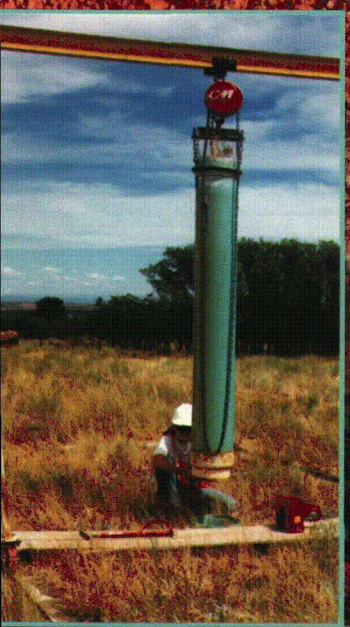
2000

Long-Term Surveillance and Maintenance Program

REPORT

LTSM



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

GJO–2000–181–TAR

Long-Term Surveillance and Maintenance Program 2000 Report

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February 2001

Large front cover photograph
A member of the Long-Term Surveillance and Maintenance (LTSM) Program inspects seeps hydraulically downgradient of the Mexican Hat, Utah, Disposal Site.

Inset photographs (top to bottom)
LTSM Program researchers weigh, drain, and then weigh again the small cover profile lysimeters at the Monticello, Utah, Disposal Site to determine the evapotranspiration potential of the cover and the vegetation growing in the lysimeter.

LTSM Program inspectors collect global positioning system location information at the Ambrosia Lake, New Mexico, Disposal Site.

Workers install a monument on the top of the Monticello, Utah, Disposal Cell that describes the contents of the repository.

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Contents

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


LTSM

Foreword

The U.S. Department of Energy Grand Junction Office (DOE–GJO) Long-Term Surveillance and Maintenance (LTSM) Program is pleased to present this summary of operations and recent accomplishments. We provide descriptions of the spectrum of activities that constitute a working stewardship program as well as the condition of and concerns about the sites in our custody.

In 1988, DOE Headquarters established the LTSM Program at GJO to provide stewardship services to sites that contain regulated low-level radioactive materials and have no ongoing mission. Program responsibilities have increased steadily since then, both in number of sites and in issues to be addressed.

In 2000, DOE assigned the Salt Lake City Processing Site and the Grand Junction Office facility (a remediated uranium mill tailings site) to the LTSM Program for long-term custody and care. The LTSM Program is currently responsible for 27 sites across the nation. Ultimately, the GJO LTSM Program will provide long-term custody and care to each DOE site where another DOE operation is not present to serve as custodian.

The third Long-Term Stewardship Workshop was held in Denver, Colorado, in August, a joint effort of the LTSM Program and the DOE Headquarters Office of Long-Term Stewardship. GJO will host the stewardship workshop again in 2001 and will continue to disseminate program information to stewards, remediation planners, stakeholders, and regulators through this and other channels.

Research continues at LTSM Program sites. Often, this research requires many years of observations to define processes and identify solutions for what are, generally, slow-acting phenomena. We are generating results from activities such as analog site modeling, arid land revegetation, and validation and monitoring of new cover technologies. Many LTSM Program research initiatives involve working in cooperation with specialists from DOE national laboratories, the U.S. Environmental Protection Agency, and universities.

Challenges lie ahead for the program. Issues include designing, monitoring, and enforcing institutional controls; defining levels of site monitoring; defining the relevant use of risk-based arguments for stewardship decisions; and choosing appropriate technology to enhance monitoring and surveillance. Throughout these efforts, GJO is committed to maintaining community involvement and addressing community needs. Our findings and conclusions will apply to other sites that will transition into stewardship in the years to come.

For more information about the LTSM Program, please contact me at (970) 248–6037 or visit our World Wide Web site at **http://www.doegjpo.com/programs/ltsm/**.

Art Kleinrath
LTSM Program Manager
U.S. Department of Energy Grand Junction Office

Acronyms

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 [Program]
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
FUSRAP	Formerly Utilized Sites Remedial Action Program
GJO	Grand Junction Office
LTSM	Long-Term Surveillance and Maintenance
NPL	National Priorities List
NRC	U.S. Nuclear Regulatory Commission
NWPA	Nuclear Waste Policy Act of 1982 (42 U.S.C. 10101, *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 (42 U.S.C. 7901, *et seq.*)
UMTRA	Uranium Mill Tailings Remedial Action [Project]

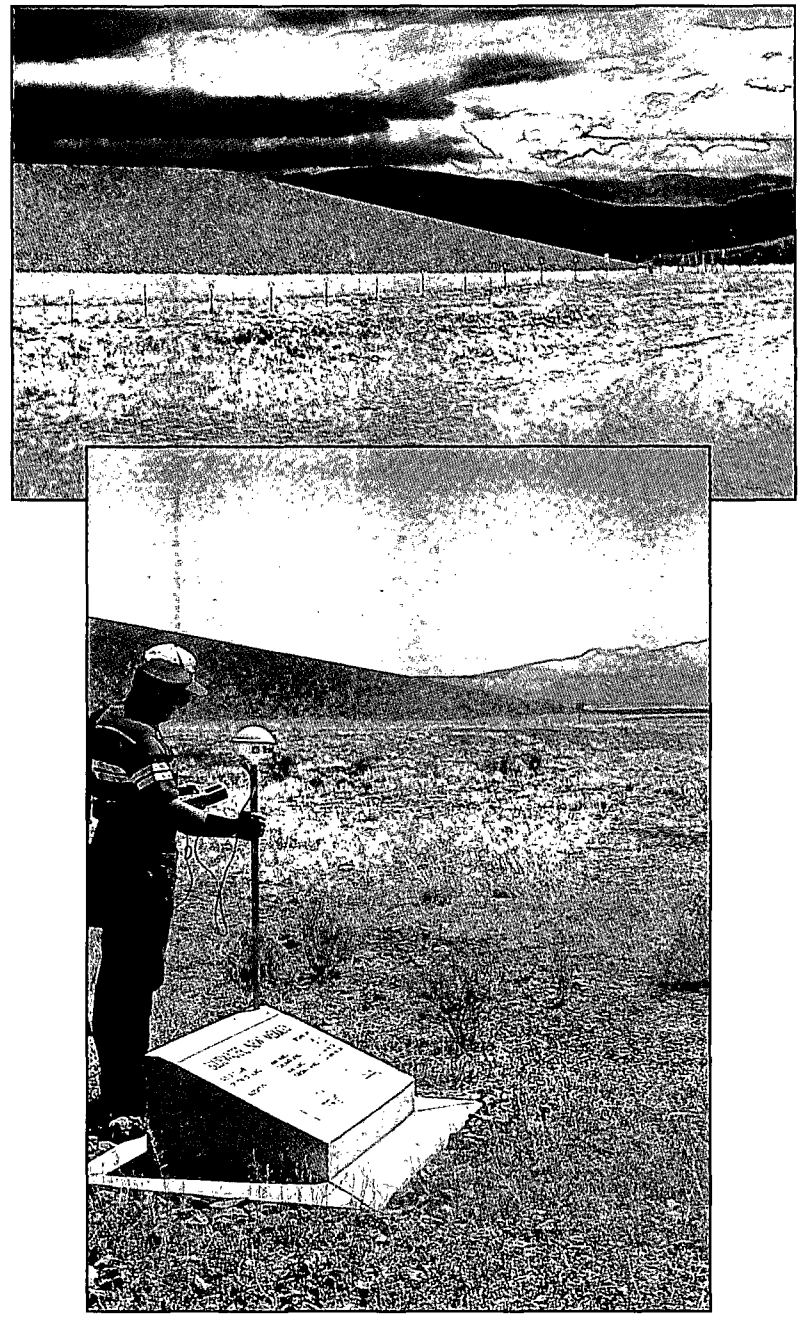
The Stewardship Imperative

The Federal government and private industry created immense volumes of radioactive waste in support of national defense, research, and civilian power programs. At present, a technology does not exist to render most of these wastes harmless. Because these wastes are potentially hazardous, they must be isolated from the biosphere. The only practical remediation solution for these wastes is consolidation, isolation, and long-term control.

The U.S. Department of Energy (DOE) estimates that radioactive or other hazardous materials may remain in place at 129 DOE sites.* Other government agencies are responsible for additional sites where radioactive and other hazardous materials will be impounded or contained. Remedial action is considered complete at these locations when the wastes are isolated and exposures to the wastes are controlled. Programmatically, this milestone is attained when the selected remedial action remedy is in place and functioning. At this point, a waste site transitions into stewardship.

Stewardship can be defined as the collection of actions necessary to maintain protection of health and safety and the environment. These actions include maintaining physical impoundment structures in good repair and functioning as designed. Stewardship also includes preventing exposure to the wastes through access restrictions and warnings and recording site conditions and activities for future custodians. In short, any action that will prevent exposure to the waste now or in the future is part of stewardship.

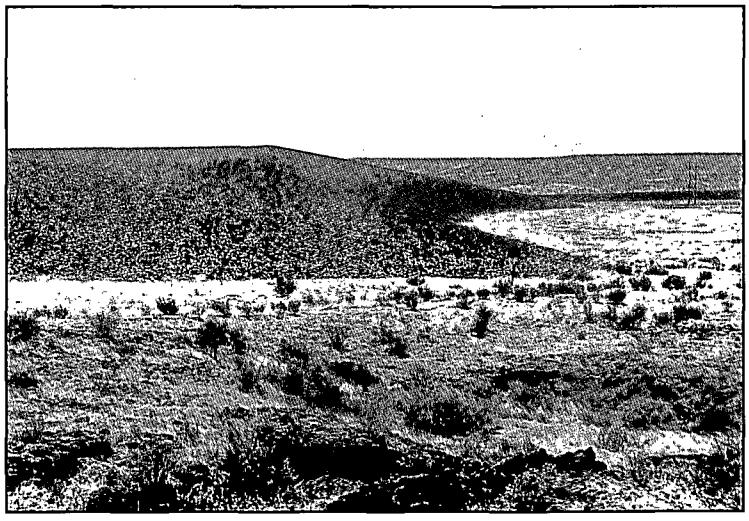
DOE established the Long-Term Surveillance and Maintenance (LTSM) Program to provide stewardship services at low-level radioactive waste disposal sites. Effective January 1, 1989, the DOE Grand Junction Office (GJO) was designated as the program office for "disposal site long-term surveillance and maintenance." DOE Headquarters reconfirmed assignment of this responsibility to GJO three times, most recently in 1998.



