cover design at the Durango, Colorado, UMTRCA Title I Disposal Cell relies on a combination of vegetation and gravel mixed into the topsoil to control soil erosion. The design was based on studies

[3]Bouwer, H., 1966. "Rapid Field Measurement of Air Entry Value and Hydraulic Conductivity of Soil as Significant Parameters in Flow System Analysis," *Water Resources Research* 2:729–738.

[4]Stephens, D.B., M. Unruh, J. Havlena, R.G. Knowlton, Jr., E. Mattson, and W. Cox, 1988. "Vadose Zone Characterization of Low-Permeability Sediments Using Field Permeameters," *Ground Water Monitoring Review* 8:59–66.

at Pacific Northwest National Laboratory which indicated that limited amounts of gravel could control soil erosion at arid sites with little effect on plant ecology or evapotranspiration.[5,6] The LTSM Program began a study of plant ecology on the Durango gravel admixture in 1998 to determine if the high percentage of gravel is altering plant growth, evapotranspiration, and, therefore, the performance of the cover. The results will be used to design the gravel admixture for the Monticello, Utah, cover.

DOE Long-Term Cover Guidance— The LTSM Program continued to support a DOE Headquarters initiative to develop a guidance document for designing long-term covers for buried wastes at DOE weapons production sites. LTSM Program researchers teamed with Sandia National Laboratories/New Mexico and Los Alamos National Laboratory personnel on a technical task plan that incorporates lessons learned from LTSM's Cover Monitoring and Long-Term Performance activity. This activity is now funded by the DOE Albuquerque Operations Office.



LTSM Program personnel install the test cover section on the Monticello, Utah, lysimeter test facility.

[5]Waugh, W.J., M.E. Thiede, and D.J. Bates, 1994. "Plant Cover and Water Balance in Gravel Admixtures at an Arid Waste-Burial Site," *J. Environ. Qual.* 23:676–685.

[6]Sackshewsky, M.R., C.J. Kemp, S.O. Link, and W.J. Waugh, 1995. "Soil Water Balance Changes in Engineered Soil Surfaces," *J. Environ. Qual.* 24:352–359.

Contacts/Resources

Russel Edge, LTSM Program Manager
U.S. Department of Energy
Grand Junction Office
2597 B$^3/_4$ Road
Grand Junction, CO 81503
(970) 248–6037

Carl Jacobson, Program Manager
MACTEC–ERS (the Technical Assistance and Remediation contractor at DOE–GJO)
2597 B$^3/_4$ Road
Grand Junction, CO 81503
(970) 248–6568

LTSM Program Web Site: http//www.doegjpo.com/projects/propage1.htm
(This site, which is under construction, will contain downloadable fact sheets about most of the LTSM Program sites, long-term surveillance and monitoring plans, site status reports, links to applicable or relevant and appropriate regulations, and other information. This site will become operational in mid-1999.)

DOE EM–40 Web Site: http//www.em.doe.gov/llw/
(This site provides descriptions of many of the DOE remedial action programs under which sites in the LTSM Program were remediated and has information on individual sites.)

DOE EM–24 Web Site: http//www.lastinglegacy.net/legacy3.1/
(This site provides descriptions of DOE's weapons complex and plans for each site and discussions of stewardship issues.)

Providing cost-effective and efficient stewardship for more than 10 years