Top photo: The Gunnison, Colorado, Disposal Cell cover incorporates a thick frost protection layer to prevent drying of the radon barrier layer. Bottom photo: An LTSM Program inspector collects location information at the Bluewater, New Mexico, Disposal Site for inclusion in a geographic information system database.

*DOE is currently defining the scope of its long-term stewardship obligation. In *From Cleanup to Stewardship* (DOE/EM–0466, October 1999), DOE estimated that 109 sites eventually would require long-term stewardship. More recent estimates place the total number of sites eventually requiring long-term stewardship at 129 sites. This figure will change as remedial action plans are implemented and new technologies are introduced.

Stewardship of DOE Low-Level Radioactive Waste Disposal Sites



The Bluewater, New Mexico, Disposal Site is situated in a high desert locale amid lava flows.

The U.S. Department of Energy (DOE) intends to assign all long-term stewardship responsibilities for sites that meet two criteria to the Grand Junction Office (GJO) Long-Term Surveillance and Maintenance (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.

All locations that cannot be released for unrestricted use require long-term care. These sites were remediated under different environmental restoration programs, each with its own regulations and standards. In each case, specific regulations, general environmental laws, and DOE orders establish standards and limits for protection of workers, the public, and the environment.

Currently, the LTSM Program is responsible for annual surveillance, monitoring, and maintenance of 27 sites remediated under Title I and Title II of the Uranium Mill Tailings Radiation Control Act of 1978 (UMTRCA), the Nuclear Waste Policy Act (NWPA) Section 151, and the DOE Defense Decontamination and Decommissioning (D&D) Program. By 2006, the GJO LTSM Program expects to provide stewardship services for more than 60 sites. These will include UMTRCA Title I and Title II sites; two sites (Monticello, Utah, and Weldon Spring, Missouri) remediated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA); and Formerly Utilized Sites Remedial Action Program (FUSRAP) sites. Negotiations for a Memorandum of Understanding are under way between DOE and the U.S. Nuclear Regulatory Commission (NRC) for the NWPA Section 151(b) sites; if accepted by DOE, some of these sites may be assigned to the LTSM Program. Descriptions of these remedial action programs and the sites governed by their regulations are provided later in this report. The table on page 4 summarizes the history of low-level radioactive waste.

For UMTRCA Title I and Title II disposal sites in the LTSM Program, DOE becomes a licensee to NRC. Inspection, reporting, and record-keeping requirements are defined in Title 10 *Code of Federal Regulations* (CFR) Parts 40.27 and 40.28 that 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; 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 unrestricted public use. Sites located on tribal land revert to tribal control, and DOE obtains a site access agreement with the tribe that allows DOE to fulfill its custodial responsibilities.

Residual radioactive materials were removed from some of the UMTRCA Title I processing sites to an off-site disposal location. Though these sites are not licensed by NRC, NRC is the regulator at these former-processing sites where only

Summary of Sites in LTSM Program Custody (February 2001)

Program	Fiscal Year						
	2000	2001	2002	2003	2003	2005	2006
UMTRCA Title I Disposal and Processing Sites	20	22	22	24	24	24	24
UMTRCA Title II Disposal Sites	2	6	15	15	15	17	18
NWPA Section 151 (c) Sites	1	1	1	1	1	1	1
NWPA Section 151(b) Sites[a]			2	4	6	8	10
D&D Sites	4	4	4	4	4	4	4
FUSRAP Sites[a]				3	3	5	5
CERCLA Sites[b]		1	1	2	2	2	2
Total	**27**	**34**	**45**	**53**	**55**	**61**	**64**

[a]Anticipated.
[b]Two discrete Superfund sites at Monticello, Utah, are counted as a single site for program planning purposes.

contaminated groundwater remains. These sites will be assigned to the LTSM Program for long-term custody and care when the groundwater compliance strategy has been approved by NRC, the state, and, as applicable, 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 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 will develop Long-Term Surveillance Plans for these sites, if necessary.

In addition, the LTSM Program maintains calibration facilities for surface and downhole radiation detection instruments. These facilities include borehole models at the Grand Junction, Colorado, Office facility; calibration pads at Walker Field Airport in Grand Junction; and field calibration facilities at Casper, Wyoming; Grants, New Mexico; and George West, Texas.

Representatives of NRC, the State of Washington, the LTSM Program, and the owner conduct the final walk-through at the Sherwood, Washington, Disposal Site.

Chronicle of Low-Level Radioactive Waste

1914 to 1928	Western U.S. sandstones mineralized with both uranium and vanadium oxides are mined for their radium content. Most of the ore is processed in Denver, Colorado, and Canonsburg, Pennsylvania.
1920s	Demand increases for vanadium as a component of steel. Mines and mills are opened on the Colorado Plateau to produce the metal. Uranium is discarded as a waste material.
1943	The Manhattan Engineer District establishes a refinery at Grand Junction to concentrate uranium from vanadium slimes produced at mills in the region.
1946	Passage of the Atomic Energy Act (superseded by the Atomic Energy Act of 1954) establishes civilian control of nuclear power production and authorizes the U.S. Atomic Energy Commission (AEC) to possess radioactive materials and regulate their use.
1950s through 1970	AEC operates a uranium exploration and procurement program from the Grand Junction Area Office to encourage domestic uranium production. Milling research is conducted by AEC at the Grand Junction Area Office and at Monticello, Utah.
1950s through 1990s	Uranium is produced commercially for the Federal government and the private sector. Because of changing demands, production is cyclical and tapers off to almost nothing from 1980 to the present. Many uranium mills are abandoned.
1964	Passage of the Private Ownership of Special Nuclear Materials Act encourages civilian development of nuclear electricity generation. This action helps create a market for domestic uranium.
1978	AEC is reorganized into the U.S. Nuclear Regulatory Commission (NRC) and the Energy Research and Development Administration, the precursor of U.S. Department of Energy (DOE). Passage of the Uranium Mill Tailings Radiation Control Act (UMTRCA) specifies remedial action at abandoned uranium ore processing mills and stewardship of the resulting disposal sites. UMTRCA provides a mechanism for active millsites to be reclaimed, owner licenses terminated, and the sites assigned to DOE for stewardship.
1980s	DOE establishes the Defense Decontamination and Decommissioning (D&D) Program, Formerly Utilized Sites Remedial Action Program (FUSRAP), and Surplus Facilities Management Program (SFMP) to remediate sites contaminated with radioactive materials during Manhattan Project and early AEC activities.
1982	Passage of the Nuclear Waste Policy Act (NWPA) authorizes DOE to become custodian of designated civilian nuclear waste sites.
1988	DOE establishes the Long-Term Surveillance and Maintenance Program at the DOE Grand Junction Office.
1999	DOE and the U.S. Army Corps of Engineers finalize a Memorandum of Understanding to transfer remediated FUSRAP sites to DOE for stewardship. DOE establishes the Office of Long-Term Stewardship. The U.S. Congress directs DOE to report on the total stewardship obligation for all DOE sites.

LTSM Program Stewardship Activities

As steward, the Long-Term Surveillance and Maintenance (LTSM) Program must ensure that the sites in its care do not cause harm to workers, the public, or the environment. The program also must ensure that the sites remain fully compliant with applicable regulations. Program systems and activities are designed to meet these goals.

The LTSM Program conducts site surveillance and monitoring activities in accordance with approved site-specific Long-Term Surveillance Plans. LTSM Program personnel inspect each assigned site at least annually. They prepare, distribute, and archive an annual site condition report. The purposes of the annual inspection are 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. At the time of the inspection, program specialists evaluate the effectiveness of site-specific institutional and engineered controls and ensure that the site remains in full compliance with applicable regulations.

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 needed 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 site-specific Long-Term Surveillance Plans. Monitoring results are reviewed to ensure regulatory compliance. All sites in the LTSM Program continue to be in full compliance.

If a disposal site receives severe damage or sustains catastrophic failure, the U.S. Department of Energy (DOE) will undertake the necessary corrective action. The LTSM Program maintains contacts with local law enforcement officials near each site who will notify DOE in case of an incident or emergency. Signs with the DOE Grand Junction Office (GJO) 24-hour phone number [(970) 248–6070] are posted at each site.

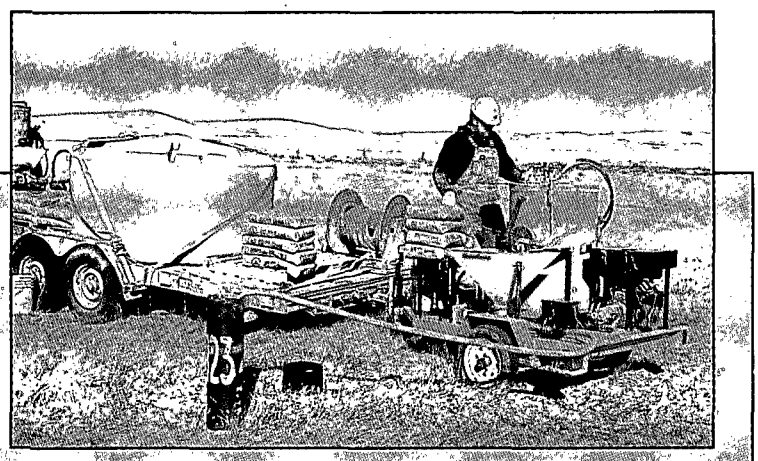
As site steward, the LTSM Program documents activities at each site. That information is archived at the GJO facility and will be available to future stewards. Records that describe baseline conditions are acquired from remedial action contractors before site transfer. Ongoing surveillance and monitoring results are preserved so trends may be established. Records are maintained in National Archives and Records Administration-compliant storage areas and are tracked in an electronic database.

The LTSM Program encourages stakeholder involvement with program operations. Stakeholders consist of all interested parties for a given site, including local residents, regulators, elected officials, and the general public. The program has implemented the *LTSM Program Public Participation Plan,* which is an appendix to the *Long-Term Surveillance and Maintenance Program Plan* posted on the World Wide Web at **www.doegjpo.com/programs/ltsm/** under "General," "Program Information."

Program personnel provide transfer assistance to site owners as remediation activities approach completion. The program obtains necessary records to conduct ongoing stewardship and develops a Long-Term Surveillance Plan for the site. Real property transfer or access acquisition activities are supervised by LTSM Program personnel, often in coordination with the U.S. Army Corps of Engineers. Program personnel participate in a site-handoff inspection and ensure that the site complies with stipulated requirements before accepting responsibility for the site.

2000 Program Accomplishments

The Long-Term Surveillance and Maintenance (LTSM) Program inspected and performed necessary monitoring and maintenance of all sites assigned to the program. Visits were also made to sites that will likely be transferred to the program, and transition assistance was provided to the owners of those sites.



Bentonite grout is pumped into a monitor well at the Spook, Wyoming, Disposal Site. The well casing was later cut off below ground level and capped.

Well Decommissioning Project Commences at Spook

In October, the LTSM Program began well decommissioning activities by decommissioning all monitor wells at the Spook, Wyoming, Disposal Site. Groundwater monitoring was no longer required at this location, and the 31 monitor wells represented a liability to DOE. These wells were plugged and the surface was restored. Well permits on file with the State Engineer's Office were closed out.

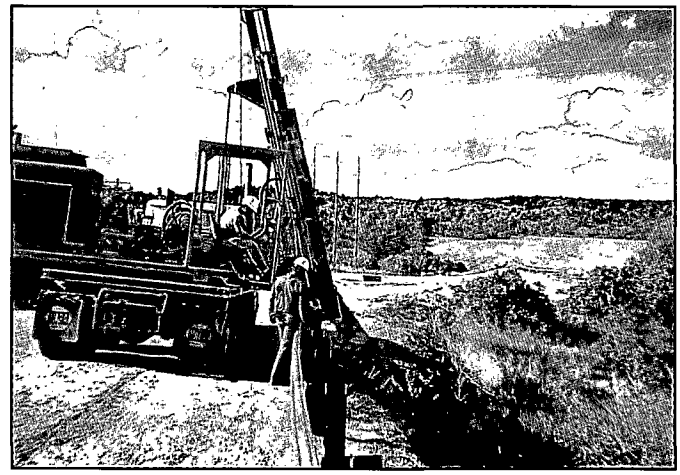
Concurrently, the LTSM Program initiated use of an electronic database to capture and manage well information. The database allows ready access to information about well permits, access agreements, well construction, and well status.

DOE owns more than 900 monitor wells at processing and disposal sites in GJO custody. More than 50 percent of these are unneeded and will be decommissioned through 2004.

During calendar year 2000, the LTSM Program

- Inspected 26 sites and prepared reports of site conditions [the U.S. Department of Energy (DOE) Grand Junction Office (GJO) facility is in transition and was not inspected]. These inspections evaluated site integrity and conformance to regulations and identified needed maintenance.
- Collected groundwater samples at 17 LTSM Program sites. Groundwater sampling is required at some of these sites according to the site-specific Long-Term Surveillance Plans to demonstrate that precipitation is not passing through disposal cell contents and carrying leached contaminants into the underlying groundwater system. Samples were collected from permanent monitor wells or, at some sites, from streams, seeps, or springs hydraulically downgradient from the disposal cell. The LTSM Program monitors groundwater associated with the disposal cells at Uranium Mill Tailings Radiation Control Act (UMTRCA) Title I sites. The program addresses compliance issues at sites where groundwater was contaminated by historical processing operations at UMTRCA Title I sites.
- Monitored groundwater levels at 13 sites. This monitoring is necessary to ensure compliance with state and Federal groundwater protection regulations. Monitoring is also used to document changes in local groundwater regimes as flow changes caused by processing-related activities dissipate and flows return to a natural state. At the Slick Rock, Colorado, Disposal Site, water levels within the cell are monitored to ensure that transient-drainage accumulations do not enter the local groundwater system. Standpipes were installed in the Slick Rock Disposal Cell for this purpose. Water levels are monitored at the Durango and Rifle, Colorado, Disposal Sites to ensure that water accumulation within the cells does not cause side slopes to become unstable.

- Continued riprap durability studies at the Lakeview, Oregon, Disposal Site. Riprap size is calculated to resist the erosive effects of a theoretical maximum precipitation event. The rock used at this location is weathering more quickly than anticipated but remains protective.
- Completed radon decay-product concentration monitoring at the Shiprock, New Mexico, Disposal Site. This work was conducted at the request of the Navajo Nation, a stakeholder at this location. Average radon decay-product concentrations did not exceed background concentrations. The program continued to monitor moisture within the cell and the cover.
- Verified the monitor well inventory at LTSM Program and Uranium Mill Tailings Remedial Action (UMTRA) Ground Water Project sites to confirm the number of unneeded wells that can be decommissioned. This activity included field verification of the wells at the Bowman and Belfield, North Dakota, sites. The State of North Dakota requested that these sites be delisted from Title I of UMTRCA after DOE had begun characterization activities. The LTSM Program will decommission DOE-owned wells, including those at Bowman and Belfield, beginning in fiscal year 2001.
- Initiated well decommissioning operations by plugging and decommissioning all monitor wells at the Spook, Wyoming, Disposal Site (see sidebar on page 6).
- Met with site operators and regulators at 10 UMTRCA Title II sites to assist in site transition to stewardship. At these locations, the site operator must complete site reclamation and achieve compliance with groundwater regulations before the U.S. Nuclear Regulatory Commission (NRC) will terminate the site-specific license.
- Drafted Long-Term Surveillance Plans for two UMTRCA Title II sites. NRC must concur in these plans before a site-specific license is terminated and the site is accepted under the DOE general license.



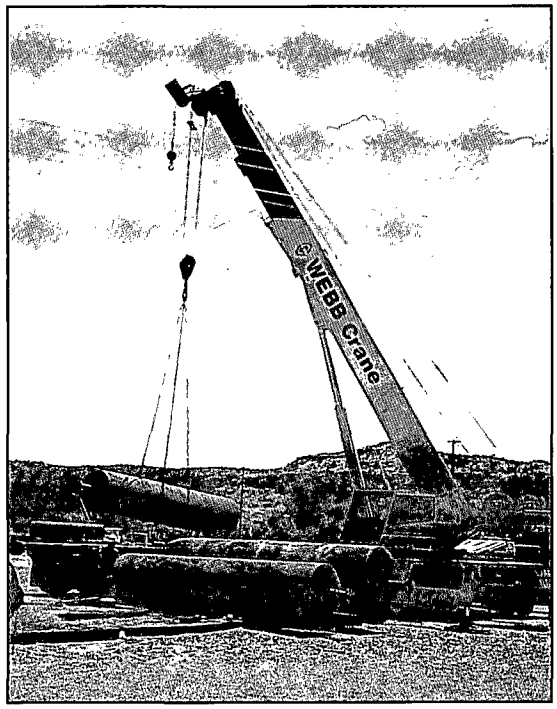
Guardrails and a gate are installed along the county road at the Durango, Colorado, Disposal Site to control access and reduce vandalism.

- Submitted the *1999 Annual Site Inspection and Monitoring Report for Uranium Mill Tailings Radiation Control Act Title I Disposal Sites* and the *2000 Annual Site Inspection and Monitoring Report for Uranium Mill Tailings Radiation Control Act Title II Disposal Sites* to NRC.
- Installed guardrails and an access gate along the county road crossing the Durango, Colorado, Disposal Site. Previously, access was restricted by signs and a gate across the entrance road within the site boundary. Dumping, poaching, trespassing, and vandalism have been ongoing problems, resulting in damage to site structures. DOE has also worked with the local sheriff's office to maintain institutional control of the facility.
- Conducted permit compliance monitoring at seven sites. This activity included monitoring for storm water discharge, wastewater discharge, and revegetation at sites addressed by permits issued by the U.S. Army Corps of Engineers, the U.S. Bureau of Land Management, and other agencies.
- Completed monitoring sage grouse populations at the Gunnison, Colorado, UMTRCA Title I site. Remediation at this location disturbed critical habitat for this protected species. The program also monitored revegetation of the former haul road to re-establish critical habitat.

A portion of the road was reseeded in 2000. DOE–GJO has fulfilled the requirements of a Wildlife Mitigation Permit and petitioned the U.S. Bureau of Land Management and the Colorado Department of Wildlife for permit closure.

- Performed routine maintenance at 13 sites. Maintenance activities included replacing signs that were defaced or stolen, repairing fences, cutting encroaching vegetation, mowing grass, and spraying weeds. Erosion control structures were installed at the Maybell, Colorado, Disposal Site to prevent offsite sediment transport by erosion. At the request of the U.S. Bureau of Land Management, the LTSM Program disked and reseeded a reclaimed area near the Rifle, Colorado, Disposal Site to eradicate cheatgrass and to encourage establishment of desirable plants.

- Resurfaced the roof on the entombed intermediate heat exchanger building at the Hallam, Nebraska, Decommissioned Reactor Site. This structure will require periodic maintenance until the radioactive materials in the reactor systems decay and the site can be released for unrestricted use.



Unneeded calibration models were removed from the GJO facility for demolition and disposal at the Grand Junction, Colorado, Disposal Site. The LTSM Program is responsible for disposal operations at this location.

- Began to stabilize the stream bank near the Canonsburg, Pennsylvania, Disposal Site. This area was remediated by the UMTRA Project. The design relies on native vegetation to stabilize the surface of the reconstructed slope that was rebuilt using fabric tension mats and drainage layers.

- Operated the Grand Junction (Cheney), Colorado, Disposal Cell. A portion of this facility remains open to receive radioactive waste from other UMTRCA sites and the Monticello, Utah, Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) sites. In 2000, the U.S. Environmental Protection Agency (EPA) and local regulators approved risk-based disposal of radioactive waste mixed with low concentrations of polychlorinated biphenyls. The LTSM Program developed the application for disposal and obtained community support for this action. NRC concurred in this action. This approval will result in the safe disposal of waste that was stored for years because a disposal option did not exist. The LTSM Program inspects the site weekly when the facility is not accepting waste.

- Received NRC concurrence in revisions to the Long-Term Surveillance Plan for the Burrell, Pennsylvania, Disposal Site. The revisions allow the LTSM Program to halt vegetation control through herbicide use and allow establishment of a woody plant community. The LTSM Program supported this proposal with a screening-level risk analysis that demonstrated that vegetation growth would not significantly increase risk and might actually reduce the amount of meteoric water that would percolate through the cell.

- Assumed responsibility for the calibration models at the GJO facility. These models are primary national standards used to calibrate surface, wide area, and downhole radiation detection instruments. The program is also responsible for calibration pads at Walker Field Airport in Grand Junction, Colorado, and secondary field

standards at Casper, Wyoming; George West, Texas; and Grants, New Mexico. Secondary calibration standards at the DOE Hanford Site in the State of Washington are tied to the primary standards at GJO. The Hanford models are used to verify the calibration of downhole geophysical instruments currently used to detect and monitor leakage of high-level radioactive waste stored in underground tanks at the Hanford Site.

- Operated treatment cells at the Durango, Colorado, Disposal Site. Sandia National Laboratories/New Mexico constructed the cells to test the effectiveness of zero-valent iron in removing uranium and other contaminants from the transient drainage water. Since 1996, the LTSM Program has operated these cells. Results have been used to design and install permeable reactive barriers at the Monticello, Utah, CERCLA Site and at Travis Air Force Base in California that use this same technology. Treatment studies at the Durango Disposal Site will continue until 2002; the transient drainage system will be permanently closed in 2004.
- Assumed responsibility for the Salt Lake City, Utah, Processing Site (see sidebar).
- Continued to input summary records data into a comprehensive site records database. This database is designed to maintain and enhance retrieval of site stewardship records and to preserve institutional knowledge for future stewards. The Rocky Mountain Region of the National Archives and Records Administration awarded its Blaine Hardesty Award to GJO for records management excellence. The award is presented to Federal agencies whose records management programs are making efficient and cost-effective use of technology to manage information and benefit the missions of the agencies.
- Initiated transition of the Monticello Radioactive Contaminated Properties (also known as the Monticello Vicinity Properties) and Monticello Mill Tailings Sites to long-term stewardship. The LTSM Program will assume complete responsibility for these sites in 2001.
- Submitted the *Guidance for Implementing the Long-Term Surveillance Program for UMTRCA Title I and II Sites* to NRC. This guidance is also applicable to sites remediated under other programs.
- Developed a program-specific Health and Safety Plan applicable to all work performed by the LTSM Program, including site-specific health and safety requirements.
- Provided input to and reviewed the draft DOE long-term stewardship report to the U.S. Congress, as required by the 2000 National Defense Authorization Act. Provided cost and stewardship assumptions to support DOE Headquarters efforts to define the extent of the Department's long-term stewardship obligation.

LTSM Program Assumes Responsibility for Salt Lake City Processing Site

Uranium ore was processed at the Salt Lake City, Utah, Processing Site until 1968. In 1988, the tailings and contaminated materials were relocated to a disposal site 85 miles west of Salt Lake City. However, groundwater that was contaminated by the processing operations remained beneath the site.

Analysis of characterization study results show that contaminated groundwater in the uppermost aquifer is isolated from potable water in lower strata and that the groundwater in the uppermost aquifer is not a potential source of drinking water because of regional contamination that did not result from uranium processing activities. NRC and the State of Utah concurred in application of supplemental standards to site groundwater.

Upon receiving regulator concurrence in the groundwater remediation strategy, DOE assigned responsibility for long-term stewardship of the Salt Lake City Processing Site to the LTSM Program. Stewardship requirements include monitoring groundwater levels and chemistry and ensuring that institutional controls remain effective. Six more former processing sites will be assigned to the LTSM Program by 2012.

GJO Hosts Third Stewardship Conference in Denver

More than 200 stewardship managers, specialists, stakeholders, and regulators attended the third Long-Term Stewardship Workshop held in Denver, Colorado, August 7–10, 2000. Eight sessions addressed a wide range of topics from policy initiatives to long-term information management to technology needs and stakeholder involvement.

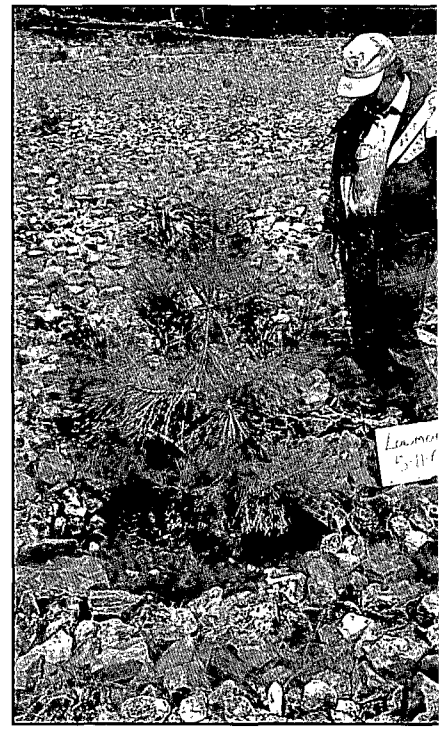
The highlight of the workshop was the luncheon that featured guest speakers Senator Wayne Allard of Colorado, Congressman Mark Udall of Colorado, and DOE Assistant Secretary for Environmental Management Dr. Carolyn Huntoon. Dr. Huntoon praised the Grand Junction Office as "one of the most cost-effective offices in the entire DOE complex, with a well-trained, motivated workforce."

This workshop was a joint effort of the GJO LTSM Program and the DOE Headquarters Office of Long-Term Stewardship. The workshop will be held again in 2001. More information about the workshop is available on the World Wide Web at **www.doegjpo.com/programs/ltsm/general/events/index/htm**.

- Cohosted the Long-Term Stewardship Workshop in Denver, Colorado, with the DOE Office of Long-Term Stewardship (see sidebar).
- Participated in the DOE Long-Term Stewardship Working Group and provided document review comments to that group.
- Presented "Engineered Covers Though the Looking Glass" in the Science and Technology Session of the third Long-Term Stewardship Workshop.
- Presented "Overcoming Barriers to Long-Term Monitoring Technology Deployment," "State of the Art of Long-Term Stewardship," and "Analogs of the Long-Term Performance of Engineered Covers" at the Technology Information Exchange Workshop in Augusta, Georgia.
- Presented information on lessons learned and applied stewardship technology at the DOE Post-Closure Stewardship Technology Needs Conference in Cincinnati, Ohio. The LTSM Program is working to define the appropriate use of technology to enhance surveillance and monitoring at remote sites. While automated monitoring systems offer continuous data capture, results may be ambiguous because of the objective focus of the systems. Site visits may still be required to maintain and upgrade the systems. Also presented "Secrets of the Past: Analogs of the Long-Term Performance of Engineered Covers" at the conference.
- Participated in a rock placement workshop hosted by NRC in Grand Junction, Colorado. This workshop included visits to UMTRCA Title I and Title II disposal sites to demonstrate to agreement-state regulators and UMTRCA Title II site owners what the UMTRA Project learned about rock placement and durability testing. The intent of the workshop was to share this knowledge so that it can be applied to UMTRCA Title II and Nuclear Waste Policy Act Section 151(b) disposal site construction and acceptance.
- Participated in the Long-Term Cover Design Guidance initiative under the DOE Office of Science and Technology Subsurface Contaminant Focus Area Project. The purpose of the project is to develop a guidance document that DOE weapons sites can use to design caps and covers that will last hundreds to thousands of years. An LTSM Program scientist leads Subsurface Contaminant Focus Area-funded research on natural analog studies of the long-term ecology of engineered covers and supports research on performance monitoring technology. The results of the activity were presented at the mid-year review in Albuquerque, New Mexico. GJO involvement in the project is an outcome of LTSM Program-funded collaboration with the Subsurface Contaminant Focus Area Project since 1998.
- Served as the Monitoring Team Lead at the Phytoremediation of Inorganics Workshop at Argonne National Laboratory. GJO prepared the Monitoring Team chapter, "Summary of the Subsurface Contaminant Focus Area Workshop on Phytoremediation of Inorganic Contaminants: Monitoring

Team Report," for the final workshop proceedings volume.

- Created a report on data requirements, existing technical data, and technical gaps related to development of the Long-Term Cover Guidance Document. GJO also is participating in efforts to define data requirements for the following components of the design process: regulatory requirements, environmental setting, engineering, performance assessment, and design verification and monitoring.
- Collaborated with the University of Arizona on a report of the Tuba City, Arizona, Disposal Site revegetation study completed in fall 1999. The manuscript was accepted for publication in the *Journal of Environmental Quality*.
- Made two presentations at the EPA Alternative Cover Assessment Project meeting in Boston. "Growing a 1,000 Year Landfill Cover" was presented at the Vegetative Covers Session of the Phytoremediation State of the Science Conference. "Monticello Lysimeter Test Facility" was presented at the Remediation Technologies Development Forum Annual Action Team Meeting.
- Began studies at the Lowman, Idaho, Disposal Site to determine if volunteer plant growth degrades the water-infiltration barrier properties of the cell cover and increases risk to human health and the environment. At this location, a diverse woodland plant community dominated by ponderosa pine forest will likely colonize on the cover of the disposal cell if active vegetation control measures are not implemented.
- Continued work on the two caisson lysimeters constructed at the Monticello, Utah, Superfund Site. Soil moisture and temperature sensors were installed in one lysimeter. Water content reflectometers were installed at sequential depths in both lysimeters to monitor changes in water storage (see "Cover Monitoring and Long-Term Performance Project" on page 24).
- Continued to collaborate with EPA Region 8 on a study of capillary barrier designs for disposal cells encompassing a broad range of soil types and layer thicknesses. GJO constructed test covers in small weighing lysimeters at Monticello (see the photograph on the cover). In 2000, three new lysimeters were installed, including one constructed of transparent material containing the entire cover profile of the Monticello Disposal Cell for "show and tell."
- Continued to develop a 7.5-acre lysimeter in the east face of the Monticello Disposal Cell cover in conjunction with the EPA Alternative Cover Assessment Program and EPA Region 8. Program personnel installed dosing siphons to measure drainage and surface runoff, water content reflectometers to measure soil water profiles, and heat dissipation units to measure soil water potential through the cover profile.
- Teamed with Pacific Northwest National Laboratory and Sandia National Laboratories/New Mexico on preparation and submittal of three Techncial Task Plans in response to a DOE Headquarters call for proposals on long-term performance cover systems. These are "Characterization of the Environmental Envelope for the Design of Long-Term Covers," "Cover Performance Verification and Long-Term Monitoring Systems," and "Long-Term Cover Performance: Side-Slope Modifications to Reduce Impacts of Drainage." The first two proposals were funded for fiscal year 2001.
- Continued to disseminate inspection results and site status information to regulators, the public, and other stakeholders.



In 2000, LTSM Program researchers began to study the effects of plant encroachment on the Lowman, Idaho, Disposal Cell to determine if vegetation control will be necessary for the life of the cell.

LTSM Program Planning and Implementation

The Long-Term Surveillance and Maintenance (LTSM) Program activities are conducted in accordance with the *Long-Term Surveillance and Maintenance Program Plan* (the program plan). Summaries of portions of the program plan are presented in this section. In addition to the information presented in this report, the program plan establishes responsibilities, regulatory requirements, and controls for the LTSM Program. Guidance and plans for routine operations and extraordinary circumstances are identified. A major component of the program plan addresses public participation. The program plan is posted on the World Wide Web at **www.doegjpo.com/programs/ltsm/**.

Mission and Objectives

LTSM Program functions are defined in mission and objectives statements. In the program plan, these broad objectives are broken down into specific goals. Strategies are presented for achieving each goal.

> ***Mission—***
> ***To fulfill DOE's responsibility to implement all activities necessary to ensure regulatory compliance and to protect the public and the environment from long-lived wastes associated with the nation's nuclear energy, weapons, and research activities.***

The objectives are

- Protect the public and the environment.
- Maintain site records and information so future custodians can continue to provide effective stewardship.
- Provide a resource to manage long-term disposal and storage sites.
- Maintain compliance with applicable regulations.
- Serve as a source of stewardship information and expertise for other entities with long-term care responsibilities.
- Provide services and products within approved schedule and budget limits.
- Provide an outreach and information dissemination resource to the public to maintain public trust in local LTSM Program sites.

Organization and Administration

The program plan establishes responsibilities for key program personnel and organizations. In the future, some stewardship services may be acquired for remote sites through cooperative agreements between the LTSM Program and local, tribal, or state agencies.

The LTSM Program is administratively responsible to the U.S. Department of Energy (DOE) Office of Environmental Management, which is responsible for the remediation and control of waste materials for which the Department is responsible.

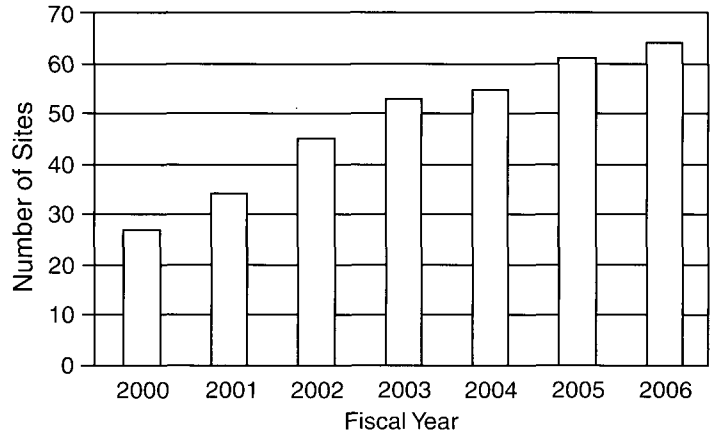
Funding is acquired through an annual budget request administered through the DOE Albuquerque Operations Office. Projected funding through 2006 is presented in a separate LTSM Program project baseline summary under the direction of the DOE Grand Junction Office. LTSM Program costs will increase from $3,504,000 in 2001 to approximately $9,870,000 in 2006 as the number and complexity of sites increases.

Assumptions

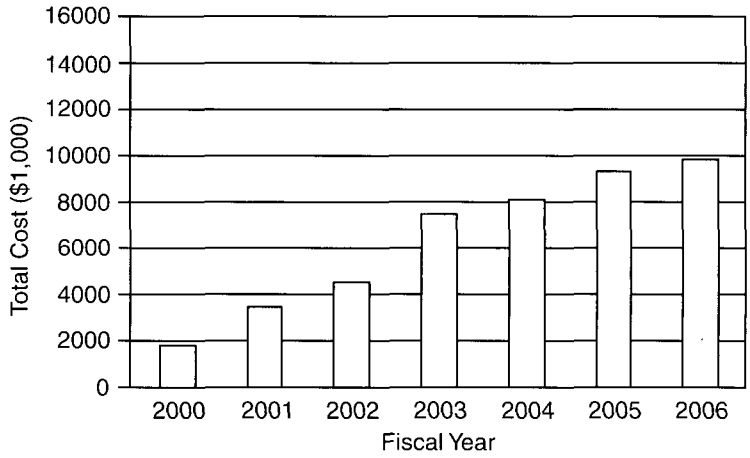
Key assumptions for the LTSM Program are divided into two categories: institutional and environmental protection/regulatory compliance.

Institutional Assumptions

- Adequate funding will be provided to carry out the LTSM Program mission.
- Native American tribes/nations, states, the public, regulators, and the U.S. Congress are program stakeholders and influence program policy and conduct.
- As program stakeholders, communities near LTSM Program sites expect no unacceptable risks from the contaminated materials.
- DOE will negotiate institutional controls to protect the public and the environment, will entrust implementation of those controls only to governmental agencies with the resources to manage and enforce them, and will periodically monitor the effectiveness of institutional controls.
- DOE will seek public participation in the development of required compliance strategies.
- Tribal, state, and local agencies will continue to take an active role in monitoring site compliance and may become actively involved in supporting stewardship operations.
- Configuration or location of sites in the custody of the LTSM Program will not be changed.
- Waste disposal capacity will be available, if needed.



Sites in LTSM Program Custody



Projected LTSM Program Cost

Environmental Protection/Regulatory Compliance Assumptions

- Applicable regulatory drivers have been identified, and the program will achieve and maintain full compliance with those laws and regulations.
- The program will monitor changes to pertinent regulations and will revise program procedures as necessary.
- The sites are stable and protective of the environment and will remain so for the foreseeable future. This assumption is predicated on the goal of cell designs, which was to construct waste impoundments that maintain isolation with only minimal maintenance. The program recognizes that corrective action may, at some future time, be required.
- Surveillance and monitoring activities will identify degradation of site containment systems and the potential for contaminant release.

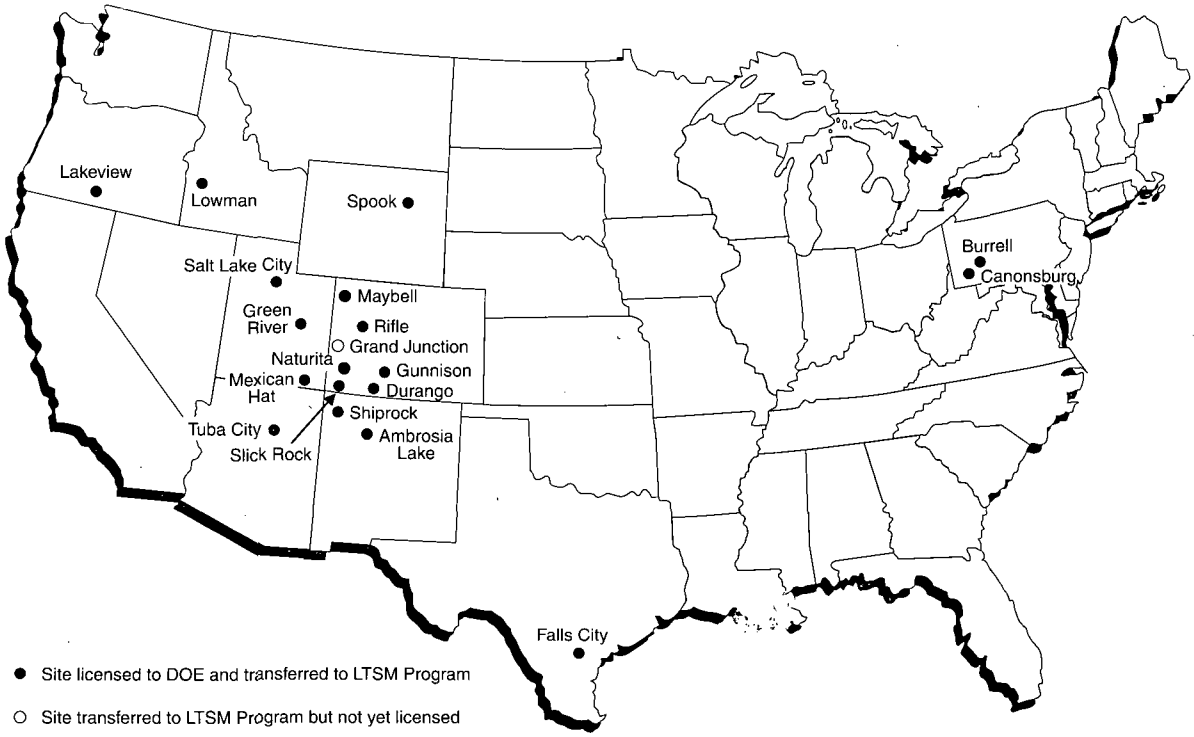
Risks

Risks and risk-reduction strategies for the LTSM Program are identified as either programmatic or site specific.

One of the long-term programmatic risks is the uncertainty of whether some individual sites or sites in a given restoration program will be transferred to the LTSM Program. Because the owner or restoration agency implements a site transfer, the actual transfer schedule is uncertain. Unresolved regulatory issues or other concerns can affect transfer schedules.

Site-specific risk reduction is achieved by monitoring trends and conducting corrective action before extraordinary events occur. Risk reduction is enhanced by adhering to the LTSM Program quality assurance program, following procedures for routine program activities, conducting periodic inspections and regulatory compliance reviews, communicating with affected parties, and planning for extraordinary situations.

LTSM Projects and Sites



Locations of UMTRCA Title I Sites

UMTRCA Title I Disposal and Processing Sites

The Uranium Mill Tailings Radiation Control Act (UMTRCA) specified 24 inactive uranium-ore processing sites for remediation. Of these, two sites in North Dakota were delisted from UMTRCA at the request of that state and were not remediated by the U.S. Department of Energy (DOE). Remediation resulted in creation of 19 disposal cells that contain encapsulated uranium mill tailings and associated contaminated material. Almost 43 million cubic yards of low-level radioactive material are contained in UMTRCA Title I disposal cells.

The U.S. Environmental Protection Agency (EPA) sets forth UMTRCA remedial action, cell performance, and groundwater standards in 40 *Code of Federal Regulations* (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 the U.S. Nuclear Regulatory Commission (NRC) concurrence that remedial action is complete and acceptance of the site-specific Long-Term Surveillance 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 former site activities, NRC will accept only the surface improvements 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.

All but one of the Title I disposal cells have been licensed. A portion of the Grand Junction, Colorado, Disposal Cell will be left open under the Long-Term Radon Management Project that is managed by the DOE Grand Junction Office (GJO) in conjunction with the Long-Term Surveillance and Maintenance (LTSM) Program.

LTSM Program personnel inspected 19 UMTRCA Title I disposal sites and 1 former processing site during 2000. The following summaries provide a brief

status report on each site; complete annual inspection reports and fact sheets are available on the LTSM Program World Wide Web site at **www.doegjpo.com/programs/ltsm/** or 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. All monitor wells will be decommissioned in 2001. The shallow depression on the cell cover first noted in 1998 is probably an artifact of cell construction and has not changed. 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 site was accepted under the NRC general license in 1994. In 2000, the LTSM Program submitted a proposed revision to the Long-Term Surveillance Plan to eliminate vegetation control on the cell cover and to reduce groundwater monitoring. NRC has concurred with the revision. An indigenous hardwood forest will likely establish on the cell cover. Analysis of groundwater monitoring results indicate that the cell is operating as designed.

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 a 3-foot-thick clayey soil radon/water infiltration barrier and layers of rock and soil; the cover was seeded with grass. Custodial maintenance at the Canonsburg Disposal Site includes mowing the grass within the site boundary and discouraging 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 through 2003. Unneeded monitor wells will be decommissioned. Canada thistle, a noxious weed, is growing at the site and may require control. In 2000, the LTSM Program began to stabilize the Chartiers Creek stream bank to prevent the channel from migrating toward remediated areas.

Durango, Colorado—DOE removed tailings, contaminated building debris, and soil from the processing location on the Animas River and from vicinity properties. The low-level radioactive material was encapsulated in the Durango Disposal Cell southwest of Durango in 1990. NRC accepted the site 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 these layers are placed a sand filter/drainage layer, a rock biointrusion layer, and a frost-protection/rooting medium layer. A planted rock-soil matrix layer protects the top slope of the cell; the side slopes are covered with riprap to protect against wind and water erosion. Groundwater is monitored annually to confirm cell performance. Guard rails and an access gate were installed along the county road that crosses the site to reduce vandalism and unauthorized access.

Falls City, Texas—NRC concurred that this disposal cell conformed to EPA standards, and the surface improvements were brought under the general license in 1997. In 1998, NRC concurred in the groundwater compliance strategy and fully licensed the site. Tailings from seven deposits were combined in a disposal cell on the original millsite. The cell top 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 was corrected after flooding

occurred on adjacent properties. Because groundwater at this location contains widespread naturally occurring contamination, it is classified as limited use. The groundwater is sampled to monitor cell performance. Unneeded monitor wells will be decommissioned in 2001.

Grand Junction, Colorado—Low-level radioactive materials from the Grand Junction, Colorado, area were relocated to the Grand Junction Disposal Cell. A portion of the cell will remain open until as late as 2023 under the Long-Term Radon Management Project. The LTSM Program assumed responsibility for the entire site in 1998, but the provisions of the site-specific Long-Term Surveillance Plan address only the closed portions of the cell. Groundwater monitoring is not required at this site because of poor ambient quality. However, shallow paleochannels near the cell are monitored to detect any seepage that might escape the cell. Volunteer plant encroachment on the rock-armored cell cover may become a concern.

Green River, Utah—Tailings, contaminated soil, and building debris were encapsulated in an on-site disposal cell in 1989. NRC accepted the Green River Disposal Site under the general license for UMTRCA Title I sites in 1998, and the site was transferred to the LTSM Program. The program conducts annual inspections and monitors groundwater quarterly. 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 as drinking water in the region.

Gunnison, Colorado—Uranium mill tailings and contaminated materials from demolished mill structures along the Gunnison River and from 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 decommissioned.

Grazing is controlled on the U.S. Bureau of Land Management temporary withdrawal area at the Maybell, Colorado, Disposal Site while vegetation re-establishes on disturbed areas.

Lakeview, Oregon—Remedial action was completed at the Lakeview Disposal 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 riprap, overlain with soil, and planted with native grasses. The olivine basalt armor rock is monitored annually for signs of accelerated weathering and consequent reduction in size. The LTSM Program monitors site groundwater to verify that contaminants are not leaching from the disposal cell. In 1999, the sampling frequency was changed from annual sampling to sampling once every 5 years.

Lowman, Idaho—In 1992, DOE consolidated radioactive materials from processing operations and from vicinity properties onto existing radioactive sand piles and encapsulated the material beneath an engineered cell cover. NRC licensed the disposal site in 1994. Groundwater monitoring is required to confirm cell performance. Plant encroachment upon the cell cover will be monitored to determine if vegetation will compromise cell integrity. Otherwise, the site is in excellent condition and does not require maintenance at this time.

Maybell, Colorado—Tailings and process-related waste were consolidated on the existing tailings pile and encapsulated in 1998. NRC concurred in the remediation and accepted the site under the general license in 1999. The site lies in a uranium-mining district and several abandoned mines and processing sites are located nearby. Local groundwater was contaminated by uranium mineralization and from mining activities and is not monitored for compliance. Groundwater levels will be measured to monitor for potential transient drainage from the cell until at least 2004. Settlement plates within the cell will be surveyed through 2003 because the large quantity of encapsulated slimes creates a potential for consolidation. An eroding drainage channel southwest of the disposal cell was stabilized with rock. The erosion did not threaten cell integrity but was preventing full revegetation of the site.

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. NRC accepted the disposal site under the general license for UMTRCA Title I sites in 1997 and the site was transferred to the LTSM Program. The Navajo Nation retains title to the land. The program conducts annual inspections; no extraordinary repairs or maintenance have been required to date. Groundwater in shallow perched zones at the site was contaminated by processing operations and is sampled at hydraulically downgradient seeps and monitor wells. The zones are naturally unsaturated and are expected to drain empty of contaminated water. DOE installed a monitor well in 2000 to verify hydrologic conditions. Processing operations at the site did not degrade groundwater in the uppermost aquifer.

Naturita, Colorado—Contaminated soil and building debris from a processing site on the San Miguel River were relocated to a sandstone quarry pit near the UMETCO Title II site at Uravan, Colorado, and were encapsulated beneath an engineered cover. NRC licensed the Naturita site in 1999. Tailings from the processing site had previously been relocated to the Hecla Durita millsite, which will become an UMTRCA Title II disposal site. Because the Naturita Title I cell is located in a region of uranium mineralization and mining activity, formation fluids beneath the site have elevated uranium concentrations. Water levels in shallow water-bearing formations are monitored to detect transient drainage; samples will be collected if enough water is present. If contamination from the cell is detected, the program will begin monitoring the uppermost aquifer, located 600 feet beneath the cell.

Rifle, Colorado—In 1996, DOE relocated wastes from two uranium- and vanadium-ore processing sites near the Colorado River and waste from decontaminated vicinity properties to the Rifle Disposal Cell, located north of Rifle. NRC granted DOE a general license for custody and long-term care of the site in 1998. Ongoing maintenance concerns include decommissioning monitor wells that are no longer used and monitoring transient drainage accumulating in the bottom of the cell. Minor site-related groundwater contamination would not pose a risk to local water supplies or human health; therefore, postclosure groundwater monitoring at the disposal site is not required.

Salt Lake City, Utah, Disposal Site—Mill tailings and associated contaminated materials were relocated from the Salt Lake City Processing Site to the Salt Lake Disposal Cell in 1988. The State of Utah conducted remedial action under the direction of the Uranium Mill Tailings Remedial Action (UMTRA) Project. NRC licensed the disposal site in 1997. The cell is located adjacent to a commercial low-level radiological waste disposal operation. The existing groundwater is classified as limited use because of poor ambient water quality; therefore, groundwater monitoring is not required.

Salt Lake City, Utah, Processing Site—In 2000, NRC concurred in the groundwater compliance strategy for the Salt Lake City, Utah, Processing Site, and DOE transferred responsibility for this location to the LTSM Program. Only contaminated

groundwater remains at this location. Groundwater in the uppermost aquifer is not a current or potential source of drinking water because of widespread ambient contamination not caused by uranium processing activities. The processing-related contamination cannot readily be cleaned up using conventional methods. Therefore, groundwater compliance is achieved through application of supplemental standards. The LTSM Program will monitor groundwater and surface water at this location until at least 2004.

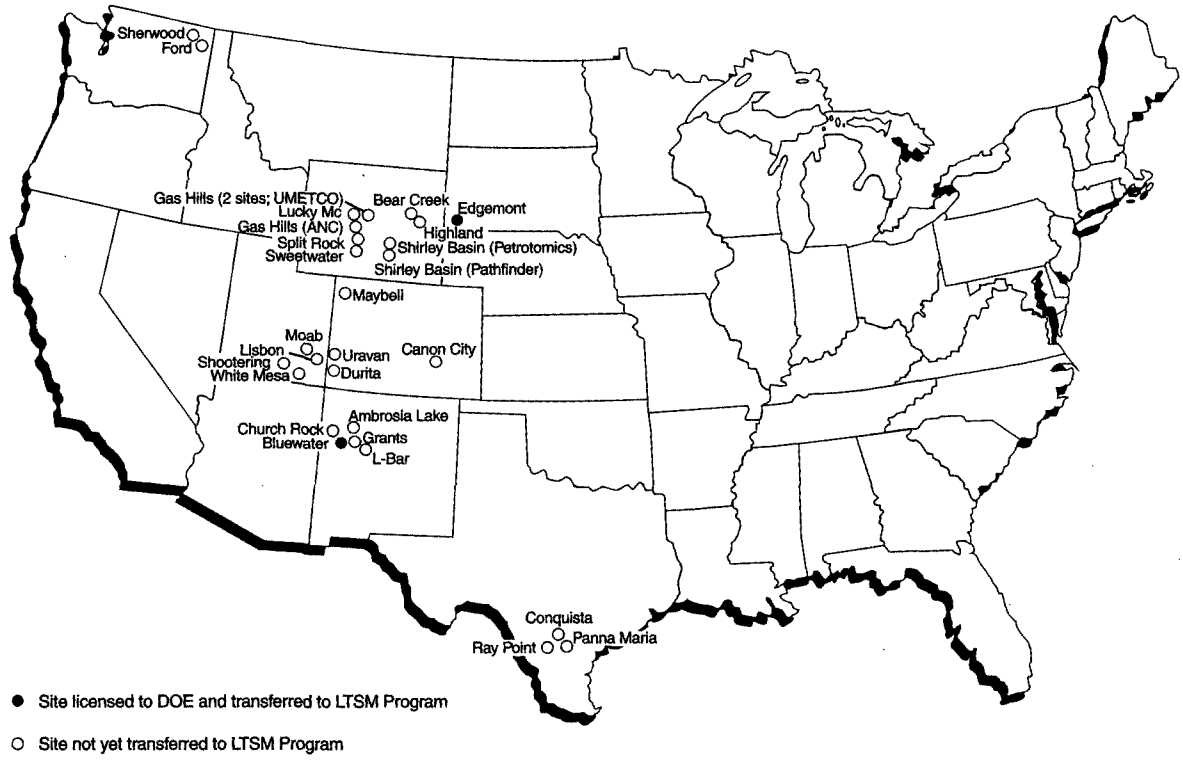
Shiprock, New Mexico—Cleanup of the Shiprock site was completed in November 1986 by consolidating and stabilizing the mill tailings in an on-site engineered disposal cell. NRC licensed the Shiprock Disposal Site in 1996. The Navajo Nation retains title to the land. Maintenance activities include controlling annual deep-rooted weeds and salt cedar (tamarisk), a noxious shrub. The UMTRA Ground Water Project, managed by DOE–GJO, is characterizing groundwater contaminated by former processing operations and may conduct active groundwater remediation in the adjacent San Juan River floodplain. The LTSM Program completed radon monitoring this year and did not detect radon concentrations above background concentrations.

Slick Rock, Colorado—Tailings from two processing sites on the Dolores River were relocated to the Slick Rock 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 low precipitation. The LTSM Program is monitoring transient drainage water accumulation within the cell.

Spook, Wyoming—This site consisted of a small, open-pit uranium mine, with associated tailings, ore piles, mine adits, and ore-processing structures. DOE placed all contaminated materials in the pit on a low-permeability soil layer and constructed an engineered cover over the waste. 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. All monitor wells were decommissioned this year because they were unneeded.

An LTSM Program inspector and a representative of the Navajo Nation traverse the side slope of the Tuba City, Arizona, Disposal Cell.

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 Site in 1996, and the site was transferred to the LTSM Program. The Navajo Nation retains title to the land. 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. The UMTRA Ground Water Project began active groundwater remediation at the site in 2000.



Locations of UMTRCA Title II Sites

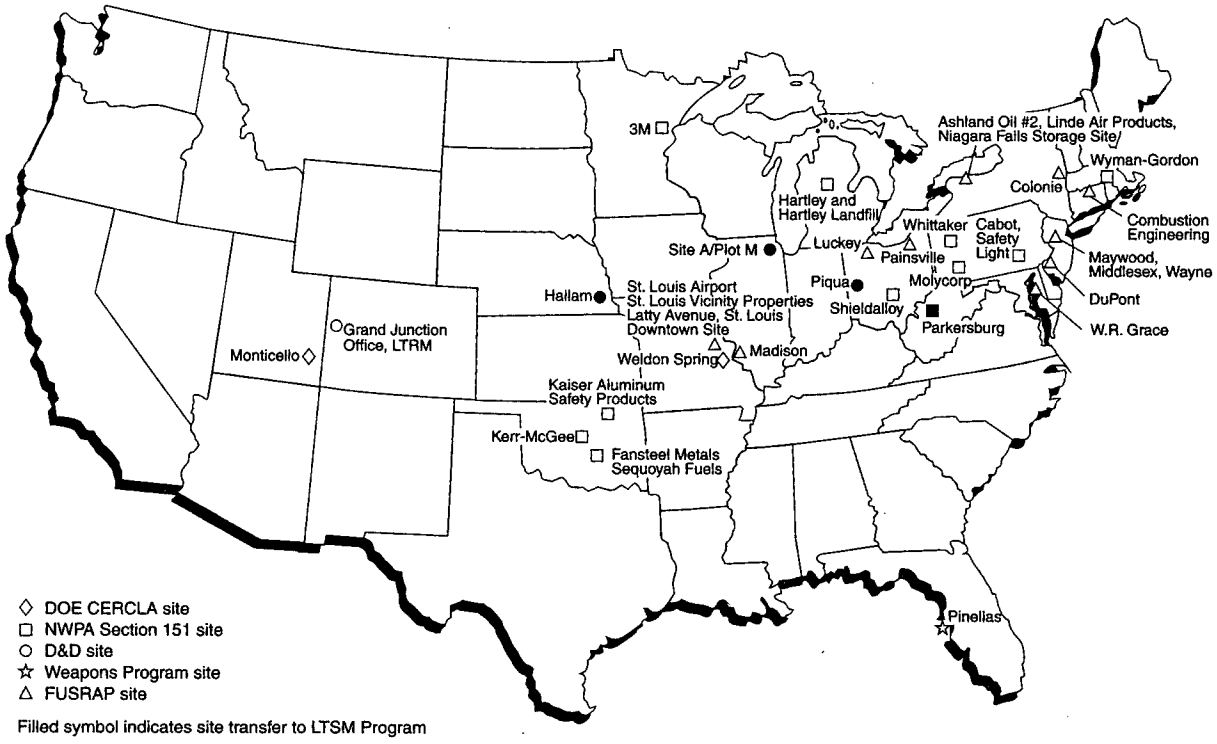
UMTRCA Title II Disposal Sites

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. DOE then accepts title to these sites for custody and care. DOE administers the sites under the provisions of a general NRC license granted at 10 CFR 40.28.

To date, the LTSM Program manages two UMTRCA Title II sites; this number is expected to increase to 18 sites by 2006 as ongoing site reclamations are completed. Ultimately, as many as 27 UMTRCA Title II sites may be managed by the LTSM Program.

Bluewater, New Mexico—ARCO Coal Company stabilized mill tailings piles in place and completed engineered covers in 1995. NRC accepted the site under the general license in 1997. The radon barrier covering the wastes is protected by rock armor. All surrounding disturbed areas were regraded and revegetated with indigenous species. The Bluewater site incorporates 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 Project, was co-located in the disposal cell with material from the millsite. NRC concurred with placing this



Locations of Non-UMTRCA Sites in the LTSM Program

disposal site 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 Nuclear Waste Policy Act (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 the U.S. Atomic Energy Commission 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 mowing to discourage the establishment of shrubs or trees that may degrade the 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. As a best management practice, DOE will monitor the groundwater at approximately 5-year intervals.

CERCLA Sites

The GJO LTSM Program will assume responsibility for three DOE sites that EPA placed on the National Priorities List (NPL). These sites were remediated in accordance with Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) guidance. Because these sites cannot be released for unrestricted use, DOE is required by statute to conduct 5-year remedy performance reviews. Stewardship activities will include inspections and monitoring of environmental media and institutional controls. These sites will transition to stewardship status between 2001 and 2003.

Weldon Spring, Missouri—The Weldon Spring, Missouri, CERCLA 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 remediated by 1994, and bulk removal of contaminants from the quarry was completed in 1995. LTSM Program stewardship activities at Weldon Spring will begin in 2002 as the site begins transition to LTSM Program custody.

Monticello, Utah, Sites—EPA listed the Monticello, Utah, Mill Tailings Site and the Monticello Radioactive Contaminated Site (also known as 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-ore processing. Contaminated materials were distributed by wind and water and limited amounts were used for construction, resulting in contamination of more than 400 vicinity properties. These properties and the millsite were cleaned up and the materials were placed in a disposal cell. All cell cover materials were placed in 1999; the cover was seeded in 2000. 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 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 in 2002.

Weapons Program 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. DOE completed facility remediation at the Pinellas site in 1997 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 site is scheduled for transfer to the LTSM Program in 2015.

D&D Program Sites

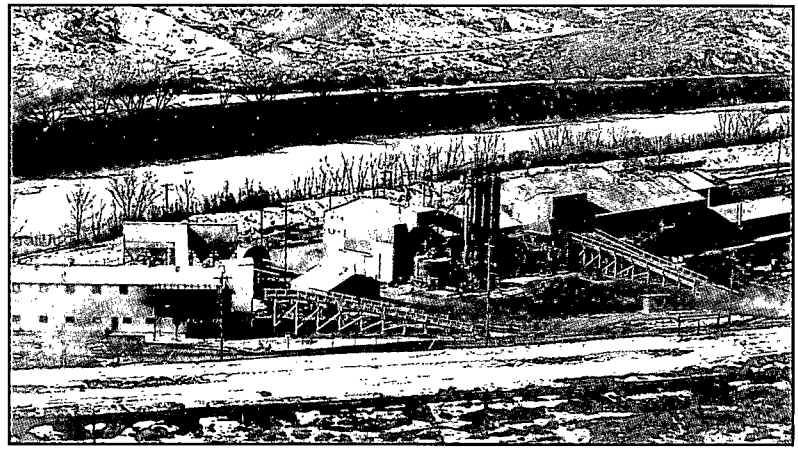
The LTSM Program has custody of four DOE Defense Decontamination and Decommissioning Program sites: Piqua, Ohio; Hallam, Nebraska; Site A/Plot M located near Chicago, Illinois; and the

Grand Junction Office site in Grand Junction, Colorado. The first three sites were transferred from the custody of the DOE Chicago Operations Office in 1998. The GJO facility began transition to the LTSM Program this year.

Hallam, Nebraska, and Piqua, Ohio—The Piqua, Ohio, and Hallam, Nebraska, sites are former nuclear reactor facilities that were built for the U.S. Atomic Energy Commission 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 the 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 Enrico Fermi's CP–3 reactor. Plot M contains radioactive waste from the mid-1940s to 1949 that was 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.

Grand Junction Office Facility—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 by 2001 or remediated when vacated. The site will complete transfer to the LTSM Program for stewardship in 2001. Groundwater and institutional controls monitoring will be necessary for 60 to 80 years until the aquifer is remediated through natural flushing.



This pilot uranium mill operated at the DOE Grand Junction Office from 1954–1958 testing milling processes.

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 Grand Junction Disposal Cell under the DOE UMTRA Project. Contaminated material from the Grand Junction Office Remedial Action Project at the DOE–GJO site was co-located with the UMTRCA waste. The 360-acre disposal 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 as much as 250,000 cubic yards of tailings from Grand Junction vicinity properties, other UMTRCA locations, and the Monticello, Utah, CERCLA 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.

FUSRAP Sites

The U.S. Congress directed the U.S. Army Corps of Engineers to remediate contaminated sites designated under the Formerly Utilized Sites Remedial Action Program (FUSRAP). DOE negotiated a Memorandum of Understanding with the U.S. Army Corps of Engineers to transfer responsibility for the sites to DOE for long-term care after remedial action is completed. The remediated sites will 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. Other containment structures were designed to endure for long periods. The LTSM Program initiated the Cover Monitoring and Long-Term Performance Project in 1998 to evaluate how changes in disposal cell environments, both observed changes and changes projected 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 new cover design guidance prepared by EPA. Results are applicable to containment and transport decisions that will be made at other locations and for other programs.

In 2000, LTSM Program researchers teamed with EPA Region 8, the DOE Office of Science and Technology, Sandia National Laboratories/New Mexico, Pacific Northwest National Laboratory, the EPA Superfund Innovative Technology Evaluation Program, and the University of Arizona to study the design and long-term performance of engineered covers. The following sections present highlights of specific projects.

Monticello, Utah, Cover Performance Monitoring—In 2000, LTSM Program scientists and engineers continued participation in the Alternative Cover Assessment Project, which is funded by the EPA Superfund Innovative Technology Evaluation Program. The goal of this project is to develop new guidance for cheaper, more effective covers for municipal and hazardous waste landfills in arid and semiarid western states [these sites currently are regulated under the Resource Conservation and Recovery Act (RCRA) Subtitle C or D]. Researchers use field studies and modeling to acquire data needed to evaluate alternative covers. The Alternative Cover Assessment Project funded installation of performance monitoring instrumentation at the Monticello Superfund Site in 2000.

Instrumentation and data telemetry for monitoring a 7.5-acre facet of the Monticello Disposal Cell cover were installed by a team of scientists and engineers from the EPA National Risk Management Research Laboratory, Pacific Northwest National Laboratory, and the LTSM Program. The instrumentation includes three nests of sensors for monitoring soil water content and soil water potential, a dosing basin for monitoring drainage from the capillary barrier for the entire 7.5-acre facet, and a second dosing basin for monitoring runoff from a 2,232-square-foot surface-runoff test plot.

Monticello Lysimeter Test Facility—The LTSM Program continued to collaborate with EPA Region 8 at the Monticello Lysimeter Test Facility on studies of alternative engineered cover designs. The alternative designs depart from conventional UMTRCA and RCRA designs in that they rely on a thick topsoil layer and a capillary barrier to retain precipitation and on soil evaporation and plant transpiration (evapotranspiration) to dry the topsoil seasonally and to limit water movement into the encapsulated tailings. Two studies are ongoing with small weighing lysimeters and large drainage lysimeters.

The small weighing lysimeters consist of 24-inch-diameter tubes filled with test cover systems, including a sequence analogous to that installed on the Monticello Disposal Cell. These lysimeters can be weighed, drained of free liquid, and then weighed again to study the water balance of various cover designs. Three new weighing lysimeters were added this year with funds provided by EPA Region 8. GJO installed the first weighing lysimeters at Monticello in 1993.

The large drainage lysimeters consist of caissons buried in the ground. A full-scale vertical profile of the Monticello Disposal Cell cover was constructed in one caisson, incorporating the most suitable materials available at the site. Instrumentation for automated monitoring of the soil-water balance is accessed in an adjacent caisson. In fall 1999, a second full-depth cover profile was constructed at the facility incorporating actual cover materials from stockpiles. Both cover profiles were constructed with water content reflectometers installed at regular intervals to evaluate water storage changes, tipping bucket gauges to monitor drainage, and clear tubes for borehole cameras to monitor root depth and abundance. The output from these devices and other monitoring instruments, including meteorological observations, is collected continuously and downloaded on command from a remote location.

In Situ Moisture Monitoring—In situ moisture monitoring continued at the Shiprock, New Mexico, Disposal Cell in 2000 to determine (1) if the tailings have dried out since closure and (2) if infiltration of the tailings can be inferred from changes in soil water content at depth. Moisture profiles are measured with a neutron hydroprobe. Calibration models were constructed using cover materials in a known configuration to convert neutron count data to soil water content.

Tuba City, Arizona, Revegetation Study—Revegetation success is critical at this desert location to stabilize drifting and windblown sand. This ongoing study has been conducted in cooperation with the University of Arizona. Test plots were established using a variety of irrigation and planting techniques. A manuscript was accepted for publication in the *Journal of Environmental Quality*. These results and research methods are applicable to many sites in arid environments such as in the southwest United States.

DOE Long-Term Cover Guidance—The LTSM Program continued to support the DOE Office of Science and Technology initiative to develop a guidance document for designing long-term covers for buried wastes at DOE weapons production sites. LTSM Program scientists serve on the design team and are collaborating on performance monitoring and long-term analog studies. This work is conducted under the Subsurface Containment Focus Area activity.

Phytoremediation—An LTSM Program scientist served as Monitoring Team Lead for the DOE Phytoremediation of Inorganics Workshop convened at Argonne National Laboratory. Teams discussed the status of research in four areas (removal from soil, sequestration in soil, groundwater applications, and monitoring), identified technology gaps, and developed recommendations pertaining to the future direction of the DOE phytoremediation initiative. Workshop proceedings are published as Proceedings from the Workshop on Phytoremediaiton of Inorganic Contaminants (**www.envnet.org/scfa/conferences.htm**).

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LTSM Program Web Site: http://www.doegjpo.com/programs/ltsm/
This site contains downloadable fact sheets about LTSM Program sites, Long-Term Surveillance Plans, site status reports, links to applicable or relevant and appropriate regulations, and other information.

DOE Albuquerque Operations Office: http://www.doeal.gov/
This site presents the mission and descriptions of the activities of the DOE Albuquerque Operations Office, under which the Grand Junction Office operates.

DOE Office of Environmental Management: http://www.em.doe.gov/
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.

Lasting Legacy: http://www.lastinglegacy.net/legacy3.1/loadup.htm
This site provides descriptions of the DOE weapons complex, plans for each site, and discussions of stewardship issues.

U.S. Environmental Protection Agency Alternative Cover Assessment Program Activities Summary: http://www.rtdf.org/public/phyto/minutes/altcov/default.htm
Summaries of the work of the Alternative Cover Assessment Program are available at this site.

State and Tribal Governments Working Group: http://www.em.doe.gov/stgwg
This stakeholder organization, sponsored by DOE, has been active since 1989 in promoting sound stewardship practices for DOE sites after remediation is complete.

Long-Term Stewardship Information Center: http://lts.apps.em.doe.gov//
This site presents references describing stewardship activities and resources within DOE.

Providing cost-effective and efficient stewardship for more than 12 years